Les Cahiers de la Chaire Economie du Climat

Série *Information et débats*

n° 22 • Mars 2013

Forest Carbon and Poverty Reduction: Project motivations, methods and the market

Neil MacEachern[1]

Although poverty reduction is increasingly becoming a component of developing world forest carbon projects, little current research examines the steps taken to support the livelihoods of communities near the projects. This paper seeks to gauge the extent to which poverty reduction represents a goal of forest carbon project developers, and determine the types of programs being implemented to this end. It aims quantify the project expenditures toward poverty reduction, and their relationship with organization type, project type and motivation, sources of funding, poverty reduction activities and certification. Finally it discusses the impact of poverty reduction on risk and credit demand *via* certification. Based on results from a cross-sectional survey, poverty reduction appears to be a widespread aim of developing world forest carbon project developers, and significant portions of project budgets are being dedicated to this end, although these differ based on numerous variables. Also, poverty reduction is seen as a way of reducing project risk, and a way of increasing marketability of credits.

1. Chaire Economie du Climat
neil.maceachern@chaireeconomieduclimat.org

Climate Economics Chair
Paris-Dauphine University
CDC Climat

Forest Carbon and Poverty Reduction

Project motivations, methods and the market

Neil MacEachern[1]

Although poverty reduction is increasingly becoming a component of developing world forest carbon projects, little current research examines the steps taken to support the livelihoods of communities near the projects. This paper seeks to gauge the extent to which poverty reduction represents a goal of forest carbon project developers, and determine the types of programs being implemented to this end. It aims quantify the project expenditures toward poverty reduction, and their relationship with organization type, project type and motivation, sources of funding, poverty reduction activities and certification. Finally it discusses the impact of poverty reduction on risk and credit demand *via* certification. Based on results from a cross-sectional survey, poverty reduction appears to be a widespread aim of developing world forest carbon project developers, and significant portions of project budgets are being dedicated to this end, although these differ based on numerous variables. Also, poverty reduction is seen as a way of reducing project risk, and a way of increasing marketability of credits.

[1]Researcher at the Climate Economics Chair
neil.maceachern@chaireeconomieduclimat.org

TABLE OF CONTENTS

INDEX OF FIGURES

INDEX OF TABLES

1 Introduction

It is now widely accepted in the scientific community that human-induced greenhouse gas emissions are a primary contributor to global climate change (National Academies 2009). The majority of historical emissions have originated in the developed world (US EPA 2011), although the negative impacts of climate change are likely to asymmetrically affect developing countries (OECD 2003). Flooding, drought, ecosystem migration, alteration of fire and pest regimes, and shifts in disease vectors are all cited as likely outcomes of climate change that would aggravate poverty most acutely in the developing world. Particularly susceptible are the rural poor, whose livelihoods depend more heavily on local ecosystems vulnerable to global climate change, and who lack the finance and infrastructure to adequately adapt (IPCC 2007).

In these countries, forest dependence and poverty are closely related. An estimated 90% of those living in extreme poverty (earning less than $1 US per day) rely directly on forests for their subsistence (World Bank 2004). Since the early stages of the climate change dialogue, forests have been recognized as having an essential role in climate regulation and the carbon cycle (Thompson 1980). Because of this, forest management has been seen as a potential vector for the reduction of emissions. With the advent of carbon markets, the trade of forest carbon offsets has been swift, with an increasing proportion being generated in developing nations (Hamilton et al. 2010; Diaz, Hamilton, and Johnson 2011).

Given the prevalence of rural poverty in these areas, forest carbon activities can have a significant impact on forest-dependent communities, for good or ill, depending on project type and method of implementation. Forest carbon can therefore represent an opportunity to aid local communities through benefit-sharing, or conversely, may exacerbate poverty, through restriction of access to local natural resources or ecosystem change.

Existing literature has suggested both the possible benefits and detriments of forest carbon on rural livelihoods; however, few attempts have been made to quantify the financial impacts of carbon finance on forest dependent people. Although it is beyond the scope of this study to calculate to the dollar the global investment in poverty alleviation *via* forest carbon projects, it aims to nonetheless determine the approximate proportion of forest carbon finance making its way to local communities, and whether or not project and organization characteristics have an effect on this.

In short, the goal of this paper is to answer the following questions:

1. Is poverty reduction an explicit goal among forest carbon projects, and what proportion of project motivation does it represent?

2. What proportion of project budgets do forest carbon project developers spend on poverty reduction measures, and what activities are being implemented to this end?

3. How do these expenditures differ between for-profit and non-profit organizations, different levels of poverty reduction motivation, project types, poverty reduction activities, and co-benefits certifications?

4. Do forest carbon project developers see poverty reduction as a method of risk reduction, and promote it to sellers as one?

5. Do certifications involving poverty reduction have an impact on the demand and sale price of credits?

The scope of this paper is limited to forest carbon projects occurring in the developing world. It is not limited to any specific method of management for forest carbon, any form of certification, or any structure of organization, nor is it limited to projects expressly aimed at reducing local poverty.

2 Rural poverty, forest dependence and forest carbon

2.1 Land use and the rural poor

2.1.1 Rural poverty and land degradation

Rural poverty is diverse in its scope and severity, and often entails different causes challenges than urban poverty. In comparison to those in urban environments, the rural poor have lower school enrolment, reduced female access to education by, higher infant mortality, poorer nutrition, and lower access to health care services (Sahn and Stifel 2004). Like their urban counterparts, the rural poor lack access to physical capital of their own (although more acutely), but also have lower access to publicly shared physical capital.

Combined with this is more weakly developed human capital in rural settings. Given lower initial levels of education and more labour intensive employment, the accumulation of skills can be slow or non-existent. Low levels of physical and financial capital reduce returns on education in the rural labour market, and lessen the incentive to develop human capital to an effective level, and increase reliance on natural capital (Khan 2000). Correspondingly, this natural capital is more likely to be overexploited, leading to the degradation of land, often with long-term consequences for those dependent upon it. This is of critical importance for developing world forests because of the pressure exerted on them, most notably by agricultural expansion required for subsistence farming (Barbier 2005).

2.1.2 Forest dependence and livelihoods

Alongside rural people's dependence on agriculture is a reliance equally as ubiquitous and essential on forests. More than 1.6 billion people rely on forests for their livelihood, with 350 million near dense forests using them for primary sustenance and income. Over 1 billion globally depend on agroforestry systems for food and revenue, and approximately 60 million indigenous people rely almost exclusively on forest for their well-being (World Bank 2001).

Those dependent directly on forests make use of them in varied ways. The most immediate use is though subsistence goods, including some locally used construction materials, but comprising primarily non-timber forest products (NTFPs) such as fuelwood, medicines, fibre, animal fodder, game, and edible vegetation. These goods are also used as sources of income when collected and sold, however, the non-cash value of forest products may be 3-4 times greater when used directly rather than when traded (FAO/DFID 2001; IUCN 2011). Economic benefit is also obtained through employment in resource management, extraction, and distribution. Finally, indirect benefits are

received *via* environmental services (notable hydrological maintenance and biodiversity), and from the role of forests in social and spiritual well-being (FAO/DFID 2001).

The benefits of forests are also depended upon by those engaged primarily in agriculture. In such cases, the interaction between agricultural and forested lands can be complex, as both may be essential to local livelihoods. In practice, the expansion of one often results in a loss of the other, with the break-even point of the trade-off arrived at through the careful weighing of relative benefits. However, decisions with long-term consequences are often dictated by short-term requirements. Although underlying forces affecting these changes are complex, agricultural expansion for crops or livestock remains the dominant proximate cause of deforestation (Geist and Lambin 2002).

2.1.3 Drivers of deforestation

As forest carbon is sequestered in tree biomass, deforestation may represent a threat to storage permanence, making the local causes of deforestation important considerations for project developers. Although it has been suggested that poverty is a primary driver of deforestation, evidence is far from unanimous. Some studies correlate poverty with deforestation (Tongpan 1991; Kerr et al. 2004), but others question or deny the link (Duraiappah 1996; Scherr 2000). Economic theory suggests that possessing smaller financial buffers, the poor have shorter time horizons and are less inclined to be concerned with longer-term impacts. However, given the time or finances required to cut forests, those with greater access to resources may be more able to invest in land clearing to expand their agricultural holdings (Angelsen and Kaimowitz 1999).

The development of infrastructure, especially roads, often contributes to deforestation. These can help provide greater market access for rural wares, allowing for agricultural and forest products to be more easily traded, which may drive agricultural expansion, or overexploitation of forests (Chomitz and Gray 1995; Cropper, Puri, and Griffiths 2001). Tenure can also have an impact on deforestation, with economic models predicting that more secure land tenure should lead to higher levels of deforestation, but empirical evidence does not unanimously support this prediction (Angelsen and Kaimowitz 1999; Holland et al. 2012; Robinson, Holland, and Treves 2011). This is important, as the securing of tenure for local communities, a goal of some forest carbon projects, may result in undesired effects beyond project boundaries.

Agricultural intensity and deforestation are also related. Given the effort required to secure and clear land, agricultural intensification may be preferable to expansion, although it can require investments or expertise that may be unavailable. If feasible, intensification can reduce the pressure to expand agriculturally, and is often associated with reduced levels of deforestation (Tachibana, Nguyen, and Otsuka 2001; Shively and Pagiola 2004; Maertens, Zeller, and Birner 2006). Efforts to increase agricultural intensity may simultaneously improve livelihoods and protect forests. However, intensification also increases land profitability, raising the opportunity cost of protecting adjacent forest, possibly undermining conservation efforts (Tomich et al. 2001).

Logging is often a cause of deforestation in the developing world. There, unsustainable logging practices are common, often with little to consultation of local populations required to permit cutting (Larson and Ribot 2007). The related depletion of forest resources can be deleterious to those who depend on them for livelihoods, but the work provided from forestry activities can provide much needed employment to areas where job prospects are few (Mayers 2006). On the

whole, the local effects of unsustainable logging are typically negative, since the informal forest products lost are usually of greater value to the local community than contributions from timber harvested (Monela et al. 2005; Mogaka 2006). Therefore, carbon projects which are able to prevent unsustainable logging may benefit communities if access to forests is maintained.

2.2 Forest carbon and finance

Forests represent a huge store of carbon, with estimates indicating some 638 gigatonnes (Gt) of elemental carbon in biomass, soil, and deadwood: a mass almost equivalent to that in the atmosphere (Madeira 2008). However, this sink is being degraded by approximately 0.9 Gt annually, representing between 10 and 20% of global anthropogenic greenhouse gas emissions (Watson et al. 2000; Harris et al. 2010). The possible reversal of this trend through prevention of deforestation and the increase of forest cover is considered by many to be an effective, low-cost of method of mitigating dangerous climate change, although estimates of price vary significantly depending on region, project type, and costing methodology (Kremen et al. 2000; Kooten et al. 2004; Kindermann et al. 2008).

With the exception of avoided deforestation, forest carbon credits (each representing one tonne of carbon dioxide equivalent (CO_2e)) are not true 'emissions reductions', but uptake carbon emitted elsewhere, a form of offsetting. For this reason, forest carbon projects are contentious, because though they reduce net emissions, they do not necessarily contribute to the decarbonisation of industrial activity, a primary goal of climate change policy (Bumpus and Man 2008).

2.2.1 Forest carbon project types

Afforestation and reforestation (A/R), the re-establishment of forest cover on previously deforested areas, represent the largest class of forest carbon projects (Peters-Stanley et al. 2011; ECCM 2012). A/R projects occur on both public and private lands with different implications for collection and distribution of rents. They can vary in their form significantly, from mixed indigenous species to fast-growing monocultures, with potentially differing levels of community benefit (Moura-Costa 1996).

The reduction of emissions from deforestation and forest degradation (REDD) entails the maintenance of forest carbon stocks that would have released by clearing or partial loss of forest cover, generally in the developing world (MOEJ 2012). Since their adoption on the voluntary market, REDD projects have been a significant contributor to overall forest carbon offsets (see Figure 1), although much controversy has surrounded their use, and their uptake in compliance markets has been limited (IIED 2009; Diaz, Hamilton, and Johnson 2011).

Improved forest management (IFM) involves the reduction of emissions by altering forest management practices, e.g. extending harvest rotation, instituting low impact logging, or increasing stand stocking (Metz et al. 2007). Although less prevalent than A/R or REDD, IFM projects continue to expand in the voluntary market (Diaz, Hamilton, and Johnson 2011).

Agroforestry represents a unique form of forest carbon. Rather than stand growth or maintenance, it is a style of agriculture integrating trees into cultivation. This increases biomass and soil carbon storage, as well as providing other potential benefits, such as increased agricultural productivity, improved water retention, lower fertilizer requirements, or tree products (MIT 2012). Because of this, agroforestry can implicitly contribute to local livelihoods while sequestering carbon.

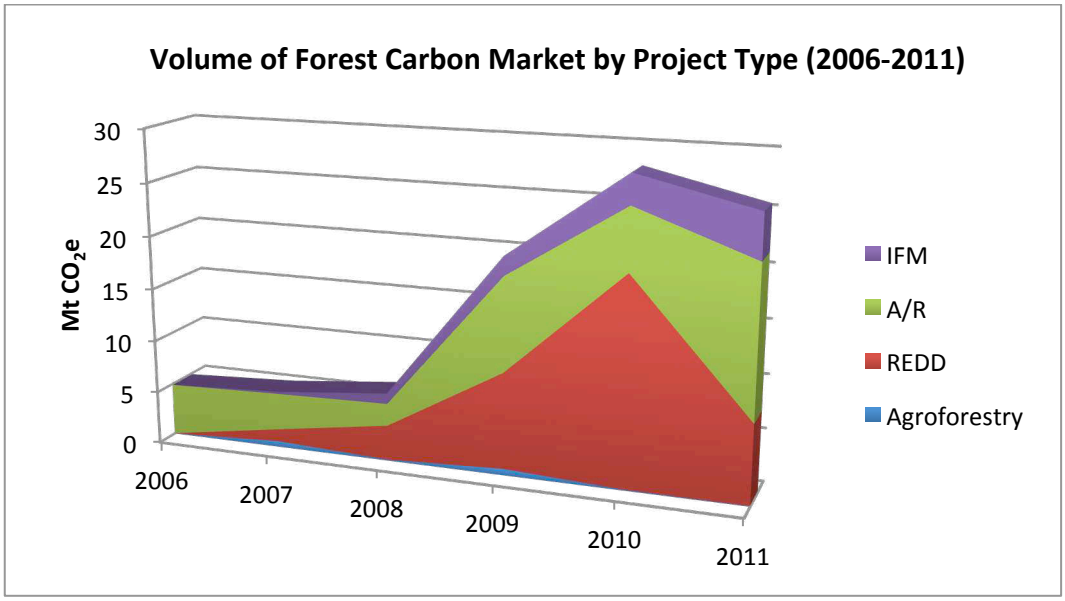

Figure 1: Forest carbon volume by project type (Peters-Stanley, Hamilton, and Yin 2012)

2.2.2 Forestry in carbon markets

Forest carbon is traded to varying extents in both compliance and voluntary markets. To this point, uptake of forestry credits has been limited within compliance systems, generating only 0.09% of credits and 0.03% of traded value (see Figure 2), although this is increasing (Kossoy and Guignon 2012; Peters-Stanley, Hamilton, and Yin 2012). Conversely, forest carbon remains one of the largest credit types in voluntary markets, representing 23 and 33 percent of volume and value, respectively (Peters-Stanley and Hamilton 2012).

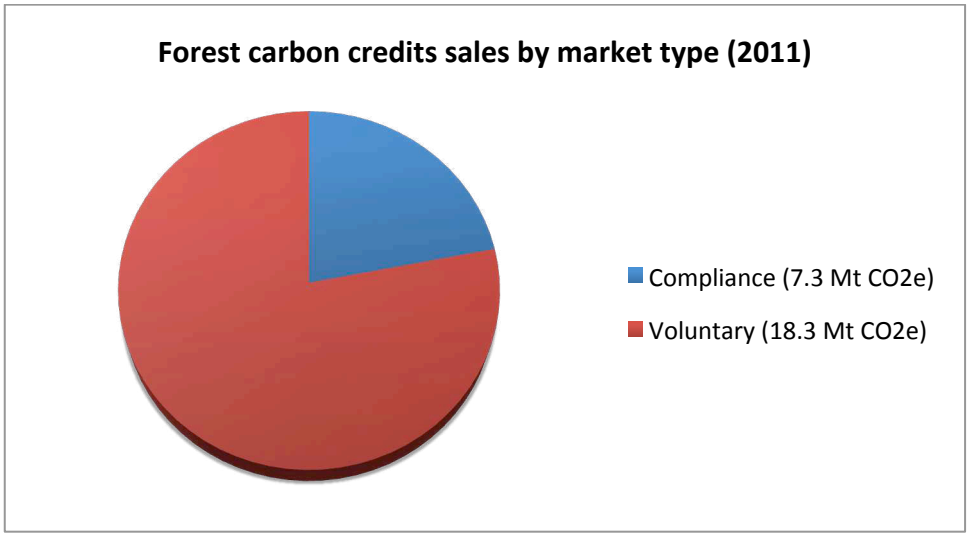

Figure 2: Market type composition of forest carbon credit sales in 2011 (Peters-Stanley, Hamilton, and Yin 2012)

In voluntary markets, final buyers of credits generally purchase to either offset their emissions purely voluntarily (typically for reasons of branding or corporate social responsibility), or as a buffer in case of upcoming compliance requirements (pre-compliance purchases). Currently, these two groups comprise 54% and 12% of voluntary transactions respectively, with the remaining share going to resellers, non-governmental organizations (NGOs), individuals, and governments (Peters-Stanley and Hamilton 2012).

Lacking centralized regulation, numerous standards have arisen in the voluntary market to ensure the credibility and robustness of offsets, with variation between individual standards. The majority of standards are primarily concerned with ensuring the legitimacy of carbon storage, although to an increasing extent, certification by co-benefits standards, those that involve environmental and social well-being, are being demanded and supplied in the voluntary market. These include the Plan Vivo, Brasil Mata Viva, and CarbonFix certifications. However, the most common co-benefit certification: the Climate, Community & Biodiversity Standard (CCBS), does not include carbon storage, and is used primary as an adjunct to carbon-only standards, particularly the Verified Carbon Standard (Diaz, Hamilton, and Johnson 2011). In general, these credits certified by these standards draw higher prices in the market, with some exceptions (later discussed).

2.2.3 Costs and funding of forest carbon

The funding of forest carbon is noteworthy because of the generally long payback periods on investment. In particular, A/R projects require high upfront investment, with payout often not occurring until credits are issued after sequestration. Even in other forest carbon project types, costs of negotiating agreements, securing title, implementing a methodology, registration, verifying emissions, and marketing and transacting credits can lead to significant capital inputs weighted heavily at project outset[1]. For projects that aim to reduce poverty, costs may further increase due to community payments or increased project complexity.

Although it is common for it is individual project developers to use equity or debt to cover costs, outside sources of funding are often required, and these can come from a variety of sources. Final credit buyers will sometimes assist in project development costs, or pay for credits prior to issuance (Diaz, Hamilton, and Johnson 2011). Many developers receive funding from bilateral donors, such as the UK Department from International Development (DFID), the French Office National des Forêts (ONF) (Forest Carbon Asia 2012a). Also, multiple international funds have been established to finance forest carbon development, with both corporate and government funders (Kossoy and Guignon 2012).

Commercial investments in forest carbon can also be made based on expected returns from non-carbon sources of revenue, which may include rubber, tree fruit, and other agricultural products (Smith and Scherr 2003). In the case of A/R and IFM projects, timber can also be a source of eventual income, driving investment (Coomes et al. 2008). Other sources of funding for forest carbon projects include private donations alongside the sale of forest carbon credits (Rival 2011).

2.3 Forest carbon and poverty reduction

2.3.1 Poverty reduction initiatives

Forest carbon has become tied to poverty reduction due to funder pressure, market demand, as compensation for forest use, and out of altruism. To this end, different kinds of poverty reduction programs have come out of projects based on developer experience, funder disposition, project capacity and regional differences. The definition of poverty reduction can sometimes be problematic, as the generation of economic activity may help to reduce poverty, even if by accident

[1] For more information on costs of forest carbon projects see Chenost et al. 2010.

(Barder 2009). This paper, however, will specifically examine programs established with the express purpose of assisting local peoples to meet their present and future economic needs.

One of the methods by which forest carbon projects can contribute to poverty reduction is through payment for ecosystem services (PES). When payments are made directly to local communities, the outcome is a new revenue stream to often very impoverished areas. For people living on the margins, the income generated by the establishment of forest carbon projects may represent a significant increase in earnings contributing to poverty reduction. However, this is dependent on how funds are disbursed. If payments are made directly to landowners, landless residents may not benefit, or worse, be negatively impacted. A more equitable option may be the disbursement of payments into an account collectively managed by the community. However oversight be necessary to ensure that community interests are fairly represented (Van Noordwijk et al. 2005).

Other options include the establishment of a fund for low interest loans within communities, so-called microcredit schemes. These aim to increase access to financial capital for local residents, and assist in economic development though investment. However, these may become problematic if loans cannot be repaid (May et al. 2004). The provision of training to community members may also be a way of building human capital to increase employability and productivity, but may only be useful if sufficient employment is available to make use of new skillsets (Poudyal et al. 2005). The subsidization of products may help to stimulate trade and assist in the alleviation of poverty, but could lead to dependence in the long term (Mkandawire 2005).

More traditional forms of poverty reduction may also entail the construction of hard infrastructure, such as wells or roads, which can yield health and economic benefits to communities (Cairncross et al. 2010). Also, project developers with little experience in poverty reduction may contribute to existing establishments, such as health clinics or schools, or donate to other aid or community development organisations already working in the project area (May et al. 2004). Finally, the employment of local people also represents a transfer of funds to communities, but consists more of an essential cost of operations, rather than a supplementary poverty reduction measure.

2.3.2 Impacts of forest carbon on local communities

Although there are obvious benefits to the receipt of payments for ecosystem services, the effects of forest carbon projects on communities can have both positive and negative effects. Given the relative novelty of forest carbon, long-term impacts may not yet be apparent, but early results, as well as theoretical outcomes can give an indication of the possible benefits and detriments of forest carbon projects on local people.

Notably, between and within project types there exists significant variation in the potential results of forest carbon, with REDD often receiving criticism, and agroforestry rarely so. Some impacts will depend heavily on project specific implementation: permissive REDD projects may result in greater guarantees of continued supply of forest products, but others may limit the access to these resources (McDermott and Schreckenberg 2009). This risk was recognized in the UNFCCC REDD safeguards, with the stipulation that any eventual adoption of REDD within the framework must respect the rights of indigenous and local peoples (Kant, Chaliha, and Shuirong 2011).

Projects that limit agricultural land are likely to harm subsistence communities unless income losses can be replaced with other revenue sources. In A/R projects this may be the case if perennial crops

are replaced with trees yielding other products, such as rubber, coffee, fruit, nuts, oil or fertilizers. In agroforestry projects, cultivated area lost may be compensated for *via* increased yield from improved water and nutrient retention and crop protection (Lal 2004). In improved forest management, for example, training workers to not damage standing trees while falling, are unlikely to have discernable negative outcomes (Putz et al. 2008). However, extending rotation may result in less local employment in the sector if corresponding increases in productivity are not achieved (Xu, Zhang, and Shi 2001).

On the whole, forest carbon projects have the potential to benefit the rural poor, if they are carefully implemented. In fact, this may be required by project funders, and for project certification. However, doing so must take into account the complex relationship between local people and forests, and the need to meet subsistence needs through agriculture and exploitation of forest products. Given the growth of forest carbon in both voluntary and compliance markets and related visibility, the importance of local benefit and need to address local impacts of projects are likely to become more pronounced in the future.

3 Cross-sectional Survey on Poverty Reduction in Forest Carbon

The data collection for this study is was done *via* a cross-sectional survey distributed to project developers. The goal of the former is to gain general insight regarding the poverty reduction measures, where applicable, by forest carbon project developers in the developing world. Poverty reduction, for the sake of this paper, represents the assistance of local residents in meeting their basic needs of year-round food, clothing and shelter, and/or build capacity for these people to improve their standard of living.

A targeted cross-sectional survey was used to obtain a sufficiently large sample size of developing world forest carbon project developers without including irrelevant responses. The survey distributed was primarily quantitative in nature, determined to examine the relationship between organization type, project type and goal, funding source, certification, and poverty reduction investments. Additionally, it aimed to gauge the effect of certifications with poverty reduction requirements on credit demand and price.

Initial test surveys were distributed to a small set of project developers known to the author to identify potential problems and suggest improvements prior to widespread dissemination. The resultant survey was available online and self-administered by respondents that had been initially contacted by e-mail from multiple project directories. Respondents were required to include contact information to allow for any clarification regarding responses. The geographic location of respondents was collected automatically, and internet protocol (IP) addresses were registered to prevent duplicate responses. Questions required responses such that the survey would not continue if they were not answered.[2]

Overall, of the 116 requests sent, 24 responses were received for the cross-sectional survey, giving a response rate of 20.6%. From the 24, two were incomplete, and two were eliminated (one as a duplicate, the other as an outlier). Qualitative data are assessed and discussed, with consideration of

[2] For more information regarding the survey, please contact the author at: neil.maceachern@chaireconomieduclimat.org

quantitative data, and typically presented in either graphical or tabular form in the following section. Correlations were assessed using the phi (ϕ) coefficient, the point biserial coefficient (r_{pb}) Spearman's rank coefficient (ρ), when applicable.

As with any body of research, there exist limitations to the data collected and possible inferences drawn. For the cross-sectional survey, although reasonable attempts were made to reach the maximum number of possible respondents, it is likely that many were not listed in the directories used, and therefore were not questioned. Some questions involve somewhat subjective values, and because figures could not be accompanied by documentation, they may not be completely accurate (although extreme outliers were omitted from analysis). There is also the possibility of respondent bias (i.e. those responding not representative of the population).

Also, the study was based on unverified responses from project developers so it is impossible to know if it is completely accurate. This, however, is normal of cross-sectional surveys. Regardless, the paper is cautious to avoid the inference of universal causation, and instead discusses possible reasons for correlations. To help reduce bias the survey was distributed to the largest group possible, and initial non-respondents were contacted multiple times to encourage participation to increase the inferential power of the study.

4 On the treatment of poverty in forest carbon projects

Of the 20 project developers included in the study, the majority (11) were private for-profit companies, and the rest (9) were non-profit organizations. In terms of project types, afforestation/reforestation were the most common, implemented by 90% of firms, followed by avoided deforestation (50%), agroforestry (40%), and improved forest management (25%). Most firms developed multiple project types, with only five (25%) implementing one type alone.

4.1 Is poverty reduction an explicit goal among forest carbon projects, and what proportion of project motivation does it represent?

Based on the responses received from project developers, poverty reduction appears to be a widespread goal of forest carbon projects implemented in the developing world. With a median value of 31-50% and an approximate mean of 47%, the reported proportion of project motivation represented by poverty reduction is consequential, and indicates that although not the primary driving force behind forest carbon, poverty reduction has been internalized as an important element in project design (see Figure 3). Despite this, reported values varied greatly, with both high absolute and relative standard deviations, showing that although poverty reduction was reported as a project goal, the rated importance differed highly between individual firms.

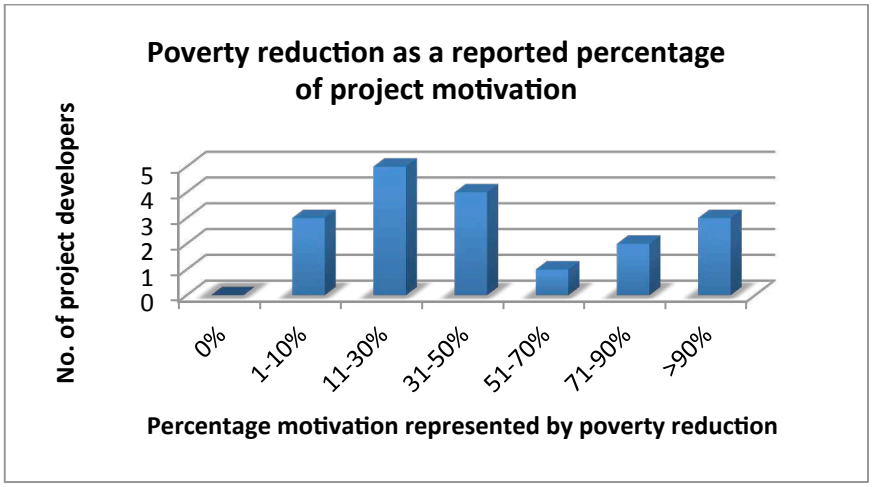

Figure 3: Value of poverty reduction as a proportion of overall project motivation

Although it might be assumed that non-profits would value poverty reduction higher than for-profit organizations, there was little difference between the estimated motivations of the two groups. This may or may not be noteworthy, as these values are somewhat subjective, and may not necessarily correspond with the economic realities of day-to-day business operations. Nonetheless, the stated importance of poverty reduction suggests an ethical facet to forest carbon that figures rather prominently.

Although the overall goal of for-profit business is implicit in the title, the involvement in climate change mitigation as an industry may indicate a greater tendency toward social responsibility. Climate change is often considered an ethical issue, as it is likely to impact future generations and the poor more acutely (Gardiner 2004; Singer 2006; Stern and Taylor 2007). It may not be surprising then, that even profit-driven enterprises operating in climate change mitigation may have a tendency toward pro-social behaviour, even if it may increase costs or reduces profitability (although this may not necessarily be the case, as will be later discussed).

4.2 What proportion of project budgets do forest carbon project developers spend on poverty reduction measures, and what activities are being implemented to this end?

The reported proportion of project budgets dedicated to poverty reduction varied among individual project developers, but the majority contributed a modest portion only, with 70% dedicating 1-20% to that end, with a survey-wide average somewhat higher at 28.5% (see Figure 4). Although this falls below reported motivations, it still represents a sizeable proportion of overall project costs, and, according to some firms, entails the majority of their expenditures. Although this may seem excessive, it is not necessarily unreasonable. In projects with lower initial capital expenditures (e.g. REDD project in areas with lower costs), a proportionally larger portion of budgets can be earmarked for poverty reduction initiatives while maintaining viability. One such project being developed plans to pay out $0.50 per tonne to communities during early project stages, and $1.50 per tonne after establishment. This represents 44% to 83% of project expenditures, making payments for ecosystem services by far the largest component of the project budget.

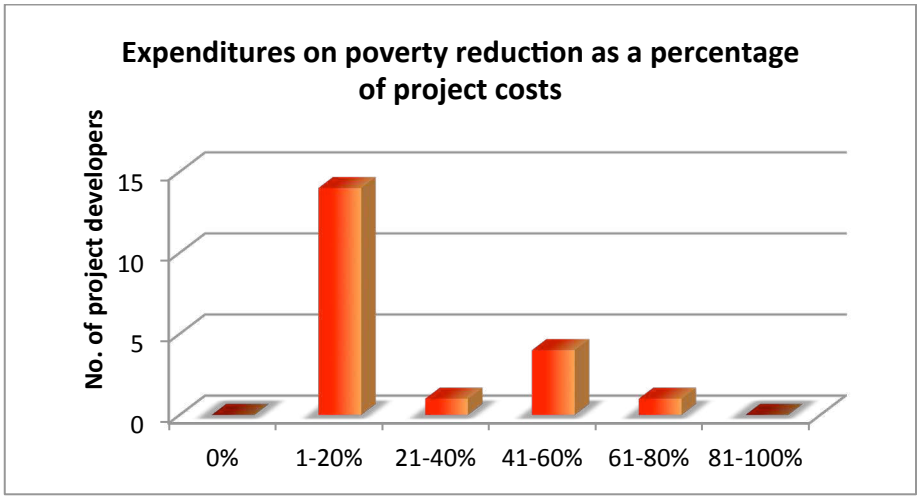

Figure 4: Reported expenditures on poverty reduction measures as a percentage of total project costs

Many different kinds of programs were put in place by respondents to reduce poverty in communities near projects (see Figure 5). Training programs were the most common (implemented by 90% of project developers), of which many forms were possible, from adaptive agricultural techniques (especially as part of agroforestry projects), to job training for project activities. In the latter case (as well as the employment itself), it is questionable as to whether or not such measures should technically be considered 'poverty reduction' activities, as they represent a means to project completion more than a tailored program above and beyond project requirements. However, since many projects are long-term, and may be in place for 25 or more years, the employment and related training may contribute economically to the community for an extended period of time, even if it is a by-product of project implementation.

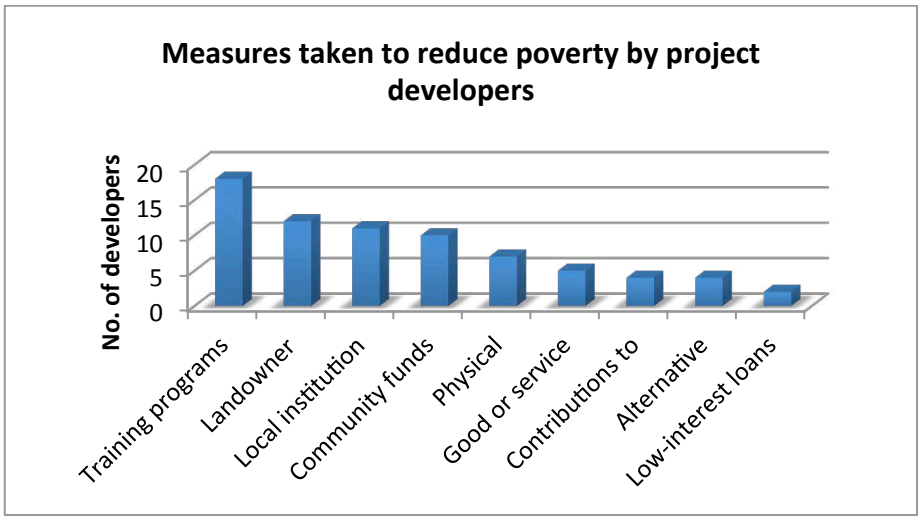

Figure 5: Types of programs instituted by project developers to reduce local poverty

The next most common reported contributor to poverty reduction was direct payments to landowners, used by 60% of firms. Again, whether or not these contribute to poverty reduction will depend on the specific project. Concerns have been raised regarding equality of payment distribution, as the poorest people often possess no land, and are therefore unable to receive such direct payments (Costenbader 2010; To et al. 2012). In such cases, forest carbon (and REDD in

particular), may exacerbate poverty by limiting access to local forest resources, but providing no compensation for those who most rely on them. In cases where payments are made to local smallholders, however, projects can increase income to poor farmers, and help improve livelihoods.

Contributions to local institutions were reported by 55% of respondents. Common among these are payments to local schools and health care facilities (Tacconi, Mahanty, and Suich 2010; World Bank 2011b). In the area near Project 3, less than a quarter of school-aged children attended classes, and one of the specific well-being indicators chosen by the community for monitoring was increased school enrolment. Although demand has a important role on educational enrolment related to opportunity cost of labour, poor quality of education due to lack of supplies, infrastructure and training discourage parents from enrolling children (Glick and Sahn 2000; Bredie and Beeharry 1998). When coupled with cost and access issues, attendance is typically low, which has a negative effect on economic growth (Birdsall, Ross, and Sabot 1995).

Health care in the developing world is in general poorly funded, and typically even worse in rural areas (Walsh and Warren 1980; Martinez et al. 2005). Aside from quality of life impacts, poorer health outcomes resulting from poor health care result in negative economic and educational outcomes, further affecting communities (Russell 2004; Ainsworth, Beegle, and Koda 2005). Given the difficulties many communities have in providing sufficient financial support to health and educational institutions, contribution to them by project developers can help to alleviate poverty in the short-term, but also help to provide care, knowledge and skills for the development of future generations.

One half of project developers established community funds as a form of assistance or compensation related to their forest carbon projects. Community funds allow for direct payments to be made, but in a fashion that can ensure more equitable access to benefits by community members. Although stipulations are often involved, it is generally at the discretion of communities themselves to decide how the funds are used, often for infrastructure, services or tools (Mahanty, Suich, and Tacconi 2012). In one case study project, this resulted in funds being used to purchase a diesel generator, a use counterproductive to the carbon storage intended by the project.

A problem that may arise from community funds is conflict over their expenditure or investment. Because of pre-existing social dynamics in communities, funds may be subject to elite capture: the asymmetrical benefit of the powerful from rent collection (To et al. 2012). Consequently, structures may need to be put in place to ensure equal input to and benefit from funds. One case studied set up an alternate payment scheme for village chiefs to prevent their interference in the management of community funds, ensuring greater control of the funds by villagers, even if somewhat less equitable.

Thirty-five percent of respondents reported making investments in physical infrastructure to assist in poverty alleviation. These can take many forms, including road construction and maintenance, electrification, the building of community structures, and others, each of which yield their own benefits to local populations (Cameron 2010; Khatri 2011). These kinds of investments can have large multiplier effects, increasing productivity and standard of living if properly implemented. With such projects, extensive consultation with stakeholders is required to ensure that investments made ensure widespread benefit to the community. Also, the construction of roads may contribute to deforestation, for reasons previously discussed.

Subsidization of goods and services was reported as a form of community assistance by almost a third of surveyed firms. This often entails the discounted sale or gift of forest or agroforestry products from projects to local residents. An example of this can be tree fruit resulting from agroforestry projects, which entail little to no cost to project developers, but can act as a source of food or income (from sale) for residents. In cases such as this, multiple economic benefits can be derived from one product, which can help to meet subsistence needs or drive local industry.

One-fifth of respondents claimed contributions to other local development agencies or NGOs as a way of reducing poverty. In some ways, this may constitute one of the more efficient methods of contributing to community development. Although development agencies differ in their levels of impact, making use of established expertise and pre-existing community connections may be a more effective way to contribute to local livelihoods for a firm developing a forest carbon project in a new region. This may especially be the case for profit-driven organizations with little experience in community development. However, such a strategy may lessen the degree of connection between the project developer and the community. In a case where assistance to local residents is provided *via* an intermediary, less respect may be built for the project in the eyes of locals if benefits are not visibly related to the project. So although the payments to other development organizations may sometimes be a better poverty reduction tool, they may not necessarily be the best option for firms looking to build a rapport with the community.

Fifteen percent of those surveyed stated that they helped to reduce poverty by providing an alternative income source to local residents. These responses were added *via* the 'other' category, and little elaboration was included to describe what this entailed. Since payments to the community or its residents are covered in other categories, alternative income source is interpreted as meaning the creation of a new local industry or the provision of access to new goods that can be traded by the community. An example of this is the seed of the Jatropha tree, which is grown as part of an A/R project. The seeds are then purchased from landowners at a fixed price, and are then pressed for use in biodiesel (Dupeloux 2012). Although such benefits may not be costly to the project developer, they can be deliberately part of project design, and can still help provide essential income to local residents.

One tenth of firms offered low-interest loans (microcredit) as a way of assisting local communities in their project area. Access to credit is a significant issue in the global South, with bank lending rates much higher than in developed nations: banks in the Congo (DR) and Brazil offer average rates of 56.8 and 39.9% respectively (CIA 2012). In similar places, it can be extremely difficult for the poor, with little collateral, to make investments in revenue generating activities. Microcredit can help to fill that gap, and evidence has generally been positive about its community impacts (Khandker 1998; Rahman 1999; Navajas et al. 2000). A potential drawback, however, is that borrowers may default on loans, and such schemes have sometimes been discontinued for this reason (May et al. 2004).

There are also other ways that project developers can assist in improving community livelihoods that do not necessarily include the transfer of funds. The enhancement of ecosystem services from projects, such as soil conservation, hydrological regulation, or ecotourism can be beneficial to community well-being (Chopra 1993). Firms may also play a positive diplomatic role. One respondent, for example, negotiated for tenure with local governments on behalf of a community. Established tenure is understandably important for long-term project security, but for communities

that have no formalized tenure over land, this may help to ensure autonomy and control over the forest in their midst. This may result in long-term implications for forests as discussed in the literature review. However, this does not mean that forest carbon contracts will not be respected since deforestation of unclaimed land may not necessarily translate to the felling of forests whose carbon has been paid for.

Overall, developers made use of diverse strategies to contribute to poverty reduction in local communities. The level of expenditures varied between firms, but averaged to just over a quarter of project expenditures, indicating a significant contribution to the livelihoods of communities overall. Although the effectiveness of these expenditures depends highly on the types of initiatives and how well they are implemented, it is clear that many project developers are dedicated to helping the communities in which they operate.

4.3 How do these expenditures differ between for-profit and non-profit organizations, levels of poverty reduction motivation, project types, funding sources, poverty reduction activities, and co-benefits certifications?

4.3.1 For-profit vs. non-profit

Although non-profit organizations on average reported spending more on poverty reduction than for-profit firms, the difference was not significant (see Figure 6). This is perhaps surprising, as without a profit motivation, non-profits could potentially dedicate more funds to poverty reduction as a proportion of their budgets. Non-profits are often also considered to be ideology-, rather than profit-driven, so the assumption may be that poverty reduction is a more 'essential' goal of the organization type, however, this did not appear to be the case in a statistically significant fashion. On this note, it is important to recall that not all non-profits are dedicated uniquely to social goals, as some of the project developers surveyed were primarily environmental organizations.

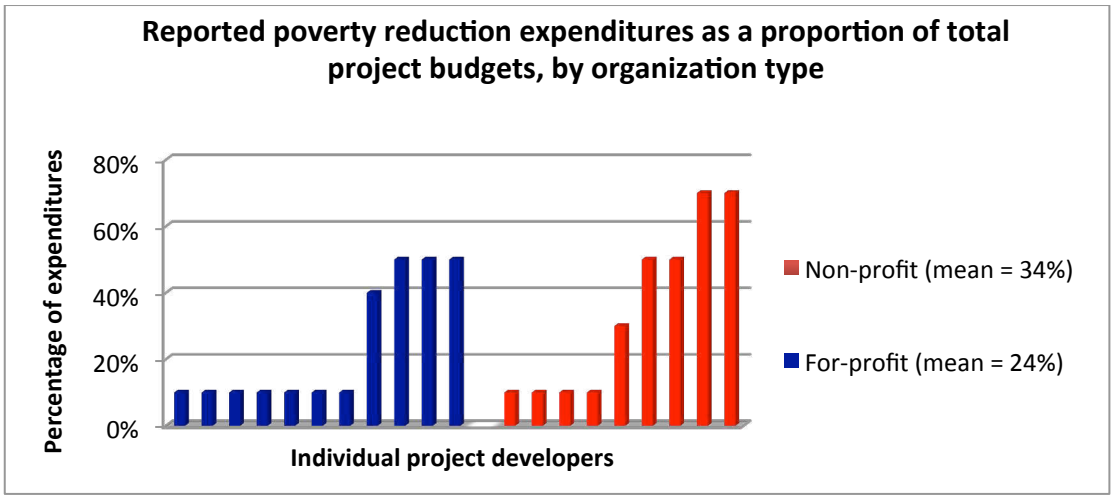

Figure 6: Reported poverty reduction expenditures by organization type

The higher-than-expected poverty reduction expenditures by for-profits may have several explanations. They may be due to reasons of corporate structure, such that for-profit companies' general operations are carried out at lower costs, freeing funds to be spent on other project elements. For-profit firms may also have better access to capital, allowing for the development of

larger projects, reducing transaction costs as a relative proportion of total expenditures. Also, poverty reduction may be seen as a *de facto* requirement of current developing world forest carbon projects, indicating a base minimum level of expenditure for certification and market access. Finally, poverty reduction may be seen as method of ensuring project success, but this will be further discussed in the risk reduction section.

4.3.2 Poverty reduction as a project motivation

There appeared to be a strong correlation between the reported importance of poverty reduction as a project goal and organization expenditures to that end (see Figure 7). Although there was a high degree of variation between individual firms within the two variables, in general the variables trended together. This may be because firms tended to be internally consistent, in that their actions correlated with their stated goals. However, since the questions were asked in the course of the same survey (although not consecutively), it is possible that expenditures were reported to align with motivations. In general, though, the values were not the same, and expenditures were reported as lower than motivation. This is likely due to the fact that in establishing a project *via* carbon finance, even if the goal is entirely to alleviate poverty, outside costs arise that do not contribute directly to poverty reduction. In any case, assuming that financial figures are reasonably accurate, it appears that project developers dedicated funds to poverty reduction fairly consistently with their expressed goals.

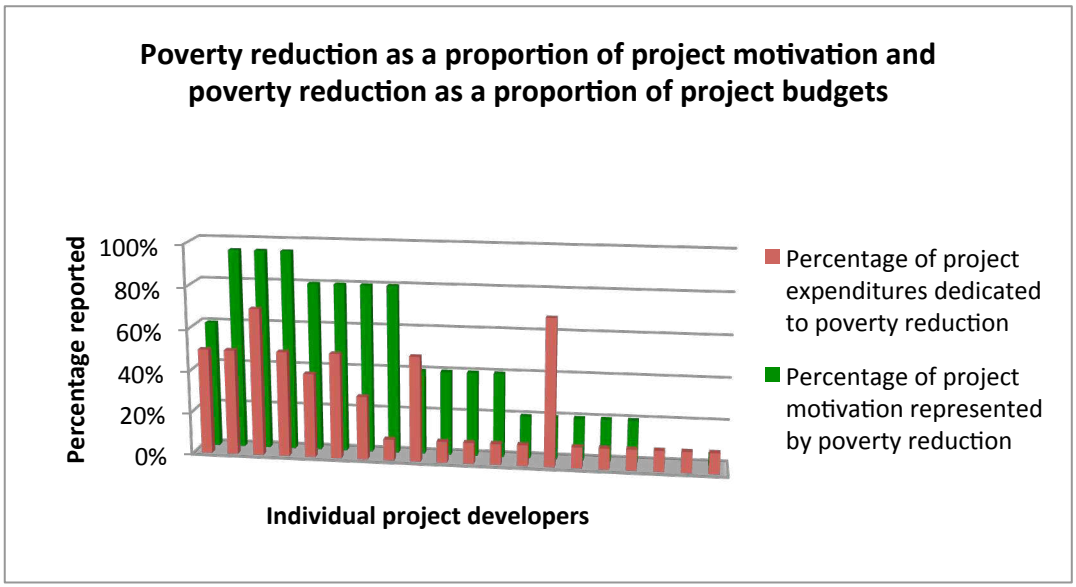

Figure 7: Comparison of reported poverty reduction motivation and expenditures

4.3.3 Project types

The only project type that was correlated with poverty reduction expenditures was improved forest management. In general, project developers that implemented IFM projects spent a smaller proportion of funds on poverty alleviation efforts. This may be because IFM is applied to projects that are first and foremost commercial forestry operations, with both poverty reduction and forest carbon as secondary aims. It is also possible that IFM projects involve costs not associated with other kinds of forest carbon projects (such as harvesting, block layout, etc.), which increase overall expenditures relative to poverty reduction. It is also worth noting that all respondents engaged in

IFM projects were for-profit, and as a sub-group, sit at the bottom end of poverty reduction expenditures.

4.3.4 Funding sources

Of all reported funding sources, only two correlated with poverty reduction expenditures: sale of timber (negatively), and private donations (positively). For timber sales, reasoning may be similar to the case of IFM, with differing aims and levels of overall expenditures. For private donations, however, the case is unique. Because these donations must be solicited from the public and rely largely on goodwill, an altruistic outcome is likely essential to encourage giving. Therefore, elevated expenditures in poverty reduction may represent part of an informal contract with donors, a justification of the use of donor funds. In a sense, since donors are the funders of certain projects, they to an extent direct an organization's activities to their goals, which to a degree likely entail poverty reduction.

4.3.5 Poverty reduction activities

Among the poverty reduction activities, only training programs showed correlation with expenditures, albeit negatively. This indicates that in general, project developers that did not institute training programs tended on average to spend more on poverty reduction. This may or may not be noteworthy, as only two developers did not implement training programs, however, the correlation was significant ($p = 0.0003$). The reason for this may be that training programs may entail lower direct financial costs than other kinds of poverty alleviation activities. Firms employing training programs may have counted them as a primary form of assistance, and invested less in other measures. Also, if project developers themselves led training programs, their costs may be hidden in general staffing costs, and may not therefore have contributed to their poverty reduction figures, skewing estimates. It should be noted that almost all poverty alleviation measures would have contributed to estimated expenditures: only training programs showed a significant difference in impact on these estimates.

4.3.6 Co-benefits certification

The CarbonFix standard showed a negative correlation with poverty reduction expenditures, and was the only certification to indicate one of any kind. Only 3 organizations surveyed used the standard (all for-profit), and all had below average expenditures on poverty reduction. This is unexpected, as the CFS is established as having well-defined requirements for improved social conditions within projects, and in a review of forest carbon standards, was given full marks for it co-benefits section (Lopes 2009). Unlike the CCBS, CarbonFix is also a carbon standard, specializing in A/R and IFM, and does not certify REDD or Agroforestry projects, which may be related to the poverty reduction expenditures of firms using it. It may also be that the level of expenditure seen in the firms using the CFS are organization specific, and may be unrelated to certification.

4.4 Do forest carbon project developers see poverty reduction as a method of risk reduction, and promote it to sellers as one?

Almost all project developers surveyed believed that poverty reduction helps to reduce risk to projects, and the majority presented this to potential buyers way of promoting their credits. It is impossible to say with certainty whether or not poverty threatens forest carbon, but based on the information presented in the literature review, there is not a solid link between poverty and

deforestation. In a meta-analysis of deforestation studies, Geist and Lambin (2002) find that poverty itself is not an attributable cause of deforestation, but rather, acts as an underlying theme that may correlate to other proximate causes. However, as is also explored, development initiatives such as road construction or agricultural investment can contribute to deforestation, complicating the role of project developers who aim to both reduce poverty and protect forest carbon.

A relatively unexplored facet of the equation, however, is the role of contractual agreements and community involvement in protecting forests. As previously noted, the deforestation of land with undefined tenure may not parallel deforestation of land that a community has formally allowed to be used for forest carbon. In cases where formal agreements are made with communities, deforestation may be avoided. However, such agreements may not be respected without some sort of compensation or tangible benefit to local residents. Therefore, gaining community support or 'buy-in' may represent a critical part of forest carbon projects, and in areas with endemic poverty this is likely to include measures that reduce poverty. This may be essential not only to ensure project permanence in the long term, but also to the initial establishment of projects, which are likely to require local knowledge and expertise.

Therefore, even if poverty is not necessarily a cause of deforestation, the reduction of poverty through benefit-sharing and targeted initiatives may still help to build goodwill between local residents and project developers, and thus contribute to smoother project operations, and reducing some costs (e.g. policing). Conversely, forest management decisions made unilaterally without local benefit may drive resentment, and complicate long-term project stability.

Poverty reduction as risk reduction becomes more important as forest carbon becomes further integrated into compliance markets. Because most voluntary purchases are made for reasons of branding or CSR, poverty reduction aids in nurturing positive public relations for buyers. Conversely, in compliance markets where offsetting is mandatory and all credits are fungible, poverty reduction in forest carbon projects may be seen only as an additional expense, yielding little immediate benefit for those retiring credits. However, if poverty reduction also contributes to project success, it may be seen less as an option, and more a requirement of forest carbon projects, compliance or voluntary.

4.5 Do certifications involving poverty reduction have an impact on the demand and sale price of credits?

4.5.1 Demand

According to the majority of project developers, the use of certification for their credits has resulted in a corresponding increase in demand, although there was no statistically significant difference between standards (see Table 1). The increased demand is likely resultant in part from increased awareness in the marketplace of the potential externalities of forest carbon in the developing world. All of the major co-benefits explored include both the assurance that communities are not negatively impacted by project activities, but also that community well-being is actively improved. Notably, any REDD credits to be exchanged under California's cap and trade system will require co-benefits certification, indicating a recognition of local well-being even in compliance settings (Simonet et al., 2012).

Table 1: Reported impact of certification on demand and price of forest carbon credits

	CCBS	Plan Vivo	Carbon Fix	FSC	Proprietary	All Standards
Respondents reporting demand increase	73%	60%	100%	100%	100%	**72%**
Respondents reporting price increase	47%	60%	67%	50%	100%	**44%**
Average price increase (when increase noted)	$2.93	$2.50	$4.00	$3.00	$0.50	**$2.94**
Overall avg. price increase (incl. those not reporting an increase)	$1.37	$1.50	$2.67	$1.50	$0.50	**$1.31**

Aside from legislation or altruism, corporate buyers may demand that forest carbon credits be certified for public relations management. In purchasing only certified offsets, buyers can to an extent claim credit for related social benefits, and avoid association with potential detrimental social impacts. In order to prevent the potential of negatively impacting communities, buyers may be shunning uncertified credits, making co-benefits standards an increasing condition of market entry.

4.5.2 Price

According to respondents, all certifications to some degree resulted in increased prices for credits, although not uniformly within or across different standards (see above table). The only certification that was significantly different was the CarbonFix standard, which was positively correlated with higher prices. Notably, the CFS was also associated with lower poverty reduction expenditures, although it is unknown if the two are related. Possible explanations for the elevated value of CFS-certified credits may be linked to marketing to target buyers, or established branding (the CFS having been in existence since 1999 (CarbonFix 2011).

Notably, the most used certification, the Climate, Community and Biodiversity Standard, yielded the lowest number of reported price jumps, and increases were not significant compared to other standards. This is notable, since a survey conducted in 2010 indicated that the majority of buyers would be willing to pay a price premium for credits with CCBS certification (Neeff et al. 2010). However, an actual examination of credit prices has indicated the opposite: that credits with CCBS certification (in conjunction with a carbon standard) sold for a lower price than their carbon-only counterparts (Diaz, Hamilton, and Johnson 2011). This, however, could be explained by several factors:

1. Because voluntary credits are sold primarily over the counter, buyers may not have access to complete market information when negotiating purchases
2. Forest carbon credits are often marketed on the unique characteristics (or 'stories') of individual projects, rather than the certification of credits alone
3. Certification may be interpreted more as a requirement for market access than as a method of increasing price
4. CCBS, as the dominant standard, may be seen as generic, possibly reducing value
5. Statistical error

Compared to the CCBS, then, the value added to CFS credits may be somewhat due to niche appeal, or better 'storytelling'. Interviews conducted by Simonet and Bouculat (2012), identify the

importance of creating a 'story' around forest carbon by linking it to community and biodiversity benefits that resonate with buyers. In such a case, smaller developers using less widespread standards may present a more unique story, and negotiate higher prices for their credits.

5 Conclusion

Forest carbon is a growing form of carbon offset in both voluntary and compliance markets, and projects are occurring increasingly in the developing world. As the relevance of forest carbon has increased, so too has the focus on the externalities of forest carbon, including the impacts of projects on local communities, a large proportion of which are poor. Many forest carbon project developers are therefore incorporating poverty reduction into their projects in the aim improving local livelihoods, and seeking certification of their credits to increase marketability.

According to the data collected in this study, poverty reduction is a widespread goal of forest carbon projects, with the assistance of local communities rivalling the sequestration of carbon in importance to project developers. Although there is high variance between respondents, on average over a quarter of project expenditures are related to poverty reduction, and these are used to fund various kinds of initiatives, although some of community benefits may be more incidental than deliberate.

The proportion of project budgets dedicated to poverty reduction by developers varied dependent on the stated importance of poverty reduction, the type of project, sources of funding, and specific poverty reduction measures. In general, developers saw poverty reduction as a form of project risk reduction, and most developers noted demand (but not necessarily price) increases linked with certification, and price increases depended to some extent on the certification obtained.

Overall, evidence collected indicates within forest carbon project developers recognition of the importance of poverty reduction on either a market, logistical, or ethical level, and diversity in the kinds of programs used to meet this goal. Although there is variation within levels of expenditure, a substantial amount of funding enters local communities that may otherwise lack methods of obtaining investment or employment. Far from simply being of benefit to local residents, expenditures to assist communities may also build local cooperation with projects, and contribute to higher sales *via* value added from certification.

Although is highly unlikely that forest carbon projects will be able to solve climate change or rural poverty on their own, forest carbon offers an access point to local communities and provides an extra source of funding for developing world poverty reduction. Likewise, the alleviation of poverty adds a face to forest carbon, and may contribute to greater funding, and demand, for forest carbon as well.

BIBLIOGRAPHY

Ainsworth, Martha, Kathleen Beegle, and Godlike Koda. 2005. "The Impact of Adult Mortality and Parental Deaths on Primary Schooling in North-Western Tanzania." *Journal of Development Studies* 41 (3): 412–439. doi:10.1080/0022038042000313318.

Angelsen, Arild, and David Kaimowitz. 1999. "Rethinking the Causes of Deforestation: Lessons from Economic Models." *The World Bank Research Observer* 14 (1) (February 1): 73–98. doi:10.1093/wbro/14.1.73.

Barbier, Edward. 2005. *Natural Capital, Resource Dependency and Poverty in Developing Countries*. Columbia University. http://policydialogue.org/files/publications/02_NaturalCapital_Barbier.PDF.

Barder, O. 2009. "What Is Poverty Reduction?" *Center for Global Development Working Paper No. 170*. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1394506.

Birdsall, Nancy, David Ross, and Richard Sabot. 1995. "Inequality and Growth Reconsidered: Lessons from East Asia." *The World Bank Economic Review* 9 (3) (September 1): 477–508. doi:10.1093/wber/9.3.477.

Bishara, Anthony J., and James B. Hittner. 2012. "Testing the Significance of a Correlation With Nonnormal Data: Comparison of Pearson, Spearman, Transformation, and Resampling Approaches." *Psychological Methods*: No Pagination Specified. doi:10.1037/a0028087.

BMV. 2012. "Partners." http://www.brasilmataviva.com.br/index.php?option=com_content&view=article&id=30.

Bredie, Joseph W. B., and Girindre K. Beeharry. 1998. *School Enrollment Decline in Sub-Saharan Africa: Beyond the Supply Constraint*. World Bank Publications.

Bryman, Alan, and Emma Bell. 2006. *Business Research Methods*. OUP Oxford.

Bumpus, Adam G., and Diana M. Liver Man. 2008. "Accumulation by Decarbonization and the Governance of Carbon Offsets." *Economic Geography* 84 (2): 127–155. doi:10.1111/j.1944-8287.2008.tb00401.x.

Cairncross, Sandy, Jamie Bartram, Oliver Cumming, and Clarissa Brocklehurst. 2010. "Hygiene, Sanitation, and Water: What Needs to Be Done?" *PLoS Med* 7 (11) (November 16): e1000365. doi:10.1371/journal.pmed.1000365.

Cameron, Zoe. 2010. "Feedback Madagascar's Work with Communities." In *Voices from Madagascar's Forests: Improving Representation and Rights of Malagasy Forest Peoples*. Norwich: University of East Anglia. http://www.redd-monitor.org/wordpress/wp-content/uploads/2010/09/VoicesfromMadagascarFinalReport2010.pdf.

CarbonFix. 2011. "CarbonFix Standard - About Us." *CarbonFix Standard*. http://www.carbonfix.info/About-us.html?PHPSESSID=g955pdo765t1o3oqtnic13dvr0.

———. 2012. "CarbonFix Standard - Project." http://www.carbonfix.info/Project.html.

Chenost, Clément, Yves-Marie Gardette, Julien Demenois, Nicolas Grondard, Martin Perrier, and Matthieu Wemaëre. 2010. *Les Marchés Du Carbone forestier/Bringing Forest Carbon Projects to the Market*. http://iklim.cob.gov.tr/iklim/Files/eKutuphane/ForestryCarbonProjects.pdf.

Chomitz, Kenneth M, and David A Gray. 1995. "Roads, Lands, Markets, and Deforestation - A Spatial Model of Land Use in Belize." http://eprints.eriub.org/269/.

Chopra, Kanchan. 1993. "The Value of Non-timber Forest Products: An Estimation for Tropical Deciduous Forests in India." *Economic Botany* 47 (3) (July 1): 251–257. doi:10.1007/BF02862291.

CIA. 2012. "Country Comparison :: Commercial Bank Prime Lending Rate." *CIA - The World Factbook*. https://www.cia.gov/library/publications/the-world-factbook/rankorder/2208rank.html?countryName=China&countryCode=ch&regionCode=eas&rank=144#ch.

Coomes, O. T, F. Grimard, C. Potvin, and P. Sima. 2008. "The Fate of the Tropical Forest: Carbon or Cattle?" *Ecological Economics* 65 (2): 207–212.

Costenbader, John. 2010. *REDD+ BENEFIT SHARING: A COMPARATIVE ASSESSMENT OF THREE NATIONAL POLICY APPROACHES*. REDD+ Partnership Workshop on Enhancing Coordinated Delivery of REDD+: Emerging Lessons, Best Practices and Challenges. Cancun, Mexico: International Union for Conservation of Nature. foris.fao.org/.../benefit_sharing_paper_draft_for_workshop.pdf.

Cropper, M., J. Puri, and C. Griffiths. 2001. "Predicting the Location of Deforestation: The Role of Roads and Protected Areas in North Thailand." *Land Economics* 77 (2): 172–186.

Diaz, David, Katherine Hamilton, and Julie Johnson. 2011. *State of the Forest Carbon Markets 2011 From Canopy to Currency*. http://www.forest-trends.org/documents/files/doc_2963.pdf.

Dupeloux, Benjamin. 2012. "Interview with Eco-Carbone by Neil MacEachern."

Duraiappah, Anantha K. 1996. *Poverty and Environmental Degradation: A Literature Review and Analysis*. IIED. http://www.uio.no/studier/emner/annet/sum/SUM1000/h09/pensumartikler2009/Duraiappah_1998_World-Development.pdf.

ECCM. 2012. "What Are CDM Rules and Conditions?" http://www.cdmcapacity.org/what_is_CDM/rules_conditions.html.

ENDS Carbon. 2012. "Directory of Carbon Offset Providers." http://www.endscarbonoffsets.com/directory/.

FAO/DFID. 2001. *How Forests Can Reduce Poverty*. http://www.fao.org/DOCREP/006/Y2172E/Y2172E00.HTM.

Fink, Arlene. 2005. *How to Conduct Surveys: A Step-by-Step Guide*. 3rd ed. Sage Publications, Inc.

Forest Carbon Asia. 2012a. "Markets & Financing." March 2. http://www.forestcarbonasia.org/themes/markets-financing/.

———. 2012b. "Forest Carbon Project Developers & Consultants: Private Sector." June 15. http://www.forestcarbonasia.org/players/project-developers-consultants/.

Forest Carbon Portal. 2012. "Forest Carbon Project Inventory." http://www.forestcarbonportal.com/projects?search=&proj_type=All&seeking=All&market=All&country=All&standard=All.

Gardiner, Stephen M. 2004. "Ethics and Global Climate Change." *Ethics* 114 (3) (April 1): 555–600.

Geist, Helmut, and Eric Lambin. 2002. "Proximate Causes and Underlying Driving Forces of Tropical Deforestation." *BioScience* 52 (2): 143–150. doi:10.1641/0006-3568(2002)052[0143:PCAUDF]2.0.CO;2.

Glick, Peter, and David E. Sahn. 2000. "Schooling of Girls and Boys in a West African Country: The Effects of Parental Education, Income, and Household Structure." *SSRN eLibrary* 19 (1). Economics of Education Review: 63–87.

Hamilton, Katherine, Milo Sjardin, Molly Peters-Stanley, and Thomas Marcello. 2010. *Building Bridges: State of the Voluntary Carbon Markets 2010*. Ecosystem Marketplace. http://www.ecosystemmarketplace.com/pages/dynamic/resources.library.page.php?page_id=7585&section=our_publications&eod=1.

Harris, Nancy, Sassan Saatchi, Stephen Hagen, Sandra Brown, Williams Salas, Matthew Hansen, and Alexander Lotsch. 2010. *New Estimate of Carbon Emissions from Land-Use Change*. Arlington: Winrock. http://www.winrock.org/ecosystems/files/Winrock%20-%20New%20Estimate%20of%20Carbon%20Emission%20from%20Land%20Use%20Change%20-%20Forest%20Day%20Poster%202010.pdf.

Holland, Margaret, Free de Koning, Manuel Morales, Lisa Treves, Brian Robinson, and Luis Suarez. 2012. "Complex Tenure and Deforestation: Implications for Conservation Incentives in the Ecuadorian Amazon1." *World Development*. http://www.landandpoverty.com/agenda/pdfs/paper/holland_full_paper.pdf.

IIED. 2009. "REDD: Protecting Climate, Forests and Livelihoods | International Institute for Environment and Development." http://www.iied.org/redd-protecting-climate-forests-livelihoods.

IPCC. 2007. *Climate Change 2007: Synthesis Report. Summary for Policymakers*. IPCC. http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

IUCN. 2011. *Understanding Forest Dependency for REDD+: Adapting the Forests-Poverty Toolkit to New Purposes*. International Union for Conservation of Nature. http://cmsdata.iucn.org/downloads/briefing_paper_redd__and_forests_poverty_toolkit.pdf .

Kant, Promode, Swati Chaliha, and Wu Shuirong. 2011. *The REDD Safeguards of Cancun*. New Dehli: Institute of the Green Economy. http://www.fao.org/fileadmin/user_upload/rome2007/docs/REDD_Safeguards_of_Cancun.pdf.

Kerr, Suzi, Alexander Pfaff, Romina Cavatassi, Benjamin Davis, Leslie Lipper, Arturo Sanchez, and Jason Craig Timmins. 2004. *Effects of Poverty on Deforestation: Distinguishing Behaviour from Location*. Working Paper 04-19. Agricultural and Development Economics Division of the Food and Agriculture Organization of the United Nations (FAO - ESA). ftp://ftp.fao.org/docrep/fao/007/ae401e/ae401e00.pdf.

Khan, Mahmood Hasan. 2000. "Rural Poverty in Developing Countries." *Finance and Development | F&D*. http://www.imf.org/external/pubs/ft/fandd/2000/12/khan.htm.

Khandker, S. R. 1998. "Fighting poverty with microcredit: experience in Bangladesh." http://www.cabdirect.org/abstracts/19991800156.html.

Khatri, Dil. 2011. *Payments for Ecosystem Services in Kulekhani Watershed of Nepal*. ForestAction. http://www.forestaction.org/app/webroot/js/tinymce/editor/plugins/filemanager/files/3.%20IASC%20paper%20Khatri.pdf.

Kindermann, Georg, Michael Obersteiner, Brent Sohngen, Jayant Sathaye, Kenneth Andrasko, Ewald Rametsteiner, Bernhard Schlamadinger, Sven Wunder, and Robert Beach. 2008. "Global Cost Estimates of Reducing Carbon Emissions Through Avoided Deforestation." *Proceedings of the National Academy of Sciences* 105 (30) (July 29): 10302–10307. doi:10.1073/pnas.0710616105.

Kooten, G. Cornelis van, Alison Eagle, James Manley, and Tara Smolak. 2004. *How Costly Are Carbon Offsets? A Meta-Analysis of Forest Carbon Sinks*. Working Paper 2004-01. University of Victoria, Department of Economics, Resource Economics and Policy Analysis Research Group. http://ideas.repec.org/p/rep/wpaper/2004-01.html.

Kossoy, Alexandre, and Pierre Guignon. 2012. *State and Trends of the Carbon Market 2012*. Washington DC: World Bank. http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/State_and_Trends_2012_Web_Optimized_19035_Cvr&Txt_LR.pdf.

Kremen, C., J. O. Niles, M. G. Dalton, G. C. Daily, P. R. Ehrlich, J. P. Fay, D. Grewal, and R. P. Guillery. 2000. "Economic Incentives for Rain Forest Conservation Across Scales." *Science* 288 (5472) (June 9): 1828–1832. doi:10.1126/science.288.5472.1828.

Lal, R. 2004. "Soil Carbon Sequestration Impacts on Global Climate Change and Food Security." *Science* 304 (5677) (June 11): 1623–1627. doi:10.1126/science.1097396.

Larson, Anne, and Jesse Ribot. 2007. "The Poverty of Forestry Policy: Double Standards on an Uneven Playing Field." *Sustainability Science* 2 (2): 189–204. doi:10.1007/s11625-007-0030-0.

Lopes, Paulo. 2009. "Review of Forestry Carbon Standards – Development of a Tool for Organizations to Identify the Most Appropriate Forestry Carbon Credit (Version 03)". London: Imperial College. http://www.4shared.com/file/134320287/10337da8/Full_document_-_Review_of_Forestry_Carbon_Standard_2009_Paulo_Lopes_Imperial_College_London.html.

Madeira, E. C.M. 2008. "Policies to Reduce Emissions from Deforestation and Degradation (redd) in Developing Countries." *Resources for the Future (Washington, DC, USA)*. http://www.rff.org/RFF/Documents/RFF-Rpt-REDD_final.2.20.09.pdf.

Maertens, Miet, Manfred Zeller, and Regina Birner. 2006. “Sustainable Agricultural Intensification in Forest Frontier Areas.” *Agricultural Economics* 34 (2): 197–206. doi:10.1111/j.1574-0864.2006.00118.x.

Mahanty, Sango, Helen Suich, and Luca Tacconi. 2012. “Access and Benefits in Payments for Environmental Services and Implications for REDD+: Lessons from Seven PES Schemes.” *Land Use Policy* (0). doi:10.1016/j.landusepol.2011.10.009. http://www.sciencedirect.com/science/article/pii/S0264837711001244.

Martinez, A., V. Villarroel, J. Seoane, and F. del Pozo. 2005. “Analysis of Information and Communication Needs in Rural Primary Health Care in Developing Countries.” *IEEE Transactions on Information Technology in Biomedicine* 9 (1) (March): 66 –72. doi:10.1109/TITB.2004.842411.

May, Peter, Emily Boyd, Fernando Veiga, and Manyu Chang. 2004. *Local Sustainable Development Effects of Forest Carbon Projects in Brazil and Bolivia*. International Institute for Sustainable Development. http://www.ibcperu.org/doc/isis/8212.pdf.

Mayers, J. 2006. “Poverty Reduction Through Commercial Forestry.” *What Evidence*. http://pubs.iied.org/pubs/pdfs/G02227.pdf.

McDermott, M.H, and K Schreckenberg. 2009. “Equity in Community Forestry: Insights from North and South.” *International Forestry Review* 11 (2): 157–170. doi:10.1505/ifor.11.2.157.

Metz, B., O. R. Davidson, P. R. Bosch, R. Dave, and L. A. Meyer. 2007. “Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.” *Cambridge University Press, Cambridge, UK and New York, NY. Retrieved June* 26: 2007.

MIT. 2012. “Mission 2013 - Agroforestry.” http://igutek.scripts.mit.edu/terrascope/?page=Agroforestry.

Mkandawire, T. 2005. *Targeting and Universalism in Poverty Reduction*. United Nations Research Institute for Social Development. http://www.unrisd.org/unrisd/website/document.nsf/462fc27bd1fce00880256b4a0060d2af/955fb8a594eea0b0c12570ff00493eaa/$FILE/mkandatarget.pdf.

MOEJ. 2012. “New Mechanisms Information Platform: REDD/REDD+.” http://www.mmechanisms.org/e/redd/background.html.

Mogaka, H. 2006. *Desertification and Livelihoods in Africa: Integrating Drylands Ecosystem Services into National Economic Planning, Kenya.* Nairobi: The World Conservation Union.

Monela, G. C., S. A. O. Chamshama, R. Mwaipopo, and D. M. Gamassa. 2005. “A Study on the Social, Economic and Environmental Impacts of Forest Landscape Restoration in Shinyanga Region, Tanzania.” *United Republic of Tanzania Ministry of Natural Resources and Tourism/International Union for the Conservation of Nature and Natural Resources. Eastern Africa Regional Office, Nairobi. 205pp*. http://cmsdata.iucn.org/downloads/flr_final_report_shinyanga_june2005.pdf.

Moura-Costa, Pedro. 1996. “Tropical Forestry Practices for Forest Carbon Sequestration.” In *Dipterocarp Forest Ecosystems: Towards Sustainable Management*. World Scientific.

National Academies. 2009. “Joint Science Academies’ Statement: Global Response to Climate Change.” G8+5 Academies’ joint statement: Climate change and the transformation of energy technologies for a low carbon future.

Navajas, Sergio, Mark Schreiner, Richard L. Meyer, Claudio Gonzalez-vega, and Jorge Rodriguez-meza. 2000. “Microcredit and the Poorest of the Poor: Theory and Evidence from Bolivia.” *World Development* 28 (2) (February): 333–346. doi:10.1016/S0305-750X(99)00121-7.

Neeff, Till, Lisa Ashford, Claire Davey, Joanna Durbin, Jan Fehse, Andrew Hedges, Tilde Herrera, et al. 2010. *The Forest Carbon Offsetting Report 2010*. Ecosecurities. http://www.carbomark.org/files/u4/ForestCarbonOffsettingReport2010.pdf.

Van Noordwijk, M, Atiek Widayati, Betha Lusiana, Kurniatun Hairiah, and Bustanal Arifin, ed. 2005. “What Can Clean Development Mechanism Do to Enhance Trees in the Landscape?

Experience Based on Rubber, Coffee and Timber-based Afroforestry Systems in Indonesia." In Jakarta: CIFOR. http://www.rainforestcoalition.org/documents/CIFORCarbonForestry.pdf.
OECD. 2003. *Poverty and Climate Change: Reducing the Vulnerability of the Poor Through Adaptation*. http://www.oecd.org/dataoecd/60/27/2502872.pdf.
Peters-Stanley, Molly, and Katherine Hamilton. 2012. *Developing Dimension: State of the Voluntary Carbon Markets 2012*. Washington DC: Ecosystem Marketplace. http://www.forest-trends.org/documents/index.php?pubID=3164.
Peters-Stanley, Molly, Katherine Hamilton, Thomas Marcello, and Milo Sjardin. 2011. *Back to the Future State of the Voluntary Carbon Markets 2011*. Ecosystem Marketplace. http://www.forest-trends.org/documents/files/doc_2828.pdf.
Peters-Stanley, Molly, Katherine Hamilton, and Daphne Yin. 2012. *Leveraging the Landscape: State of the Forest Carbon Markets 2012*. Washington DC: Forest Trends. www.forest-trends.org/documents/index.php?pubID=3242.
Plan Vivo. 2012. "Project << Plan Vivo." http://www.planvivo.org/projects/.
Poudyal, A. S, R. P Poudel, B. Kandel, and A. K Saha. 2005. "Community Forestry for Poverty Alleviation: Social Inclusion and Sustainable Forest Management Initiatives A Case Study from Sundar Community Forest, Morang District." http://www.forestrynepal.org/images/02-%20Presented%20Papers%20and%20Powerpoints/Theme%203/Paper/09-%20Poudyal%20et%20al_Nepal.pdf.
Putz, Francis E, Pieter A Zuidema, Michelle A Pinard, Rene G. A Boot, Jeffrey A Sayer, Douglas Sheil, Plinio Sist, Elias, and Jerome K Vanclay. 2008. "Improved Tropical Forest Management for Carbon Retention." *PLoS Biol* 6 (7) (July 15): e166. doi:10.1371/journal.pbio.0060166.
Rahman, Aminur. 1999. "Micro-credit Initiatives for Equitable and Sustainable Development: Who Pays?" *World Development* 27 (1) (January): 67–82. doi:10.1016/S0305-750X(98)00105-3.
Rival, Laura. 2011. *Ecological Threats, New Promises of Sustainability, and the Evolving Political Economy of Land Use Change and Rural Development in Latin America*. UNRISD. http://www.unrisd.org/80256B42004CCC77/(httpInfoFiles)/32CEF49A675F3FE8C125792100342178/$file/2-2%20Rival.pdf.
Robinson, Brian, Margaret Holland, and Lisa Treves. 2011. *Does Secure Land Tenure Save Forests? A Review of the Relationship Between Land Tenure and Tropical Deforestation*. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). http://ccafs.cgiar.org/sites/default/files/assets/docs/ccafs-wp-07-does-secure-land-tenure-save-forests.pdf.
Russell, Steven. 2004. "The Economic Burden of Illness for Households in Developing Countries: A Review of Studies Focusing on Malaria, Tuberculosis, and Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome." *The American Journal of Tropical Medicine and Hygiene* 71 (2 suppl) (August 1): 147–155.
Sahn, David E, and David C Stifel. 2004. *Urban-Rural Inequality in Living Standards in Africa*. Working Paper UNU-WIDER Research Paper RP2004/04. World Institute for Development Economic Research (UNU-WIDER). http://ideas.repec.org/p/unu/wpaper/rp2004-04.html.
Scherr, Sara J. 2000. "A Downward Spiral? Research Evidence on the Relationship Between Poverty and Natural Resource Degradation." *Food Policy* 25 (4) (August): 479–498. doi:10.1016/S0306-9192(00)00022-1.
Shively, Gerald, and Stefano Pagiola. 2004. "Agricultural Intensification, Local Labor Markets, and Deforestation in the Philippines." *Environment and Development Economics* 9 (02): 241–266. doi:10.1017/S1355770X03001177.
Simonet, Gabriela, Guillaume Bouculat, and Anabelle Oliviera. 2012. *Forest Carbon: Tackling Externalities*. Paris: Chaire Économie du Climat.
Singer, Peter. 2006. "Ethics and Climate Change: A Commentary on MacCracken, Toman and Gardiner." *Environmental Values* 15 (3): 415–422.

Smith, Joyotee, and Sara J Scherr. 2003. “Capturing the Value of Forest Carbon for Local Livelihoods.” *World Development* 31 (12) (December): 2143–2160. doi:10.1016/j.worlddev.2003.06.011.

Stern, N., and C. Taylor. 2007. “Climate Change: Risk, Ethics, and the Stern Review.” *SCIENCE-NEW YORK THEN WASHINGTON*- 317 (5835): 203.

Tacconi, Luca, Sango Mahanty, and Helen Suich. 2010. *Payments for Environmental Services, Forest Conservation and Climate Change: Livelihoods in the Redd?* Edward Elgar Publishing.

Tachibana, Towa, Trung M. Nguyen, and Keijiro Otsuka. 2001. “Agricultural Intensification Versus Extensification: A Case Study of Deforestation in the Northern-Hill Region of Vietnam.” *Journal of Environmental Economics and Management* 41 (1) (January): 44–69. doi:10.1006/jeem.1998.1131.

Thompson, Kenneth. 1980. “Forests and Climate Change in America: Some Early Views.” *Climatic Change* 3 (1): 47–64. doi:10.1007/BF00144985.

To, Phuc Xuan, Wolfram H. Dressler, Sango Mahanty, Thu Thuy Pham, and Claudia Zingerli. 2012. “The Prospects for Payment for Ecosystem Services (PES) in Vietnam: A Look at Three Payment Schemes.” *Human Ecology* 40 (2) (April): 237–249. doi:10.1007/s10745-012-9480-9.

Tomich, T, M van Noordwijk, S Budidarsono, A Gillison, T Kusumanto, D. Murdiyarso, F Stolle, and A Fagi. 2001. “Agricultural Intensification, Deforestation, and the Environment: Assessing Tradeoffs in Sumatra, Indonesia.” In *Tradeoffs or Synergies? Agricultural Intensification, Economic Development and the Environment*. Wallingford, UK}: CAB International. http://www.asb.cgiar.org/content/agricultural-intensification-deforestation-and-environment-assessing-tradeoffs-sumatra-indon.

Tongpan, Sopin. 1991. “Poverty and Deforestation.” In . http://agris.fao.org/agris-search/search/display.do?f=1995/TH/TH95005.xml;TH9321573.

UMD. 2003. “Online Suvery Design Guide.” http://lap.umd.edu/survey_design/questionnaires.html#131.

UNFCCC. 2012. “CDM: Project Activities.” http://cdm.unfccc.int/Projects/registered.html.

US EPA. 2011. “Global Greenhouse Gas Data | Climate Change - Greenhouse Gas Emissions | U.S. EPA.” http://www.epa.gov/climatechange/emissions/globalghg.html.

VCS. 2012. “The VCS Project Development Database.” https://vcsprojectdatabase2.apx.com/myModule/Interactive.asp?Tab=Projects&a=1&t=1.

Walsh, Julia A., and Kenneth S. Warren. 1980. “Selective Primary Health Care: An Interim Strategy for Disease Control in Developing Countries.” *Social Science & Medicine. Part C: Medical Economics* 14 (2) (June): 145–163. doi:10.1016/0160-7995(80)90034-9.

Watson, R, I Noble, B Bolin, N Ravindranath, D Verardo, and D Dokken. 2000. *Land Use, Land-Use Change, and Forestry*. http://www.ipcc.ch/pdf/special-reports/spm/srl-en.pdf.

World Bank. 2001. *A Revised Forest Strategy for the World Bank Group*. Washington DC. http://goldteak.com/default/images/stories/documents/World%20Bank’s%20New%20Forestry%20Policy.pdf.

———. 2004. *Sustaining Forests: A Development Strategy*1. http://documents.worldbank.org/curated/en/2004/01/4978559/sustaining-forests-development-strategy-vol-1-2.

———. 2011a. “Poverty Analysis - Analyzing Poverty and Inequality.” http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTPA/0,,contentMDK:20202211~menuPK:435069~pagePK:148956~piPK:216618~theSitePK:430367,00.html.

———. 2011b. “Reforestation Project Is DRC’s First Registered Under Kyoto Protocol.” *Congo Community To Use Carbon Payments To Put Kids Through School*. March 8. http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/EXTAFRSUMESSD/EXTFORINAFR/0,,contentMDK:22851551~menuPK:2493505~pagePK:64020865~piPK:149114~theSitePK:2493451,00.html.

Xu, Deying, Xiao-Quan Zhang, and Zuomin Shi. 2001. “Mitigation Potential for Carbon Sequestration Through Forestry Activities in Southern and Eastern China.” *Mitigation and Adaptation Strategies for Global Change* 6 (3): 213–232. doi:10.1023/A:1013383204154.

Yin, Robert K. 2002. *Case Study Research: Design and Methods, Third Edition, Applied Social Research Methods Series, Vol 5*. 3rd ed. Sage Publications, Inc.

Yun, Gi Woong, and Craig W. Trumbo. 2000. “Comparative Response to a Survey Executed by Post, E-mail, & Web Form.” *Journal of Computer-Mediated Communication* 6 (1): 0–0. doi:10.1111/j.1083-6101.2000.tb00112.x.

Série Information et Débats

n° 22 • Mars 2013

Nous contacter :
Chaire Economie du Climat - Palais Brongniart (4e étage)
28 Place de la Bourse, 75 002 Paris, France
Tel : +33 (0)1 73 01 93 42
Fax : +33 (0)1 73 01 93 28
Email : contact@chaireeconomieduclimat.org

Directeur de la publication : Christian de Perthuis

La Chaire Economie du Climat est une initiative de CDC Climat et de l'Université Paris-Dauphine

Chaire Economie du Climat
Université Paris-Dauphine
CDC Climat