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Mark Purdon, Razack Lokina

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Ex-post Evaluation of the Additionality of Clean Development Mechanism Afforestation Projects in Tanzania, Uganda and Moldova

Mark Purdon, PhD
Visiting Fellow, Department of International Development
Associate, Grantham Research Institute on Climate Change and the Environment
London School of Economics and Political Science (LSE)
Email: m.purdon@lse.ac.uk

Razack Lokina, PhD
Professor, Department of Economics
University of Dar Es Salaam
Email: rlokina@udsm.ac.tz

Abstract

This study presents findings from a systematic comparative research effort to investigate the additionality claims of CDM afforestation projects in Tanzania, Uganda and Moldova. Using what we refer to as an *ex-post* comparative baseline approach that accounts for how project financing and background economic conditions evolve over a CDM project's implementation and crediting periods, we demonstrate that the projects in Uganda and Moldova are very likely to be fully additional while only approximately one-quarter of carbon credits resulting from the Tanzania project are genuine. The conditions of additionality can change significantly over the course of a CDM project in a way that undermines project environmental integrity because the CDM rules do not accommodate changing baseline conditions. Rather, current CDM rules allow initial baseline conditions to be frozen over a project's crediting period. We recommend that a reformed CDM, REDD, NAMA or other new market mechanism adopt some of the elements of our approach including use of comparative performance benchmarks, an additionality risk management tool and engaging donors in the development of "ODA-baselines" for climate mitigation projects which combine carbon finance and development assistance.

Keywords

Clean Development Mechanism, Additionality, Baselines, Afforestation/Reforestation, Sub-Saharan Africa, and former Soviet Union

Introduction

This paper offers a systematic evaluation of the additionality claim of Clean Development Mechanism (CDM) afforestation projects across Tanzania, Uganda and Moldova using what we refer to as an *ex-post* comparative baseline approach. The primary concern with the CDM is that carbon credits are not truly fungible with emission reductions in developed countries against which they are traded. This issue is discussed in climate policy literature under the term "additionality" (Purdon & Lachapelle, 2012). Afforestation CDM projects are additional when they result in net carbon sequestration above what would have occurred in the absence of the CDM project activity (UNFCCC, 2005b: Annex, para.8). The real difficulty in the evaluation of additionality is determining appropriate baselines against which the emission reductions/removals of a CDM project are measured (Dutschke, Butzengeiger, & Michaelowa, 2006; Gillenwater, 2011; Meyers, 1999; Shrestha & Shrestha, 2004). In practice, the UNFCCC requires additionality be assessed at only a CDM project's inception through a counterfactual exercise that identifies an emissions baseline scenario which is surmounted by the CDM intervention (CDM EB, 2007). But because this counterfactual scenario is defined by project developers themselves, there is concern that justification for CDM financing is misrepresented and that, in reality, many projects would have been implemented "anyway" without it (Lohmann, 2005; Wara, 2008; Wara & Victor, 2008).

The present study is unique in that the additionality of CDM afforestation projects in Tanzania, Uganda and Moldova is evaluated *ex-post* over the projects' implementation and crediting periods using information obtained through field-based observation and detailed policy analysis over time. Such empirical research into CDM projects is scarce. Despite the attention the CDM has received, most research into additionality has relied on information presented in CDM project documents (Alexeew et al., 2010; Au Yong, 2009; Ganapati & Liu, 2008; Michaelowa & Purohit, 2007; Schneider, 2007). But CDM project documents are prone to information asymmetries which problematizes the

evaluation of additionality claims (Wara, 2008; Wara & Victor, 2008). It is difficult to justify the evaluation of additionality based on information presented in CDM project documents because it is precisely the information which they contain that is held in question. Lacking basic empirical research into CDM additionality, it is difficult to ascertain when it or similar carbon finance instruments are effective and why.

Based on our *ex-post* comparative baseline approach, we demonstrate that the afforestation projects in Uganda and Moldova are very likely to be fully additional while only approximately one-quarter of carbon credits resulting from the Tanzania project are genuine. The conditions of additionality can change significantly over the course of a CDM project in a way that is not currently accommodated in the CDM methodologies and can undermine the environmental integrity of individual projects. We recommend that a reformed CDM, REDD, NAMA or other new market mechanism adopt some of the elements of our ex-post comparative approach including the development of comparative performance benchmarks, an additionality risk management tool and engaging donors in the development of baselines that quantify emission associated with official development assistance (ODA)—"ODA-baselines".

Research Design and Methods

Project Selection and Field Effort

We investigated CDM afforestation projects across Tanzania, Uganda and Moldova that were operational in 2009, the time fieldwork (Table 1). In selecting projects, we investigated all afforestation/reforestation projects that had reached the validation stage in the CDM project cycle by December 2008 and were therefore listed on the CDM website. Projects were visited during a field effort that lasted from January to August 2009.

We described our findings in terms of three CDM afforestation projects though, given the complicated nature of the CDM, they technically correspond to a total of ten independent projects. Projects were aggregated when they involved the same basic techniques, time periods and project developers. For example, the Uganda project was comprised of five “small-scale” projects. Small-scale projects have the advantage that the rules for design and implementation are less onerous, yet it is possible to bundle a number together to generate a more financially viable project (Purdon, 2009b: 8-10; UNFCCC, 2010a). The rules for small-scale afforestation projects also insist that they “are developed or implemented by low-income communities and individuals as determined by the host Party” (UNFCCC, 2005c: para 1(i)).

Fieldwork included key informant interviews at the village, district and national levels, identification of important policy documents. District-level interviews with individuals in government, the private sector and NGOs sought to understand district administrative procedures affecting CDM projects and evaluate CDM projects in relation to other district development efforts (Tanzania, n=20; Uganda, n=12; Moldova n=6). National-level interviews with individuals in the government, private sector, NGOs and amongst donors focused on climate change and development policy (Tanzania, n=19; Uganda, n=22; Moldova, n=16). While more relevant for evaluating the sustainable development impact of CDM projects investigated, household surveys across nine villages associated with projects (n = 243) and interviews with local actors (n = 109) were also undertaken (see Purdon, 2013). The technical evaluation of additionality proceeded through 2013, drawing on information obtained during fieldwork and updated regularly through review of policy documents.

Table 1: Afforestation projects investigated across Tanzania, Uganda and Moldova

Project	Project Developer	Technical Support / Financial Brokerage	Project Implementation Period	Project Crediting Period	Size	Plantation Size	Carbon Removals *	Estimated Carbon Value**	Carbon Payment (ERPA)	References
					ha		MtCO2e	million USD	million USD	
Tanzania CDM Afforestation	**Private Sector**	**Private Sector**	**1997-2013**	**2000-2025**	**30,042**	**19,496**	**8.4** (5.5)	**$28.1 ($18.5)**		(CDM-PDD, 2007, 2008c; IFC, 2010; VCS-PD, 2009)
• Afforestation in grassland areas of Uchindile & Mapanda			1997-2014	2000-2019	18,379	13,450	6.4 (3.5)	$21.2 ($11.6)		
• Reforestation at the Idete Forest Project			2006-2013	2006-2025	11,663	6,496	2.0	$6.6		
Uganda CDM Afforestation	**State Agency**	**World Bank**	**2006-2010**	**2006-2029**	**2,105**		**0.6**	**$2.6**	**$0.9**	(CDM-PDD, 2006a, 2006b, 2006c, 2006d, 2009; NFA and Biocarbon Fund, 2006; WB Carbon Finance Unit, 2014a)
• Uganda Nile Basin Reforestation Project – No. 1-5										
Moldova CDM Afforestation	**State Agency**	**World Bank**	**2002-2009**	**2003-2025**	**39,049**		**7.6**	**$25.1**	**$13.4**	(CDM-PDD, 2008b, 2010; Moldsilva, 2009: 18; WB Carbon Finance Unit, 2014a, 2014b)
• Moldova Soil Conservation Project			2002-2008	2003-2022	20,290		3.6	$11.9	$11.2	
• Moldova Community Forestry Development Project			2006-2009	2006-2025	10,589		3.8	$12.5	$1.8	
• Voluntary Carbon Project between Moldsilva and the World Bank			2003-2007	Unknown	8,170		0.18	$0.6	$0.44	

*For the Tanzania afforestation project, numbers in parentheses indicate carbon credits associated with the VCS version of the project.
**Based on a carbon price of $3.3 per tCO_2e for projects in Tanzania and Moldova (Diaz, Hamilton, & Johnson, 2011: vi; Lecocq, 2003; PCF, 2003: 33); $4.15 for projects in Uganda (NFA and Biocarbon Fund, 2006).

Ex-Post Comparative Baseline Approach

We examined additionality claims using what we refer to as an *ex-post* comparative baseline approach. A comparative approach helps resolve two issues with the CDM. First, are concerns associated with the validity of counterfactual baseline scenario against which carbon credits are claimed. Given asymmetric information between project developers and those charged with monitoring the claims they make in CDM project documents, it is difficult to assess the validity of the counterfactual scenario (Lohmann, 2005; Wara, 2008; Wara & Victor, 2008). Comparative approaches are superior to counterfactual approaches because "All causal analysis also requires comparison. Without comparison, there can be no counterfactual: what would have happened to outcome (Y) if there were no intervention (X) or if the intervention (X) had been different?" (Langbein & Felbinger, 2006: 59). Basically, comparison allows us to make better inferences about what the counterfactual actually would have been.

Second, the *ex-post* comparative baseline approach accommodates changes in socioeconomic conditions over a project's crediting period. Almost all CDM methodologies permit the utilization of a frozen baseline approach, whereby historical emissions at the point of the CDM project's inception are "frozen" and expected to have remained the same for the duration of the crediting period (IEA, 2009: 69-93; Purdon, 2009a: 60-62). Technically, project developers have been allowed to select one of three basic approaches to developing a baseline scenario for CDM projects: (i) historical trends, (ii) the "most likely" land-use change expected at the time of the project's inception and (iii) expected land-use change due to economic development, taking into account barriers to investment.[1] In practice, project developers generally freeze

[1] The baseline approach of afforestation/reforestation CDM projects was originally set forth in Paragraph 22 of the original CDM rules (UNFCCC, 2005: para.22(a-c)). These included baseline approach 22a (Existing or historical, as applicable, changes in carbon stocks in the carbon pools within the project boundary) and baseline approach 22c (Changes in carbon stocks in the pools within the project boundary from the most likely land use at the time the project starts). Both baseline approach 22a and 22c have the effect of freezing the ex-ante baseline scenario over the entire crediting period. Baseline approach 22(b) anticipated "Changes in carbon stocks in the carbon pools within the project boundary from a land use that represents an economically attractive course of action, taking into account barriers to investment" though has been used in few A/R projects. The "additionality tool" for the latest version of the CDM consolidated A/R methodology permits the continued use of frozen baselines. Paragraph 9 of the

baseline conditions observed at the project's inception. In this study, project developers in the Moldovan and Ugandan projects used a historical baseline approach (CDM-PDD, 2008b: 33; 2009: 15; 2010: 32) while the Tanzania project developer use one based on the "most likely land use at the time the project starts" (CDM-PDD, 2007:27; 2008c: 25). As the baseline is not updated in any of the projects, the Tanzanian baseline is also effectively frozen.

The use of frozen baselines has important implications when it comes to changing policy conditions that offer incentives for emission reductions/removals. With the intention of reducing conflicts of interest between the generation of carbon credits and domestic policies that also have the effect of reducing emissions, the CDM Executive Board decided in 2005 that changes in government policy during a CDM project's crediting period would not be counted as a change in baseline conditions (CDM EB, 2005). Thus if a renewable energy subsidy were implemented during a CDM project's crediting period, the CDM project developer can use the original baseline emissions scenario without the subsidy—which allows them to generate more credits. The reason the CDM architects decided in this manner was to avoid generating a perverse incentive for government to keep environmental policy dirty—and thus benefit CDM project developers—when it could be a tool for reducing /removing emissions. But as some observers have noted, this has meant that the CDM Executive Board "disabled their own additionality criteria" (WFC, 2009: 4). While the goal of generating favorable investment conditions is worthy, there is little knowledge about how changing additionality conditions might affect the actual amount of genuine carbon credits

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"Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities, Version 01" reads: Identify realistic and credible land-use scenarios that would have occurred on the land within the proposed project boundary in the absence of the afforestation or reforestation project activity under the CDM. The scenarios should be feasible for the project participants or similar project developers taking into account relevant national and/or sectoral policies and circumstances, such as historical land uses, practices and economic trends. The identified land use scenarios shall at least include: Continuation of the pre-project land use; Forestation of the land within the project boundary performed without being registered as the A/R CDM project activity; If applicable, forestation of at least a part of the land within the project boundary of the proposed A/R CDM project at a rate resulting from (i) Legal requirements; or (ii) Extrapolation of observed forestation activities in the geographical area with similar socio-economic and ecological conditions to the proposed A/R CDM project activity occurring in a period since 31 December 1989 as selected by the project proponents.

generated under the CDM and thus whether the current design is appropriate. Our research seeks to fill this gap.

Project Finance and Background Economic Baseline Conditions

The first step of the *ex-post* comparative baseline approach was to compare baseline conditions used in the CDM project documents with conditions informed by investigation of how CDM project financing and background economic conditions outside the CDM project area changed over the project's implementation period and, if necessary, extrapolating for the project's crediting period. In reality, both financial incentives and background socio-economic conditions change over the 7-10 year window during which a CDM project can claim credits—even more serious for CDM afforestation projects which are administered over a 20-30 year crediting period.

Project Finance Baseline Conditions

Project finance additionality is concerned with the financial barriers that would have prevented a project from proceeding if not for the support provided by the CDM. Financing is not the only barrier to the implementation of a CDM project—technological barriers and barriers due to prevailing practice are also recognized (CDM EB, 2011b)—but it is by far the most important. In this study, we established a project finance baseline by reconstructing the financial history of each project in order to determine if funding sources not reported in the CDM project documents were used. New financial opportunities that arise over the course of a project's crediting period complicate the evaluation of additionality because they alter the initial baseline.

Because many CDM projects are also attractive targets of donor financing, the focus of project finance additionality was on ODA and the identification of what Asuka (2000) refers to "ODA-baselines". The CDM's initial rules emphasized "that public funding for clean development mechanism projects from [developed countries] is not to result in the diversion of ODA and is to be separate from and not counted towards the financial obligations of [developed countries towards ODA]" (UNFCCC, 2001: preamble). Developing countries sought such a provision because of their concern that ODA would

be diverted to the generation of carbon offsets, already in the interests of developed countries as means of reducing their compliance costs with Kyoto. However, there are good reasons to combine ODA and CDM financing, particularly the promotion of projects in areas in least developed countries. In this regard, in a controversial decision the OECD decided that ODA could be used for everything except the final purchase of CDM carbon credits (OECD, 2004).

In practice distinguishing between public funding and ODA has proven difficult. All CDM projects require that the project developer affirm that "any public funding does not result in a diversion of ODA and is separate from and is not counted towards [ODA commitments of developed countries]" (UNFCCC, 2005a: Appendix B, para(f)). Many observers find this language to be unclear—particularly the purposes to which ODA can be legitimately allocated and from which it is not to be diverted (Dutschke & Michaelowa, 2006). As the case-studies presented here will demonstrate, project developers often interpret the rules to mean that ODA *cannot* be used in CDM projects—thus under-reporting the use of ODA. Nonetheless, as we hope to show, it is possible to incorporate ODA into CDM baselines.

Background Economic Baseline Conditions

Background economic baselines refer to baseline conditions that are driven by political and economic events outside the control of a CDM project developer. For example, renewable energy is often sought for reasons quite independent of its capacity to reduce emissions. Thus while a private sector CDM project developer might originally devise a project entirely on the basis of carbon finance, the need for carbon finance declines if the government adopts a renewable energy subsidy to reduce oil imports. As discussed earlier, such changing background economic conditions are not well accommodated in the CDM given its reliance on frozen baselines.

Background economic baselines were constructed by considering how CDM tree-planting efforts compared with similar efforts underway in the project's vicinity but not claiming carbon credits. In other words, a project's additionality claims was evaluated by considering a project within its development context. The scope of this comparison is

important. First, for CDM afforestation projects, it is important to evaluate all economic agents planting trees within a reasonable distance to the CDM project to observe whether tree-planting efforts claimed by the CDM are not also found in the project's general vicinity—something that the CDM architects refer to as "common practice analysis" (CDM EB, 2007). The scale of this comparison varied for each project: afforestation projects in Tanzania and Uganda were localized at the district level while the Moldovan project was national in scope. Second, economic activities to which the CDM is compared need to be of similar economic output (electricity, timber, carbon sequestration), but not identical in the way that this output is produced. For afforestation projects, a tree plantation comprised of exotic species claiming carbon credits should be compared with other efforts to incentivize tree-planting, including those using only indigenous species. The output in both is carbon sequestered in trees.

Quantitative Evaluation of Additionality

The second step of the comparative baseline approach was to create a timeline where changes in baseline conditions were mapped out; this timeline was then overlaid onto the project's emissions removals modeled in the CDM project documents. All CDM project documents quantify *ex-ante* emissions associated with a counterfactual baseline scenario as well as those anticipated with the CDM project scenario—indeed, it is the difference between these two from which carbon credits are derived.

The specification of *ex-ante* emissions in the CDM project documents offers a short-cut for modeling additionality over time: for a specific year, if *ex-post* baseline conditions are found to have sufficiently been violated then the ex-*ante* emissions removals from that year onward are deemed bogus (they are really part of the baseline) and subtracted from the project's total emission removals. With CDM afforestation projects, calculations are slightly more complicated because trees absorb carbon over time. For example, genuine tree-planting effort will continue to generate real emissions removals over the CDM project's crediting period though tree-planted subsequent to an event violating additionality will not. Bogus carbon credits were determined as a percentage of cumulative tree planted after an event violation the conditions of additionality in order to

estimate changes in real emissions removal. This allows us to capture changes in time: while carbon credits prior to an event violating the conditions of additionality are still genuine, those subsequent are deemed bogus.

There is a certain limitation in the ex-post modeling approach as it was based on fieldwork undertaken in 2009 and subsequent analysis through 2013, which is before the close of the crediting period of all projects investigated. Nonetheless, we are confident in the representivity of additionality evaluations undertaken because observations were concluded subsequent to the implementation phase of all projects investigated—except for the Tanzania CDM afforestation project which was slated to continue tree-planting through 2014. However, as will be discussed, the most important changes in baseline conditions for the Tanzania project have occurred before the close of the Tanzania project's implementation period. For the Uganda and Moldova cases, in order to counter arguments that projects would have happened at some point during the crediting period of projects we construct a threshold baseline planting threshold that can be monitored to gauge when there is a risk of violating the conditions of additionality.

Tanzania CDM Afforestation

Project Overview and Additionality Claim

Two CDM afforestation projects were investigated in Tanzania (CDM-PDD, 2007, 2008c). Over a twenty year crediting period, the two projects were expected to generate 8.4 million tCO2e in carbon credits. Subsequent to fieldwork, the first project has been withdrawn from the CDM process though has succeeded in gaining accreditation in the voluntary markets (VCS, 2010).[2] This paper focuses on the CDM version of this project, noting that the additionality claims between the CDM and VCS versions of the project

[2] The first CDM afforestation project was deemed ineligible for the CDM because it was initiated in 1997 but had still not been registered by 2006, thus not meeting a deadline imposed by the UNFCCC (Confidential Interview (TD9), Mufindi District, March 2009). CDM projects that had started before 2000 have been eligible for the CDM but only if submitted for registration before 31 December 2005 (CDM Rulebook, 2011).

are virtually identical.[3] The second project is still going through the CDM regulatory process. Both afforestation projects are being implemented by Green Resources Limited (GRL), a Tanzanian subsidiary of a Norwegian forest company Green Resources AS (GRAS, 2010; Nambombe & Mussami, 2007). The parent company employs more than 3,000 people and has $55 million in since 1995 across its operations in Tanzania, Uganda, Mozambique and Sudan (GRAS, 2010). The company claims that all carbon offset revenues will be reinvested in new carbon offset activities or be used for community developments in Africa (*Ibid.*). The implementation period of the Tanzania CDM afforestation projects effectively extends from 1997 through 2014.[4] See the Table 2 for a statistical overview of the afforestation projects and Map 1 which shows the situation of the CDM afforestation projects within Mufindi district.

In the CDM project documents, GRL argued that a lack of available domestic financing prevented afforestation in the project areas from proceeding (CDM-PDD, 2007: 33-34; 2008c: 40-41):

> *A key issue facing the forestry sector is that despite a relatively comprehensive institutional and legal framework…implementation is severely limited by inadequate human and financial capacity and the delayed finalization of various institutional arrangements. As the domestic funds for the forestation are limited, local farmers are usually not able to fully finance forest establishment because it is hard for them to get loans from banks for the purpose of reforestation activities (loans for agricultural activities are much easier to obtain) (CDM-PDD, 2007: 33-34, emphasis in the original).*

More significant, in both CDM projects, GRL maintains that no public funding was used (CDM-PDD, 2007: 21; 2008c:24). Rather, a large investment was required which "is only possible with the incentive from the CDM" (CDM-PDD, 2007: 36). Carbon finance would resolve "the perceived investment risks of the project by providing a more steady timing and guaranteed (fixed purchase price of CO2) income stream that makes the project more independent from timber market risks and the risks associated with long transport distances from timber markets" (CDM-PDD, 2008c: 40-41). In the absence of

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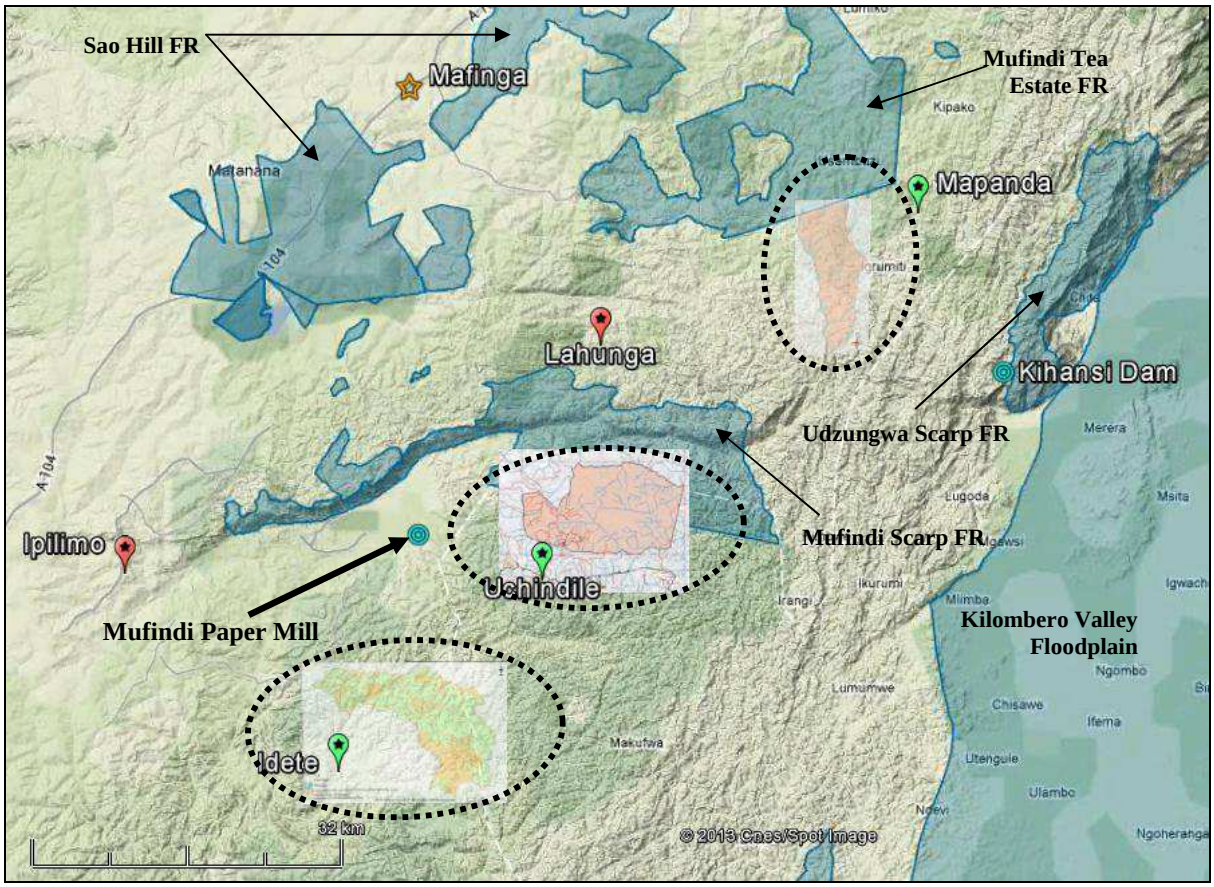
[3] The VCS version of the project has a number of technical changes from the original CDM document: namely a longer crediting period (2002-2100) yet also claiming fewer total emissions at 3.5 MtCO2e while also allocating 5.6 MtCO2e to a non-permanence buffer reserve (see VCS-PD, 2009).

[4] The Mapanda-Uchindile project was initiated in 1997 and scheduled to be completed in 2004, yet was found during fieldwork to have been pushed back to 2014. For the second CDM project, its implementation period is officially slated from 2006-2013.

the CDM project, GRL claimed that the CDM project area would remain grassland: “The grassland with scattered trees and shrubs has remained as it is since generations and is therefore assumed to remain steady state” (CDM-PDD, 2007: 37).

Map 1: Situation of Tanzania CDM afforestation projects amongst industrial forest activity in Mufindi district



Maps of plantation areas for Mapanda-Uchindile and Idete CDM projects, encircled dotted lines, in are taken from the carbon project documents and overlaid onto maps of Forest Reserves and Protected Areas derived from ProtectedPlanet.Net using Google Earth.

Project Finance Baseline

During 2009 field visits, interviews suggested that neither of the CDM projects had found buyers for their carbon credits and that GRL was effectively implementing the

projects using in-house resources—thus absorbing the risk that carbon finance might not materialize. However, in contrast to its additionality claim, GRL received additional donor financing in 2003 and 2010 which undermines to a certain degree the conditions of project finance additionality. The first was a $2 million loan from Norfund (2011a). Norfund is a hybrid company owned by the Norwegian Government through the Ministry of Foreign Affairs and acts as a key instrument of Norwegian development policy; the Norwegian parliament allocates annual capital grants to Norfund in its development assistance budget (Norfund, 2011b). In 2010, the Norwegian parent company of GRL received loans of $25 million from the World Bank ($18 million) and Norfund ($7 million), largely for its Tanzanian forestry operations which included tree-planting (GRL, 2009: 5; Norfund, 2011a). This included a $6.5 million "carbon loan" from the World Bank for delivery of an undisclosed amount of carbon credits (IFC, 2010). Because the World Bank's carbon finance operations generally operate on payment on delivery system (Lecocq, 2003), we consider this loan to be ODA and not World Bank involvement in the carbon market. The Norwegian parent company also received close to $1 million from the World Bank, Norway and Austria (GRL, 2009: 5).

Without intimate knowledge of GRL's financing (as a private firm GRL's accounting is not in the public domain), it is difficult to determine how these funds affected additionality. For example, it is not clear how the $2 million loan issued in 2003 was used. To be conservative in our critique of the additionality of this project, it is assumed that the 2003 loan was not used towards afforestation efforts. However, the $25 million loan issued in 2010 went towards planting 12,000 ha of new forest and other forestry-related activities in Mufindi district (GRL, 2009: 5), which contrasts with the additionality claim above. The precise effects of the loan on additionality are lacking as we do not know specific terms such as interest rates, payback conditions and market interest rates for forestry projects in Tanzania. Nonetheless, these matters are overshadowed by significant changing background economic conditions around 2005-2006 described below.

Financial analysis undertake at the initiation of the CDM projects suggests that attracting private investment in the forest sector in Tanzania is a challenge, which would tend to justify the financial additionality claims of the project. The internal rate of return (IRR) of the afforestation projects is 11.3% without and only 14.6% with-carbon-finance (CDM-PDD, 2008c: 40). However, the with-carbon-finance IRR is based on a price of $6 per tCO2e, which is certainly overly optimistic. Forest carbon credits issued under the VCS are reported to have fetched prices between $3-4 per tCO2e during 2009-2010 (Diaz et al., 2011: vi). This is the almost the same as prices paid by the World Bank for CDM forest carbon credits in Moldova and Uganda (Lecocq, 2003: 33; NFA and Biocarbon Fund, 2006), though prices on the voluntary market—especially during the carbon market's early days—were appreciably lower than those on compliance markets such as the CDM (also see Diaz et al., 2011: vi). This suggests that CDM financing would not on its own incentive the implementation of the project, if profit is the main motivation (which is the case with private sector but not true of CDM project developers in Uganda and Moldova). But also this IRR analysis is problematic because it is based on government royalty rates before their increase in 2007, an issue we discuss in more detail in the next section. Subsequent to these reforms, forestry activities in Tanzania have become more financially attractive and the original IRRs are no longer valid.

Background Economic Baseline

The background economic baseline claimed in the CDM project documents can be evaluated by comparing tree-planting activities undertaken inside the CDM project area with non-CDM planting in the project's vicinity. For the Tanzania project, the appropriate scope of comparison included all forestry activities in Mufindi and Kilombero districts, which is actually home to Tanzania's forest industry. The Udzungwa Escarpment, which forms the southern tip of the Eastern Arc Montaine forest ecosystem (MNRT, 2006: 10), has long been an attractive location for forestry and tea because of its relatively humid climatic conditions—though this is not discussed in the CDM project documents. Indeed, there are at least three other major forest reserves in the district, including the central government's Sao Hill Plantations—the largest in Tanzania at 41,600 ha (World Bank, 2003: 3). Sao Hill plantations have existed since colonial times and were

nationalized by the newly independent Tanzania as part of the 1967 Arusha Declaration and targeted for expansion as part of Tanzania's industrial forestry strategy (Christiansson, 1985: 123; World Bank, 2003). As a result, other important elements of Tanzania's industrial forestry base are also located in Mufindi district, including Sao Hill sawmill and Mufindi Paper Mill—East Africa's largest sawmill and paper mill, respectively (Christiansson, 1985; MNRT, 2001; SHI, 2012; World Bank, 2003).

Of the two mills, Mufindi Paper Mill is by far larger: with capacity for processing 530,000 m^3/yr raw logs per year versus the estimated 168,000 m^3/yr raw logs per year consumed by Sao Hill sawmill (CDM-PDD, 2008a: 3; GRL, 2012).[5] As shall be discussed in more detail below, these mills were constructed as government parastatals in the 1980s but were shut down during the structural adjustment period in the 1990s (Murison, 2002; World Bank, 2003). Mufindi Paper Mill was shut down in 1997, though later purchased by a Kenyan firm and resumed operation in 2005 (Kulekana, 2008).[6] Similarly, GRL acquired and reopened the much smaller Sao Hill sawmill in 2003 (GRL, 2011: 5).

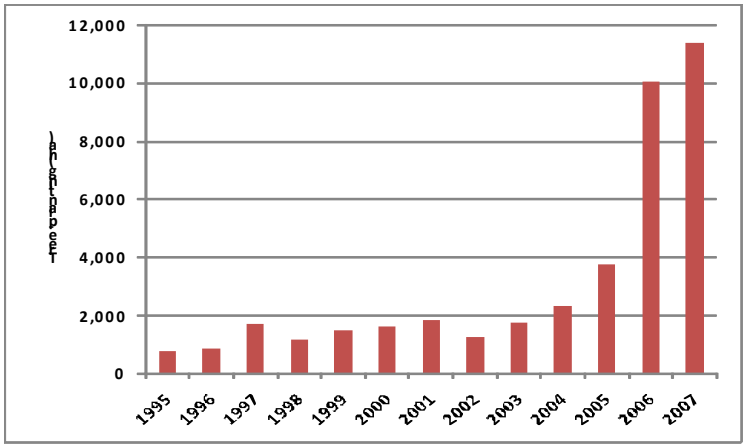
Precise information on lands available for afforestation outside the CDM project areas, necessary for comparing baseline afforestation activity, was lacking for the Tanzania project. Information on forest operations in other plantations and forest reserves in the non-CDM areas such as Sao Hill Plantations and Unilever Tea Estates could not be found. Nonetheless, insight might be gleaned from comparing GRL's planting rates with data on tree-planting effort by individual villagers across the district (Figure 1).These data show a near doubling of the afforestation rate between 2005 and 2006, suggesting an important change in incentives for tree-planting though one independent of the CDM. Another indicator that tree-planting was attractive independent of carbon finance was the fact that a second afforestation company, a Kenyan firm named Highland, had

[5] The estimate of Sao Hill sawmill's annual consumption is based on a 50% conversion factor of raw to sawn timber (see UNECE/FAO, 2009: 9). GRL expects that the Sao Hill sawmill will produce 60,000-84,000 m3/year of sawn wood (GRL, 2012).

[6] As of 2008, the mill was producing nearly 40,000 tonnes of paper annually and plans on reaching a maximum capacity of 130,000 tonnes.

arrived to same village where the first CDM afforestation project was located in 2006, acquiring 1700 ha of land from the village for tree-planting.[7] Explaining trends in individual villager tree-planting and Highland's arrival requires examination of changing incentives for afforestation in the district, including local and national incentives.

Figure 1: Afforestation effort in Mufindi District, 1995-2007



Source: Mufindi District Natural Resource Office

We begin first with changing local incentives, particularly recently renewed demand for timber in Mufindi district. The reopening of Sao Hill Sawmill and Mufindi Paper Mill, in 2003 and 2005, respectively, has created incentives to plant trees. However, of the two mills, Mufindi Paper Mill has a commanding impact on the local economy because of the size of its operations, consuming more than three times as many raw logs as Sao Hill. A World Bank analysis published in 2003—before the mill's sale—found that the government's Sao Hill Plantations in the district were losing money (World Bank, 2003: 76). But if the mill were to come online, the economic value of Sao Hill Plantations would rise from effectively zero to an estimated value of $10.8-14.7 million (*Ibid.*). GRL's 2003 reopening of the sawmill would have a similar, though smaller effect. The implication is that at least since Mufindi Paper Mill re-opened in 2005, it has become profitable to practice forestry in the district.

[7] *Villager, Mapanda Village, Interview T20, 5 March 2009.*

But there have also been changing incentives at the national level. The most important of these have been changes in forest product royalty rates (see Appendix). In the terminology used for forestry in the Commonwealth, "royalty" is defined as the fee paid to the owner of the forest which is the government in this case (National Audit Office, 2012: 13-14).[8] The vast extent of government plantations affords the Tanzanian national government the power to set prices in the sector by setting royalty fees. Royalty fees and other permits are set out in "Schedule 14" of the official regulations of the *2004 Forest Regulations*, which can only be changed through an act of Parliament (Milledge, Gelvas, & Ahrends, 2007: 244-245). While the royalty rates are supposed to conform to market forces, the actual method of their determination is, in the words of one government official interviewed, "totally political."[9] In 2006, an attempt was made by the then Minister of Natural Resources and Tourism to raise the price of forest products nearly four-fold in order to reflect the environmental value of the forest products and approach global market prices.[10] However, the proposed royalty rate hike contributed to a political backlash that ultimately saw the Minister removed from his post (Mbunda, 2007). Parliament eventually assented in 2007 to a rate hike that still doubled the 2002 value of royalty rates. While collection of these royalty fees has been found to be dramatically inefficient—with under-collection of royalties estimated at 96% (Milledge et al., 2007: 4)— it can be assumed that the rise in royalty rates has had some effect on tree-planting efforts.

Quantitative Evaluation of Additionality

Tables 3 and 4 below quantitatively model genuine carbon credits resulting from each of the subprojects that comprise the Tanzania CDM afforestation project, controlling for the effects of the change in the conditions of additionality observed over the projects' implementation period. Given these changes, we conclude that only approximately one-

[8] A royalty fee is a fixed sum payable for each exploited unit and is equivalent to the term "stumpage price" which is defined as the sale price of standing timber (National Audit Office, 2012: 13-14).
[9] *Tanzania Government Officer, Dar es Salaam, Interview TN6, 30 March 2009.*
[10] *Tanzania Government Officer, Dar es Salaam, Interview TN6, 30 March 2009.*

quarter of the Tanzania CDM -afforestation projects' claimed carbon credits are genuine—2.2 MtCO2e out of 8.5 MtCO2e claimed.

The first CDM afforestation project, started in 1997, was initially additional but after 2005 no longer was additional as Mufindi Paper Mill became operational. Recall that we modeled the effects of violations of the conditions of additionality by subtracting annual bogus carbon credits from a project's annual claimed emission removals. Bogus carbon credits were determined as a percentage of cumulative trees planted each year after 2005—the year when Mufindi Paper Mill came back online. For example, in 2007 cumulative bogus tree-planting stood at 2,023 ha of a total 4,595 ha planted since 1997, or 44%. However, carbon credits resulting from tree-planting prior 2005 were deemed valid. All of the trees planted for the second CDM project, which was initiated in 2006, were planted after the opening of Mufindi Paper Mill and also more likely to benefit from the 2010 loan, suggesting that none of them are truly additional. While this development context might further evolve over the 20-year crediting period of the projects, significant changes have already occurred which undermine a significant portion—though not all—of the project's additionality claim.

The above analysis is conservative. While the 2003 loan was small and could plausibly have gone to activities other than tree-planting, part of the 2010 loan was clearly directed towards tree-planting—though its exact effects on tree-planting are unable to be known with the lack of specifics about the loans conditions. However the concerns with financial additionality are superseded by more important changes in the background economic conditions of the project that occurred in 2005 with the reopening of Mufindi Paper Mill.

An alternative interpretation, one more favorable to the CDM additionality claims made by GRL, would argue that the Tanzania CDM project spurred the re-opening of Sao Hill Sawmill and Mufindi Paper Mill. This is questionable for a number of reasons. First, it assumes too much of the CDM valuation vis-à-vis the much larger investments needed to refurbish the mills. Assuming a $3.3 per tCO2e price, the Tanzania CDM afforestation project might be valued at $28.1 million in carbon finance though considerably less

($18.5) under the VCS version of the project. Furthermore, at least in 2009, no buyer had yet emerged for the carbon credits, which puts the figures above in question. Yet the acquisition of Mufindi Paper Mill alone was at least $40 million (Kulekana, 2008) and GRL's investments in Sao Hill Sawmill at least $10 million though likely significantly more (GRL, 2012; IFC, 2010).[11] This is not to say that GRL did not conceive of the need to increase timber supply to feed its mill as part of the comprehensive business plan. But rather it is to argue that the causal arrow points the other way: that the refurbished mills were originally based on existing local supply and came to cultivate additional supply.

Second, the supply of raw logs for the mills need not come from GRL's CDM plantations; they can come from a variety of sources in Mufindi district. For example, GRL currently has a "long term" contract with government owned Sao Hill plantations for 300,000 m^3/yr of raw logs (GRL, 2011: 6). Raw logs for GRL's sawmill could be supplied by other companies in the area responding to the rising demand for logs—as suggested by local tree-planting and new entrants in the plantation business observed during fieldwork. GRL's claim in the CDM project documents that no tree-planting in the area appears invalid because the incentives have changed significantly.

The question remains how the effect of rising prices from the reopened mills differs from the price of carbon. Such a distinction might be possible through econometric analysis of more detailed data on the price of raw logs, planting effort by GRL and other companies and individuals in the area in the area. But the availability of such detailed information is one of the main challenges facing carbon finance. Until such detailed information is available we consider the changes in baseline conditions over the CDM afforestation project's implementation period significant enough to undermine the project's additionality claim.

[11] GRL reports that upgrading the Sao Hill Sawmill, including adding on a combined heat and power plant, in addition to its plantation activities cost a total $64.2 million (IFC, 2010: 2). The IFC has lent GRL $10 for the sawmill and the $6.5 million carbon loan for afforestation, described earlier, as well as undisclosed carbon payment for a recent carbon offset project involving the combined heat and power plant (*Ibid.*).

Table 3: Ex-post evaluation of genuine carbon credits after additionality evaluation for CDM 1 project in Tanzania

Period		Year	Event	(A) Baseline Removals*	(B) Carbon Credits Claimed*	(C) Annual Planting Effort**	(D) Bogus Planting $= \sum_{i=y_{2006}}^{y_t}(C)_i / \sum_{i=y_{1997}}^{y_t}(C)_i$	(E) Bogus Carbon Credits $=(A)_{y-1}*(D)_{y-1}$	(F) Genuine Carbon Credits =(B)-(E)
				tCO2e	tCO2e	ha	%	tCO2e	tCO2e
CDM Crediting Period	CDM Implementation Period	1997	CDM 1 Project Initiation	-	-	40	0%	-	-
		1998		-	-	689	0%	-	-
		1999		-	-	10	0%	-	-
		2000		-	47,586	-	0%	-	47,586
		2001		3,514	37,918	80	0%	-	37,918
		2002	$2 Million Norfund Loan	12,388	32,400	282	0%	-	32,400
		2003	GRL Sawmill Acquisition	7,555	47,833	172	0%	-	47,833
		2004		17,564	65,204	399	0%	-	65,204
		2005	***Mufindi Paper Mill Reopens***	***39,587***	***35,425***	***900***	***0%***	-	***35,425***
		2006	CDM 2 Project Initiation	31,816	91,840	723	22%	-	91,840
		2007	Royalty Rate Increase	57,200	108,526	1,300	44%	20,152	88,374
		2008		57,200	125,981	1,300	56%	47,780	78,201
		2009		57,200	181,746	1,300	64%	71,015	110,731
		2010	$25 million Norfund Loan	57,200	248,867	1,300	70%	116,777	132,090
		2011		57,200	252,730	1,300	74%	173,518	79,212
		2012		57,200	419,685	1,300	77%	186,367	233,318
		2013		58,520	505,486	1,330	79%	322,395	183,091
		2014		37,400	591,384	850	81%	400,849	190,535
		2015		-	654,037	-	81%	476,805	177,232
		2016		-	785,890	-	81%	527,319	258,571
		2017		-	834,432	-	81%	633,626	200,806
		2018		-	722,829	-	81%	672,763	50,066
		2019		-	635,842	-	81%	582,783	53,059
Total				**551,544**	**6,425,641**	**13,275**		**4,232,149**	**2,193,492**

*Source: CDM-PDD (2007: 21); **Source: CDM-PDD (2007: 42);

Table 4: Ex-post evaluation of genuine carbon credits after additionality evaluation for CDM 2 project in Tanzania

Period		Year	Event	(A) Baseline Removals*	(B) Carbon Credits Claimed*	(C) Annual Planting Effort**	(D) Bogus Planting	(E) Bogus Carbon Credits	(F) Genuine Carbon Credits
							$= \sum_{i=y_{2006}}^{y_t} (C)_i \Big/ \sum_{i=y_{1997}}^{y_t} (C)_i$	$=(A)_{y-1}*(D)_{y-1}$	=(B)-(E)
				tCO2e	tCO2e	ha	%	tCO2e	tCO2e
		2005	***Mufindi Paper Mill reopens***	**-**	**-**	**-**	**-**	**-**	**-**
CDM Crediting Period	Implementation	2006	CDM 2 Project Initiation	-	-	140.7	100%	-	-
		2007	Royalty Rate Increase	-	-	252.8	100%	-	-
		2008		-	-	659.3	100%	-	-
		2009		-	-496	1235	100%	-496	-
		2010	$25 million Norfund Loan	-	3330	829.5	100%	3330	-
		2011		-	13572	853.5	100%	13,572	-
		2012		-	31600	144.5	100%	31,600	-
		2013		-	67116	1094.9	100%	67,116	-
		2014		-	112759	-	100%	112,759	-
		2015		-	161992	-	100%	161,992	-
		2016		-	208974	-	100%	208,974	-
		2017		-	277544	-	100%	277,544	-
		2018		-	331606	-	100%	331,606	-
		2019		-	328517	-	100%	328,517	-
		2020		-	299554	-	100%	299,554	-
		2021		-	286229	-	100%	286,229	-
		2022		-	171541	-	100%	171,541	-
		2023		-	94489	-	100%	94,489	-
		2024		-	89008	-	100%	89,008	-
		2025		-	-100827	-	100%	-100,827	-
Total					**2,082,514**	**5,210**		**2,082,514**	**0**

*Source: CDM-PDD (2008c: 24); **Source: CDM-PDD (2008c: 43)

Uganda CDM Afforestation Project

Project Overview and Additionality Claim

The *Uganda Nile Basin Reforestation Project* is being undertaken at the Rwoho Central Forest Reserve (CFR) in southwestern Uganda.[12] The project is actually comprised of five "small-scale" CDM afforestation projects that together cover 2,015 ha of Rwoho CFR and are expected to sequester 647,745 tCO_2e over twenty years (CDM-PDD, 2006a, 2006b, 2006c, 2006d, 2009). Rwoho CFR extends across 9073 ha of low-lying mountains of Ntungamo, Isiringo and Mbarara districts of which approximately 6000 ha are available for afforestation (NFA, 2007a: 14-15).[13] The project is being implemented by National Forestry Authority (NFA) with financial and technical support from the World Bank. Through its Biocarbon Fund, the World Bank agreed to buy the first 261,220 tonnes of carbon credits at a unit price of $4.15 per tCO_2e to be delivered at the projects' first monitoring window in 2015—a payment totalling $1.1 million (NFA and Biocarbon Fund, 2006).

NFA was established in 2001 with the primary responsibility of managing Uganda's Central Forest Reserves (CFRs), and establishing procedures for the sustainable use of Uganda's forest resources (*2003 The National Forestry and Tree Planting Act*:s.54). It was the main government forestry body after a structural adjustment programme in the late 1990s saw the dissolution of the Forestry Department (MWLE, 2002: 103-124), which was linked to declining forest cover and plantation capacity (FAO, 2006: 20; Jagger, 2008; LTS, 2010; Turyahabwe & Banana, 2008: 651-653). The poor state of Uganda's forests and industrial forestry resources, discussed further below, have

[12] Note that though the CDM project is actually described as a "reforestation" project, it is better designated as "afforestation". While Rwoho is now described as an even mix of forest-grass savannah (NFA, 2007a: 3-4), the CDM planting sites were grassland as recently as the 1960s (CDM-PDD, 2009: 10). Some areas were subject to a limited tree-planting effort over 1964-1978 totaling 800 ha though largely deforested due to disturbance or harvesting since at least 1990.

[13] There is a 2978 ha block in the northern section of Rwoho CFR set aside for biodiversity conservation (NFA, 2007a: 14).

become an important issue for the Ugandan government. It prioritized private and community forestry in the *2005 Poverty Eradication Action Plan* and also advocated for linkages with the CDM (MoFPED, 2005: 77-78). More recently, and subsequent to the CDM projects investigated, Uganda's *2010 National Development Plan* (NDP) commits to restoring Uganda's forest cover to 1990 levels, 4.9 million ha or 24% of the national territory, by 2015 (MoFPED, 2010: 95-96).

All CDM project lands are under the authority of the NFA. In order to engage local communities, and thus benefit from the CDM's simplified provisions for small-scale projects, an agreement was reached between the NFA and a local NGO—the Rwoho Environmental Conservation and Protection Association (RECPA). Thus, of the 2015 ha CDM project area, the vast majority is being managed by the NFA with a 200 m buffer strip around the reserve designated as community planting areas under a collaborative forest management (CFM) agreement with RECPA (RECPA & NFA, 2006: 16). In 2007, NFA entered into a tree farming license with RECPA to plant 60 ha within the CDM project area (NFA, 2007b). See Table 5 for a statistical overview of the project and Map 2 for the location of Rwoho and Bugamba CFRs in southwestern Uganda.

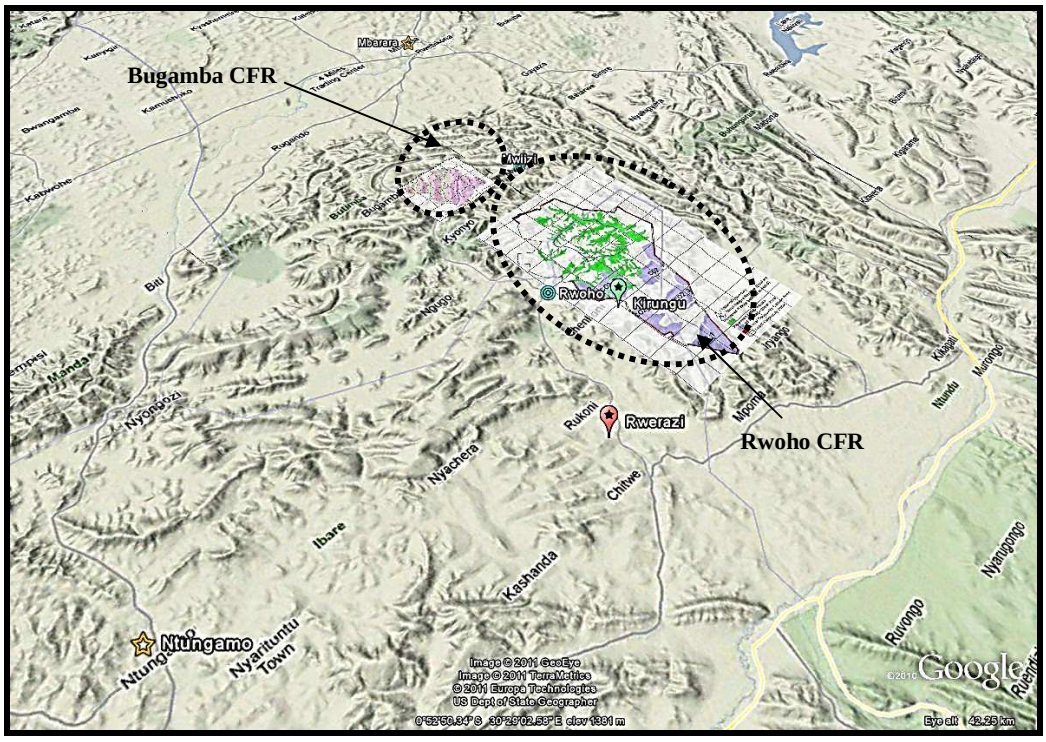
NFA claims that without carbon finance the afforestation project would not have been able to proceed for two primary reasons: a lack of funds and the inability to attract them (CDM-PDD, 2006d: 15-16). The state forest agency also claims that the baseline afforestation rate in the 2,015 ha CDM project area is effectively zero: no afforestation would have happened in this area if not for the CDM through the project's 20 year crediting period—which is staggered amongst the five projects from 2006-2029 (Table 5). How well does this argument stand up to scrutiny?

Table 5: Projects evaluated in Uganda

Forest Compartment	District	Total Area (ha)	NFA (ha)	Community/ RECPA (ha)	Sequestration (tCO_2e/20 yr)	Implementation Period (Start Date)	Crediting Period
Compartment 1	Isingiro	468.0	402.4	65.6	149,951	2009	20 yrs (2009-2028)
Compartment 2	Ntungamo	370.0	334.1	35.9	118,551	2010	20 yrs (2010-2029)
Compartment 3	Isingiro	341.9	319.2	22.7	111,798	2007	20 yrs (2007-2026)
Compartment 4	Isingiro	347.1	324.9	22.2	111,214	2008	20 yrs (2008-2027)
Compartment 5	Ntungamo	487.6	413.0	47.6	156,231	2006	20 yrs (2006-2025)
TOTAL		2,014.6	1,793.6	194.0	647,745		

Uganda Nile Basin Reforestation Projects No. 1-5 (CDM-PDD 2006a, b, c, d; 2009)

Map 2: Rwoho and Bugamba Central Forest Reserves



Project Finance Baseline

The CDM was the only identified source of funding for the tree-planting activities in Rwoho CFR; indeed, as a semi-autonomous state agency, the NFA has received little donor support since its establishment in 2003 and has struggled to remain financial solvent. The *2002 National Forest Plan* expected that the NFA would sustain itself largely from revenues from timber sales and timber license fees from forest reserves. Of the $15.1 million that NFA received for activities over 2003-2013, nearly 70% ($8.9 million) of this was allocated in the first two years of the organization's existence to help with its establishment (MWLE, 2002: 141). See Table 6 below.

Table 6: Planned donor and government support to NFA, 2003-2012 ($million)

	2003	2004	2005	2006	2007	2008	2009	2010	20111	2012	Total
NFA Start up	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
NFA Capital expenditures	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
NFA Donor	4.6	3.0	1.5	1.0	0.6	0.6	0.6	0.6	0.6	0.6	13.8
TOTAL	5.8	3.1	1.5	1.0	0.6	0.6	0.6	0.6	0.6	0.6	15.1

Sources: MWLE (2002)

Since this initial funding allocation, NFA has been struggling financially. A recent review concluded that NFA's revenues have failed to meet projected targets and planned programmes have not been implemented due to lack of finance; revenue from timber sales is expected to decline further in the near term as remaining mature plantations are harvested (LTS, 2010: 15). This has been compounded by an alleged corruption issue which has seen NFA's bank accounts frozen since 2009 by court order (*Ibid.*). In terms of performance, NFA has been outshone by a public-private partnership for tree-planting in Uganda, the Sawlog Production Grant Scheme, or SPGS (Jacovelli, 2009). Given the success of SPGS relative to NFA, it was SPGS which has most recently been awarded additional donor financing. In 2009, SPGS received an additional $20.8 million from donors in order to plant 30,000 ha by 2013 (SPGS, 2009), while NFA continued to receive little additional support.

While not a government body, the Sawlog Production Grant Scheme (SPGS) has been amongst the most important organizations created as a result of the forest reforms in Uganda. It is a joint project of the European Union (EU) and Government of Uganda which gives grants to individuals and companies (local and foreign) establishing timber plantations. SPGS scheme works by granting funds to private individuals or companies possessing at least 25 ha in order to subsidize costs for the first two years of plantation establishment (Jacovelli, 2009: 121). Initially housed within the NFA, SPGS moved to MWLE because of a perceived conflict interest in housing the grant scheme at NFA which is also seeking financing for their plantations (Jacovelli, 2009: 121). Notably, SPGS has been more successful in planting on CFRs than NFA. The most recent data indicate that approximately 52,000 ha of timber plantations have been planted in Uganda since 2004, when reforms to its forest sector were implemented (Table 7). While SPGS has been responsible for nearly half of Uganda's total plantation effort, NFA has been responsible for only about 23%. Oddly, SPGS was not involved in CDM afforestation efforts, which we attribute to the fact that its core funding requirements have been met through ODA.

Table 7: Tree-planting effort of various organizations in Uganda, 2004-2011

Organization	Planting Area (ha)		
	CFR	Private Land	TOTAL
NFA	12,000	/	12,000
SPGS	20,000	5,000	25,000
Private Investors	7,000	8,000	15,000
TOTAL	39,000	13,000	52,000

Sources: Based on numbers presented in Kawooya (2011) and Tugumisirize (2011) and assuming that 80% of SPGS planting has taken place in CFRs, which was the case as recently as 2010 (Jacovelli, 2009: 121).

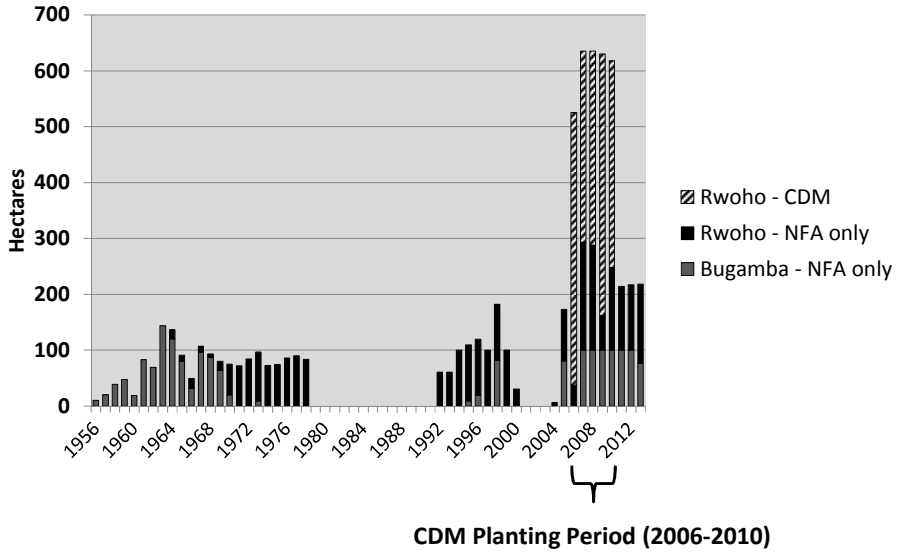
Attracting private financing for forestry appears difficult in Uganda, which tends to justify the financial additionality claims of the project. The Bank of Uganda does not consider forestry an interesting investment option in Uganda (JACO CDM, 2009: 10). Alternative investments yield higher IRR to forestry projects including Treasury Bills (15%) and even agricultural activities like maize (24%). Investment analysis that the IRR of the project is 13.6 % without-carbon-finance and only 14.7% with-carbon-finance, assuming

carbon credits valued at \$3/tCO_2e (JACO CDM, 2009: 14). The \$4.15 per tCO_2e price that NFA received from the World Bank means that the IRR was likely higher. Nonetheless, the fact that the project is implemented by a project developer with profit and developmental mandate may explain why, despite the lack of impact of carbon finance on profitability rates, the project is still found to be additional.

Background Economic Baseline

The CDM baseline planting rate in Rwoho CFR could be verified by two means: comparison of CDM planting rates to NFA's non-CDM finance planting in Rwoho and comparison to planting rates in nearby Bugamba CFR, about 15 km away (see Map 2). The two reserves are managed together and information on planting rates for both CFRs is found in their joint forest management plan (NFA, 2007a; Uganda Forest Department, 1984). We distinguished between trees planted in Rwoho CFR independent of carbon finance and those planted through the CDM by subtracting annual CDM planting effort presented in the CDM project documents from total planting effort reported by NFA in its management plan. These data from 1956 to 2012 are presented in Figure 2. They generally support the additionality claims of the CDM: planting has historically been restricted to approximately 100 ha/ yr in each reserve, though there are important gaps in such planting during the 1980s and early 2000s. Over the 2006-2010 CDM project implementation period, independent *non-CDM* planting by NFA in Rwoho CFR averaged 126 ha/yr and under 100 ha/yr in adjacent Bugamba CFR. In comparison, the CDM was responsible for having financed the planting of 403 ha/yr. In other words, over the 2006-2010 CDM project implementation period, a total of more than 2643 ha were planted in Rwoho of which 2015 ha was due to the CDM project activities. It is also worth noting that, according to NFA's forest management plan, non-CDM planting was expected to return to the historical rate of about 100 ha/yr in 2010, after the CDM project's implementation period came to a close.

Figure 2: Planting Effort in Rwoho and Bugamba Central Forest Reserves, 1956-2012



Sources: 1956-1980: Uganda Forest Department (1984: Appendix 1, Bugamba and Rwoho Area Statements); NFA (NFA, 2007a: Tables 3, 4, 17 & 18); CDM-PDD (2006a, 2006b, 2006c, 2006d, 2009).

Other incentives for tree-planting in Rwoho CFR were not observed during the CDM implementation period. There was evidence of afforestation activities outside the reserve, however. A government sponsored tree-planting scheme was being undertaken in three other parts of Ntungamo district, though not in Rwoho subcounty.[14] The wife of President Museveni—Janet Museveni, also a Member of Parliament—had also initiated a tree-planting campaign in Ntungamo, but also outside the CFR (Mugisha, 2008). The SPGS is also active in the district, including supporting the planting of 40 ha of land by RECPA outside of Rwoho CFR (Mwayafu & Kimbowa, 2011: 4), but not active in the reserve. But because NFA is responsible for managing Rwoho, such programmes have limited impact on tree-planting in the reserve

Finally, Uganda's domestic forest industry is highly underdeveloped—largely attributed to the period of conflict that the country endured in the 1970s through 1980s (Webster,

[14] *District Government Officer, Ntungamo, Interview UD7, 18 May 2009.*

Osmaston, & Osmaston, 2003: 167)—consequently a broad price signal to incentivize tree-planting, as observed in the area of Tanzania's afforestation project, was not found in Uganda. Uganda's current timber demand is met by timber plantations planted in the 1960s and 1970s which have almost been exhausted (SPGS, 2007: 11). It has been estimated that at least 120,000 ha of plantation forest will be needed by 2020 (SPGS, 2011: 4), though NFA estimated that only 3,000 ha of plantations remained in 2005 (NFA, 2005: 10). The timber industry is underdeveloped, with mobile sawmills being the most dominant forms. A recent study found only one major plywood manufacturer in the country (Kambugu, Banana, & Odokonyero, 2010: 196) though a electricity pole plant was started up in 2010 through Norwegian investment (GRL, 2011: 5). Pulp and paper is also underdeveloped in Uganda. The Uganda Investment Agency states that "most of the paper products in Uganda are imported" (UIA, 2011: 7). To the best of the author's knowledge, there is only one company producing paper packaging (Kasozi, 2007)–and even the feedstock here may be derived from waste residues and not timber.

While one can be confident that the CDM project was additional over its implementation period from 2006-2010, additionality over the entire 25 year crediting period cannot be known with certainty. Baseline planting rates in Rwoho CFR may change in the future. However, we can better understand the risk that additionality would be violated in the future. Recall that the CDM afforestation area represents only about a third of the planting area in Rwoho CFR (Table 8). According to NFA's 2007 management plan, there remained a total of 3945 ha non-CDM designated afforestation area. We determined through our comparative *ex-post* baseline evaluation, that NFA planted 630 ha of this area which leaves 3315 ha available. At the historical baseline planting rate of approximately 126 ha per year, it would take NFA an additional 26 years to plant this area—after the CDM project's crediting period comes to a close. In other words, at the historical rate, there would be sufficient space in the non-CDM areas of the reserve such that NFA would not need to encroach into the CDM planting areas. If NFA's independent, non-CDM planting were to rise above 246 ha/yr, it would complete planting of the non-CDM lands in Rwoho before the 20-year CDM crediting period came to a close. Barring a rapid increase in planting rates to at least 246 ha/yr, which appears

unlikely given the historical rate of 126 ha/yr, this CDM project is found to be highly additional.

Table 8: Management Areas of Rwoho CFR in 2007

Management Area	ha	Designated use
CDM/Timber Production	402.4	CDM Block 1
	334.1	CDM Block 2
	319.2	CDM Block 3
	325	CDM Block 4
	410.8	CDM Block 5
	346.7	Community CDM Blocks 1, 2, 3, 4 and 5
Subtotal CDM	**2138.2**	
Other Timber Production	58.1	Other Community Planting Areas
	2406.0	Areas allocated to private investors
	1480.4	Existing Plantation Area in Rwoho CFR
Subtotal Other Timber	**3944.5**	
Conservation	1302	Strict Nature Reserve
	743.6	Valley and Wetland
	931.8	Wooded Areas
Subtotal Conservation	**2977.4**	
GRAND TOTAL	**9060.1**	

Source: NFA (2007a: 14-15). Note the small discrepancy between community CDM blocks reported by NFA (346.7 ha) here and those in the CDM documents (194.0 ha)

Quantitative Evaluation of Additionality

Our assessment of the CDM afforestation projects in Uganda is that all 0.65 MtCO2e of carbon credits originally expected are genuine (Table 9). Carbon finance appeared to be the only source of financing outside the limited in-house revenues and government support to which NFA had access while tree-planting rate significantly increased during the CDM implementation period. Finally, the baseline planting rate that NFA was able to support independently (identified through our comparative baseline approach as 126 ha/yr) was unlikely to result in the implementation of the CDM project “anyway”—at least not during the crediting period considered. Monitoring NFA’s baseline planting rate to determine if it reaches the additionality threshold over the CDM crediting period, as discussed above, could be used as an index of the projects’ additionality and used to adjust the carbon credits generated by the project.

Table 9: Quantitative ex-post evaluation of the additionality of five small-scale CDM projects in Uganda

Period		Year	Event/Financing	CDM Project					
				(A) Baseline Removals*	(B) Carbon Credits Claimed*	(C) Annual Planting Effort**	(D) Bogus Planting	(E) Bogus Carbon Credits	(F) Genuine Carbon Credits
							$= \sum_{i=y_{2006}}^{y_t} (C)_i \Big/ \sum_{i=y_{1997}}^{y_t} (C)_i$	$=(A)_{y-1}*(D)_{y-1}$	=(B)-(E)
				tCO2e	tCO2e	ha	%	tCO2e	tCO2e
CDM Crediting Period	Implementation	2006	CDM 5 Project Initiation	-	-4,697	488	0%	-	-4,697
		2007	CDM 2 Project Initiation	-	7,240	342	0%	-	7,240
		2008	CDM 3 Project Initiation	-	9,169	347	0%	-	9,169
		2009	CDM 4 Project Initiation	-	11,546	468	0%	-	11,546
		2010	CDM 5 Project Initiation	-	31,544	370	0%	-	31,544
		2011		-	34,595	-	0%	-	34,595
		2012		-	29,316	-	0%	-	29,316
		2013		-	40,633	-	0%	-	40,633
		2014		-	39,826	-	0%	-	39,826
		2015	CDM Payment ($1.1m)***	-	40,873	-	0%	-	40,873
		2016		-	23,918	-	0%	-	23,918
		2017		-	38,684	-	0%	-	38,684
		2018		-	40,577	-	0%	-	40,577
		2019		-	36,327	-	0%	-	36,327
		2020		-	13,094	-	0%	-	13,094
		2021		-	35,336	-	0%	-	35,336
		2022		-	33,745	-	0%	-	33,745
		2023		-	25,815	-	0%	-	25,815
		2024		-	27,877	-	0%	-	27,877
		2025		-	44,581	-	0%	-	44,581
		2026		-	34,368	-	0%	-	34,368
		2027		-	26,530	-	0%	-	34,368
		2028		-	18,626	-	0%	-	34,368
		2029		-	8,224	-	0%	-	34,368
Total					**647,747**	**2,015**			**647,747**

** Sources: CDM-PDD (2006a: 11; 2006b: 11; 2006c: 11; 2006d: 11; 2009: 12).*

*** Source: NFA (2007a: Tables 3, 4, 17 & 18); CDM-PDD (2006a: 2; 2006b: 2; 2006c: 2; 2006d: 2; 2009: 2).*

**** Sources: NFA and Biocarbon Fund (NFA and Biocarbon Fund, 2006).*

Moldova CDM Afforestation Project

Project Overview and Additionality Claim

There are three carbon finance afforestation projects underway in Moldova, all implemented by Moldsilva, the state forest agency, though only two are being implemented under the CDM. Because of similarities between the project developers and timing, we consider them together as a single project. The first CDM project is a 20,290 ha tree planting effort (CDM-PDD, 2008b) entitled the *Moldova Soil Conservation Project*, which became the second afforestation project in the world to be approved by the CDM Executive Board (World Bank, 2009). The second CDM project, entitled *Moldova Community Forestry Development Project*, has aimed to afforest 10,589 ha (CDM-PDD, 2010). In contrast to projects in Tanzania and Uganda, the Moldova projects are national in scope. Together, the two CDM projects in Moldova are comprised of 3431 discrete parcels (with an average parcel size of 15 ha) involving three-quarters of all villages in Moldova. The third non-CDM afforestation effort is financed through a forward contract for the purchase of voluntary carbon credits between Moldsilva and the World Bank to plant 8,170 ha (Moldsilva, 2009: 18). Altogether, a total of 39,049 ha were planted between 2002-2009 under the three projects for a combined crediting period extending until 2035.

As in Uganda, the project developer, Moldsilva was a state agency which was expected to be largely self-sufficient in achieving the national planting objectives given it by government. Moldsilva was established in 1996 as an independent and financially autonomous government agency: partial funding was to be derived from the state but it was also empowered to generate its own income through district forest enterprises under its authority which operate on revenue generated from timber sales (World Bank, 2007: 7). The precursor to Moldsilva was 90% financed by the state budget in 1990 though it now receives less than 10% of its resources from the state (UNECE, 2005: 112, also see Figure XXX below).

The additionality claim of the Moldova CDM afforest project is that in the absence of the CDM project, the 39,049 ha would see "further degradation under growing population demands and will result in adverse impacts on adjoining lands" (CDM-PDD, 2008b: 40-42; 2010: 46-52). Apart from the carbon finance, it was argued, there were limited financial resources for tree-planting except what Moldsilva's forest enterprises could generate themselves through harvesting timber:

> *elements of the project activity such as investment needs of restoration, stakeholder collaboration, and cost effective use of technical capacity are of Moldsilva only feasible provided the additional resources enable the project entity to overcome the multiple barriers that prevented the restoration of degraded lands in the past. The lack of investment capacity of the [sic] Moldsilva and local councils and absence of incentives have discouraged investments in the restoration of degraded lands and are likely to continue to be so under the business as usual scenario (CDM-PDD, 2008b: 49; 2010: 46)*

How does the additionality claim stand up to scrutiny?

Project Finance Baseline

The analysis below indicates that carbon finance projects became an extension of government policy, allowing Moldsilva to further afforest 39,049 ha of degraded land towards a national afforestation target which Moldsilva was mandated by to reach but for which Moldsilva had insufficient resources.

It is important to understand the relationship between the CDM project and the government's broader efforts to tackle land degradation in Moldova. In the *Strategy for the Sustainable Development of the Forestry Sector (2003-2020)*, the government called for an increase in Moldova's forest estate by at least 130,000 ha by 2020. Traditionally known for its rich agricultural lands, especially its chernozem "black earth" soils, Moldova has amongst the highest levels of land degradation of any country in Eastern Europe (Istrate & Hens, 1996: 55; I.A. Krupenikov, 2008; I.A. Krupenikov & Boinchan, 2004; van Lynden, 2000: Figure 2c). Tree planting has been advocated for addressing land degradation in other Eastern European countries because it is one of the most economically efficient ways of addressing the problem (Balana et al., 2012; Khamzina, Lamers, Worbes, Botman, & Vlek, 2006; Reubens et al., 2011; Singh, 2012; Zdruli, Eswaran, Almaraz, & Reich, 1997).

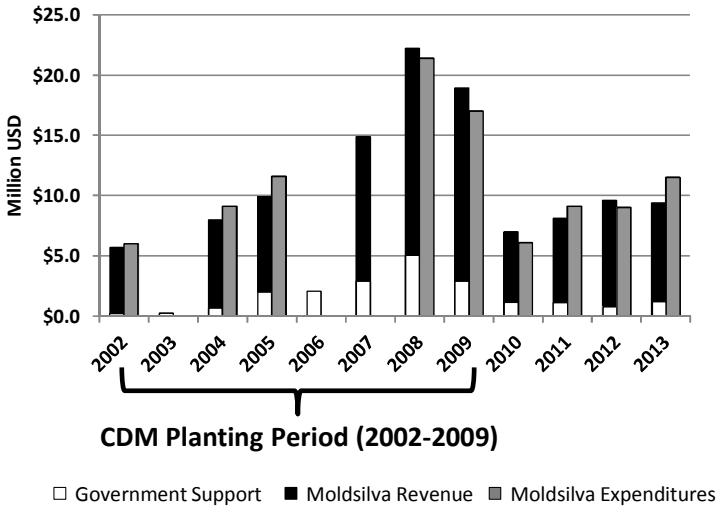
A large part of the government's effort was to be undertaken with funds provided under the 2003 *State Program for Afforestation and Regeneration of Forest Land for 2003-2020*, which targeted 95,118 ha of degraded land (CDM-PDD, 2008b: 54-57; 2010: 57-60; FAO, 2007: 4). The remainder of the *Strategy's* target is to be met through forest restoration techniques such as assisted natural regeneration that does not require tree-planting *per se* (UNECE, 2005: 111). Thus, the 95,118 target of the *State Program* serves as a important guideline for the effectiveness of Moldsilva's afforestation effort.

A first piece of evidence in support of the financial additionality claim of the Moldova afforestation project is that government support towards Moldsilva's activities does not demonstrate any significant increase during the implementation period of the carbon finance projects from 2002-2009—an increase that would have been expected under the *State Program*. See Figure 3 that breaks down trends in Moldsilva's financing from 2002-2013. Government support peaks in 2008 at about $5.0. However, Moldsilva's own revenues a show strong yet steady increase which peaks in 2008 at $17.4 million, though falling abruptly in 2010—after the close of the CDM project's implementation phase. Budget documents in themselves do not disclose the sources of Moldsilva's revenues, but for reasons we outline below we believe that they are largely derived from carbon finance. This suggests that carbon finance played a critical role—it was the only other source of financing outside Moldsilva's own internal operations.

There were actually two World Bank carbon finance programs at play: the Prototype Carbon Fund (PCF) and BioCarbon Fund (BioCF). The main difference between the two is that the PCF allocated some financing upfront, while the BioCF gives payment only upon delivery of carbon credits (Lecocq, 2003; Ranade, 2009). The PCF allocated $5.2 million to the first CDM project over 2002-2010, including $1.8 million in terms of carbon credits at a price of $3.3 per tCO_2e (PCF, 2003: 28 & 33). The BioCF only first issued payment for this project in 2012, upon completion of the project's first monitoring report. It bought 851,911 tCO_2e (World Bank, 2012)—representing a cash injection of $2.8 million. The BioCF is scheduled to make a payment for 550,000 tCO_2e for the second CDM project, likely at this project's first monitoring in 2017—representing a purchase of

$1.8 million (Moldsilva, 2009: 18). While payment for the carbon is made upon delivery, it is highly likely that Moldsilva was able to use emission reduction purchase agreements as collateral in order to get a loan from a local bank. For example, as early as 2003 the World Bank and Moldsilva signed a Letter of Intent and confirmed they would enter into an emissions reduction purchase agreement shortly thereafter (CDM-PDD, 2008b: 46). The PCF and BioCF have agreed to purchase 1.3 and 1.9 $MtCO_2e$ from the CDM projects, representing $10.6 million (WB Carbon Finance Unit, 2014a, 2014b). As for the voluntary carbon project, the World Bank has purchased 175,000 tCO2e at a price of $2.5 per tCO_2e (Moldsilva, 2009: 18).

Figure 3: Moldsilva's internal financing, 2002-2013



Source: Government Support obtained from Ministry of Finance. Moldsilva Revenue and Expenditures: 2002 (Moldsilva, 2013c); 2004-2005 (Curtea de Conturi, 2006); 2007-2009 (Curtea de Conturi, 2010; Moldsilva, 2011); 2010-2013 (Moldsilva, 2013a). Note that for 2003, 2006 and 2007 available data are incomplete.

A second piece of evidence in support of Moldsilva's claim that it did not have sufficient resources to otherwise plant the 39,049 ha carbon finance lands was provided during interviews. As an official of Moldsilva explained,[15] in the absence of the CDM projects afforestation would have proceeded but only at a smaller scale:

> *The CDM was a financial supplement for the project, without these carbon credits, they would have still implemented this kind of a project, but on a smaller area. The profit margin [for afforestation] is very small. The internal rate or return, even with financial support from carbon credits is [still] very small. But there were exact and direct orders from the President of Moldsilva, who said that this project should be implemented.*

[15] *Moldova Government Officer, Chisinau, Interview MN9, 10 August 2009.*

…

The financial means which are obtained through selling carbon credits isn't the goal of the project, it's just a way of reducing expenditures. The implementation would have still taken place in Moldova, but the carbon credit transactions are a method of reducing costs, not the purpose itself.

This description of the low financial attractiveness of the carbon finance afforestation projects is supported by the financial analysis presented in the CDM project documents. The IRR of the first CDM afforestation project is negative with and without carbon finance over a 20 year crediting period; only over a 40 year crediting period is the IRR positive, at a meagre 5.6% with carbon finance compared to 3.7% without carbon finance while commercial loans in Moldova require an IRR of 15-20% (CDM-PDD, 2008b: 50-54). Altogether, attracting private financing for forestry appears difficult in Moldova. Furthermore, from interviews with Moldsilva, the CDM appeared to resolve cash flow problems encountered when executing its forestry efforts.[16] In the first year of implementation, in 2002, carbon finance supported nearly two-thirds of total planting efforts in the country, though its share decline over time as Moldsilva was able to plant on non-CDM project lands.[17]

A final piece of evidence in favour of the financial additionality claims of the project were, ironically, tensions surrounding the afforestation projects in some of the villages investigated. One village counsellor was quite clear that if it had not been for the afforestation project the area "would have remained pasture."[18] Another district official spoke of the challenge of restoring degraded lands: "Since [the Soviet period], more land has become degraded and there is a national plan for improving degraded land, but the amount of money granted is insufficient for implementing the project."[19] Altogether the key informants and experience in the field supports the financial additionality claims of the CDM project, that Moldsilva possessed financing to implement a portion of the 95,118 ha targeted under the *State Program* but that carbon finance allowed it to plant more by significantly adding to Moldsilva's revenues.

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[16] *Moldova Government Officer, Chisinau, Interview MN9, 10 August 2009.*

[17] *Moldova Government Officer, Chisinau, Interview MN9, 10 August 2009.*

[18] *Business Manager, Săiţi Village, Interview M1, 1 August 2009.*

[19] *District Government Officer, Căuşeni, Interview MD1, 7 August 2009.*

Background Economic Baseline

The validity of the background economic baseline claim implicit in the CDM project documents can be evaluated by comparing tree-planting activities undertaken inside the CDM project area with non-CDM planting outside. For such an investigation, all of Moldsilva's tree-planting efforts in the country are considered as Moldsilva's activities are national in scope. Distinguishing between the CDM planting effort and non-CDM tree-planting under the *State Program* is possible with data that Moldsilva maintains on its national forestry effort (Moldsilva, 2010a, 2010b). Planting effort described in the CDM and World Bank voluntary project documents[20] could then be subtracted from data on Moldova's national afforestation and reforestation effort.[21] Results are presented in Figure 4 for the period 1997-2012, which extends before and after the implementation period of the carbon finance project.

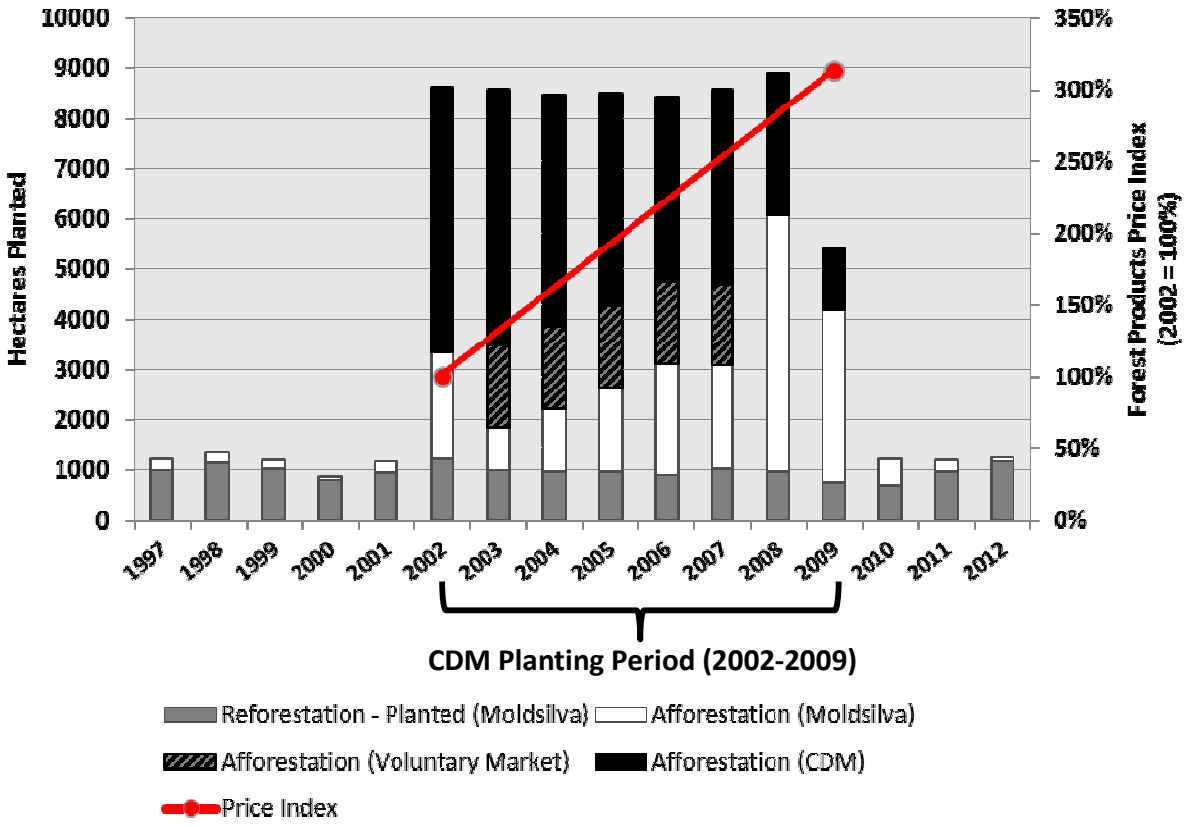
Results indicate that there was hardly any tree-planting ahead of 2002, the start of the carbon finance project, while tree-planting drops again after the end of the project's implementation period in 2009. Over the period 2002-2009 a total of 65,545 ha was afforested and reforested by Moldsilva, a period corresponding to the planting period of the CDM afforestation project. Of this, 26,495 ha was planted independently by Moldsilva under the *State Program* while the carbon finance projects led to the planting of 39,049 ha—nearly doubling Moldsilva's independent planting effort. The average carbon finance tree-planting effort stood at 4881 ha/yr over 2002-2009. In comparison, Moldsilva's independent *non-carbon-financed* tree-planting effort averaged 1161 ha/yr through 1997-2001, increased to 3312 ha/yr over 2002-2009 during the carbon finance implementation period before dropping to 1221 ha/year for 2010-2012 thereafter. This

[20] Recall that included with my assessment of the CDM is the World Bank voluntary carbon finance agreement with Moldsilva. Its total planting effort for the five year period was 8,170 ha, which gives 1,634 ha/yr.

[21] Note that data on Moldova's national forestation effort includes data on afforestation, reforestation and assisted natural regeneration (ANR). Only the first two were retained for baseline determination. ANR is the human protection and preservation of natural tree seedlings in forested areas, and would not be feasible on unforested, degraded lands where the government seeks to expand forest cover. ANR is expected to only contribute to the maintenance of Moldova's existing forest, not establishment of new forests. However the distinction between afforestation and reforestation in the field can be sufficiently unclear in the field that it warranted including both measures. Recall that the scope of additionality should ensure that the economic activities compared to the CDM are of similar output (i.e., carbon sequestration), but not in the way that this output is produced.

dynamic suggests that carbon finance actually had a positive spillover effect on Moldsilva' productivity, allowing Moldsilva to increase its own independent planting rate during the CDM implementation period. Altogether these results suggest that the carbon finance projects were highly additional because they did not displace but actually added to afforestation efforts that Moldsilva was able to undertake independently.

Figure 4: Total Tree-Planting Effort in Moldova, 1997-2012



Sources: Tree-planting: CDM-PDD (2008b: Tables 13 & 22); CDM-PDD (2010: Table 13); Moldsilva (2010a, 2010b, 2013b): Forest Products Price Index derived from Moldsilva (2011: 31; 2013c).

We considered whether changes in background economic conditions over the implementation period of the carbon finance projects might have driven these observed trends in tree-planting. While background economic conditions did change, these do not appear to have been sufficient to drive the level of afforestation associated with the CDM. Over the period 2002-2009, the price of timber rose by 50% to 90% while the

price of firewood increased 340% from $8.2 to $34.3 per m^3. The price of firewood in particular would be expected to have an effect on tree-planting as firewood constitutes 84% of Moldsilva's harvesting effort (Moldsilva, 2011: 31)— though because of illegal logging, largely by rural populations for fuel, the extent of firewood harvesting is likely larger (UNECE, 2005: 110).[22] However, rising forest product prices, largely firewood, do not appear to explain afforestation rates. While the limited price information precludes more robust econometric analysis, Figure 4 suggests that increasing prices more plausibly explains the slight increase in Moldsilva's independent planting rates over 2002-2009 rather than total planting effort, which includes carbon finance. Total planting effort is relatively stable and actually declines in 2009, which is in conformity with the close of the implementation period of the carbon finance projects and quite the opposite of price trends.

The results above are supported by other evidence. For example, the 2003 planting effort corresponds with a World Bank report which observed that Moldsilva afforested a total of 7500 ha of degraded agricultural lands, including around 5000 ha of the CDM project lands (World Bank, 2004: 18-19). Furthermore, an agent of one of Moldsilva's district forest enterprises estimated that the CDM project had permitted 30,000 additional hectares to be planted over the eight years of the project, which corresponds to numbers presented here.[23] An official at the World Bank reported during conversation that Moldsilva would have afforested 30,000 ha on its own and that the CDM projects allowed for 30,000 ha more, roughly corresponding to the analysis above.[24]

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[22] In 2008, Moldova only produced domestically 51% of its industrial roundwood consumption and 18% of its sawnwood (FAO, 2011: 133).

[23] *Moldsilva Rayon Agent (MD5), confidential interview.*

[24] The World Bank official explained "[In 2008, Moldsilva] claimed they had overall afforested since 2001 about 60,000 ha…Of those 60000, 30,000 ha have been afforested under [World Bank] projects. So I would again [claim] in the spirit of what we believe is true for additionality and these protects that without our carbon finance funds, they wouldn't have afforested the additional 30,000 hectares and they would have stayed with the 30,000 that they would have afforested on their own. Those 30,000 are beyond our project (*Multilateral Donor Agency Officer, Chisinau, Interview MN4, 26 August 2009*)." While this overlooks the voluntary market project, it is correct with regard to the CDM.

While one can be confident that the carbon finance projects were additional over the implementation period, additionality over the entire crediting period cannot be known with certainty. Would the lands claimed afforested by carbon finance have been planted by Moldsilva “anyway”? The crediting periods of the three carbon projects vary, but altogether extend from 2002 through 2035 for a total of 34 years. Additionality would be violated only if, by the end of the CDM crediting period, Moldsilva had planted enough trees independent of carbon finance in order to reach the 95,118 ha target prescribed in the *State Program*. We can assert with confidence that this is highly unlikely.

To violate additionality, Moldsilva would need to sustain a planting rate of at least 2818 ha/yr annually from 2002 through 2035. However, we have observed through our comparative *ex-post* baseline approach that Moldsilva’s independent, non-CDM planting rates under the *State Program* averaged 2742 ha/yr from 2002-2012. In other words, this suggests that by 2012 Moldsilva would have planted 30,158 ha towards the *State Program’s* target, leaving nearly 70% of the targeted lands untouched. At Moldsilva’s historical rate, it would take 35 years to fully plant the 95,118 ha targeted, which is just slightly longer than the carbon finance crediting period. However, this assessment is conservative as there indications that average historical planting rate is tapering off; carbon finance boosted Moldsilva’s overall productivity, allowing it to be more effective during the carbon finance implementation phase 2002-2009. In other words, it is likely that Moldsilva’s planting effort would have been even slower than that observed through our comparative analysis. Overall, all credits appear genuine, though monitoring of Moldsilva’s independent tree-planting rate to verify if it passes the 2818 ha/yr threshold could be used as an index of the project’s additionality.

Quantitative Evaluation of Additionality

Our assessment of the CDM afforestation projects in Moldova is that all 7.4 MtCO2e of carbon credits originally expected are genuine (Table 10). Carbon finance appeared to be the only source of financing outside the limited in-house revenues and government support that Moldsilva had access while tree-planting rate significantly increased during the CDM implementation period and in a manner that contrasted with prevailing

background economic trends. Finally, the baseline planting rate that Moldsilva was able to support independently (identified through our comparative baseline approach at 2742 ha/yr) was unlikely to implement the carbon finance project “anyway”—at least not during the crediting period considered. Monitoring Moldsilva’s baseline planting rate to determine if it reaches the additionality threshold over the CDM crediting period, as discussed above, could be used as an index of the projects’ additionality and used to adjust the carbon credits generated by the project.

Table 10: Quantitative ex-post evaluation of the additionality of two CDM projects in Moldova

Period			Year	Event/Financing*	(A) Baseline Removals**	(B) Carbon Credits Claimed**	(C) Annual Planting Effort***	(D) Bogus Planting	(E) Bogus Carbon Credits	(F) Genuine Carbon Credits
								$= \sum_{i=y_{2006}}^{y_T} (C)_i \Big/ \sum_{i=y_{1997}}^{y_T} (C)_i$	$=(A)_{y-1}*(D)_{y-1}$	=(B)-(E)
					tCO2e	tCO2e	ha	%	tCO2e	tCO2e
CDM 1 Crediting Period		Implementation	2002	**CDM 1 Project Initiation**			5,302	0%	-	
			2003				5,098	0%	-	
			2004				4,620	0%	-	
			2005	CDM 1: PCF Financing Initiated			4,247	0%	-	
			2006	**CDM 2 Project Initiation**	2	7,741	3,378	0%	-	7,741
	CDM 2 Crediting Period		2007		396	29,001	3,861	0%	-	29,001
			2008		1,002	56,344	2,818	0%	-	56,344
			2009		1,786	83,140	1,255	0%	-	83,140
			2010		2,725	102,475	-	0%	-	102,475
			2011		3,785	117,312	-	0%	-	117,312
			2012	CDM 1: BioCF Payment 1 ($2.8m)	5,085	132,029	-	0%	-	132,029
			2013		6,552	133,736	-	0%	-	133,736
			2014		8,169	134,473	-	0%	-	134,473
			2015		9,935	152,231	-	0%	-	152,231
			2016	CDM 2: BioCF Payment 1($1.8m)	11,845	164,593	-	0%	-	164,593
			2017	CDM 1: PCF Financing Concluded	13,639	176,746	-	0%	-	176,746
			2018		15,616	179,509	-	0%	-	179,509
			2019		17,600	146,364	-	0%	-	146,364
			2020		19,568	174,526	-	0%	-	174,526
			2021		21,425	175,331	-	0%	-	175,331
			2022	CDM 1: BioCF Payment 2 (est $8.6)	23,441	174,593	-	0%	-	174,593
			2023		25,461	119,110	-	0%	-	119,110
			2024		27,493	88,211	-	0%	-	88,211
			2026	CDM 2: BioCF Payment 2 (est $5.0)	29,533	108,240	-	0%	-	108,240
			2027		31,529	134,772	-	0%	-	134,772
			2028		33,550	155,533	-	0%	-	155,533
			2029		35,400	152,321	-	0%	-	152,321
			2030		37,389	148,287	-	0%	-	148,287
			2031		39,365	111,444	-	0%	-	111,444
			2032		41,329	137,725	-	0%	-	137,725
			2033		43,173	136,861	-	0%	-	136,861
			2034		44,977	130,982	-	0%	-	130,982
			2035	CDM 2: BioCF Payment 3 (est $4.5m)	46,733	124,527	-	0%	-	124,527
Total				**est $27.8m**	**756,911**	**7,391,196**	**29,324**			**7,391,196**

* Sources: For 2002-2017 - PCF granted $5.2 to the CDM 1 project from 2005-2017, $1.8 of which was in the form of an explicit carbon payment (PCF, 2003: 1 & 28); World Bank (2012); Moldsilva (2009: 18). For 2022-2035, assumed BioCF buys credits remaining at 10-year monitoring windows (price of $3.3/tCO2e).
** Sources: CDM-PDD (CDM-PDD, 2008b: 30-34); CDM-PDD (CDM-PDD, 2010: 28-29)
*** Sources: CDM-PDD (CDM-PDD, 2008b: 27-28); CDM-PDD (CDM-PDD, 2010: 26)

Conclusions and Policy Recommendations

This study is important because it provides a comparative, empirical evaluation of additionality claims and resulting carbon credits of three CDM afforestation projects. While comparative methods are not perfect, they are a practical surrogate for the counterfactuals that are at the heart of the debate about the CDM's effectiveness. And while afforestation projects are more complicated than other CDM projects because of the non-permanence of carbon credits (Maréchal & Hecq, 2006), we believe that research into additionality of afforestation projects has implications for other CDM projects and results-based management more broadly.

Most importantly, we have been able to demonstrate variation in CDM project additionality, which represents a considerable contribution to the debates about the CDM which tend to either assume the mechanism is all good or all wrong. Using an ex-post comparative baseline approach, the CDM afforestation project in Tanzania was demonstrated to be highly non-additional, while projects in Uganda and Moldova were found highly additional. A broader explanation as to why project developers for the Uganda and Moldova projects implemented genuinely additional projects and the developer in Tanzania did not remains. This requires a more detailed examination of the motivations of each, which is beyond the scope of the current paper (though see Purdon, 2012). Briefly, we attribute the fact that CDM afforestation projects in Uganda and Moldova were highly additional to the motivations of their project developers—state forest agencies. State agencies have the capacity to see afforestation projects implemented but are motivated by developmental objectives *as well as* financial incentives—in contrast to private sector actors. The price of carbon is currently too low to be a reliable financial incentive to motivate the private sector, which explains why the additionality of GRL's project in Tanzania was so vulnerable to changing background economic conditions—these conditions were the primary incentives for the project, not carbon finance. State forest agencies in Uganda and Moldova were able to use carbon finance to extend existing state programmes—despite the lack of profitability of such programmes.

A second important insight is that the conditions of additionality are something that can change over time and affect the amount of emissions removals due to the CDM intervention as financial incentives and background economic conditions evolve. Yet the use of frozen baselines remains popular in carbon finance. For example, they feature prominently in existing REDD methodologies (VCS, 2011b, 2011c), which could lead to concerns about bogus credits and sap confidence in the instrument when it is fully implemented. Yet REDD, at least on the voluntary markets, is facing a severe supply-demand imbalance. In 2013, of the potential 22 million annual carbon credits currently available through REDD voluntary market projects, market demand is at only 6.8 million (CI, 2013).

Lastly, we can answer questions about the robustness of the CDM regulatory system. Can project developers game the system? While such scheming possible, in agreement with Zhang and Wang (2011), we conclude that it is not necessarily fraudulent activity on the part of project developers that is often to blame for violations of the condition of additionality; rather "it is the current CDM baseline methodology that fails to predict future emissions in a fast changing economy" (p.49). In the case of the Tanzania afforestation project, changes in background economic conditions, namely the reopening of Mufindi Paper Mill, generated greater incentives for tree-planting that undermined its additionality claim. This suggests that for the private sector, carbon finance is often only a very small financial layer in their overall business plans and mistakes about project baseline were largely due to unforeseen changes in the development context that really drive their profitability. This is amplified by the fact that the CDM's frozen baseline approach means that the CDM is incapable of accommodating such change. As for financial additionality, rules on how to include donor financing in the CDM have been very unclear, which likely explains why GRL did not report on donor financing. However, the fact that GRL was able to contribute to rising demand for raw logs in the area by acquiring Sao Hill Sawmill, thereby undermining its own additionality, does confirm the concerns of some observers that the counterfactual approach is rife for manipulation. Here we are confident that a

comparative approach, such as through sector specific benchmarking, discussed below, is a way to address these information asymmetries head-on.

Policy Recommendations

We recommend that the UNFCCC and other carbon standard consider move away from an approach to additionality that only entails a counterfactual assessment based on conditions at project inception and, instead, use elements of our *ex-post* comparative baseline approach. Specifically, three remedies can help improve the monitoring of additionality: the use of sectorial performance benchmarks, the development of an additionality risk management tool and the inclusion of ODA in the development of project baselines. These remedies are necessary to address the key problem confronting the CDM and similar results-based climate mitigation initiatives: with the price of carbon low, its effects are difficult to observe. If the current CDM counterfactual regulatory approach is a magnifying glass, the remedies we suggest constitute a microscope to detect an even smaller price signal and distinguish its effects from other changing financial and background economic conditions. Yet when providing the recommendations below, we also recognize that the UNFCCC must also deal with the realities of the limited availability of data necessary for establishing an *ex-post* comparative approach, particularly in least developed countries. And of course the costs for such measurement must be balanced with the ultimate aims of the climate change regime to reduce emissions.

First, regarding background economic conditions, a comparative approach where information for an entire sector is collected, rather than on a project-by-project basis, would enable baseline conditions to be more accurately observed. While data availability for the construction of such sectorial benchmarks will remain a challenge in developing countries, the UNFCCC's elaboration of sector specific standardized CDM baselines should be seen as a promising step in acquiring the necessary information for comparative analysis (CDM EB, 2011a; Michaelowa, 2008; UNFCCC, 2010b).

Second, a tool for managing the risk of violating additionality (see Meyers, 1999) might be devised to accommodate changing baseline conditions. Project developers would likely object to an *ex-post* additionality evaluation as undertaken here, because it submits their investment returns to changing economic factors beyond their control. Yet the management of uncertainty has been successfully tackled in other areas. Indeed, an additionality risk management tool might draw inspiration from a system to manage the non-permanence of carbon credits issuing from forest and agriculture projects (Diaz, 2010; VCS, 2011a). Here an *ex-ante* additionality risk analysis would be used to assign the project an additionality risk score which would indicate the amount of carbon credits that need to be deposited in a pooled additionality buffer account. Building on the comparative approach to the monitoring of baseline conditions described above, an evaluation of project additionality would have executed *ex-post* on a regular basis in order to establish a dynamic baseline. Carbon credits in this account would only be issued upon an *ex-post* additionality evaluation at the end of the crediting period, with the exact amount of credits issued depending on the degree to which additionality has been violated.

An alternative solution is shorter crediting periods, favored by many reformers of the CDM. The 20-30 year window for CDM afforestation projects (7-10 years for other CDM projects) would be reduced, which would arguably increase the accuracy of additionality assessments. This is because a shorter time horizon reduces uncertainties surrounding the evolution of the conditions additionality. But there is also little empirical research to understand the rate at which the conditions of additionality can change. Our results demonstrate that such changes can occur rapidly: for the CDM afforestation project in Tanzania, the conditions of additionality were undermined upon the reopening of Mufindi Paper Mill within only five years of the project's official start. An ex-post approach captures this change. While understanding the need to foster investment, a revised CDM or other climate finance instruments should shift its focus towards boosting consumer confidence in carbon credits. For example, the current REDD market is unsustainably oversupplied (CI, 2013), suggesting investment is no longer the primary challenge.

An additionality risk management tool may also help resolve the challenge of how to incentive governments to adopt green policy while also awarding private sector action. The CDM is currently designed such that the introduction of green policy measures during a CDM project's crediting period is not counted as a change in baseline conditions. But this only solves half the problem: removing the perverse incentive for governments to retain dirty policies for the benefit of CDM project developers though still allowing CDM project developers to benefit from these policies in terms of defining their counterfactual emissions baselines. But if government were allowed to claim carbon credits held in the additionality buffer account when implementing green policy, they would have more incentive to do so while economic shock to CDM project developers will be abated. Such a system would better reward those responsible for emission reductions/removals, whether it be government r individual project developers. Of course, such a system cannot replace a full accounting for emissions reductions in an economy—that is best addressed through a cap-and-trade system or similar approach. But for developing countries without the information infrastructure to track all emissions, such an approach would improve on the current CDM arrangement.

Third, with regards to project finance additionality, we recommend that the donors be involved in the modeling of ODA-baselines against which emission reductions associated with CDM are compared. Amongst the projects investigated here, a case could be made that GRL deliberately misrepresented information relevant to project finance additionality, particularly donor involvement. However, this actually points to a fundamental problem with the CDM's design: the CDM currently encourages such behavior because of the lack of clarity about how to combine ODA with CDM financing. We recommend that donors estimate the emission reductions associated with their contributions in order to model ODA-baselines for inclusion for any carbon crediting scheme. Here it should be observed the CDM may be transforming into what are being called NAMAs—nationally appropriate mitigation actions (Okubo, Hayashi, & Michaelowa, 2011; South Pole Carbon, 2011). The gist of NAMAs is that they are actions identified by governments in developing countries, thus ostensibly ensuring that mitigation activities align with a state's development priorities. In an important departure

from the CDM however, NAMAs are also expected to allow the combination of private and public financing. While unreported ODA contributions were not found to decisively undermine additionality claims amongst the projects investigated here, for other projects they may. It is important to be able to combine the emission reduction effects of both public and private financial resources.

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Appendix

Table 11: Change in royalty rates for forest products felled on government owned forests in Tanzania between 2002 and 2007

	2002 Tsh/m^3	2007 Tsh/m^3
All softwood plantation species except *Juniperus procera*		
Class 1 (DBH < 10 cm)	To be sold as firewood	To be sold as firewood
Class II (DBH 11-20 cm)	1,500	2,000
Class III (DBH 21-25 cm)	2,000	4,000
Class IV (DBH 26-30 cm)	3,000	10,000
Class V (DBH 31-35 cm)	3,500	17,300
Class VI (DBH > 35 cm)	4,500	19,200
Juniperus procera		
All sizes	50,000	50,000
All hardwood plantation species except *Eucalyptus*		
Cederella, Grevillea, Acacia Acrocarpus and Maesopis		
Class 1 (DBH < 10 cm)	To be sold as firewood	To be sold as firewood
Class II (DBH 11-20 cm)	To be sold as poles	4,000
Class III (DBH 21-30 cm)	8,000	8,000
Class IV (DBH – 2002: > 30 cm; 2007: 31-35 cm)	10,000	15,000
Class V	/	20,000
Teak		
Class 1 (DBH < 10 cm)	To be sold as firewood	To be sold as firewood
Class II (DBH 11-20 cm)	To be sold as poles	32,000
Class III (DBH 21-30 cm)	8,000	80,000
Class IV (DBH – 2002: > 30 cm; 2007: 31-35 cm)	10,000	120,000
Class V	/	160,000
All Other Hardwood Plantation Species		
Class 1 (DBH < 10 cm)	To be sold as firewood	To be sold as firewood
Class II (DBH 11-20 cm)	To be sold as poles	3,000
Class III (DBH 21-30 cm)	8,000	6,000
Class IV (2002: DBH > 30 cm; 2007: DBH > 31-35 cm)	10,000	12,000
Class V	/	15,000
All *Eucalyptus* species		
E. salinga & E. grandis		
Class 1 (DBH < 10 cm)	To be sold as firewood	To be sold as firewood
Class II (DBH 11-20 cm)	To be sold as poles	6,400
Class III (DBH 21-30 cm)	8,000	16,000
Class IV (DBH > 30 cm)	10,000	28,000
All Other Eucalyptus species		
Class 1 (DBH < 10 cm)	To be sold as firewood	To be sold as firewood
Class II (DBH 11-20 cm)	To be sold as poles	To be sold as poles
Class III (DBH 21-30 cm)	8,000	6,400
Class IV (DBH > 30 cm)	10,000	16,000

Source: Schedule 14 (Part II, Section B) under regulation 29(i) of the Forest Act.

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