Restoring forest carbon stocks while addressing local livelihoods: Opportunities and challenges of the global climate change regime

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TABLE OF CONTENTS

List of Abbreviations

ANAM	National Authority for the Environment
FCPF	Forest Carbon Partnership Facility
IPCC	Intergovernmental Panel on Climate Change
OUDCIE	Organización para la Unidad y Desarrollo de la Comunidad de Ipetí-Emberá
REDD+	Reducing emissions from deforestation and forest degradation in developing
UNFCCC	United Nations Framework Convention on Climate Change
TCIE	Tierras Colectivas de Ipetí-Emberá - Collective Lands of Ipetí-Emberá

List of Tables

Chapter 1

Chapter 2

Chapter 3

List of Figures

Chapter 1

Chapter 2

Chapter 3

Preface

The present thesis is manuscript-based, consisting of a collection of papers of which I am the primary author. Chapter 1 was submitted and is under revision, Chapter 2 has been published, and Chapter 3 is being formatted for submission. Manuscripts are as follows:

Chapter 1: Holmes, I., Kirby, K. R., & Potvin, C. (2015). Agroforestry within REDD+: Experiences of an indigenous Emberá community in Panama. *Agroforestry Systems, Submitted*.

Chapter 2: Holmes, I., & Potvin, C. (2014). Avoiding Re-Inventing the Wheel in People-Centered Approach to REDD+. *Conservation Biology, 28*(5), 1380-1393.

Chapter 3: Holmes, I., Coomes, O. T., & Potvin, C. (2015). Lessons from REDD+ early implementation: easy and cheap? *In preparation*.

Contribution of Authors

I am the primary author of all the studies conducted in this thesis. I formulated the hypotheses and the experimental design, collected the data (in some cases this was done in collaboration with others; details below), completed the qualitative and quantitative data analysis and wrote the manuscripts. Catherine Potvin was the supervisor for this thesis and supervised the conceptual framework, experimental design, interpretation of results, and writing of all manuscripts in this thesis.

For Chapter 1, Kathryn R. Kirby provided a database that contains information from 16 agroforestry plots that were sampled in the Indigenous Collective Land of Ipetí-Emberá 12-36 years after establishment, as part of her M.Sc. under Catherine Potvin's supervision. During the writing stage of the manuscript she also made comments that greatly improved the final submitted version.

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Thesis Abstract

Reducing Emissions from Deforestation and Forest Degradation (REDD+) has emerged as a climate change mitigation mechanism as forest loss and degradation is the second highest anthropogenic source of greenhouse gas emissions. Local and indigenous people who manage forests are foci for REDD+ projects as such groups hold tenure to over 10% of global forests. REDD+ initiatives provide both opportunities and risks to local communities. On the one hand, they could limit the access and use rights of forest dwellers, restricting their livelihoods, but on the other hand they could offer an opportunity to combine the agendas of forest conservation and rural development, allowing for an increased flow of resources to marginalized communities, and delivering co-benefits such as poverty reduction and improved livelihoods.

Although REDD+ projects and demonstration activities have proliferated in the last five years there is little literature examining if these initiatives succeed with regard to their carbon outcomes (emission reduction and carbon sequestration), and if they respect the knowledge and rights of forest-dependent people residing in the communities hosting REDD+ projects. This thesis fills this gap by conducting comprehensive research using a mixture of qualitative and quantitative research methodologies.

The overarching question this research seeks to answer is how local communities can reduce emissions from deforestation, benefiting from carbon offset trading while improving local livelihoods. By analysing a four-year-old, reforestation-based carbon-offset project on the collective lands of the indigenous Ipetí-Emberá, the study provides data on early mortality, tree growth and carbon sequestration capacity of 29 species that are commonly used by small farming households in Latin America and elsewhere, and shows that agroforestry systems could provide forest peoples with an entry point to REDD+ without restricting their livelihoods. Furthermore, by analyzing literature from rural development and sustainable forest management, I explore the factors that should be considered when implementing REDD+ and provide a framework of best practices and indicators that could be used by stakeholders to improve REDD+ project design, monitoring, and evaluation. Finally, the thesis presents the results of an in-depth case study that, in four cycles of collaborative action research (2002-2013), documented the challenges and lessons learned in implementation of a REDD+ project in the collective lands of the indigenous Ipetí-Emberá community. Though economic incentives for participants and the equitable distribution of benefits remain important to project participants, this study highlights that the importance of

adapting REDD+ strategies to best suit community needs, and REDD+'s potential as a conflict resolution mechanism for tenure issues deserve more recognition as alternative factors that can contribute to meaningful participation in REDD+.

Résumé

La réduction des émissions dues à la déforestation et à la dégradation des forêts (REDD +) est un mécanisme d'atténuation des changements climatiques, car la perte des forêts et de la dégradation est une importante source anthropique d'émissions de gaz à effet de serre. Les populations locales et autochtones qui gèrent les forêts sont un pôle majeur des projets REDD + puisque ces groupes occupent et/ou possèdent plus de 10% des forêts mondiales. Les initiatives REDD + présentent à la fois des opportunités et des risques pour ces communautés. D'une part, elles pourraient limiter l'accès aux forêts, ce qui pourrait menacer leurs moyens de subsistance. D'autre part, elles pourraient offrir la possibilité de conjuguer programmes de conservation des forêts et développement rural permettant d'accroître les flux de ressources financières, contribuant ainsi à la réduction de la pauvreté.

Bien que les projets REDD + et les activités de démonstration aient proliféré au cours des 5 dernières années, peu 'études ont examiné si ces initiatives ont atteint leurs objectifs de réduction des émissions et/ou séquestration de carbone), et si elles ont respecté les connaissances et les droits des personnes qui résident dans les communautés d'accueil des projets REDD +. Cette thèse comble cette lacune en effectuant une recherche exhaustive employant diverses méthodes de recherche qualitative et quantitative. Le sujet phare de cette thèse est la façon dont les communautés locales peuvent réduire les émissions provenant de la déforestation, bénéficiant ainsi de l'échange de crédits de carbone tout en optimisant les moyens de subsistance locaux. Cette étude comprend une analyse d'un projet de compensation de carbone par moyen de reboisement qui a eu lieu au Panama sur les terres collectives des indigènes Ipetí-Emberá sur un période de quatre ans. Elle présente des données sur la mortalité précoce, la croissance des arbres et de la capacité de séquestration du carbone de 29 espèces qui sont couramment utilisés par les petits producteurs agricoles en Amérique latine et ailleurs. Les résultats démontrent que les systèmes agroforestiers pourraient fournir aux populations forestières un point d'entrée pour la REDD + sans restreindre leurs moyens de subsistance. En outre, en analysant la littérature sur le développement rural et la gestion durable des forêts, je propose un cadre de bonnes pratiques ainsi que des

indicateurs qui pourraient être utilisés par les parties prenantes pour améliorer la conception de projets REDD +, leurs suivi et évaluation. Finalement, la thèse présente les résultats d'une étude de cas approfondie qui s'est déroulé en quatre cycles de recherche concertée (2002-2013) et met en lumière les défis et les leçons apprises dans la mise en œuvre d'un projet REDD + dans les terres collectives de la communauté Ipetí-Emberá au Panama. Bien que les incitations économiques et la répartition équitable des avantages restent importants pour les participants au projet, cette étude démontre que l'importance d'adapter les stratégies REDD + aux besoins de la communauté, et le potentiel de REDD+ en tant que mécanisme de résolution de conflits pour les questions de régime foncier méritent plus d'attention étant des facteurs qui affectent la participation effective et substantielle au programme REDD +.

General Introduction

Forests are the most important terrestrial store of carbon, containing about 60% of the total carbon in terrestrial ecosystems, and play a key role in controlling the climate (IPCC, 2000; Streck & Scholz, 2006). Yet, despite the increased awareness of climate stability and climate change (Houghton, 2005; Houghton et al., 2000; IPCC, 2007), gross global deforestation totals 12.3 million hectares per year (FAO, 2005). Forest clearance is an important source of greenhouse gas emissions, contributing approximately 36% of the carbon dioxide (CO_2) added to the atmosphere between 1850-2000. An additional 18% of CO_2 emissions in the 1990s are the result of land-use change (Houghton, 2005; Houghton et al., 2000; IPCC, 2007). According to recent estimates on the overall perturbations on the global carbon cycle, emissions from deforestation and other land-use change represents 9.18% of global anthropogenic emissions in the last decade (2004-2013) (Le Quéré et al., 2015).

Despite the importance of forests as both sources and sinks of carbon, the Kyoto Protocol limits acceptable forestry activities to reforestation and afforestation projects under the Clean Development Mechanism. Under this mechanism carbon sinks created by reforestation/afforestation qualify for carbon credits that Annex 1 countries could buy from developing countries to meet their emission reduction commitments (Pedroni, et al., 2009; Streck & Scholz, 2006). Thus the Clean Development Mechanism fails to include avoiding deforestation and conservation (Pedroni, et al., 2009; Streck & Scholz, 2006). This not only leaves the largest source of greenhouse gas emission in many developing countries unaddressed, but also limits the opportunities for developing countries to benefit from a potential, novel emission trading scheme (Streck & Scholz, 2006).

Discussions leading to the formal recognition that avoiding deforestation could be used as a climate change mitigation strategy began in 2005, at the 11th Conference of the Parties (COP-11) to the United Nations Framework Convention on Climate Change (UNFCCC), when Costa Rica and Papua New Guinea made a proposal to begin a negotiation on positive incentives and policies to “stimulate action” and reduce emissions from deforestation. Two years later, at the 13^{th} Conference of the Parties in 2007, a decision was reached to encourage countries to initiate demonstration activities on Reducing Emissions from Deforestation and Forest Degradation (REDD+) (UNFCCC, 2007). This decision was historic, as it allowed for inclusion of forests under a post-2012 climate change regime as well as addition of developing countries in global efforts to reduce climate change (Corbera et al., 2010; Pelletier et al., 2010; Potvin & Bovarnick, 2008).

REDD+ originally focused on reducing emissions from deforestation but its scope was broadened to also take into account “the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries” (UNFCCC, decision 2/CP.13), thus accommodating a range of countries’ circumstances (Potvin & Bovarnick, 2008).

REDD+ has since become a strategic issue in the climate change agenda (Pedroni, et al., 2009; Potvin & Bovarnick, 2008) and a very popular theme for both civil society and academia. One discussion on REDD+ explores the possible impacts of its implementation on local communities and particularly on Indigenous Peoples. This argument has emerged due to the large amounts of remaining forests in developing countries that are in indigenous areas and are means to livelihood for millions of people (Agrawal, 2007; White & Martin, 2002). Early discussions on this topic were generated in gray literature intending to raise the concern that REDD+ could limit the access and use rights of forest dwellers, thereby restricting their livelihoods (Griffiths, 2007; IFIPCC, 2007; Peskett et al., 2008). Civil society organizations defending human rights also voiced their concern that REDD+ would prioritize climate change mitigation over poverty alleviation, further marginalizing forest-dependent populations (Castro, 2008). Other authors suggest that REDD+ could constitute a new threat to indigenous communities by creating incentives towards centralized forest governance, resulting in inequitable benefit-sharing and encouragement of nationalization of carbon rights (Phelps et al., 2010; Sandbrook et al., 2010; Van Dam, 2011).

Other authors argue that REDD+ offers an opportunity to combine the agendas of forest conservation and rural development, allowing for an increased flow of resources to marginalized communities, and delivering co-benefits such as poverty reduction and improved livelihoods (Brown et al. 2008; Agrawal, et al., 2011). They suggest this because REDD+ investments are likely to come from development agencies and donors for whom development and poverty reduction are important motivations, and also because forest-dependent communities, most often poor, will require appropriate incentives for REDD+ effectiveness (Brown et al. 2008).

REDD+ is already mobilizing significant financial resources (Venter & Koh, 2012). Funding for REDD+ includes newly established voluntary carbon funds (i.e., about US$8 billion from the REDD+ Partnership), bilateral agreements (i.e., US$1 billion from the Norway–Indonesia REDD+), and multi-lateral funds such as the Forest Carbon Partnership Facility (FCPF- US$385 million) (FCPF, 2015). Further, the United Nations REDD Programme (UN-REDD) has allocated US$ 227,279,400 for REDD+ Readiness (UN-REDD, 2015), and the Copenhagen Accord indicates that US$100 billion would be mobilized by 2020 for climate mitigation and adaptation with a significant share expected for REDD+ (UNFCCC, 2009). Comparing REDD+ figures to those from the 1990s, when the developing country budget for protected areas was estimated at

US$ 0.7 billion (James et al., 1999), these figures show that REDD+ has been efficient at funnelling money to developing countries' forest sectors.

The UNFCCC recognizes that REDD+ needs to address social issues, including poverty (UNFCCC, decision 2/CP.13). The Cancun Agreement (UNFCCC, 2011) noted that REDD+ initiatives should follow safeguards such as respecting the knowledge and rights of Indigenous Peoples and members of local communities; including the full and effective participation of relevant stakeholders, in particular Indigenous Peoples and local communities; and enhancing social and environmental benefits, while taking into account the need for sustainable livelihoods of Indigenous Peoples and local communities and their dependence on forests in most countries (UNFCCC, 2011). Even though "major challenges remain in operationalizing these [safeguards] in practice" (Kanowski et al., 2011, p. 12) there is no doubt that REDD+ implementation will have to find ways to integrate forest-dependent communities such that access to the lands and cultures integral to their livelihoods are not undermined.

As most forested areas in developing countries are managed by indigenous and local communities, some authors argue that REDD+ will inevitably require implementation with forest dwellers (Angelsen & Wertz-Kanounnikoff, 2008; Cronkleton et al., 2011). In the last years REDD+ has triggered a proliferation of carbon projects worldwide (Niles, 2009). Interestingly, a study found that of the REDD+ projects that are under implementation only few have project information available, and there is very limited information available that allows evaluating their socio-economic and biophysical impacts (Caplow et al., 2011; Niles, 2009). This stimulated calls for enhanced knowledge on REDD+ implementation, with authors citing a systematic lack of evidence on how REDD+ is being implemented on the ground in pilot projects, and lack of focus on outcomes from the involvement of Indigenous Peoples in REDD+ projects (Agrawal et al., 2011; Caplow, et al., 2011; Hajek et al., 2011).

Given that important amounts of remaining forests are located in indigenous areas, that REDD+ projects are proliferating, that there is an international agreement to implement REDD+ in a way that allows for local participation and enhances local livelihoods (safeguards) and that there is a clear lack of information available on REDD+ implementation on the ground, this research aims to explore alternatives to implement REDD+, integrating local and indigenous communities in a way that their cultures, livelihoods, lands and territories are respected. The proposed thesis has three chapters that are broken down as follows:

- Chapter 1: *Agroforestry within REDD+: Experiences of an indigenous Emberá community in Panama*
- Chapter 2: *Avoiding re-inventing the wheel in a people centered approach to REDD+*
- Chapter 3: *Lessons from REDD+ early implementation: easy and cheap?*

Chapter descriptions and contributions to knowledge

Chapter 1: *Agroforestry within REDD+: Experiences of an indigenous Emberá community in Panama*. This chapters supports the idea that agroforestry, which consists of mixed-species plots that combine fruit and timber species, provides means for indigenous communities to engage in carbon offsetting initiatives without forfeiting access to, or benefits from, forests. In this chapter, I present an analysis from a four-year-old, reforestation-based carbon-offset project on the collective lands of Ipetí-Emberá, Panama. In total, 9.5 ha of agroforestry systems were established (4,688 trees from 31 species). Biophysical performance of each tree (survival, mortality, tree growth) was surveyed twice at one and three years after planting. In addition, carbon sequestration capacity of the agroforestry plots was projected for 25 years. This chapter provides data on early mortality, tree growth and carbon sequestration capacity of 29 species that are commonly used by small farming households in Latin America and elsewhere. In addition to providing this data, which enables projection of carbon sequestration in agroforestry plots in future projects, this study explores socio-economic characteristics of households that established agroforestry plots as well as their motivations to engage in agroforestry and their perception of the realization of expected benefits from their plots. As participants who identified the lack of immediate returns from timber plots as a hindrance to their participation in the project opted for forest with fruit tree species, the study provides evidence of agroforestry as an entry-point to REDD+ for community members who may otherwise be unable to participate in a carbon sequestration project.

Chapter 2: *Avoiding re-inventing the wheel in a people centered approach to REDD+*. In this chapter, I conducted a qualitative research synthesis from people-centered approaches to conservation and rural development that identified best practices, as well as the factors influencing them and their relationships. Best practices included local participation in all phases of the project;

project supported by a decentralized forest governance framework; project objectives matching community livelihood priorities; project addressing community development needs and expectations; project enhancing stakeholder collaboration and consensus building; project applying an adaptive management approach, and project developing national and local capacities. Using the identified best practices and the respective factors I developed an assessment tool that consisted of indicators and criteria that REDD+ projects should meet for successful implementation with local and indigenous communities. Using this tool, six existing REDD+ projects in Latin America were evaluated by 29 development practitioners and researchers working on REDD+ and community-based conservation. Most of the best practices were part of the evaluated projects. However, limitations of some of the projects related to decentralized forest governance, matching project objectives with community livelihood priorities, and addressing community development needs. Moreover, adaptive management and free and prior informed consent have been largely overlooked in the evaluated projects. This chapter is the first study to provide a holistic, data-driven framework of best practices and indicators that could be used by stakeholders to improve REDD+ project design, monitoring, and evaluation. In addition to providing guidelines for the long term sustainability of REDD+ projects, through this assessment tool, this study highlights which best practices are most commonly neglected. Free, prior and informed consent and adaptive management were noted as practices that, if addressed, have great potential to reconcile national climate change mitigation goals with local interests but are lacking in current projects.

Chapter 3: *Lessons from REDD+ early implementation: easy and cheap?* This chapter provides empirical insights from a long-term participatory action research initiative (2002-2013) undertaken in an indigenous community in Panama. The study aimed broadly to answer how forest carbon offset initiatives can address local livelihoods and benefit local communities. Here, the lessons learned from this initiative since inception and the barriers and opportunities faced when implementing REDD+ on the ground are presented. This chapter demonstrated that even though a forest-carbon initiative may address equitable benefit redistribution and livelihoods, this is not necessarily sufficient to ensure successful implementation on the ground. REDD+ also requires adapting national institutions that support REDD+ implementation. Generally, observers assumed that the most important barrier for forest conservation is a lack of economic incentives. However we found that the challenge is much broader than that - it is driven by a complex combination of social, cultural, political and economic factors that must be understood and addressed at the scale of the landscape. We also conclude that it is important not only to understand the drivers of deforestation but also to recognize agents of deforestation; failing to do so can imperil those activities and measures designed to implement REDD+ on the ground. These lessons are catalogued to advise future projects of strategies to adopt when implementing REDD+ projects, and to increase the knowledge base on how best practice techniques operate on the ground and where future projects can look to improve.

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Chapter 1: Agroforestry within REDD+: Experiences of an indigenous Emberá community in Panama

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Abstract

Reducing carbon emissions from deforestation and forest degradation (REDD+) has become central to efforts to mitigate climate change. Approximately 10% of the world's forests are managed by local and indigenous peoples. Agroforestry may provide these communities with a means to engage in carbon offsetting initiatives without forfeiting access to, or benefits from, forests. Here, we present an analysis of social and ecological data from a four-year-old, reforestation-based carbon-offset project on the collective lands of Ipetí-Emberá, Panama. Mixed-species agroforests or timber-only plots were established by a subset of community members under voluntary carbon-offset agreements with a private client. We (1) describe how plot carbon accumulation trajectories were related to species composition; (2) determine if established agroforests are likely to meet carbon sequestration targets by the end of the 25-year project period; (3) describe the motivations and experiences of participants who chose to establish agroforests; and (4) compare socio-economics of participants versus non-participants. Our study provides data on early mortality, tree growth and carbon sequestration capacity of 29 species that are commonly used by small farming households in Latin America and elsewhere. We also provide evidence to counter claims that offset projects could amplify inequality in rural communities, as participants to agroforestry, when compared to non-participants, were not remarkable in terms of their assets or wealth. Our study provides information that shows that agroforestry systems could provide forest peoples with an entry point to REDD+ that does not restrict their livelihoods.

INTRODUCTION

Reducing Emissions from Deforestation and Forest Degradation (REDD+) has become a strategic issue in climate change agendas since the Thirteenth Conference of the Parties (COP-13 in 2007) of the United Nations Convention Framework on Climate Change (UNFCCC) (UNFCCC, 2007). The inclusion of REDD+ as a climate change mitigation strategy under UNFCCC allowed for broadly including forests in the international climate change global regime and provided an entry point for many developing countries into global efforts to reduce climate change (Potvin & Bovarnick, 2008). Activities eligible under REDD+ include reducing emission from deforestation and forest degradation as well as conservation of forest carbon stocks, sustainable forest management of forests, and enhancement of forest carbon stocks (UNFCCC, 2008).

Approximately 400 million hectares (10%) of forests in the world are under community tenure regime providing livelihoods means for about 800 million people (Agrawal, 2007; White & Martin, 2002). There is thus a concern that if REDD+ focuses exclusively on avoiding deforestation it could restrict the rights of local and indigenous communities to manage forest resources so as to best meet their livelihood needs (Griffiths, 2007). Implementation of REDD+ through a more comprehensive approach, namely finding ways in which local and indigenous communities continue having access to the benefits (food, medicine, shelter) they receive from forests could assist in addressing this concern (Blom et al., 2010; Holmes & Potvin, 2014). Mixed use of forest through agroforestry offers great potential in this respect (Cerbu et al., 2013; Minang et al., 2014). Agroforestry often goes hand in hand with small-scale farming systems (Pandit et al., 2013), and is an ancient livelihood strategy for subsistence farmers and indigenous communities (Takimoto et al., 2008). Allowing the integration of agriculture and forestry, agroforestry has been shown to improve food security and reduce environmental degradation in many parts of the world (Nair, 2007).

Agroforestry systems could qualify as REDD+ activities in various ways (Minang et al., 2014). They have great potential for carbon (C) sequestration compared to traditional agriculture (Nair et al., 2009; Soto-Pinto et al., 2010; Takimoto, et al., 2008), and could qualify as enhancement of carbon stocks via reforestation. The maintenance of existing agroforestry systems could also qualify as "forest conservation" as they often meet the definition of forest under UNFCCC (2006, Decision 16/CMP.1) (i.e., minimum area of 0.05-1.0 ha, minimum height at maturity of 2-5 m and minimum tree crown cover of 10-30 per cent). Further, if agroforestry systems are designed to increase agricultural productivity per unit area of land, they could also help in avoiding further deforestation by reducing need for new agricultural land (Branca et al. 2013). Finally, agroforestry could assist in addressing forest degradation by providing on-farm fuelwood, charcoal, and timber (FAO, 2005).

In recent years, REDD+ demonstration activities and projects have flourished, with at least 100 under implementation (Cerbu et al., 2011). Several of these initiatives include agroforestry as a component of REDD+ (Holmes & Potvin, 2014; Minang et al., 2014), but limited information about on-the-ground implementation is available.

Successful implementation of agroforestry depends on biophysical performance (i.e., the yield expected from the system) and on sustained adoption by households and communities (i.e., ensuring these are maintained over a long period) (Franzel et al., 2002a; Pattanayak et al., 2003). To better understand the potential of agroforestry as a strategy for REDD+ projects, we conducted a case study investigating both of these aspects, as well as the expected carbon sequestration potential of the agroforestry systems themselves. The case study examines a carbon-offset project undertaken in an indigenous community in Panama and addresses the following questions: (a) What is the tree species performance (growth and mortality)? (b) What is the carbon sequestration capacity of the established agroforestry systems and its compliance with the carbon-offset contract? (c) What are the characteristics of households that chose to participate in the agroforestry carbon-offset contract in comparison to those that do not? (d) What are the participants' perceptions of the agroforestry carbon-offset contract (i.e. expected and realized benefits from the project and species preferences)?

METHODS

Case Study Background

The study was undertaken in the *Tierra Colectiva* (collective lands) of Ipetí-Emberá (TCIE), an indigenous community located in eastern Panama province, approximately 160 km east of Panama City (Potvin et al., 2007). The primary vegetation in the TCIE consists of moist tropical forest (Holdridge lifezone system). The mean annual temperature is 25°C and the mean annual precipitation is 2500 mm, with a distinct dry season extending from December to April (Kirby & Potvin, 2007). Soils in the community are clay-rich with an average pH of 6.4 (Kirby & Potvin, 2007).

The present research builds on a multi-year participatory study (2002–2005) that investigated the feasibility of implementing a voluntary forest-carbon trading project in the TCIE. The study included: a socio-economic household survey (Tschakert et al., 2007), the completion of a forest carbon inventory and estimation of the average above- and below-ground carbon stocks of different land-uses (Kirby & Potvin, 2007; Tschakert, et al., 2007), a comparative analysis of opportunity costs of reforestation and cattle ranching (Coomes et al., 2008) and a participatory establishment of a carbon baseline scenario (Potvin, et al., 2007).

The community was created in the early 1970s by the Panamanian government to accommodate Emberá families relocated due to the building of a hydroelectric complex (Dalle & Potvin, 2004; Wali, 1989). The collectively owned territory encompasses 3,145 ha divided into plots (ranging from 1-100 ha; mean land holding size of 44 ha) managed by different households (Tschakert, et al., 2007). In 2004, primary forest covered 46% of the TCIE, forest fallow 26%, pasture 18% and agroforests 2% (Potvin, et al., 2007). A participatory assessment showed that carbon stocks in the TCIE were likely to decline by more than 50% by 2024 (from 301,859 t C in 2004 to 155,730 t C in 2024) due to an increase in pastures and a reduction in fallow cycles to establish croplands (Potvin, et al., 2007). In 2004, the population was 550 people (71 families) who resided in a central village along the Ipetí River (Tschakert, et al., 2007). Households had diversified economies involving subsistence and market-oriented agriculture, cattle ranching, fishing, hunting, forest product extraction, off-farm labour, ethno-tourism, and handicraft production (Coomes, et al., 2008). The household median annual income (2004) was USD$1,200 (Tschakert, et al., 2007).

The carbon-offset contract

The baseline studies described above allowed the community-based organization OUDCIE (*Organización para la Unidad y el Desarrollo de la Comunidad de Ipetí-Emberá*) to sign a carbon-offset contract with the Smithsonian Tropical Research Institute (hereafter "the client"). In 2008, the client purchased a total of 7,500 tCO_2e to offset part of its carbon dioxide emissions. Of this, 3,600 tCO_2e were to come from (enhancing forest carbon stocks through reforestation, and 3,900 tCO_2e from avoided deforestation). Initially, reforestation was planned with native timber species only, but in 2009 villagers requested to include agroforestry systems that combined fruit and native timber trees. In total, 14 ha were reforested. Areas reforested with native timber species represent 4.5 ha (4 ha established in 2008 with 7 participating households and 0.5 ha in 2009 with 1 household) and areas under agroforestry 9.5 ha (4.5 ha established in 2009 with 7 participating households and 5 ha in 2010 with 5 households). This study focuses on the agroforestry component of the contract.

Agroforestry systems were designed by participants, who selected a four-story (four canopy layers) agroforestry system as the best option for sequestering carbon, while also being culturally appropriate (Emberá families have traditionally maintained agroforests as part of their swidden agricultural systems (Covich and Nickerson, 1966; Herlihy, 1986; Kirby, 2011). Participants categorized the four stories as: timber species, fruit trees, palms and small fruit trees (hereafter "tree categories"), and chose the species to be planted and the amount of land to allocate to the contract. In total 4,688 trees were planted (753 timber; 1,651 fruit; 84 palm, and2,200 small fruit), representing 31 species. The contract included some provisions to ensure an expected carbon sequestration capacity (625 trees per ha with at least 90 timber trees and 270 fruit trees, agroforestry activities could only be established in existing pastures or short fallow areas; see Appendix A for more).

Seedlings of fruit trees, and small fruits were bought from a commercial nursery located in the city of Divisa (407 km from the TCIE) and were transported to the community. Timber species were produced in a nursery established in the TCIE, except for *Dalbergia retusa* that came from the Smithsonian Tropical Research Institute (STRI) nursery (120 km from the TCIE).

The contract included carbon-offset payments based on estimates of carbon stocks in existing agroforestry systems in the TCIE, assessed in 2003 (Kirby and Potvin 2007). A sample of 16 of these agroforests had an average age (time-since-establishment) of 24 years and aboveground carbon stocks of 71 ± 2.5 $tCha^{-1}$ (~ 251 tCO_2eha^{-1} stored in trees and palms > 10cm diameter at breast height-DBH) (Kirby & Potvin, 2007). Participants committed to maintaining their agroforestry plots for 25 years, controlling weeds and replanting dead trees. The client paid US$10.22/t$CO_2$e for reforestation in addition to providing the seedlings, fertilizers for planting, insecticide to control leaf-cutter ants and provided capacity building for designing and establishing the agroforestry plots (Appendix A). Participants are receiving a total of US$2,565 per ha. Payments for carbon sequestration are ongoing and are being disbursed bi-annually for the 7 years following agroforestry establishment. The timeline for payment disbursement was negotiated between community leaders and the client in order to assist participants in the early establishment and maintenance of their plots. The rationale was that after sapling establishment the risk of plantation failure (i.e., mortality) is minimal (Gonzalez & Fisher, 1994; van Breugel et al., 2011). Of the payments, 80% is given directly to each participant and 20% goes to a community fund.

Species performance: mortality and tree growth

To quantify the biophysical performance (survival, seedling/sapling mortality and tree growth) of the established agroforestry systems we conducted two censuses at 1 and 3 years after planting (hereafter t_1 and t_3 respectively; the planting year is t_0). Trees planted in 2009 were measured in 2010 and 2012 and those planted in 2010 were measured in 2011 and 2013. Individual trees (n = 4,688) were recorded as alive or dead to determine the survival and mortality by species in the two time periods: t_0-t_1 and t_1-t_3. Post establishment sapling mortality was verified five years after planting. Basal diameter (BD, stem diameter at 10 cm above soil surface) and diameter at breast height (DBH, stem diameter at 1.30 m above soil surface) were also measured and served to estimate initial tree growth rates. BD was used to calculate basal area (BA) for each tree at each point in time and we used this measure as a proxy for tree biomass since it can be scaled up from the tree to the plot level (Gottelli & Potvin, 2008). BA was summed at the plot level across all tree species for t_1 and t_3 and we calculated the proportion of BA per species and for each of the tree categories and the relative growth rate for BA (RGR_{BA}) (Equation 1).

Equation (1):

$$RGR_{BA}(cm^2 year^{-1}) = \frac{\ln(BA2) - \ln(BA1)}{t}$$

Where *ln*: natural logarithm. *BA2:* Basal area three years since planting (census 2) and *BA1:* basal area at one year old (census 1). Time interval (t) is defined for each individual tree as the time (in days/365.25) between the first and second census.

Outliers were identified using box plots and excluded from the analysis (whiskers drawn to the furthest point within 1.5 x inter quartile range from the box). We used repeated measures ANOVA to test differences in BA across the different tree categories at year 1 and year 3 and one-way ANOVAs to determine differences in RGR_{BA} across tree categories. We used Tukey Kramer HSD post-hoc tests to identify differences between tree categories ($p < 0.05$). Replanted trees or trees that were cut and have re-sprouted were excluded from mortality and tree growth analyses.

Modeling carbon sequestration of the established agroforestry systems over time

Under REDD+ changes in carbon stocks need to be monitored to ensure carbon storage targets are being met (Skutsch et al., 2007). Yet, information on growth rates that would allow for modeling carbon over time is not readily available for most species (Wishnie et al., 2007). We were interested in projecting carbon sequestration capacity of the agroforestry plots, and in evaluating their projected compliance to the carbon-offset contract at 25 years since planting. This was done in three steps: (a) model DBH growth curves (DBH over time); (b) project tree biomass and (c) scale-up individual tree biomass and carbon at the plot level.

Modeling tree growth

A challenge faced when trying to estimate the carbon storage potential of the established agroforestry systems was the absence of data on tropical fruit tree growth rates. Carbon is estimated from aboveground biomass derived from DBH values. In absence of time series for DBH of most fruit tree species, we modeled DBH growth curves by using agroforestry inventory data to estimate mean DBH per species by age, and fitting a logistic regression model to the DBH data (Equation 2). This allowed modeling of DBH to age 25, the time line specified by the carbon-offset contract (see all calculations in Appendix B).

Equation (2):

$$\frac{c}{1 + e^{(-a*(age-b)}}$$

Logistic model used to develop tree growth curves for species and families. Where *a* = Growth rate; *b* = inflection Point and *c* = Asymptote.

For 13 species, DBH values at different ages were obtained from the database of Kirby and Potvin (2007) containing information from 16 agroforestry plots that were sampled, in the TCIE, 12-36 years after establishment (Appendix B). Logistic growth models were developed for 14 species, which were not present in the Kirby and Potvin (2007) database or had few observations, by pooling species of the same family from the Kirby and Potvin (2007) database (with similar observed growth pattern- family growth curve). A common practice in agroforestry in the TCIE is to add trees over time (Kirby & Potvin, 2007). Therefore, recently planted trees (i.e., trees with a DBH smaller than the smallest DBH of the next youngest agroforest) were considered outliers and removed. For an additional five species, data at the family level was not available in the Kirby and Potvin (2007) database (Appendix B). For three of these species (*Terminalia amazonia, Dalbergia retusa, Tabebuia rosea*) we used data from a multi-species plantation in central Panama that contained growth data for these species for the first 12 years after planting (Potvin, 2011). We complemented this data with growth data collected from another multi-species tree plantation in Costa Rica for the same species, or for a species from the same family showing similar growth pattern to those from our study at age 16.5 years (Piotto, et al., 2010). We could not find information on tree growth at a given age for two species (*Garcinia intermedia, Chrysobalanus icaco*); these species represent 0.0025 % of the total trees planted so were excluded from the analysis.

Projecting tree carbon yield

The "estimated" DBH at aged 25 served to predict tree carbon storage (C) per tree (kg/tree). DBH served as an input in allometric equations to calculate aboveground biomass that was converted to C assuming a 47% mass-to-mass ratio (Kirby & Potvin, 2007). We acknowledge that the choice of allometric models is an important source of uncertainty in carbon estimations (Pelletier et al., 2010), however, given the lack of available species-specific allometric equations we used a multispecies allometric equation developed by Chave, et al. (2005) for tropical trees. We used one-way ANOVAs to determine differences in the contribution to C sequestration at 25 years of age between the four tree categories.

Scaling-up carbon at the plot level

To predict carbon at the plot level we used census data at t_3 to determine the number of surviving trees by species, total dead trees and trees absent (i.e., trees originally specified in the plot design to comply with the carbon contract that had not been planted). Because seedling/sapling mortality in plantations normally stabilizes in the early years (Gonzalez & Fisher, 1994; van Breugel et al., 2011) and because participants committed to replant dead seedlings/saplings, we assumed that these numbers would remain constant from t_3 until the agroforests reached 25 years of age. As the plots varied in size, we scaled them to one hectare for comparison purposes (1 ha = 625 trees). We only used data from 9 of 12 plots as one plot was affected by a flooding event in 2010 and two plots had incomplete census data. Using the estimated carbon per tree at 25 years of age (as in the section above) and the number of trees per species per plot (as per census data) we then estimated carbon by plot (Equation 3).

Equation (3)

$C\ plot_x = \sum A_i \times AGB_i$

Where C plot $_X$ is the total carbon of plot $_X$ (in t C ha^{-1}) as projected at 25 years of age. A_i is the number of trees of species *i* that were alive in census 2 (three years since planting) and AGB_i = aboveground biomass (in Mg $tree^{-1}$). AGB was converted to carbon (C) assuming a 47% C content (Kirby & Potvin, 2007).

Characteristics of participant versus non-participant households

To understand why certain families decided to participate in the project, and why some decided to do so using agroforestry systems rather than timber tree plantations, we conducted (in 2009) a comprehensive survey comparing the economic and demographic characteristics of households in the community. The survey was based on previous work conducted in the community (Tschakert et al., 2007). The survey included household income and demographic variables. Surveyed households included all households participating in the reforestation project (12 with agroforestry and 4 with timber plantations) and the 28 non-participant households previously surveyed by Tschakert et al. (2007).

Land-use portfolios and land holdings are also important factors in agroforestry adoption (Bellow, et al., 2008). Thus, we used ARCGIS 10.2 to calculate the amount of land each surveyed household had in different land-uses (cropland, pasture, tall fallow, used forest, reforestation and community land) by using a digitized participatory land-use map (methods in Vergara-Asenjo et al., 2015) that was overlaid with a base map that delineated each parcel in the community (Potvin, et al., 2007).

Differences in the demographic, economic and land holding characteristics between participants and non-participants were evaluated using one-way ANOVAs for each variable. Because the level of assets and endowments is an important factor in predicting participation in agroforestry and conservation projects (Barrett, et al., 2001) we compared five groups including “participant-agroforestry”, “participant-timber” “richer non-participant”, “intermediate non-participant” and “poorer non-participant”.This classification was possible because non-participant households, previously surveyed in 2004, were categorized using a participatory wealth ranking into one of three groups: rich, intermediate or poor (Tschakert, et al., 2007) and according to community leaders in 2009 this grouping was still relevant. Means were contrasted with post hoc Tukey Kramer HSD tests when significant differences were identified ($p < 0.05$). Data transformations were employed where necessary to meet assumptions of normality.

Participants' perception of the agroforestry carbon-offset contract

Understanding the acceptability and realization of expected benefits of agroforestry from participants' perspective is key for comprehending the adoption of the practice (Franzel, et al., 2002; Salam, et al., 2000). To understand household perception of participating in the carbon-offset project we conducted semi-structured interviews with the 12 households participating in agroforestry in 2012, which was 2 or 3 years after they had engaged in the project, depending on their planting season. Interviews included questions on motivations for engagement, expected benefits and reasons for selecting specific species. Participants' oral or written consent, depending on literacy level, was sought as well as consent for an audio record the interview. During the interviews the income ladder participatory method was used (Guijt, 1998) to explore the household perception on the economic impact of participating in the agroforestry carbon-offset contract (Details in Appendix A).

To analyze the semi-structured interviews, three interviews were selected randomly, transcribed verbatim and coded qualitatively (following Auerbach & Silverstein, 2003) to create a coding framework to analyze the rest of the interviews. Member checking was used to modify preliminary interpretations as needed (Morse et al., 2002). To determine the association between motivations and socio-economic characteristics of the households, we conducted Fisher exact tests using SAS and JMP (SAS Institute, 2012).

RESULTS

Species use and preferences

A total of 31 species were established in the agroforestry systems (full list of species and characteristics in Appendix C). Of these, 19 were fruit trees, 7 were timber trees, 3 were small fruit trees and 2 species were palms. Participants mentioned selecting the species for various purposes they provide, including household consumption (43% of species), sale in the market (49%), construction (22%), traditional/cultural (8%), medicinal (11%), and handicraft (3%). Fifty-two percent of the species serve more than one purpose. The five preferred species were *Dalbergia retusa*, *Matisia cordata*, *Citrus sinensis*, *Coffea* spp. and *Persea americana*. All of these have at least two purposes and were reported as being easy to sell.

Species performance: sapling mortality and tree growth

Sapling mortality rate in t_1 was 22% (out of the number of trees in t_0; n = 4,688) and 25% in t_3 (out of t_1 survivors; n = 3,658) (Figure 1). The three species that experienced the highest percent mortality at t_1 were *Byrsonima crassifolia* (56%), *Theobroma cacao* (41%) and *Persea americana* (35%), while *Matisia cordata* (56%) and *Borojoa panamensis* (45%) experienced the highest percent mortality at t_3 of species for which at least 10 individuals were planted. The mean cumulative mortality per tree category (t_0-t_3) were fruit trees 40%, for small fruits 47%, palms 19% and timber 21% (Figure 1).

Figure 2 shows that, three years after plot establishment, sapling mortality stabilized in all except one plot. This plot belongs to a young participant that had a baby who was seriously ill and who left the village for an entire year in order for his baby to receive medical treatment. Plots 12 and 13 had the least mortality.

Interestingly, these plots belong to the eldest participants (over 65 years old) whose main activity was taking care of their plots. These plots were also those located closest to households.

An ANOVA on relative growth rate using basal area (RGR_{BA}, cm^2 $year^{-1}$) showed that timber trees had a significantly higher growth rate than fruit trees in the first three years ($F_{(3, 159)} = 4.42$, $p = 0.0052$) (Figure 3). The three species that showed the highest mean RGR_{BA} were *Bixa orellana*, *Inga spectabilis* and *Terminalia amazonia* while those with the lowest were *Syzygium jambos* and *Borojoa panamensis*.

Modeling carbon sequestration of the established agroforestry systems over time

Tree growth model

We projected DBH over time up to 25 years of age by developing logistic growth curves for 13 species and 11 families (Figure 4). Small fruit trees are projected to remain with a lower DBH then either fruit trees and timber. For fruit trees, the largest DBH are projected for the Sapotaceae (*Chrysophyllum cainito* and *Pouteria sapota)*, while *Inga spectabilis*, *Persea americana,* the Anacardiaceae, (*Spondias purpurea and Mangifera indica)* as well as the Bombacaceae (represented by *Matisia Cordata)* also promise to reach large DBH. For timber species, the model suggests that the more slender trees after 25 years would be *Paquira quinata* as well as *Dalbergia retusa*, represented by the Fabaceae-papilonoideae. The model further suggests that two species might not have reached an asymptote for DBH after 25 years: *Anacardium excelsum* and *Annona muricata*.

Projected tree carbon yield

The mean projected carbon yields per individual (kg $tree^{-1}$) (±SD), at 25 years of age, within tree categories were: 251 (±252) for fruit, 145 for palm, 21 (±11) for small fruit and 342 (±187) for timber. ANOVA found that timber has significantly higher projected carbon yield than small fruit trees ($F_{(3,28)} = 5.0131$, *p*

= 0.0074) (Figure 5). Two fruit species (*Pouteria sapota* and *Chrysophyllum cainito)* showed the highest projected carbon per individual, higher than any of the planted timber trees.

Projecting carbon at the plot level

We were interested in assessing the carbon sequestration capacity of the established plots and if the plots were complying with the expected carbon sequestration, as per the carbon-offset contract, estimated at 71 t C ha^{-1} at 25 years. Assuming no mortality after planting, the mean (±SD) projected carbon sequestration capacity at 25 years of age, scaled to 1 ha, was 81 (± 11) t C ha^{-1}. However, including only the number of surviving trees in t_3, the mean projection decreased to 59 (± 16) t C ha^{-1} (Figure 6). Though participants committed to replant dead trees this only occurred partially - only 60% of the trees that died in t_0-t_1 were replanted by t_3.

Characteristics of participant versus non-participant households

Participant-agroforestry households had significantly lower total annual income than the richest non-participant households in the community ($F_{(4, 41)} = 4.13$, $p = 0.0073$) (Table 1). They also had significantly lower income from livestock as compared to richer non-participants and to participants-timber ($F_{(4, 41)} = 4.26$, $p = 0.0062$). While income from livestock of participants-agroforestry was similar to that of poorer and intermediate non-participant households, participant-agroforestry households had significantly higher value of productive capital (i.e., household resources used in agriculture, commerce, and for other productive purposes; Appendix D), ($F_{(4, 41)} = 4.26$, $p = 0.0062$). ANOVAs showed no significant differences for land holding characteristics among the five groups of households, however, participant-agroforestry households were not the most land rich group and had the least amount of pasture of all the groups (both total ha and percentage of total landholdings) (Table 1).

Participants' perception of the agroforestry carbon-offset project

Expected and realized benefits from the project

Several expected benefits motivated participation in the agroforestry carbon-offset project (Figure 7). The most widely cited expected benefit was the generation of household income from their agroforestry plot (83%). Interestingly, receiving the seedlings to establish the plot was cited more extensively as a motivation to participate (67%) than receiving monetary compensation for managing the plantation (8%). Fisher exact tests did not show any significant association of the motivations to participate relative to the demographic and economic characteristics of the households.

At 2-3 years since planting, all participants mentioned that they were receiving benefits from their plots such as ownership of a multipurpose plot (67%) and plot revenues (50%) (Figure 8). All participants who mentioned such benefits had incorporated annual food crops into their agroforests. Species intercropped included yam, cassava and plantain while five participants reporting revenues had sold achiote *(Bixa orellana)* and one participant guanábana (*Annona muricata*) (two species that produce at young age). Results from the participatory income ladder exercise showed that seven families (58%) perceived that they had risen at least one step on the ladder since they started the project (71% of families who established plots in 2009 and 40% of families who established plots in 2010) (Figure 8).

All participants mentioned that they needed more training to fully realize the expected benefits from their plots. The most cited capacity-building need was increasing participants' ability to access markets (75%). Two participants (22%) mentioned requiring knowledge for processing fruits (*Bixa orellana*, *Theobroma cacao* and *Mangifera indica*), and three (33%) mentioned needing skills to create an entrepreneur association to better negotiate prices and reduce transport costs to Panama City.

DISCUSSION

Importance of monitoring and maintenance to project success

REDD+ is a performance-based mechanism where economic incentives will be made based on carbon gains as compared to a carbon baseline scenario (or reference level). Because of this, maintenance and enhancement of forest carbon stocks need to be monitored (Skutsch et al., 2011). This study projected that, with complete replanting of dead seedlings/saplings, the agroforests' carbon sequestration capacity is 81.11 (±11.62) t C ha^{-1} above ground after 25 years; if below-ground carbon sequestered in growing tree roots were also considered, this amount could reach 100 t C ha^{-1} (assuming an approximately 24% root-to-shoot ratio, Cairns et al., 1997; Jobbagy and Jackson, 2000). Our estimates were therefore conservative considering only above-ground carbon pool. Woody debris, litter and soil also store significant amounts of carbon in agroforests (Kirby and Potvin 2007); monitoring carbon accumulation in these pools may therefore reveal further gains in carbon in areas reforested as agroforests. The estimate of 100 t C ha-1 of agroforests is comparable to estimates of carbon sequestration in teak (*Tectona grandis*) plantations in Panama that reach 120.2 Mg C ha^{-1} in 20 years above- and below-ground (Kraenzel et al., 2003). In Eastern Panama, 99% of the area actively reforested between 1990 and 2000 is under teak (Sloan, 2008). Teak plantations have negative consequences for biodiversity, reducing the recruitment of native secondary species and being unattractive to seed-dispersing animals (Healey & Gara, 2003). Agroforestry systems, therefore, offer an alternative to teak, having the potential to sequester almost as much carbon and providing benefits for biodiversity and food security that teak does not.

The projected carbon yield (81 t C ha^{-1} at 25 years), would only have been achieved if trees that died had been replanted. Including mortality at year 3 reduced our carbon projections to 59 Mg C ha^{-1}. Early seedling mortality of trees, particularly fruit and small fruits trees species was high. A possible reason for the high mortality of seedlings is that they were not produced locally and in addition to being established in different biophysical conditions might also have suffered stress due to the distances they travelled (Mexal et al., 2008).

Understanding the causes of mortality should be a priority of future research, since mortality threatens both the carbon sequestration potential of agroforestry and peoples' sustained interest in their plantations (Garen, et al., 2009; Holl et al., 2003). Providing local farmers with incentives and resources to address early mortality and knowledge to enhance management of their plot performance will be key for long-term sustainability of the project and in achieving the expected carbon yield. Our study suggests that these incentives and resources are likely to differ among participants; for example, we found low mortality in the plots maintained by the oldest participants, and the highest mortality in the plot maintained by a participant with a family emergency that required them to leave the community for a year. Maintaining community nurseries after the initial planting period, or providing additional seedlings in the early years of a project could assist in ensuring that dead trees are replanted (Wilson, 2014). Another option could be limit payments to live trees (Daniels et al., 2010).

At the design level, our results provide key insights to the design of a "carbon buffer," i.e., the setting aside of a certain amount of carbon offsets to be used to replace unexpected carbon losses or in case of reversals in emissions reductions (i.e., leakage or impermanence) (Winrock International, 2009). The use of buffer was pioneered by the Voluntary Carbon Standards (VCS) which developed a tool for conducting risk assessment and determining the percentage buffer pool for each project (see, VCS, 2008, p.5). The FCPF fund has also adopted a buffer approach to set aside a reserve to ensure liability (FCPF, 2013). Using the VCS tool the present project would have required a 40% buffer to address carbon losses or impremanence over time (high risk, see Appendix E). The data provided in the present study, namely carbon accumulation per tree by species, will allow participants to determine the additional number of trees to plant to achieve a 40% buffer as per VCS.

Species matter for both carbon and livelihoods

It has been argued that REDD+ could reduce people's access to forests and to the benefits they receive from them (Griffiths, 2007; Peskett, 2008). Further, there are concerns that the enhancement of carbon stocks through reforestation within REDD+ could threaten biodiversity if the initiatives become mere carbon farms (Edwards et al., 2010). Contrary to this, our study showed that when free to design a reforestation system, local people may select an array of species that provide livelihood benefits. In this study, participants chose species valued for their wood, fruits, medicines, and cultural values. The multi-strata agroforestry system that participants designed had high native tree diversity and is thus likely to support native biodiversity (Harvey et al., 2006; Harvey and Villalobos, 2007; Perfecto et al., 2007). Our experience suggests that agroforestry systems may be a valuable option for sequestering carbon and providing livelihood benefits for local and indigenous peoples participating in REDD+. Consistent with studies in Panama and elsewhere we found that choosing species that serve livelihood purposes was key to local farmers' participation in the reforestation initiative (Garen et al., 2011; Garen et al., 2009; Zanella, et al., 2014).

Overcoming data limitations to project future carbon stocks

Reforestation for the purpose of enhancing carbon stocks requires rigorous monitoring of carbon sequestration of these systems over time. Assessments of biomass and respective carbon content are often done in ecological studies using allometric equations that use input parameters such as tree dimensions (DBH) (Kirby and Potvin, 2007). In conducting our study, we faced a major limitation in estimating biomass and carbon: the lack of information on tree growth - over time for the species chosen by participants. The limited data on growth and mortality of locally used species is a source of difficulties in devising sound reforestation strategies that best adapt to small-farmers needs (Montagnini et al., 2005; Wishnie, et al., 2007). Our study provides knowledge on tree growth that will assist in improving carbon predictions of 29 species that are important for the livelihood strategies of local farmers and indigenous peoples in Panama and elsewhere (López & Somarriba, 2005).

Further, our findings provide insights into the contributions to successful carbon sequestration of both individual species and the mix of species of different 'types' or 'tree categories'. Overall, we found that, for the early stage, fruit species had higher mortality and slower growth rates than timber species. Interestingly, fruit trees species were not significantly different in their carbon content as compared with timber species. In particular, we highlight the carbon sequestration potential of two native fruit species, *Chrysophyllum cainito* and *Pouteria sapota,* as fast-growing canopy species that provide livelihood benefits in the form of marketable fruits and household consumption. The data provided here on growth, mortality, and the benefits provided by different species and tree 'categories' will serve in designing reforestation and restoration initiatives that allow for enhancing carbon stocks, while matching forest conservation outcomes and local livelihoods, an essential factor in REDD+ implementation (Holmes and Potvin 2014).

Winners and losers: will REDD+ lead to further inequality in rural communities?

Differences among households and communities in terms of assets and endowments have been shown to explain participation in agroforestry and more generally in conservation-development initiatives, with participation biased towards those who are land, income and asset-rich (Barret et al., 2001; Coomes et al., 2004; Mercer, 2004; Pattanayak, et al., 2003). This has raised equity concerns about possible winners and losers of these initiatives at the local scale (Brown et al., 2004; Tschakert, et al., 2007). Similar concerns have been raised for forest-carbon projects, noting that these could aggravate existing social inequalities by enhancing resource concentration among more powerful stakeholders (Barr & Sayer, 2012; Brown & Corbera, 2013) and further marginalizing already disadvantaged communities and households (Boas, 2011; Castro, 2008).

Our study suggests that those concerns might not always hold true, since participants in the agroforestry carbon-offset project were not the wealthiest of the community. For all variables but value of productive capital, they were similar to the poorest group. Jindal el al. (2008) also describes that poorest households participated widely in an agroforestry forest-carbon project in Mozambique. Literature suggests that poorer households might not engage due to subsistence constraints (food needs) or because they are more susceptible to risk or might have no resources to invest (Levasseur et al., 2004). In our study and in similar studies (see Jindal, et al., 2008) participants in the agroforestry projects received carbon payments from the beginning of their participation in the project suggesting that these payments might be facilitating the engagement and transition to adopting more sustainable land-use systems of poorer households.

An interesting finding in the present study was that households that reforested exclusively with timber species were among the richest in the community, with high income in livestock and with high proportion of their land in pasture. This is consistent with theory that predicts that differences observed between those that engage in agroforestry versus timber will reflect abilities to withstand the "long waiting period" before timber provides returns to households (Coomes, et al., 2008, p.209). A meta-analysis in agroforestry adoption showed that agroforestry systems that are designed for yielding multiple-outputs in multiple-seasons reduced risk and uncertainty and foster adoption (Pattanayak, et al., 2003). We found that three years after plot establishment, half of the participants had received income from sales of early-maturing fruit trees and the majority of participants harvested inter-crops,; therefore, shortening the "waiting period" as compared to timber. Agroforestry systems that provide multiple benefits in multiple years facilitate the engagement of poorer households in these projects.

Our findings highlight that providing a "menu" of activities where different households could choose various options that best adjust to their social, cultural and economic conditions, rather than a blue print approach (Tomich et al., 1998; Tschakert, 2004), might assist adoption and a more equitable REDD+ implementation. Engaging stakeholders in designing these acceptable "menu" of activities, as we did in our case study, is also a way to successfully increase participation of a diversity of households, including poor households and households with less social capital whose project-design preferences and expectations might not otherwise be heard (Franzel et al., 2002b; Zanella et al., 2014).

CONCLUSION

Since agriculture and forestry go hand in hand in small-farming communities, REDD+ must ensure project participants that they will continue to have access to the benefits they receive from their forests, including agricultural production. For rural and indigenous communities, participation in REDD+ is unlikely to be motivated by the potential to "farm carbon", but rather by co-benefits such as enhanced livelihoods, incomes and biodiversity (Edwards et al., 2010; Thangata & Hildebrand, 2012). Overall, our case study provides an encouraging example of how agroforestry may help forest communities engage with REDD+ in a way that benefits their livelihoods and the global climate change agenda. While the present case study shows locally relevant results some of our findings can inform REDD+ project designs, engaging local communities with their local reality while allowing them to participate in the global change agenda. We present data on carbon sequestration potential of 29 species commonly used by small farming households in Latin America that could support the inclusion of agroforestry in REDD+ projects. Our findings also highlights strategies that could reduce risks of failure associated with agroforestry projects in the context of REDD+, in particular regarding the importance of assisting participants in addressing early mortality of trees, as mortality negatively impacts the carbon sequestration potential of agroforestry, and could also reduce peoples' sustained interest in keeping their plantations.

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APPENDICES

Appendix A: Plot Design and Participatory Methods
Appendix B: Calculations - Logistic Growth Curves
Appendix C: Master List of Species
Appendix D: Household Demographics and Assets
Appendix E: Application of risk factors to Afforestation/Reforestation Projects

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Tables and Figures

Table 1: ANOVA results for economic and land holding variables comparing households that participated in the agroforestry-carbon offset project to those households that participated by planting only timber trees, and to three wealth groupings of non-participant households. Values shown are mean (±Standard Deviation- SD) unless stated otherwise. Letters A, B and C represent results from Tukey Kramer Honest Significance Difference within groups; those with different letters in the same line are significantly different.

	Richer non-participant *(n =9)*	Intermediate non-participant *(n =8)*	Poorer non-participant *(n =11)*	Participant-agroforestry (n=11)	Participants-timber (n=4)
Value of non-land assets ($) [a,d]	2275(±2721) A,B	506(±424) B,C	438.91(±441.65) C	1184.80(±721.46) A,B,C	5431.50(±7847.48) A
Value livestock ($)[b,d]	4683(±9869) A	316(±370) A,B	217(±290) B	212(±160) B	7278(±4879) A
Value productive capital ($)[c,d]	463(±571) A,B	25(±70) B	90(±285) B	515(±568) A	175(±350) A, B
Value consumer durables ($)[d, e]	1407(±2438) A	232(±143) A,B	123(±68) B	365(±487) A,B	4322(±7715) A
Total annual income, median ($)	6069 A	2408 A,B	1224 A,B	887 B	4043 A,B
Total land (ha)	3.74(±0.82)	1.97(±2.12)	1.70(±1.98)	2.53(±20.9)	2.81(±1.89)
Pasture (ha)	12.11(±19.07)	10.11(±14.48)	6.07(±10.45)	3.04(±5.47)	8.04(±10.49)
Pasture (%)	15.71(±23.59)	16.52(±24.14)	10.91(±18.90)	3.33(±5.82)	16.22(±19.08)

[a] non-land assets include all household possessions
[b] Value of livestock include all livestock, small (chicken and pigs) and big (horses and cows)
[c] value of productive capital include all household resources used for productive purposes such as those used in agriculture and commerce
[d] data was log transformed to fulfill assumption of normality
[e] consumer durables are those household items that have no-productive purpose

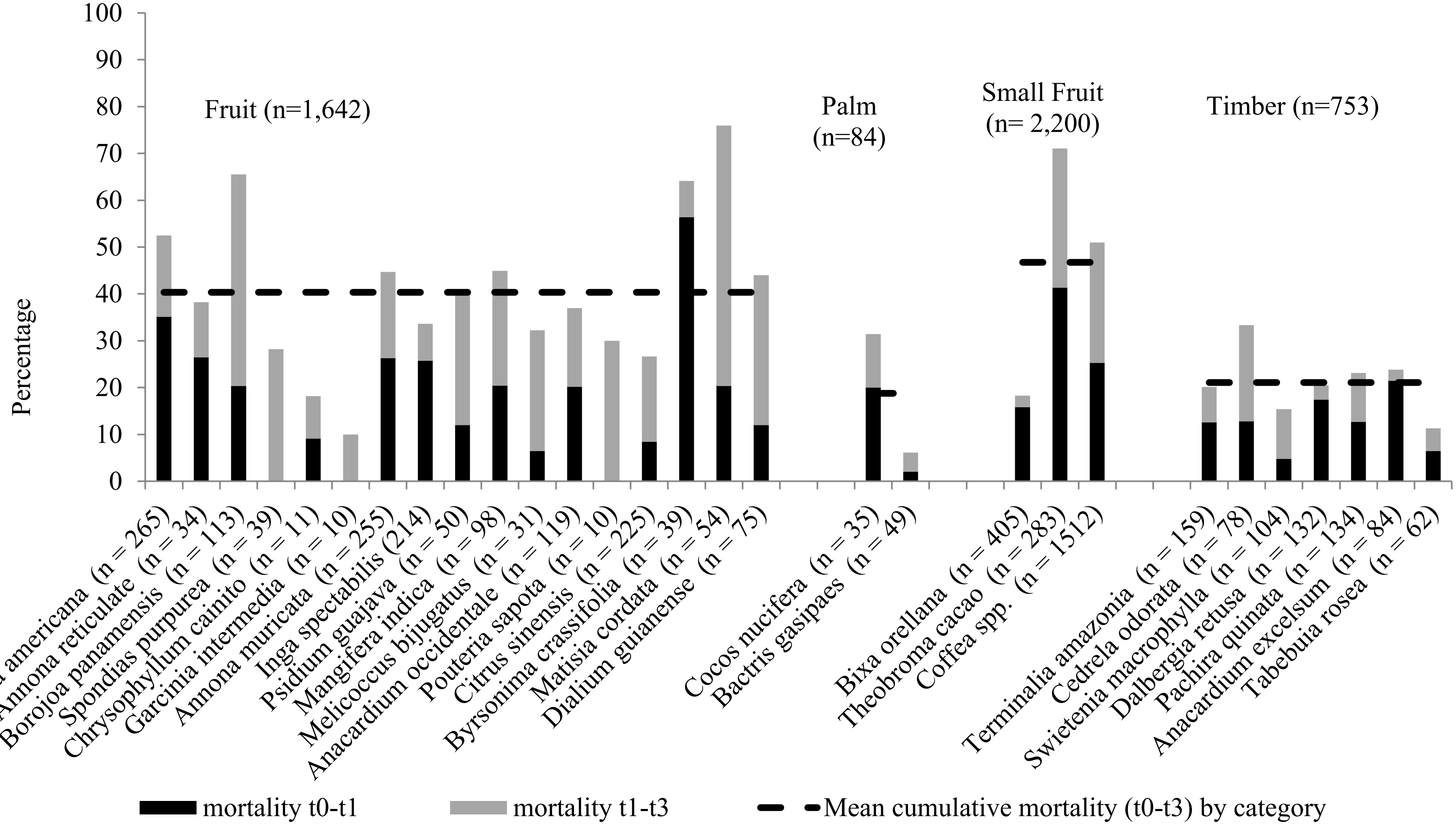

Figure 1: Percent of sapling/seedling mortality by species in the first three years for different time intervals (t_1 one year since establishment (t_o) while t_3 is three years after plantation). Only species represented at least by 10 individuals are included here, with "n" indicating the total number of individuals planted at t_o.

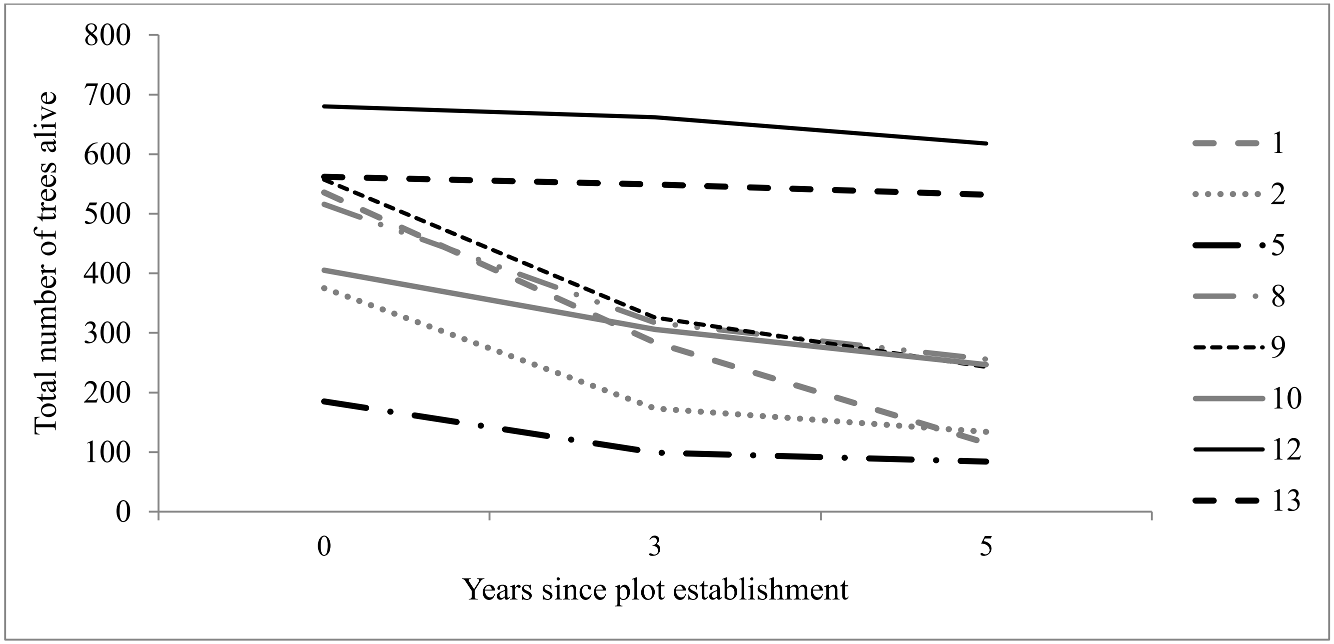

Figure 2: Total number of trees by plot by year (up to five years since plot establishment).

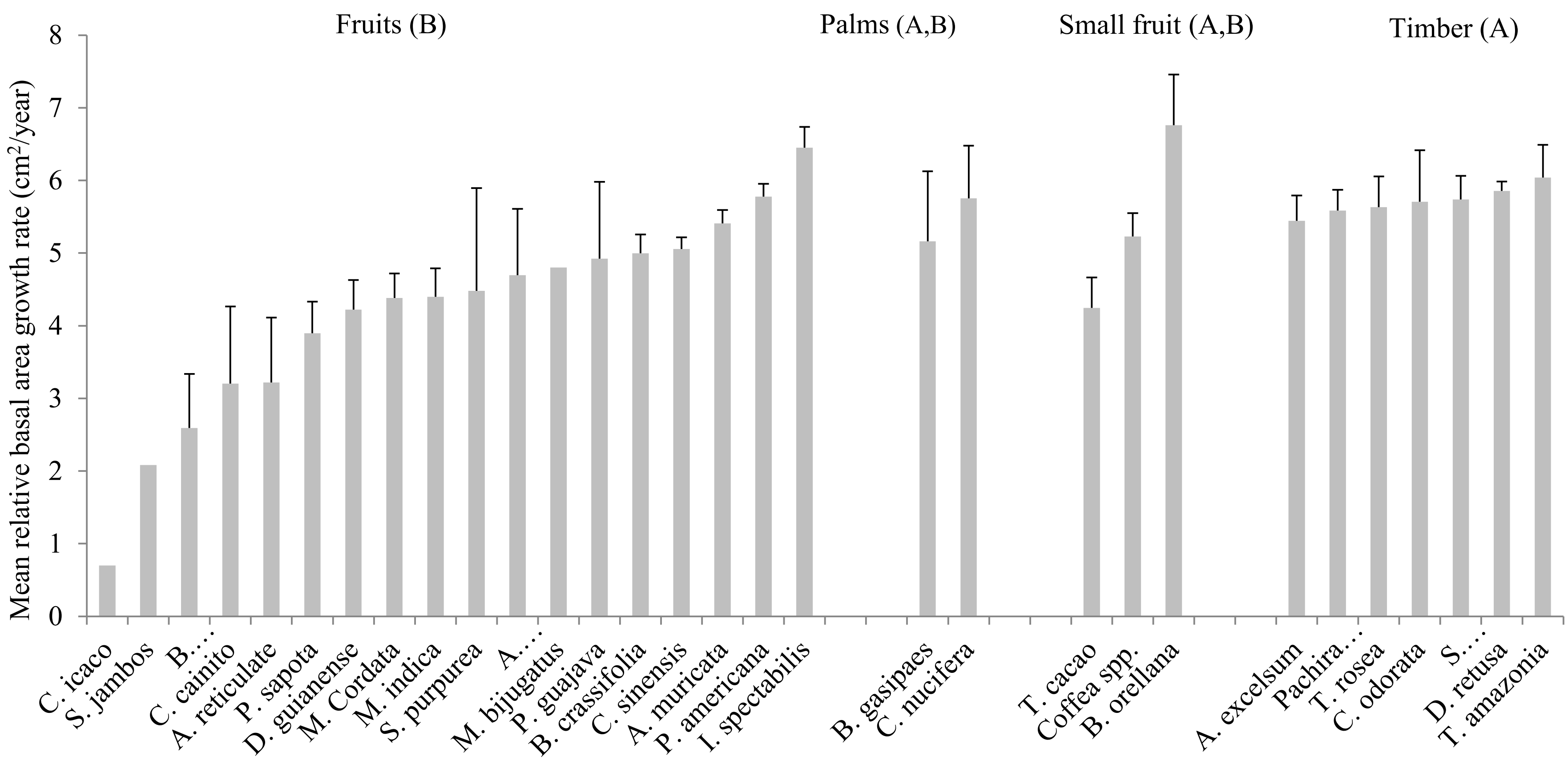

Figure 3: Mean relative basal area growth rate (cm2 year -1) per species, grouped by category of trees. Letters A and B represent results from Tukey Kramer HSD within categories of trees; categories of trees with different letters are significantly different. Error bars represent one standard error from the mean.

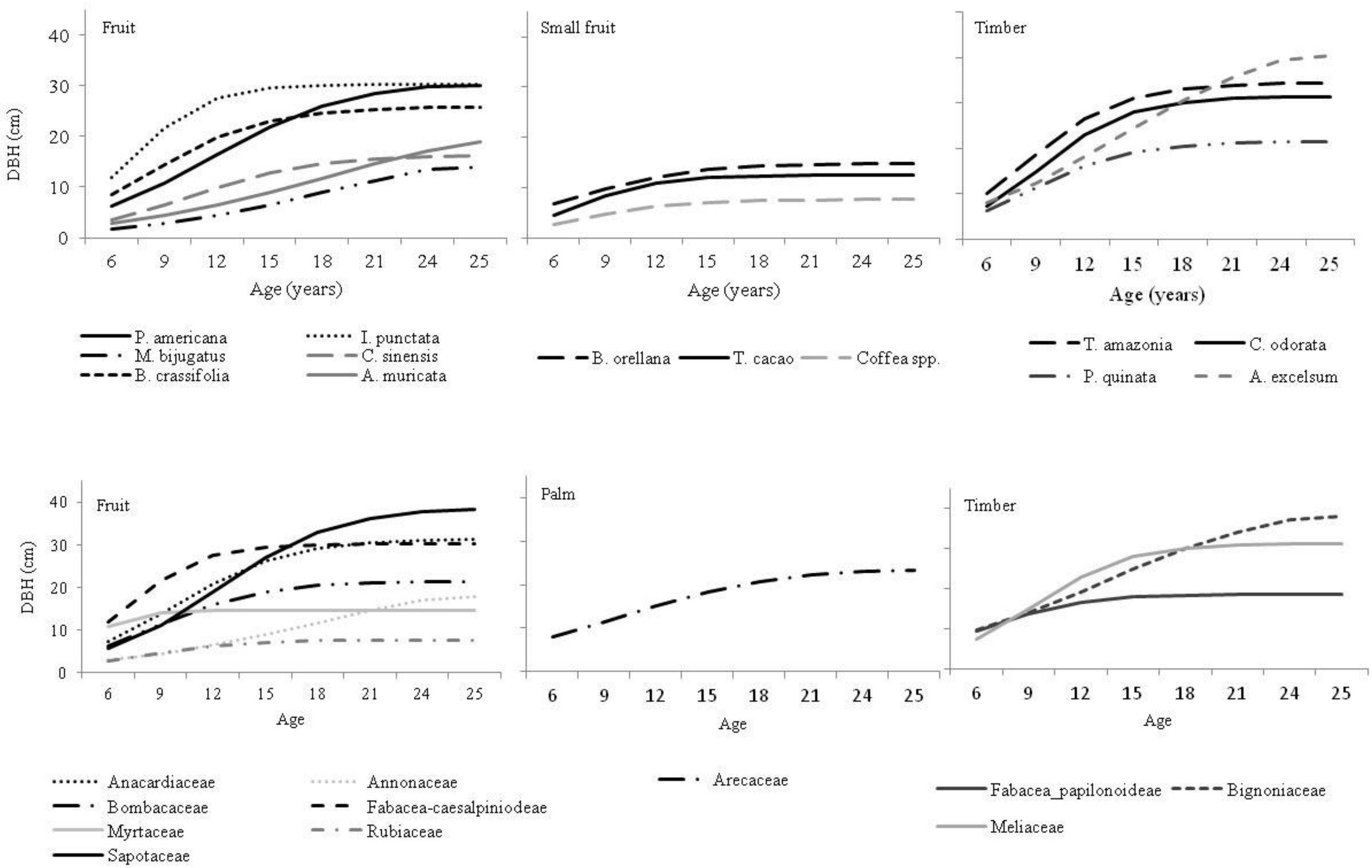

Figure 4: DBH growth curves by species and families developed by logistic model. The top panel shows the species-specific growth and the bottom panel the family growth curves. Details on calculations and data used to develop each curve are available in Appendix B.

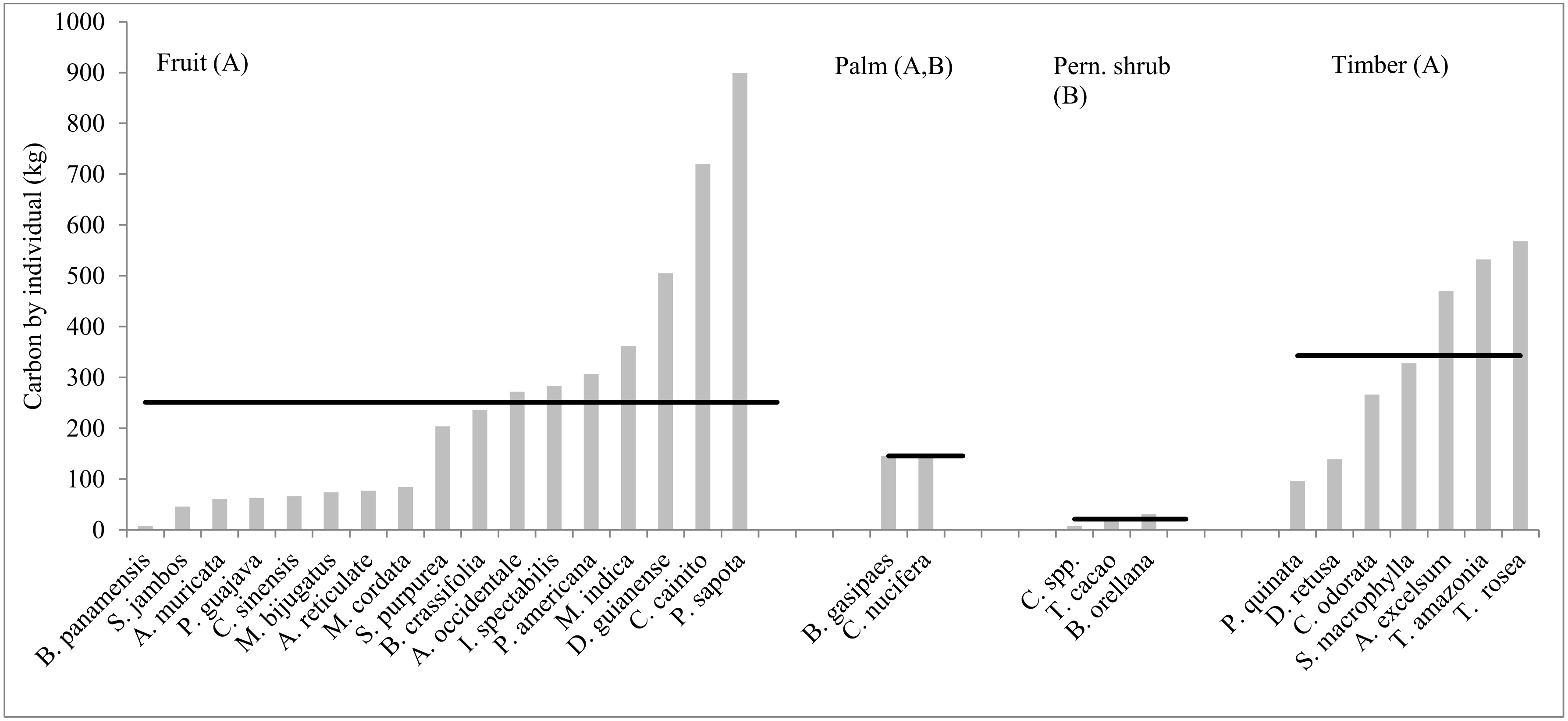

Figure 5: Estimated carbon at 25 years (kg) per individual of each of the 31planted species using predicted DBH as in Figure 5. The horizontal line in the figure shows the average carbon (kg) of individuals from all species in each category.

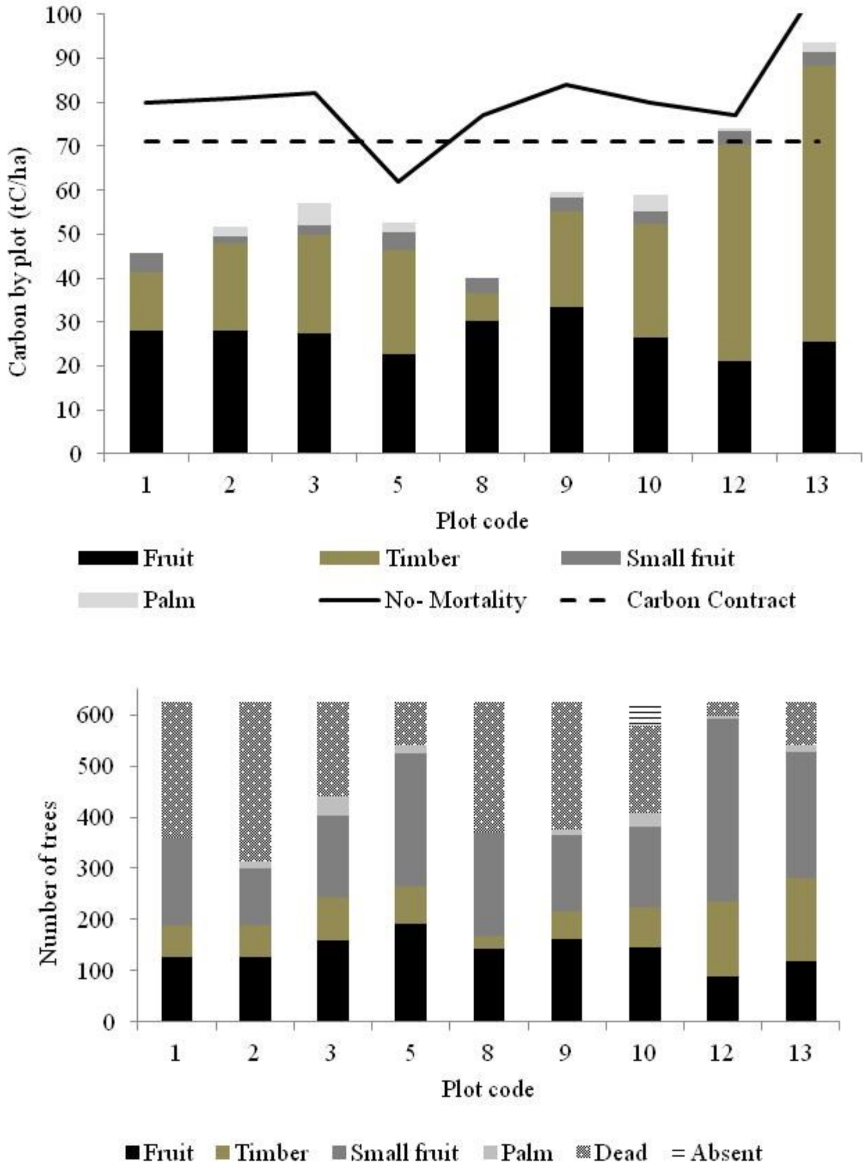

Figure 6: Projected carbon sequestration capacity and number of trees per plot (results scaled to 1 ha). The top panel shows the projected carbon sequestration per plot at 25 years of age (t C ha-1) with mortality (i.e., assuming no replanting of trees that died between t_0 and t_3; bars) and without mortality (i.e., assuming all trees planted in t_0 reached age 25; solid black line). Colored sections of the stacked bars represent the total C by tree category within each plot. The dashed black line shows targeted carbon sequestration at year 25, as per the carbon contract (71 t C ha-1). The bottom panel shows the number of trees per category of trees three years after planting. Absent trees, correspond to trees originally specified in the plot design to comply with the carbon contract that had not been planted

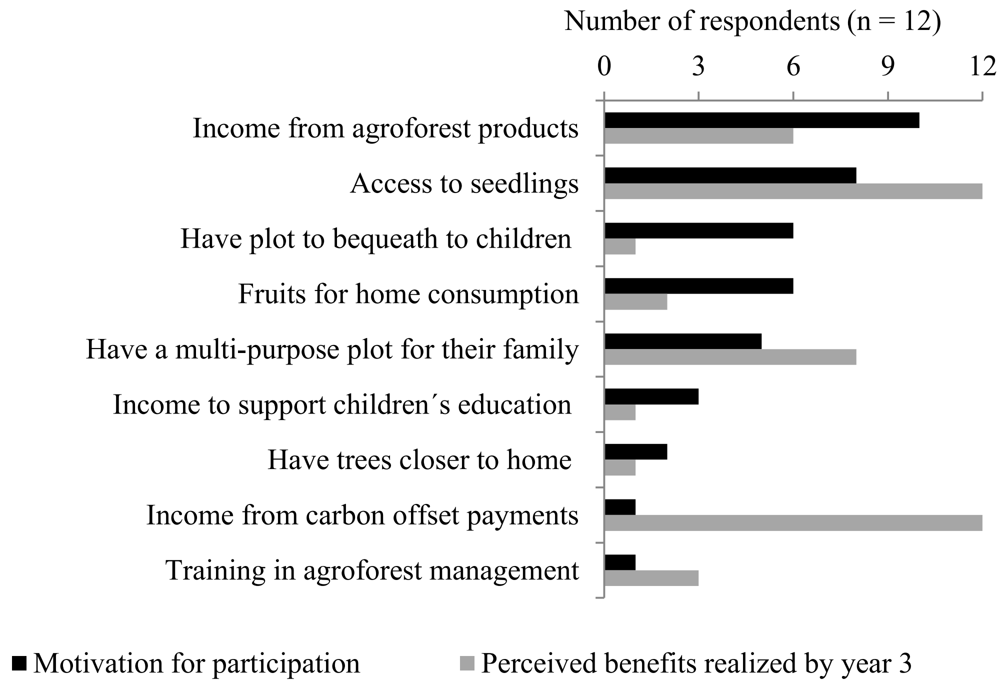

Figure 7: Participants' reasons for participating in the agroforestry project, and benefits realized by year 3. Categories of motivations/benefits are based on the coding of semi-structured interviews with 12 participants in 2012. Only responses mentioned by at least two households are included. The goal of the interviews was to better understand decisions to participate and perceptions of project benefits to date. All benefits are "perceived benefits", except "donation of seedlings" and “income from carbon offset payment” which were not explicitly mentioned in the interviews as a realized benefit, yet all agroforests were established with donated seedlings and all participant households have received bi-annual payment from their participation in the project.

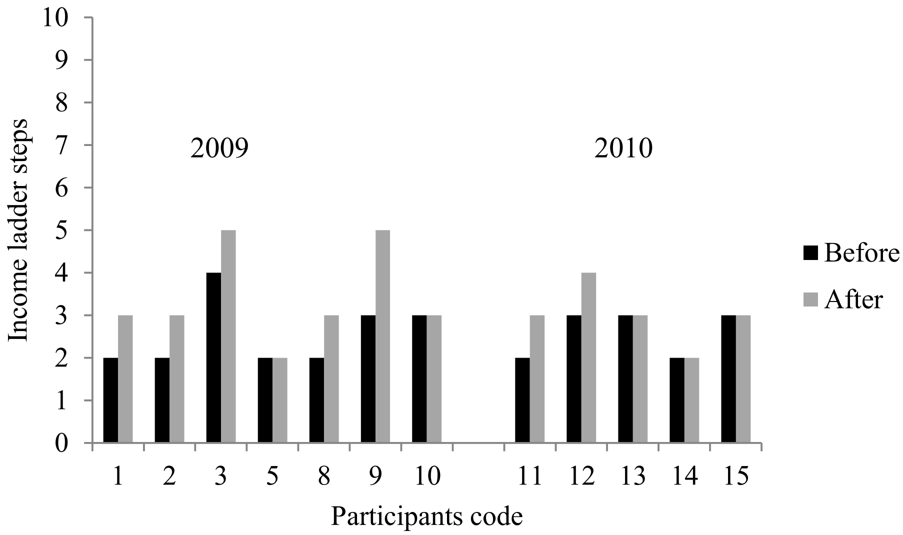

Figure 8: Perceived household income before and after engaging in the agroforestry carbon-offset project as per the participatory income ladder method (Guijt, 1998) (details in the methods section). The income ladder has ten steps; step one represents the lowest income and step ten the highest income. Results are separated by plantation year (2009 and 2010).

Linking Statement 1

Agroforestry is a traditional livelihood strategy for subsistence farmers and indigenous communities throughout Latin America and elsewhere. It allows the integration of agriculture and forestry and provides food security in many parts of the world. Agroforestry is an appealing option for sequestering carbon on agricultural land while leaving the bulk of the land in agricultural production. Despite its potential, agroforestry remains under-recognized as a greenhouse gas mitigation option mostly because of a lack of scientific foundation required for building carbon accounting and modeling tools. **Chapter 1** addressed this lack of knowledge by providing data on early mortality, tree growth and carbon sequestration capacity for 29 species that are commonly used by small farming households in Latin America. **Chapter 1** also explored socio-economic characteristics of households that established agroforestry plots, their motivations to engage in agroforestry and their perception of the realization of expected benefits. Using agroforestry as a REDD+ strategy could assist in ensuring sustained livelihoods and food security as well as continued access to forest benefits. Access to agricultural production and food security is, however, only one aspect to consider when implementing REDD+; there are other factors that could hinder or enhance the effective participation of marginalized rural and indigenous communities in these types of projects. **Chapter 2** explores which factors should be considered when implementing REDD+ with rural and indigenous communities, by analyzing literature from rural development and sustainable forest management. **Chapter 2** presents seven best practices that should be put into place when designing and executing a REDD+ project in such local contexts.

Chapter 2: Avoiding re-inventing the wheel in a people centered approach to REDD+

Status: Holmes, I., & Potvin, C. (2014). Avoiding Re-Inventing the Wheel in a People-Centered Approach to REDD+. *Conservation Biology, 28*(5), 1380-1393.

ABSTRACT

One important debate regarding Reducing Emissions from Deforestation and Forest Degradation (REDD+) in developing countries concerns the manner in which its implementation might affect local and indigenous communities. New ways to implement this mechanism without harming the interests of local communities are emerging. To inform this debate, we conducted a qualitative research synthesis to identify best practices from people-centered approaches to conservation and rural development, developed indicators of best practices, and invited development practitioners and researchers in the field to assess how the identified best practices are being adopted by community-level REDD+ projects in Latin America. Best practices included local participation in all phases of the project; project supported by a decentralized forest governance framework; project objectives matching community livelihood priorities; project addressing community development needs and expectations; project enhancing stakeholder collaboration and consensus building; project applying an adaptive management approach, and project developing national and local capacities. Most of the best practices were part of the evaluated projects. However, limitations of some of the projects related to decentralized forest governance, matching project objectives with community livelihood priorities, and addressing community development needs. Adaptive management and free and prior informed consent have been largely overlooked. These limitations could be addressed by integrating conservation outcomes and alternative livelihoods into longer-term community development goals, testing nested forest governance approaches in which national policies support local institutions for forest management, gaining a better understanding of the factors that will make REDD+ more acceptable to local communities, and applying an adaptive management approach that allows for social learning and capacity building of relevant stakeholders.

INTRODUCTION

In developing countries, large areas of forest occur on local and indigenous communities (hereafter local communities) lands and are essential for the livelihoods of millions of people (Agrawal 2007). Since Reducing Emissions from Deforestation and Forest Degradation in developing countries (REDD+) became an acceptable mitigation option within the United Nations Framework Convention on Climate Change (UNFCCC), a vigorous debate has emerged regarding the possible effects of its implementation on local communities (Agrawal et al. 2011).

Early discussions regarding the effects of REDD+ on local communities stem from civil society's concerns that prioritizing climate change mitigation over poverty alleviation might further marginalize forest-dependent populations because it could impose limits on usage rights and access to forest resources, thereby restricting their livelihoods (Griffiths 2007). Researchers have also suggested that REDD+ could constitute a threat to local communities by creating incentives to centralize forest governance, possibly resulting in unequal benefit sharing of carbon revenues and nationalization of carbon rights (Phelps et al. 2010). Others argue that depending upon its implementation, REDD+ could provide important co-benefits, such as poverty reduction and improved livelihoods (Brown et al. 2008).

UNFCCC has acknowledged the concerns of local communities and adopted safeguards for REDD+ implementation. These safeguards include respecting the knowledge and rights of local communities, allowing for their full and effective participation, and enhancing social and environmental benefits by considering sustainable livelihoods and their reliance on forests (UNFCCC 2011). The implementation of safeguards must address relevant international obligations, including protecting local communities' rights through free and prior informed consent, as mandated by the United Nations Declaration of the Rights of Indigenous peoples and the Universal Declaration of Human Rights (UNFCCC 2011). Implementing such safeguards is an important challenge for REDD+ (Kanowski et al. 2011) because indicators to assess how these safeguards are being implemented have not been developed and the implementation of these safeguards is not mandatory (Chhatre et al. 2012).

REDD+ projects have proliferated, with about 100 being implemented world-wide (Cerbu et al. 2011). This has promted researchers to examine ways of implementing REDD+ while minimizing its potential adverse effects on local communities. Lessons from the implementation of people-centered approaches to conservation are being revisited, including those of integrated conservation and development and community-based forest management (i.e., Agrawal & Angelsen 2009; Brandon & Wells 2009; Blom et al. 2010). Implementation of rural development projects may also offer important lessons: REDD+ could "[merge] the agendas of environmental conservation and rural development but … [this requires an] improved integration of lessons from past policies and projects concerned with development, resource governance, and conservation into the design of future REDD+ initiative" (Agrawal et al. 2011: 389).

To inform debate on implementing REDD+ in local communities without reinventing the wheel (Agrawal et al. 2011:390), we considered whether existing best practices that stem from people-centered approaches to conservation and rural development could inform REDD+ and whether current REDD+ projects implemented in local communities apply these best practices, and if so, how. Our study provides a possible framework of best practices and indicators that could be used by stakeholders to improve not only REDD+ project design, but also later monitoring and evaluation, which may help reconcile national initiatives and local interests.

METHODS

Identifying best practices from the literature

To identify best practices, we conducted a qualitative research synthesis (Major & Savin-Baden 2010) following a meta-ethnography approach for comparative analysis of literature (Noblit & Hare 1988) (details in Appendix F). We searched documents on best practices when implementing integrated conservation and development, community-based forest management, and rural development projects (hereafter bodies of literature). Selected documents were in English, published after 1980, focused on developing countries, and, where relevant, pertinent to forest conservation. We included peer-reviewed articles, books, book chapters, and gray literature that had been cited in peer-reviewed documents. We qualitatively coded the documents to identify best practices as well as the factors influencing them and their relationships (Dey 1993; Auerbach & Silverstein 2003, coding details in Appendix F). We reached theoretical saturation (i.e., when additional documents did not improve our understanding of the best practices [Auerbach & Silverstein 2003]) after analyzing 19 documents (Table 1).

To determine if the different source documents concur regarding these best practices, we categorized each document into one of the aforementioned bodies of literature and grouped them into 3 types of documents: theoretical studies, not based on primary fieldwork; fieldwork studies, presenting results from case studies; and lessons applied to REDD+, which described success factors in the context of REDD+.

A contingency table analysis followed by Fisher's exact test (Conover 1980) was conducted to verify whether a body of literature or type of document had an effect on the frequency of mentioning best practices and to identify significant associations amongst them. The relevance of the best practices to REDD+ was established by comparing them with social and environmental principles and criteria that had been developed by the United Nations Collaborative Programme on REDD+ (UN-REDD) (UN-REDD 2012).

Adoption of best practices by community-level REDD+ projects

To determine if REDD+ projects adopted the identified best practices, we created a database synthesizing existing forest carbon project databases (reviewed databases available in Appendix G). We focused on Latin America and the Caribbean because this region has the greatest total area of forest of all developing regions (39%, or 891 Mha) (FAO 2011) and the largest area of forest under community tenure (Agrawal 2007). Projects in the database included local-scale initiatives that aimed at reducing deforestation and forest degradation, with explicit carbon emission reduction targets estimated relative to a baseline scenario (Caplow et al. 2011).

Sixty-nine REDD+ projects met the aforementioned criteria; 20 were being carried out with available information on project design or implementation (more details in Appendix G). We classified 9 of these projects as community-level projects, where rural or indigenous communities have customary or statutory tenure or usage rights to the land and the REDD+ project directly targeted these communities. We retained 6 of these projects because 2 were undergoing validation and thus the information available was not finalized. The third project did not have sufficient information that was publicly available to assess the identified best practices (Table 2).

To assess how the projects were or were not addressing the identified best practices, we developed an evaluation tool of indicators and respective assessment criteria, created based on the factors identified from the research synthesis. The tool included 2 types of assessment criteria: ordinal, representing different levels of achievement for a particular indicator and nominal (no order). The tool also had a 5-point, Likert-type items scale (poor, fair, good, very good, excellent) to rate overall project performance for each best practice (evaluation tool in Appendix H). The evaluation tool was pre-tested with 5 researchers in the field and modified according to their recommendations.

Using the snowball sampling technique (Patton 1990), we invited development practitioners and researchers working on REDD+ and community-based conservation to evaluate one randomly assigned community-level REDD+ project. This approach was taken to ensure that more than one person was evaluating each project and to increase the rigor of the evaluation of best practices adoption (i.e., triangulation). Survey participants (hereafter respondent) were invited to analyze available project reports (i.e., project design documents) in meeting the identified best practices and their respective indicators (details in Appendix I). We sent out 93 invitations, 39 invitees volunteered to participate, and we received 29 completed evaluations.

To analyze ordinal assessment criteria, we used the mode of the sample. We determined associations among the different assessment criteria with contingency table analysis and Goodman-Kruskal's gamma. Responses to the 5-point, Likert-type items scale were treated as ordinal data (poor, lowest value [1]; excellent, highest value [5]). To evaluate whether the overall ratings for each best practice varied among the 6 selected REDD+ projects, we performed the exact Kruskal-Wallis test, including multiple pair-wise comparisons when $p < 0.05$ (Conover 1980). For nominal assessment criteria, we also used the mode of the sample, contingency table analysis, and Fisher's exact tests to determine associations between assessment criteria and to determine if the frequencies of the evaluation responses differed among the different projects. We used SAS software to perform all statistical analyses (SAS Institute 2012).

RESULTS

Best practices from the literature

The research synthesis allowed identifying 7 best practices as well as the factors influencing them and their relationships (Fig.1). We found a broad consensus among the different bodies of literature and the types of documents regarding the identified best practices ($p > 0.05$, Table 3). All identified best practices, except for one, related to one or more UN-REDD social and environmental principles and criteria (Table 4).

Ensuring local participation in all phases of the project (BP1) was mentioned as a best practice throughout the 19 analyzed documents. Seventy-nine percent of the documents linked participation to the idea of empowerment that included sharing power among community members, allowing more marginalized individuals to participate in and benefit from projects (47%), and sharing power between governments and communities (73%). The latter articles mentioned that effective decentralization, which allows communities to control their resources, is an essential condition for local participation.

Project supported by a decentralized forest governance framework (i.e., a policy framework that strengthens local rights to use and manage forest resources) (BP2) was prescribed as a best practice to achieve positive conservation and livelihood project outcomes (17 of 19 documents). Fifty-three percent of these documents mentioned that successful projects depended on communities developing and enforcing their own institutions, norms, and rules for resource use (Agrawal &

Gibson 1999), while 41% suggested that communities should have external support to enforce some of these rules (i.e., to control external forest users).

Project objectives matching community livelihood priorities (BP3) was mentioned as a best practice in 17 documents and occurred when projects provided adequate livelihood diversification alternatives to local communities (81%). Achieving this best practice depended upon understanding local livelihood strategies (75%) and acknowledging heterogeneity of livelihood portfolios among community groups (56%).

Project addressing community development needs and expectations (BP4) was mentioned as a best practice in 15 documents and entailed providing direct benefits (i.e., compensation) at the household level (53%); improving availability of social development services (i.e., health and education) (60%); or adopting a mixed approach that included both compensation and development services (33%). There was a significant association between this best practice and BP3-matching livelihood priorities (Fisher s 2-sided test, $p = 0.035$, $n = 19$).

Conservation and rural development projects often involve several stakeholder groups with differing agendas. Thus, enhancing stakeholder collaboration and consensus building among project stakeholders (BP5) was mentioned as a best practice in 16 documents. Three factors influenced enhancement of collaboration and consensus-building among project stakeholders: ability of communities to build strategic alliances with relevant project stakeholders, including government and non-governmental organizations (NGOs) (43%); identification of relevant stakeholders and their project roles (31%); and existence of bridging institutions that facilitate coordination and dialogue (44%).

Conservation and rural development projects take place over a long period and under changing social and environmental circumstances. Therefore, application of an adaptive management approach (BP6) was mentioned as a best practice in 13 documents. This best practice required establishing monitoring and information systems that informed implementation (64%).

Project developing national and local capacities was mentioned in 17 documents and called for building project stakeholders' knowledge and management abilities. Building capacity of local people was mentioned in all documents, while 31% also noted the importance of building government capacities.

Adoption of best practices in REDD+ project implementation

Most best practices received overall ratings of very good and good (5 and 2 best practices, respectively; Table 5). A single project received the lowest rating poor for 1 of the best practices, while 3 best practices were rated as excellent in at least 1 project. Kruskal-Wallis tests indicated significant differences among projects in terms of their overall ratings for 4 best practices (details in Appendix J).

Respondents reported assessment criteria for BP1-participation in project design and in implementing decision making, which denoted a high degree of participation (Fig. 2). Three projects addressed local empowerment by allowing more marginalized community members to participate in the project. Survey respondents mentioned that the project reports provided evidence that resources were committed to community participation in project design (62%) and implementation of decision making (65%).

With regard to BP2-decentralized forest governance, 3 projects were implemented in areas where communities held statutory rights to land. Two projects were in the process of obtaining their statutory tenure rights, but projects were not assisting communities in resolving their tenure rights (gamma = 0.438, $p = 0.362$, $n = 15$). We tested the link, identified from the research synthesis, between this best practice and BP1-participation and found a significant positive association. Projects with higher scores for overall participation were in communities that had statutory rights to land (gamma = 0.689, $P = 0.0001$, $n = 29$). We also tested if land tenure was associated with communities holding carbon ownership and receiving carbon benefits. Nearly half the respondents (47%) indicated that the project reports did not provide information about community carbon ownership. Another 7% reported that local communities did not hold carbon ownership. Two projects indicated that communities held 100% carbon ownership. Respondents (55%) likewise indicated that no information was available on carbon benefit sharing; 2 projects allocated 100% of the project's carbon revenues to the communities. There was no statistically significant association between land tenure (excluding responses of "information not available" and blank responses) and either carbon ownership (gamma = 0.676, $p = 0.097$, $n = 15$) or carbon-benefit sharing (gamma = 0.111, $p = 0.776$, $n = 12$).

The objectives of all projects mentioned local livelihoods that promoted alternative livelihoods (BP3-matching livelihood priorities). Only 2 projects involved the participation of communities in deciding these alternatives. The research synthesis indicated an association between this best practice and BP4-addressing community development needs. However, results from the REDD+ project evaluations failed to find a significant association between the overall ratings for these 2 best practices (gamma = 0.366, $p = 0.179$, $n = 24$).

With regard to BP4-addressing community developmental needs, respondents noted that limited information was available about developmental services supported by the projects, with health, education, and communication services being the most widely cited. Three projects reported helping communities in accessing these 3 services. Similarly, respondents reported there was very limited information on project incentives (45% of valid responses; 54% reported information was not available). Nearly half of these responses (48%) reported that project participants received cash incentives, while 52% received non-cash incentives.

With regard to BP5-stakeholder collaboration, on average projects had 5.83 stakeholders. Communities established more partnerships with local NGOs and other communities than with carbon market actors and governments. There were no statistically significant associations between reported partnerships and the effective representation of communities within these partnerships (see Appendix J).

All projects addressed BP6-adaptive management. Most of them had systems to monitor socio-economic and carbon variables (83% and 100% of the projects, respectively), but only half had monitoring systems for biodiversity. Local communities participated in these monitoring schemes in 4 projects.

All project addressed BP7-enhanced capacities. Project reports mentioned capacity-building activities targeting local community participants and included training in leadership development, conservation practices, alternative livelihood diversification, and project administration and management. There was no mention of projects addressing capacity building at the government level.

DISCUSSION

Livelihoods and development needs

Concerns for the long-term success of REDD+ projects have led to the idea that promoting alternative livelihood strategies would successfully reduce emissions from deforestation and degradation and increase carbon stocks (Aukland et al. 2003). All of the evaluated REDD+ projects mentioned providing alternative livelihood strategies, as proposed by BP3-matching livelihood priorities, but local communities mostly have not been involved in choosing or designing these strategies. This approach therefore suffers from some limitations, including a lack of understanding of the various factors that shape local livelihoods strategies (Coomes et al. 2004) and a lack of involvement of local people in determining links between resources and proposed alternatives(Salafsky & Wollenberg 2000).

Another important result of our study is that the REDD+ project survey failed to unveil links between BP3-matching livelihood priorities and BP4-addressing community development needs. For example, projects have provided only limited support for improving developmental services to local communities. For forest-dependent communities, the forest provides food, shelter, and medicine, so all projects should ensure that people continue to have access to these benefits (Kaimowitz & Sheil 2007). This could be realized by integrating desired conservation outcomes and alternative livelihoods into longer term community development goals, which could be done by using development means toward conservation ends (Salafsky 2011). This approach is particularly appropriate when threats to natural resources are related to unsustainable resource use (Salafsky 2011); therefore, this is a relevant approach for REDD+ implementation.

The aforementioned approach would require a better understanding of the links between the human and ecological benefits expected from conservation interventions (Salafsky 2011). Sustainable livelihood approaches (SLAs) (Ellis & Biggs 2001) might offer a way to understand the links between development needs and forest conservation in the context of REDD+ implementation. Sustainable livelihood approaches emerged in the late 1990s and have become very popular among several development agencies, including those associated with the United Nations. Despite their popularity, such approaches have not been well addressed in debates on designing REDD+ interventions with local communities. Given that SLAs have been extensively applied, several lessons could be drawn that would guide the planning of REDD+ local interventions. For one, improved selection of on the ground activities and better targeting of interventions would be facilitated according to local circumstances (Coomes et al. 2004). These actions may assist in matching development needs, local livelihoods, and forest conservation.

Forest governance

REDD+ has been conceived as a national-level mechanism. Undertakings at this scale are believed to reduce leakage, ensure permanence, and provide accurate monitoring, reporting, and verification (Angelsen et al. 2008). Some, though, have noted that REDD+ makes national governments the principal forest stakeholders and that this position could be detrimental for encouraging decentralized forest management (i.e., it would provide incentives for re-centralization of forest governance) (Phelps et al. 2010). Studies have shown that local communities have an important role in forest conservation (Agrawal & Chhatre 2006; Stocks et al. 2007) and that decentralization that includes greater community rule-making authority (local institutions) is associated with positive carbon storage and favorable livelihood outcomes (Agrawal & Chhatre 2006).

Discussions on forest governance for REDD+ have emphasized the need to clarify forest tenure (Streck 2009; Sunderlin et al. 2009) (i.e., to determine who is allowed to use forest resources, for how long, and under what conditions [Larson et al. 2010]). Uncertain tenure facilitates deforestation (Geist & Lambin 2002), while clear forest tenure facilitates compensation and distribution of incentives for forest management (Streck 2009). In assessing BP2-descentralized forest governance, our study revealed a gap between the claims of resolving tenure for REDD+ and the reality of REDD+ projects on the ground. Half the evaluated projects were undertaken where communities had statutory land tenure. Yet, tenure does not guarantee carbon ownership or access to carbon benefit sharing. Other studies have also shown that decentralization might not benefit communities if it comes with restrictions upon the use of forest resources and their management (Larson et al. 2010). Therefore, we support claims that ownership rights alone are meaningless if communities do not have ability to devise and enforce local institutions that would allow them to benefit from decentralization processes (Agrawal & Chhatre 2006).

Successful REDD+ implementation entails nurturing changes at the local level. Consequently, there is a need to determine decision-making processes that enable forest rights at multiple scales. Including exploring effective decentralization mechanisms that allow local communities to control their forests and have rights to use and benefit from these resources. Furthermore, these processes should support collective action toward building resilient, transparent, and accountable local institutions (Ostrom 1990; Agrawal & Chhatre 2006). This form of implementation will require a change in forest governance, particularly in terms of local stakeholder inclusion in national decision-making processes, together with recognizing forest rights and institutions at various scales (Sikor et al. 2010). In this sense, our research supports claims for the need to test approaches to forest governance in which national policies support local institutions for forest management (i.e., nested governance) (Hayes & Persha 2010; Sikor et al. 2010).

Participation

Our qualitative research synthesis showed that BP1-participation was a key element for project success. Interestingly, the literature we reviewed seemed to overlook a crucial step in the community engagement process: project approval. All of the factors influencing BP1 considered issues to be addressed once projects had been accepted by communities. Yet, we could not find any publications that addressed factors influencing the adoption or rejection of projects by communities. Projects that empower people to manage their own resources need to be initially accepted by the communities so they can make their own decisions about the processes and activities that affect their lives (Michener 1998). This missing fundamental step is therefore linked with free and prior informed consent (FPIC), which is key for REDD+ implementation.

Our study showed that community-level REDD+ projects generally addressed BP1-participation in their project reports very well. This result contrasts with an important controversy on how national-level REDD+ readiness processes (i.e., processes by which countries are preparing their REDD+ strategy) (assisted by UN-REDD and the Forest Carbon Partnership Facility of the World Bank) are addressing local participation and Free and prior informed consent. The national coordinator of Indigenous Peoples in Panama (COONAPIP), the Civic Council of Popular and Indigenous Organisations (COPINH) of Honduras, and the Salvadoran National Indigenous Coordinating Council (CCNIS) have rejected the REDD+ readiness process in their respective countries, claiming that safeguards have not been respected and that indigenous communities and traditional authorities have not participated effectively in these processes (REDD Monitor 2012; Potvin & Mateo-Vega 2013).

Divergent reaction to REDD+ could be related to the lack of information available regarding project participants' perceptions of participation processes (Booth & Halseth 2011). If REDD+ is to be implemented in a genuinely people-centered approach, then there is an urgent need to make case studies available that assess how REDD+ initiatives address the full and effective participation of local communities and how these initiatives put Free and prior informed consent into operation. In people-centered approaches, local communities build their capacities to manage their resources and make informed choices about the issues that affect their lives. Including community assessment of participatory measures would allow broadening the meaning of participation and, thus, complete the wheel. Further, inclusion of this process would contribute to a better understanding of the factors that will make REDD+ more acceptable to local communities and, ultimately, would assist in reconciling national initiatives and local interests.

Adaptive management, collaboration, and capacities

Adaptive management entails managing natural resources while simultaneously learning about both the resources themselves and the implemented management strategies (Williams 2011). This approach recognizes that ecosystems do not respond linearly to management and use and that natural systems are interconnected with social-ecological systems (Berkes et al. 1998). Surprisingly, we found that BP6-adaptive management was largely overlooked in REDD+ debates, particularly from a donor's perspective. None of the UN-REDD social and environmental principles or criteria addresses this best practice.

Yet, there are many reasons to favor undertaking an adaptive management approach during REDD+ implementation. Adaptive management is well suited to situations when variation in environmental conditions, resources of interest, and management impacts are unpredictable (Williams 2011). Such uncertainties are inherent in REDD+ projects. Adaptive management could therefore contribute to REDD+ development and implementation at any given scale.

Implementing REDD+ using an adaptive management approach would strengthen 2 other best practice (BP6-stakeholder collaboration and BP7-increased capacities). In defining social learning as "an intentional process of collective self-reflection through interaction and dialogue among diverse participants (stakeholders)," Fernandez-Gimenez et al. (2008:3) emphasized the links between adaptive management and social learning. If adaptive management enhances collaboration among project stakeholders (Berkes 2004; Fernandez-Gimenez et al. 2008), then it would help in adopting BP6.

Adaptive management could also assist in addressing BP7-increased capacities. The REDD+ mechanism has been designed in 3 phases, based on the premise that this would allow REDD+ countries to build their capacities while advancing through the different phases. REDD+ is often carried out by national agencies which frequently face weak institutional capacities (Davis et al. 2009). Several countries are subsequently receiving funds to build their capacities to put the needed REDD+ apparatus into place. Therefore, it is important to better define effective and ethical development assistance for REDD+ aimed at ensuring that these capacities are successfully built in developing countries (Gow 1991). To achieve this, there is a need to better understand how REDD+ fits into the existing priorities of developing countries and what is (or is not) already in place to fulfil these priorities; understand the structural problems that lead to deforestation; and recognize that developing nations should be able to take an active role in their own development rather than acting passively only as aid recipients (Crocker 2008). This approach applies equally at different scales, from national agencies to local communities.

From design and implementation to monitoring and evaluation

Surprisingly there was a lack of information on monitoring and evaluation. Fifty percent of the projects were validated by an external certifier, but their validation reports did not provide enough information to assess if projects had adopted the identified best practices. This information gap has also been highlighted by other studies which mention that available documentation does not provide systematic information about local communities and that credible counterfactual scenarios, particularly socio-economic ones, are often vague or non-existent (Caplow et al. 2011; Lawlor et al. 2013). This in itself raises concerns regarding the possibility of monitoring the implementation of REDD+ projects.

We propose that the best practices and their respective indicators identified in this study provide a possible framework to develop effective monitoring of the impact of REDD+ interventions. This framework could be used and adapted by various stakeholders for adopting a people-centered approach to REDD+. Local communities could use this framework as a checklist of best practices for designing, implementing, and monitoring projects on their land. Further, project developers, managers, and certifiers could use this checklist to assess the adequacy of project design. In the long term, this checklist could also be used for project monitoring and evaluation that allows assessment of what works or what does not work to adapt the project or program strategy for reaching the expected outcomes (adaptive management). These measures will contribute to the long-term sustainability of REDD+ initiatives and we hope help reconcile national initiatives and local interests without reinventing the wheel.

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APPENDICES

Appendix F: Detailed Methodology
Appendix G: Reviewed Database and Documents
Appendix H: REDD+ Project Assessment Tool
Appendix I: Details about Evaluation Approach
Appendix J: Results of Kruskal-Wallis for Best Practices

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Tables and Figures

Table 1: Documents analyzed in the qualitative research synthesis for identifying best practices from people-centered approaches to conservation and rural development.

Type of article	Body of literature[a]	Number of case studies	Reference
Theoretical studies	RD[b]	Not applicable	Gow & Morss 1988 Tacconi & Tisdell 1992 Ashley & Maxwell 2001
	CBC[c]		Seymour 1994 Western 1994 Berkes 2004 Pretty & Smith 2004 Kaimowitz & Sheil 2007
	ICD[d]		Brown2002Garnett et al. 2007
Field work	RD	30	Uphoff et al. 1998
		46	Zoomers 2005
	CBC	1	Thakadu 2005
	ICD	57	Shahbaz et al. 2011
Lessons applied to REDD+	CBC	Not applicable	Agrawal & Angelsen 2009 Hayes & Persha 2010 Cronkleton et al. 2011
	ICD		Brandon & Wells 2009 Blom et al. 2010

[a] Abbreviations: RD, rural development; CBC, community-based conservation; ICD, integrated conservation and development.

Table 2: Overview of community-level REDD+ projects evaluated for best practice adoption.

Project name	Project goals	Project approach	Community details	Drivers of deforestation
The Juma Sustainable Development Reserve Project, Brazil (CCBA (The Climate Community and Biodiversity Alliance) 2008)	halting deforestation and promoting sustainable development through establishing a protected area for sustainable use	strengthen environmental monitoring and control, generate income through sustainable business, community development, scientific research and education direct payment for environmental services (Bolsa Floresta Program)	about 339 families live in 35 communities and most have no land titles depend on subsistence and extractive activities; income below average minimum wage in Brazil	increasing rates of agricultural and cattle production and illegal logging and land grabbing
Noel Kempff Mercado Climate Action Project, Bolivia (ConserveOnline 2012)	mitigating carbon dioxide emissions from the atmosphere, preserving biological diversity and promoting sustainable development in local communities	cease legal and illegal logging and expand the boundaries of the park by including the newly indemnified concession area, achieve long-term protection and regeneration of the park expansion area s by working with local communities	The indigenous territory of Bajo Paragua, comprised of 4 communities, is located in the project area. The territory did not hold legal title to the land when the project was initiated. Communities practice subsistence agriculture and harvesting of fruits and timber from the forest. They also hunt and fish.	logging, anthropogenic fires for agricultural conversion and slash-and-burn agriculture,
Suruí forest carbon project, Brazil CCBA (The Climate Community and Biodiversity Alliance) (2011b)	halting deforestation and its associated greenhouse gas emissions and to contribute to the preservation of the Paiter	forest protection food security and sustainable production institutional strengthening development and implementation of a financial mechanism - Suruí Fund	The Paiter Suruí indigenous people inhabit the project area. Their territory has legal recognition. They are distributed in 24 villages with about 1,231 people. Their traditional livelihood strategies include hunting, fishing,	forest conversion for extensive cattle ranching

	Suruí lifestyle and traditions		and harvesting forest products. More recently they began to develop economically productive activities like logging and cattle ranching.	
The Chocó-Darién conservation corridor project, Colombia (CCBA (The Climate Community and Biodiversity Alliance) 2011a)	preventing global climate change and safeguard the ecosystems and wildlife of the Darién by strengthening territorial identity and governance capacity of the Council of Afro-Colombian Communities of the Tolo River Basin (Cocomasur)	building governance capacity reducing Carbon emissions, investing in green commodity production	The project is undertaken in the collective lands of COCOMASUR, which received legal recognition for their territory in 2005. The area is managed by the 9 Local Councils of Cocomasur, representing a mix of Afro-descendant and metizo communities from 31 villages (826 families, 5,782 people). Most people depend on subsistence resources including agricultural products, hunting, and fishing.	conversion of forest to pasture for cattle ranching and to a lesser extent, selective logging
Scolel-Té, Mexico (Plan Vivo 2012)	carbon sequestration and emission benefits along with environmental and social co-benefits, including biodiversity maintenance	assisting farmers develop more sustainable land management and better livelihoods through the provision of carbon services	In 2010 the project involved 2,437direct project participants and about 6,400 Mayan and mestizo families from about 25 communities from 8 ethnic indigenous and groups.	Information was not available because it depended on the specific circumstances of each participant.

	and poverty reduction			
The Ipetí-Emberá Carbon Project, Panama (Holmes et al. 2012)	increasing carbon stocks and reducing emissions from deforestation while enhancing participation of local communities in sustainable land management decisions	reforestation with native species and agroforestry systems for enhancing carbon stocks and addressing livelihoods establish a community patrolling system to reduce deforestation due to invasion	The project is located in the collective land of Ipetí-Emberá, which has no legal title. The population is represented by 71 families (550 people). Of these, 22 families are direct project participants. Primary economic activities include subsistence cultivation, cattle ranching, acting as day laborers, and handicraft production.	conversion of forest to pasture for cattle ranching, slash-and-burn agricultureinvasion from adjacent colonist population

Table 3: Results for contingency table analysis on best practices (BP) from people-centered approaches to conservation and rural development from the literature grouped by body of literature and type of article.[a]

Document group	Ensuring local participation in all phases of the project (BP1) (%)	Project supported by a decentralized forest governance framework (BP2) (%)	Project objectives matching community livelihood priorities (BP3) (%)	Project addressing community development needs and expectations (BP4) (%)	Project enhancing collaboration and consensus-building among project stakeholders (BP5) (%)	Project applying an adaptive management approach to implementation (BP6) (%)	Project developing national and local capacities (BP7) (%)
Body of literature							
rural development (5)[b]	100	80	100	80	80	80	100
community based conservation (9)	100	89	89	67	100	67	100
integrated conservation and development (5)	100	100	80	100	80	60	60
total (19)	100	89	89	79	84	68	89
exact fisher test *(p)*	[c]	1.0	1.0	0.53	0.12	1.0	0.117
Type of article							
theoretical study (10)	100	100	90	90	80	70	100
field work (4)	100	75	100	100	100	75	75
lessons to REDD+ (5)	100	80	80	40	80	60	80
total (19)	100	89	89	79	84	68	89
exact Fisher test *(p)*	[c]	0.210	1.0	0.068	1.0	1.0	0.210

[a] Percentages of documents in the group category that mentioned this best practice.

[b] Number of documents in this group category.

[c] No statistics were computed because this best practice is a constant.

Table 4: Comparison of identified best practices from people-centered approaches to conservation and rural development and UN-REDD social and environmental criteria.

Best practices identified from the literature	UN-REDD social and environmental criteria (UN-REDD 2012)
Ensuring local participation in all phases of the project (BP1)	ensure full and effective participation of relevant stakeholders, in particular, indigenous peoples and other forest dependent communities, with special attention to the most vulnerable and marginalized groups (criterion 4)
	seek free, prior, and informed consent of indigenous peoples and other forest-dependent communities and respect and uphold decision taken (whether consent is given or withheld) (criterion 9)
Project supported by a decentralized forest governance framework (BP2)	respect and promote the recognition and exercise of equitable land tenure and carbon rights by indigenous peoples and other local communities (criterion 7)
Project objectives matching community livelihood priorities (BP3)	respect and protect traditional knowledge and cultural heritage and practices (criterion 11)
	ensure land-use planning for REDD+ explicitly accounts for ecosystem services and biodiversity conservation in relation to local and other stakeholders values and for potential synergies and trade-offs between different benefits (criterion 21)
Project addressing community development needs and expectations (BP4)	ensure equitable, non-discriminatory, and transparent benefit sharing and distribution among relevant stakeholders with special attention to the most vulnerable and marginalized groups (criterion 12)
	protect and enhance economic, social, and political well-being of relevant stakeholders, while minimizing adverse effects on well-being, with special attention to the most vulnerable and marginalized groups (criterion 13)
	ensure consistency with and contribution to national poverty reduction strategies and other sustainable development goals (including those outlined under the Millennium Development Goals framework), including alignment with ministries and sub-national strategies and plans that may have an impact on, or be affected by, the forest sector or land-use change (criterion 16)
Project enhancing collaboration and consensus-building among project stakeholders (BP5)	promote coordination, efficiency, and effectiveness, including cooperation across sectors and in the enforcement of laws (criterion 5)
Project applying an adaptive management approach to implementation (BP6)	
Project developing national and local capacities (BP7)	Ensure transparency and accessibility of all information related to REDD+, including active dissemination among relevant stakeholders (criterion 3)

Table 5: Overall performance of adoption best practice (BP) from people-centered approaches to conservation and rural development by the evaluated REDD+ projects. [a]

REDD+ evaluated project[b]	BP1-participation mode (%)	BP2-decentralized forest governance mode (%)	BP3-matching livelihood priorities mode (%)	BP4-addressing community development needs mode (%)	BP 5-stakeholders collaboration mode (%)	BP6-adaptive management mode (%)
A (5)	VG (40)	G (60)	VG (60)	G (50) [c]	VG (60)	VG (40)
B(5)	E (40) [c]	VG (33) [c]	VG (80)	VG (40) [c]	VG (50)	VG (40)
C (5)	F (60)	F (60)	G (40)	F (60)	P (60)	G (40)
D(4)	VG (75)	E (50) [c]	G (75)	G (75)	VG (50)	VG (50)
E (5)	G (60)	VG (50)	VG (80)	E (67)	VG (50) [c]	E (60)
F (5)	VG (80)	E (33) [c]	VG (100)	E (33) [c]	F (60)	VG (40)
Overall (29)	VG (41)	G (36)	VG (60)	G (38)	VG (32)	VG (37)
Kruskal-Wallis *p* value	0.0036[e]	0.3285	0.6417	0.0583	0.0028 [c]	0.0250 [c]

[a] Best practices more fully defined in Table 4. Abbreviations: P, poor; F , fair; G, good; VG, very good; E, excellent.

[b] The main purpose of the analysis was not to determine which projects were doing well or not; rather, it was to gain a general idea of how best practices are being adopted by the evaluated REDD+ projects. Therefore, we randomly assigned a letter code to each project to maintain their anonymity in the evaluation. Number in parentheses is the total number of evaluators that assessed best practices adoption (i.e., number of respondents per project).

[c] Multiple modes exist. The highest value is shown.

[e] Significance: $p < 0.05$.

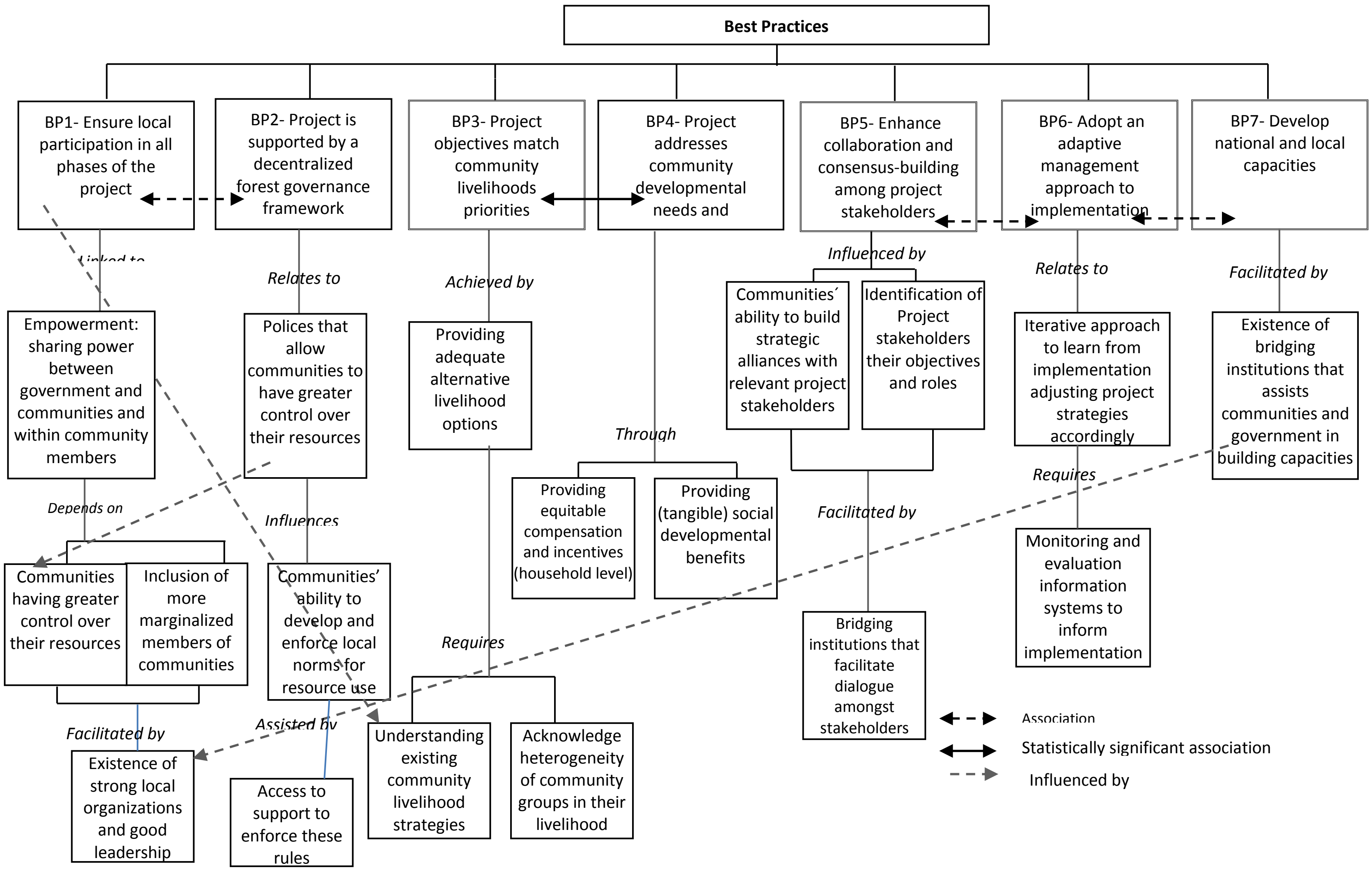

Figure 1: Concept map showing best practice from people-centered approaches to conservation and rural development identified from the literature and substantive relationships among them.

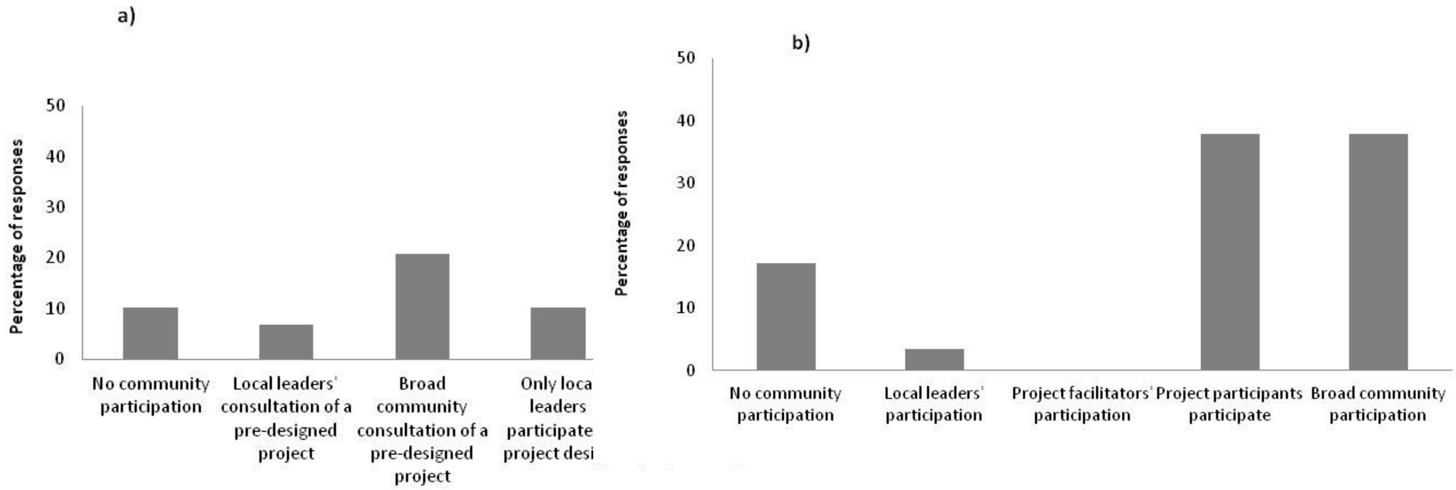

Figure 2: Results of assessment of adoption of best practice 1 (BP1-participation) by REDD+ projects in (a) project design and (b) project implementation.

Linking Statement 2

Chapter 2 illustrated seven best practices that should be considered when implementing REDD+ with rural and indigenous communities, addressing local livelihoods and ensuring broad participation of community members. **Chapter 3** provides a holistic review of the challenges encountered in the case-study of the carbon offset project implemented in the *Tierras Colectivas* of Ipetí-Emberá (introduced in **Chapter 1**) while attempting to follow the best practices described in **Chapter 2**. A mix of semi-structured interviews and participatory methodologies are used to document the challenges faced by a wide range of actors in this collaborative action research cycle-based study. The chapter grounds the lessons prescribed in **Chapter 2** by detailing the issues with land-tenure and bureaucratic hurdles that may impede project progress, but also describes the solutions to be found at the grassroots level.

Chapter 3: Lessons from REDD+ early implementation: Easy and cheap?

Status: Holmes, I., Coomes, O. T., & Potvin, C. (2015). Lessons from REDD+ early implementation: Easy and cheap? *In preparation*.

ABSTRACT

REDD+ offers developing countries an opportunity to engage in the global climate change mitigation agenda through the sale of carbon credits for reforestation, avoided deforestation and forest conservation projects. Local and indigenous people who manage forests are foci for REDD+ projects as such groups hold tenure to over 10% of global forests. The availability of funding for REDD+ projects has increased in the past five years and the number of projects has proliferated, but there remains little literature examining if these initiatives succeed with regard to their carbon outcomes (emission reduction and carbon sequestration), and if they respect the knowledge and rights of forest-dependent people residing in the communities hosting REDD+ projects. Here we present a synthesis of the challenges and lessons learned in implementation of a REDD+ project in an Emberá community documented in four cycles of collaborative action research (2002-2013). The present case study examines how local communities can reduce emissions from deforestation, and benefit from carbon offset trading while improving local livelihoods. Through employing a hybrid of semi-structured interviews and participatory methodologies, it was found that success with REDD+ hinges on broader issues than those widely discussed in REDD+ literature. Though economic incentives for participants and the equitable distribution of benefits remain important to project participants, this study highlights that adapting REDD+ strategies to best suit community needs, the role of a support system for implementation "bridging institutions" and REDD+'s potential as a conflict resolution mechanism for tenure issues deserve more recognition as alternative factors that can contribute to meaningful participation in REDD+. Additionally, utilizing a landscape approach that recognizes a diverse scale of actors can lead to positive results with REDD+. Future projects will benefit from recognizing the time-heavy nature of such mechanisms in planning realistic projects, and should seek to address drivers of deforestation in addition to drivers of participation in REDD+.

INTRODUCTION

Reducing Emissions from Deforestation and Forest Degradation is now an accepted climate change mechanism under the United Nations Convention Framework of Climate Change (UNFCCC). It allows developing countries to contribute to mitigation by undertaking five activities: reducing emissions from deforestation, reducing emissions from degradation, conserving carbon stocks, managing forest sustainably and enhancing forest carbon stocks (UNFCCC, 2007, decision 2/CP.13).

REDD+ is mobilizing significant financial resources from the international community as well as the private sector (Angelsen & McNeill, 2012). To date, funding from public sources dominates contributions, including bilateral agreements (i.e., the Norway–Indonesia REDD+- US$1 billion), and multi-lateral funds such as the Forest Carbon Partnership Facility (FCPF- US$385 million) (FCPF, 2015) and the United Nations REDD Programme (UN-REDD- US$227,279,400) (UN-REDD, 2015). Much of such funding is aimed at REDD readiness, assisting countries in preparing to develop and implement carbon mitigation measures. In contrast, funding for early pilot initiatives comes mostly from the private sector through voluntary carbon funds (Cerbu et al., 2011; Streck & Parker, 2012). Investment in REDD+ is much higher than historical spending in conservation. James et al. (1999) estimated the total budget for protected areas in developing countries during the 1990s was US$ 0.70 billion, a fraction of REDD+ investment. Such high levels of investment have raised hopes for enhanced forest conservation in parallel to effective carbon management (Venter & Koh, 2012).

The interest for REDD+ can in part be traced to Stern (2006), who argued that REDD+ is a cost-effective option for climate change mitigation. This claim has been questioned on the basis that it is more likely to be a very expensive endeavour that may bring uncertain impacts for climate change and for people (Eliasch, 2008; Minang & van Noordwijk, 2013). Nevertheless, REDD+ provides an opportunity for developing countries to engage in a process of changes regarding forest resources and to address the causes of deforestation (Streck & Parker, 2012), as well as an opportunity to create incentives for farmers and communities that could implement these changes at the local level (Karsenty & Ongolo, 2012). Indeed, many countries are currently hosting REDD+ pilot projects. Kshatriya et al. (2013) identified some 300 REDD+ pilot projects around the world in 2013. Most projects, however, are in the development phase and experience with implementation is relatively limited (Danielsen et al., 2013). In Latin America, for example, only 20 REDD+ projects are under implementation out of 48 for which information is available (Holmes and Potvin, 2014).

Research to date on REDD+ pilot projects has emphasized getting the economic incentives right for participant buy-in, contract development and enforcement, and project planning (Cerbu et al., 2011; Lawlor et al., 2013). The few studies available on implementation show that when put into practice, REDD+ faces both opportunities and challenges that are contingent on local contexts and actors (Jindal et al., 2012; Maraseni et al., 2014; Holmes and Potvin, 2014). The present study contributes to this small but growing literature by providing empirical insights from a long-term REDD+ participatory action research initiative (2002-2013) undertaken in an indigenous Emberá community in eastern Panama. The initiative was originally conceived in the context of the voluntary carbon market that developed in parallel with the Clean Development Mechanism. It evolved to include avoid deforestation, livelihood enhancement and conflict resolution within the context of a voluntary REDD+ pilot project. We present the lessons learned from this 11-year project, identifying successes and failures, and providing recommendations for future REDD+ implementation.

METHODS

Description of the case study

The long-term participatory action research initiative took place in an indigenous Emberá community in eastern Panama (hereafter the community). The community is situated in the Alto Bayano region of Panama, about 120 km east of Panama City and 1 km south of the Pan American Highway. The primary vegetation is tropical moist forest (Holdridge Life Zones system). The region receives an annual average of 2500 mm of rainfall, with a marked dry season between December and April; the mean annual temperature is 26ºC (Instituto Geográfico Nacional, 1998).

Migration and settlement patterns of the Emberá population in the Bayano region have been well described by Wali (1989, 1993). The Emberá people were first established in the Bayano area during the 1950s, when they migrated from the Darien, Panama's easternmost province. In the mid-1970s, a hydroelectric dam was constructed on the Bayano River, creating Lake Bayano and displacing some 400 Emberá, 1500 Guna, and 2500 colonist farmers (Wali, 1993). The Majecito Agreement signed between then President Omar Torrijos and the Emberá community in 1975 entitled the Emberá to new land but without granting full legal rights to the land.

In 2004, the community had a population of 550, with most of the 71 families residing in a central village along the main River (Tschakert et al., 2007). The community encompasses 3,145 ha, with the land divided into plots ranging in size from 1 ha to 100 ha. Plots are allocated by the chief to individual households and decisions on land-use management are made at the household-level. Community regulations prohibit households from selling their plots. Land cover in 2004 included forest (46%), pasture (18%), tall fallow fields (19%), and short fallow fields (8%) (Potvin et al., 2007). Households' livelihoods rely on subsistence cultivation, cattle ranching, day labour, and handicraft production. Timber, beef, and manioc *(Manihot esculenta)* are the principal market goods.

The community is governed by a political body, the *dirigencia*, led by a community chief (*noko*) chosen by a community assembly. The community is also home to a community-based non-governmental organization (NGO), which was established in 1998. Its mission is to promote conservation and sustainable development as well as to preserve the culture and traditions of the Emberá people.

Collaborative action research in the community

The community initiated a long-term collaboration with the Neotropical Ecology Laboratory of McGill University in 1996. Since the onset, a collaborative action research approach was employed, a method by which research is conducted jointly between researchers and local participants to empower participants to identify and study the issues that affect their lives and to promote social change (Greenwood & Levin, 2007). Action research is undertaken in cycles that are initiated by implementing an action and reflecting upon it to develop a new research cycle, enabling both participants and researchers to 'learn by doing' (Greenwood & Levin, 2007). Lessons from the earlier phase allow the formulation of new research questions and actions for the next cycle, in a progressive learning path (Elliott, 2013; Kapoor & Jordan, 2009). Multiple methods are used in action research and the participatory nature and the full involvement of local participants are of central importance.

The first studies in the community, in the late 1990's, examined the conservation status of traditional plant resources (Dalle et al., 2002; Dalle & Potvin, 2004). Research showed that about a third of the studied species were considered by villagers to be threatened or potentially threatened (Dalle & Potvin, 2004). These results stimulated community interest in exploring land-use alternatives that would allow for forest restoration and conservation, particularly reforestation. As mentioned by a former community leader, *"Through this study we realized that if we continued cutting trees we were going to end up with no forest; we needed to do something about it."* (Pacheco, 2012).

In 2002, the community began exploring the feasibility of implementing a reforestation/afforestation initiative for carbon storage, species conservation and enhancing local livelihoods (Potvin et al., 2007). This lead the community to engage, in 2008, in a voluntary carbon-offset project with a Panama-based research institute (hereafter the client) that agreed to purchase a total of 6,900 t CO_2e over 25 years. The contract aimed at enhancing forest carbon stocks through reforestation (3,600 t CO_2e equivalent to 10 ha) and avoiding deforestation (3,300 t CO_2e equivalent to 24 ha in three years – 8 ha per year). For reforestation, the contract allocated US$4,500/ha (US$10.22/tCO_2e) with funds to be disbursed over the first eight years. The client committed to provide the seedlings for the first planting season (2008) and to assist the community-based NGO in establishing a local nursery for future plantations. For avoiding deforestation, the contract was US$100/ha per year based on opportunity cost analysis (Coomes et al., 2008). Eighty per cent of payments were to be made directly to participants and 20% pooled into a community development fund managed by the community-based organization (more details in Holmes et al., 2016). In this paper we describe the three research cycles that unfolded during this carbon-offset project implementation and draw the lessons learned from the community's experience with REDD+.

Data collection and analysis

The overarching research question that guided the participatory action research between 2009 and 2013 was the following: how can forest carbon offset initiatives benefit local communities, reconciling emission reduction and local livelihoods? To answer it, a total of 101 semi-structured interviews were conducted with community leaders, project participants and other stakeholders (see Table 1, interview guides in

Appendix K). Research assistants from the community ensured full comprehension of the questions and answers and translated between Spanish and Emberá as needed. Participatory methods were used during interviews as a way to encourage participants to share information as well as to validate information collected using other approaches. Such methods included participant observation, transect walks, timelines, force-field analysis, H-form exercise and resource mapping/sketching (details in Appendix L).

The semi-structured interviews were coded qualitatively following Auerbach & Silverstein (2003), including identifying important concepts and categorizing them into interview themes. Multiple coding was used to cross-check coding and interpretation of data gathered by different members of the research team (Barbour, 2001). For example, data gathered and analyzed by interns and students were always validated in supervisory meetings (with IH and CP). Further, member checking – a qualitative validation method for verifying research findings with participants (Morse et al., 2002) – was also used to validate and modify preliminary interpretations as needed.

The study followed McGill University's Policy on the Ethical Conduct of Research Involving Human Subjects, the Neotropical Environment Option Protocol for conducting research with Indigenous Peoples in Panama, as well as the agreement and rules set forth in Resolution 2 of the 16th of March 2008 by the *Congreso Local de la Comunidad.*

RESULTS AND DISCUSSION

The first research cycle considered here focused on the participatory design of a forest-carbon contract, including the internal process undertaken by community leaders to engage local villagers as well as negotiation of the contract with the carbon buyer. The second research cycle focused on early implementation of the forest-carbon contract, including adjustments to the contract to better suit local conditions and participants' needs, identifying the barriers faced during implementation and exploring participants' perceptions of the early implementation phase. The third research cycle broadened the scope of analysis by aiming to understand the ways of life and livelihood strategies of other actors, specifically *colonos* (non-indigenous colonists) that live adjacent to Emberá land. It also explored possible ways to overcome one of the identified barriers to implementation – pernicious land-use conflicts between *colonos* and the community villagers.

Lesson 1: REDD+ participation entails a slow process of engagement

Earlier studies suggested that carbon stocks in the community were likely to decline by more than 50% between 2004 and 2024 (from 301,859 t C to 155,730 t C) due to projected increase in pasture area and reduction in fallow cycle duration on established croplands (Potvin, et al., 2007). As the community began to discuss a carbon-offset initiative there was much interest expressed by local leadership and households. Indeed, in 2004, villagers pledged - in a collective hypothetical land-use allocation exercise under a carbon-project – to set aside a total of 870 ha for the project. Despite the initial enthusiasm, a full four years were required for community members to agree to the project.

Interviews with local leaders, conducted for the present study, revealed tensions within the community regarding a benefit-sharing mechanism, particularly over whether the revenues should be for community development or for participating households. The former Cacique mentioned that, in her view, a carbon project should help the collective development of the community, an opinion shared by the president of the community-based NGO. The authority wanted to establish a community development fund for improving local infrastructure and access to services such as education and health. This view, however, was not shared by interested community members, possible participants.

> *"Families that wanted to participate wanted to receive the entire portion of the carbon funds; while our vision (as leaders) was that a part of the funds should be for a collective fund to benefit the entire community - for us, this is development - and another portion*

to families so they could buy their personal stuff. This internal difference blocked the idea of a carbon project until 2007" (Casama, 2012).

"I am the one that works all day under the sun weeding my [reforestation] plot so why should the carbon project renovate and buy seats for the communal meeting house? I prefer that this money is in my pocket" (carbon offset project participant, 2012).

In 2006, a working group established by the Cacique assessed options to go forward with the project and decided to begin the project as a pilot initiative. Recruiting community members to participate in the carbon project took considerable time. The project started in 2008 with only seven interested participants. After three years of implementation, there are now 22 participating households. Based on the participatory exercise conducted in 2004, the 22 participating households pledged to allocate 431 ha to the project, representing on average 30% of their total land. Despite their pledges, the participants actually allocated an aggregate of 19 ha to the project – only 1.3% of their total land. Allocation of novel land-use by participants was consistent with their initial intentions but at a much reduced scale, and participants' interest shifted over time from timber to agroforestry (Figure 1).

During a community meeting in 2012, after 4 years of project implementation started, 54 people expressed an interest in engaging in a second carbon-offset project, suggesting that seeing the results of others that engaged first made them less risk-adverse. This "demonstration effect" is consistent with forest carbon-offset carbon projects elsewhere that have shown that pilot initiatives can act as a catalyst for others to engage and scale up (Jindal et al., 2012; Poffenberger, 2015). Our observation supports earlier claims that local willingness to participate and engage in new strategies often requires long timeframes which need to be considered in the project design phase (Mayrand & Paquin 2004).

Why is engagement in REDD+ such a slow process? The concept of carbon credits or selling carbon is not widely understood by local communities, as carbon is intangible, and there is considerable uncertainty about how REDD+ will affect existing tenure and use rights (i.e., changes in carbon tenure) (Poudel, 2014). For REDD+ to be fully understood by communities, sufficient time must be available to negotiate conditions under which communities will feel motivated to participate (Poudel, 2014; Tiani et al., 2015). As Salim (2003) notes, consent must be understood as a process and negotiated between affected parties throughout all stages of a project, which inevitably takes time.

Lesson 2: Trade-offs between livelihood improvement and carbon outcomes are critical

The initial carbon-offset contract included reforestation of existing pasture and short fallow areas. Although reforestation was initially planned with only native timber species (on 10 ha), in 2009 participants explained that they did not have enough land to devote exclusively to timber and asked to include agroforestry systems that combine fruit and native timber trees as a reforestation option. Participants argued that exclusive allocation of land to timber could compromise household food security and livelihoods, and they were concerned about the long maturation time and lag in receiving benefits from timber. As noted by one interviewee:

> *"It is important to have options so reforestation could ensure that I could continue using my land to grow cassava, plantains and the products I need to feed my family" (interview with potential participant, 2009).*

The client agreed on adjusting the reforestation strategy, and agroforestry became a reforestation option in 2009. This change was accepted because the client's interest lay in the total amount of carbon sequestered, regardless of the way it was achieved. As mentioned by the client's representative: *"This is not different from buying pineapples; you buy a number of them and want to have them in hand when you pay".* Agroforestry systems were chosen as the reforestation strategy by 55% of participants (12 households), and only one new participant chose to reforest exclusively with timber species.

Previous studies have emphasized the need to provide a menu of activities from which participants can choose to ensure broad participation and to shape the project strategy to local livelihoods needs (Tomich et al., 1998; Tschakert, 2004; Venter & Koh, 2012). In a recent review of 40 PES projects, Grima et al. (2016) found that initiatives that improved livelihoods and community development were more successful than those that did not. Our resutls suggest that trade-offs between livelihood enhancement and carbon outcomes can be identified and reinforced through adaptive management during project implementation.

Lesson 3: Multi-actor land conflicts can undermine REDD+

Only three households were interested in engaging in the avoided deforestation component of the project. As the project unfolded we learned that these participants held parcels in an area that historically faced an intense land conflict between the community and local *colonos*. Since 1992, *colono* families that lived on land near the community had begun clearing the forest for agriculture on community land.

Participants designed an enforcement action plan including*: (i)* posting signs to delineate the avoided deforestation parcels; *(ii)* training a community–based patrol to ensure compliance; and, *(iii)* establishing a reforestation border in the conflict area. The action plan was implemented and within six months it became clear that the land conflict between *colonos* and the community was more complex than originally thought. Despite sign postage, colonists continued to invade the community. Mapping of the area (completed by taking GPS points in all areas cleared by *colonos* in 2008) showed that 36 ha of community land had been cleared by colonists between February and March 2009, including short fallow fields (31 ha), tall fallow fields (4 ha), and primary forest (1 ha) (Figure 2). Tensions increased as clearing continued and threats of violence by colonists rose.

Community leaders decided to initiate political actions aimed at resolving the land conflict through dialogue and state representation. Their complaints were lost in the bureaucracy; none of the formal notes sent were acknowledged nor could they be found in the government record or archives. Interviews held in 2009 with representatives of two key agencies – the National Authority of the Environment (ANAM) and Política Indigenista – suggest that the unresolved land tenure status of the community prevented the agencies from enforcing any action on the ground to resolve the land conflict. Furthermore, the agencies lacked clarity in their mandate in terms of addressing land and land-use conflicts where tenure status was unclear; interviewees argued that their agencies had no legal mandate *per se* to resolve conflicts.

For participants and local leaders, the carbon offset initiative - besides providing incentives for forest conservation – promised to assist them in stopping land invasion, resolving land conflicts and enabling them to formalize their land tenure status. Discussions on forest governance for REDD+ have emphasized the need to clarify forest tenure – *sensu* Larson et al. (2010) – and to determine who is allowed to use forest resources, for how long and under what conditions (Streck, 2009; Sunderlin et al., 2009). Because uncertain tenure can facilitate deforestation (Geist & Lambin, 2001), the requirement for tenure is considered a potential disincentive for local communities to participate in REDD+ (Skutsch et al., 2011). We found the opposite - that unresolved tenure was an incentive for participation rather than a deterrent.

Land allocation policies in developing countries consider intact forests as “unproductive” resources (Rudel, 2005). One way of “improving” land is through deforestation (Geist & Lambin, 2001; Rudel, 2005) as cleared land is considered to be more valuable than standing forest (Lopez & Valdes, 2000), and, in countries like Panama, the Constitution and Agrarian Code indicate that deforestation signals land ownership. Another way to “improve” land is to invest in the land (Sjaastad & Bromley, 1997) by, for example, establishing trees (see Fortmann & Ridell, 1985 for the tenure role of trees) or by partnering with conservation organizations (Schwartzman & Zimmerman, 2005). Sjaastad & Bromley (1997, p. 553) write, “although insecurity of tenure is a disincentive to invest, it is - paradoxically - often also an incentive because investment will itself increase security”. REDD+ can therefore offer a way for local communities to prove the land is being used “productively” (i.e., productive in carbon), showing investment in and improvements to their land and increasing the value of standing forests. Communities with unresolved tenure issues may view REDD+ as an instrument for gaining land title and tenure security over their lands.

Lesson 4: Mediation and conflict resolution mechanisms are needed for REDD+ implementation

In an effort to support dialogue between local stakeholders with competing interests for the land and the government, a working group, “The Advisory Council on Conflict Resolution and REDD+ (hereafter the Council) was formed, to identify possible ways forward. Between May and December 2011, the Council brought together 68 participants representing 34 organizations including representatives from government agencies (14), Indigenous Peoples (5), colonists (5) and NGOs (4), establishing a successful intercultural collaborative dialogue on the contentious issue of territorial conflicts among different sectors (Consejo Consultivo en Resolución de Conflictos en REDD+, 2012). The Council developed a series of recommendations addressing considerable confusion about the roles and responsibilities of government agencies in land tenure and invasion law enforcement (Consejo Consultivo en Resolución de Conflictos en REDD+, 2012, Table 2. Nonetheless, despite efforts to build capacity for land conflict resolution and new government laws, considerable confusion remains about the roles and responsibilities of government agencies in land law enforcement. In places that are inhabited jointly by groups with diverse interests (i.e., indigenous and colonist farmers), where interrelations between different stakeholders at the landscape level can complicate or even jeopardize REDD+ implementation, we suggest that the REDD+ implementation toolbox needs to incorporate conflict resolution methods such as mediation (Amado et al., 2015).

Recently, a landscape approach that integrates agriculture, conservation, and other land-uses is gaining momentum for REDD+ implementation (Sayer et al., 2013). This approach acknowledges the decisions made by multiple actors and cultures at the landscape level (Pfund et al., 2011) and enables the search for solutions that broadly address conservation and development challenges (Sayer, 2009). Undertaking REDD+ implementation based on a landscape approach would enable looking beyond the forest, acknowledging competing land-uses as well as the complete array of actors that shape land-use beyond local communities (Figure 3). Deforestation is a complex process influenced by land-use decisions at the local level, which are determined by the available resources (financial, labour) and by the socio-cultural background of the actors (Coomes, et al., 2008; Robiglio, 2003).

Lesson 5: Strong sustained local leadership and nested bridging institutions are critical for successful REDD+ implementation

A key theme that emerged through interviews and discussions in the study community was the need for strong, sustained local leadership during REDD+ implementation. Participants overwhelmingly agreed (88%) that the project lacked the leadership needed to support, motivate, and galvanize the project. Anticipating these limitations, a national NGO was invited by the client to support project implementation of the carbon-offset project. Their role was to monitoring the reforestation plots (verification) and assist participants and the community-based NGO in building project implementation capacity.

A key factor that explains the lack of strong local leadership throughout the project life is that, in 2008, a generational change of leaders occurred and the capacities of elder leaders were not passed on to the new generation. For the new, young leaders of the community who faced the demands of having young children and of building an economic future for their families, time committed to project coordinating activities without compensation was costly and sometimes counterproductive. The national NGO initially brought in to increase local capacity building made some advances but in the end could not fulfil its role, because of a lack of funding and of experience in working with carbon sequestration projects in indigenous communities; this project was the first of its kind in Panama.

Capacity building is a long-term endeavour and bridging institutions that assist project implementation in the first years are particularly influential. As Berkes (2009, p. 1692) notes, "bridging organizations provide a forum for the interaction of these different kinds of knowledge, and the coordination of other tasks that enable co-operation: accessing resources, bringing together different actors, building trust, resolving conflict, and networking". REDD+ is a complex mechanism and implementation in indigenous and small rural communities poses particular challenges for bridging institutions that assist communities and governments in capacity building, which is vital for successful REDD+ implementation (Holmes & Potvin, 2014).

Generalizing lessons learnt from this case study.

As we conducted this synthesis we questioned how representative these lessons learned were for the implementation of other REDD+ projects elsewhere. Socio-economic and cultural aspects of communities in which REDD+ is being implemented vary widely. Lawlor, et al. (2013) reviewed 41 projects across 22 countries - from Latin America, Asia and Africa – and Sills, et al. (2014) reviewed another 23 projects in six countries. Projects take place in a range of ecosystems, from drylands to tropical rainforests, with project size ranging from 42 to 642,184 ha and local populations varying from 1,025 to 250,000 people (Lawlor et al., 2013; Sills et al., 2014). The Panamanian project analyzed here is small compared to most other REDD+ case studies reviewed, with 19 ha and 22 participants.

Reviewing the literature on early REDD+ implementation, however, suggests that community-based REDD+ projects do have much in common. Implementation strategies tend to be similar as they try to address challenges rural and indigenous communities apparently face throughout the globe. For example, the majority (91%) of the projects reviewed by Lawlor, et al. (2013) and Sills, et al. (2014) address small-scale drivers of land-use change mostly related to agriculture and cropping systems. Most of the projects (80%) include afforestation/reforestation strategies with both timber and agroforestry. As noted by Lawlor et al. (2013), project incentives most commonly involved payment for ecosystem services (39%) and integrated conservation and development (29%). Securing land tenure is also an important motivation for community participation; most projects support communities in their claims to secure tenure (Lawlor, et al., 2013; Sills, et al., 2014), a need that also holds true for a project in Colombia with 14 communities (Castro-Nunez et al., 2016). Several projects note that project areas are subject to invasions and projects support communities in enforcing their land demarcation areas (Hayes et al., 2010). One of the lessons learned in our study found little echo in other case studies – namely the need for strong local leadership. Lawlor et al. (2013), however, noted that conservation NGOs are involved in the implementation of 40% of the reviewed projects. There is a need to ensure local capacities are passed to community-based NGOs, local leaders and projects participants to ensure sustainability of projects over the long term.

CONCLUSIONS

Our study suggests that implementing REDD+ is neither easy nor cheap. Although REDD+ has been portrayed as a cost-effective strategy for climate change mitigation (Stern, 2007), cost-effectiveness is context-dependent and conditional on the remoteness of areas, the nature of social, cultural and environmental landscapes, governance and tenure regimes, and more (Viana et al., 2009). Our study, conducted over 11 years in the community, showed that for forest-carbon initiatives to embrace livelihood enhancement, equitable benefit redistribution, and carbon outcomes, an array of factors should be considered for successful implementation on the ground.

Observers have generally assumed that the most important barriers for forest conservation are a lack of positive economic incentives and effective contract enforcement (Cerbu et al., 2011; Lawlor et al., 2013). We found that the challenge is much broader than that. The prospect for successful implementation of REDD+ in rural communities is underpinned by a complex combination of social, cultural, political and economic factors. The present analysis highlights the need to recognize multiple agents responsible for deforestation. We contend that failing to do so can imperil communities' efforts to implement REDD+ in intercultural landscapes where interest groups collide over the fate of the forest. In particular, REDD+ requires fostering local leadership, building capacities at all levels, and fortifying institutions that support implementation in rural and indigenous communities; and this is a long-term and costly effort.

We therefore propose that successful implementation of REDD+ projects in small rural or indigenous communities demands a complete shift of paradigm, one that moves away from "evidence-based payment" towards an integrated development approach. The key lesson we learned is that REDD+ takes time, since it involves redefining livelihood strategies. We also learned that tangible livelihood benefits, as in the case of establishing agroforestry plots, facilitate adoption by reducing the perceived risk of engaging in REDD+. For small communities, we therefore suggest that REDD+ projects should be considered as emerging sustainable social-ecological systems, *sensu* Ostrom 2009, acknowledging the combined importance of strengthening not only the Resource System (here territory) and Resource Unit (the forest), but also the Governance, and Actor subsystems. Repositioning REDD+ in the context of sustainable social-ecological systems questions the possibility of successfully financing REDD+ projects using a market-based approach. It is indeed unlikely that, at the current market price for carbon, evidence-based payments could support the development of increased leadership of local organizations or the necessary help for bridging institutions. Alternative models of support for community-based REDD+ initiatives are needed, such as the Juma project in Brazil (Agustsson et al., 2014) or the N'hambita community carbon project in Mozambique (Jindal et al., 2012), that combine evidence-based payment with development and poverty reduction, and are apparently better at supporting community development needs and challenges in the context of REDD+.

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APPENDICES

Appendix K: Interview Guides from Internships and Honors Thesis
Appendix L: Participatory Methods

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FIGURES AND TABLES

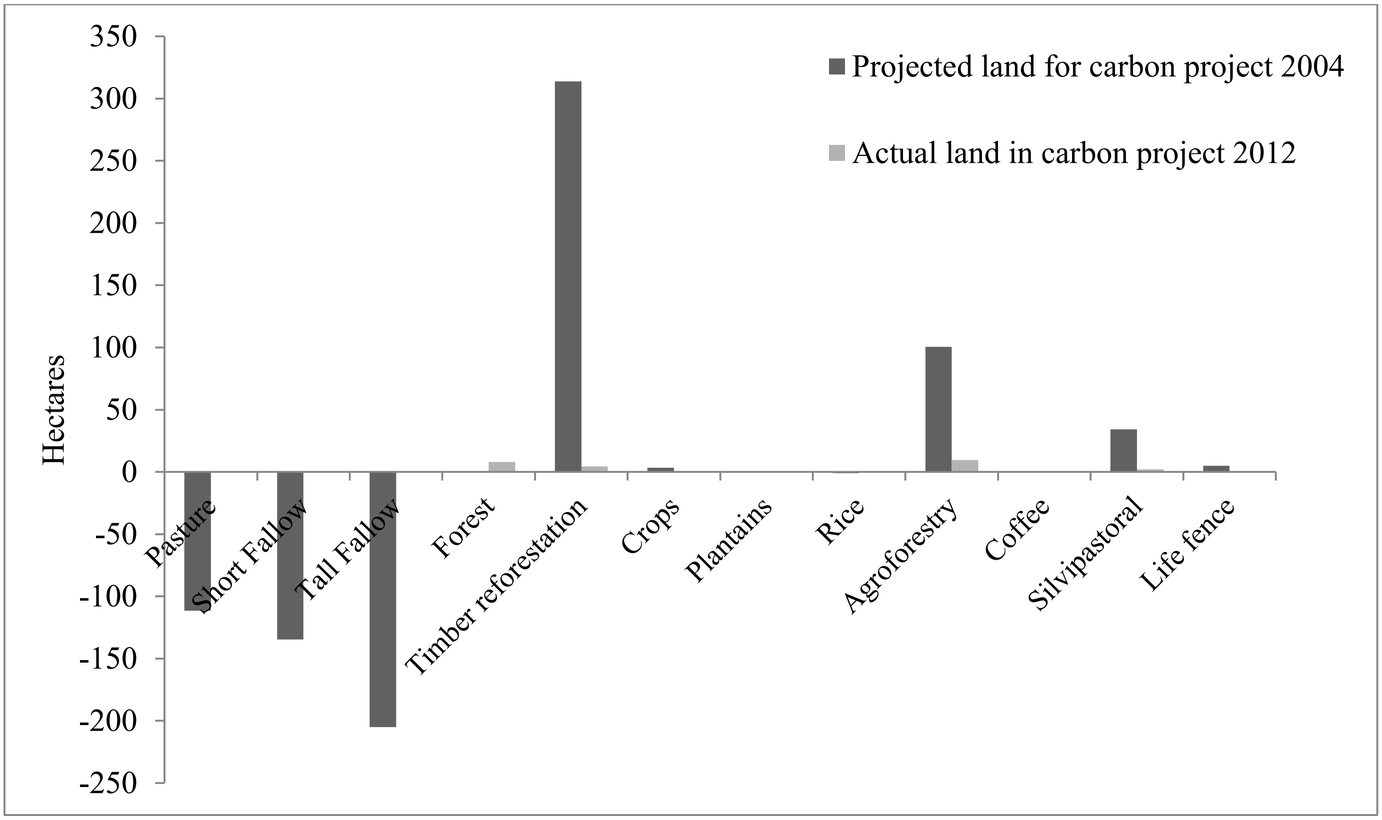


Figure 1: Initial projection and actual land (in hectares) allocated by participants to the carbon-offset project in 2004 and in 2012.

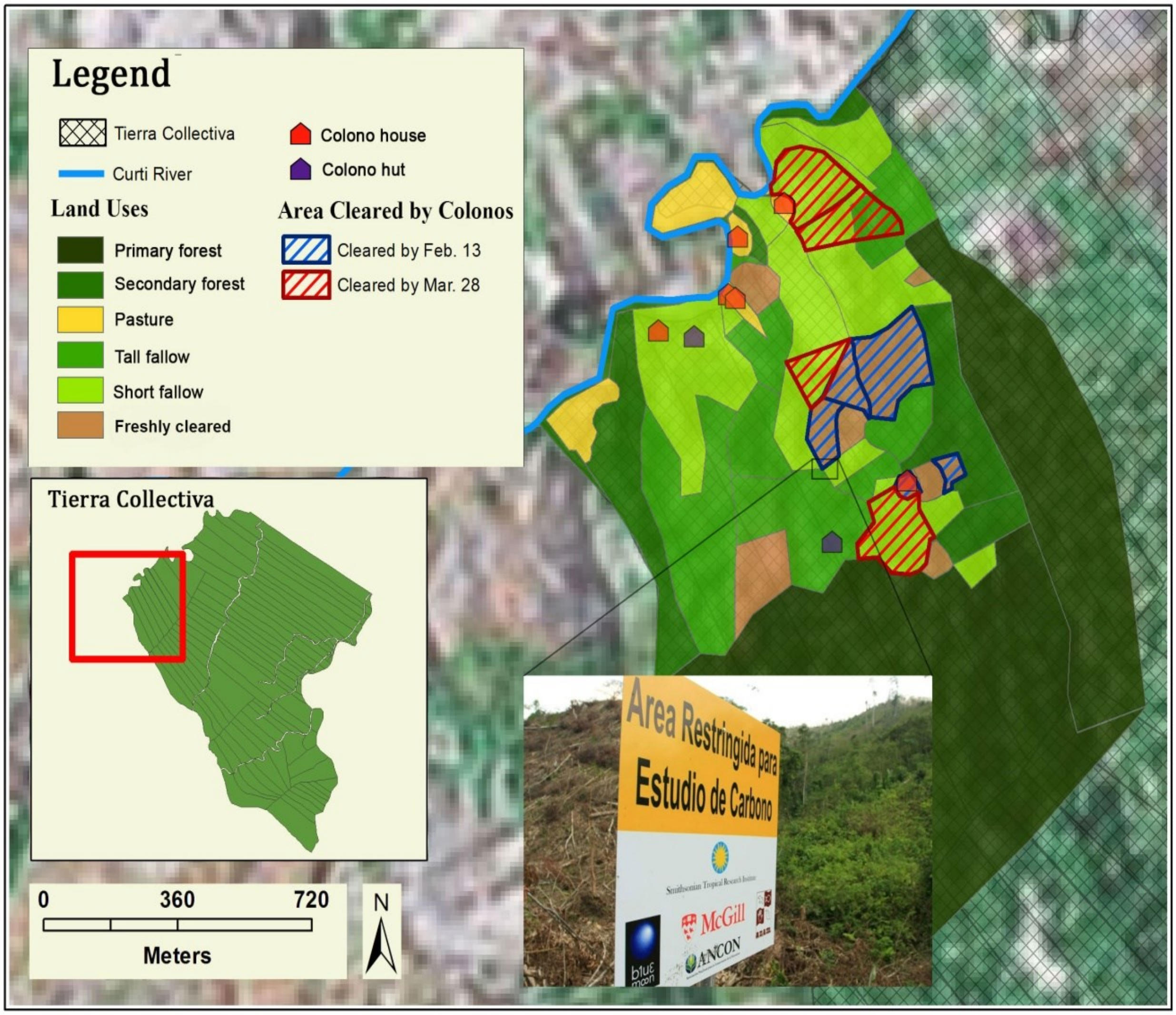
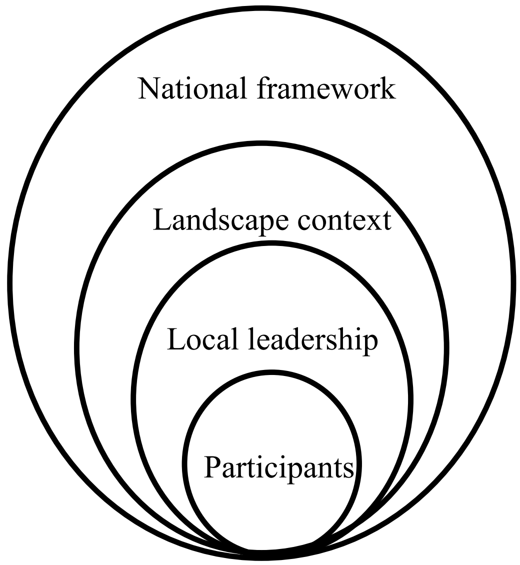


Figure 2: Map of the area where avoided deforestation parcels are located. The figure shows that despite participants' initiation of a forest monitoring and patrolling system, which included posting signs to delineate the avoided deforestation parcels, colonists continued to invade and clear the forest. The figure also identifies eight colonist families living inside the community area.



Observed barriers to implementation		***Emerging solutions***
Weak government support	→	REDD+ as part of the development agenda
Conflicting stakeholders desire	→	Mediation as a conflict resolution tool
Lack of leadership and capacity	→	Support from a bridging institution
Perceived risk for participation	→	Improved livelihood through agroforestry

Figure 3: Concept map showing REDD+ implementation considering a landscape approach and summary of observed barriers to REDD+ implementation and emerging solutions.

Table 1: Total number of interviews conducted, 2008-2012.

Interviewee	2008	2009	2010	2011	2012	Total
Former community chiefs	2	5				7
Current community chief	1	1	1	1	1	5
Current Alto bayano chief	1					1
Community-based NGO representative	1	1	3	2	2	9
National NGO representative	2	1	1			4
UN representative	1	1	1		1	4
The client representative	1	1	1		1	4
ANAM representative representative		3	2			5
Avoided deforestation participants		3	3			6
Reforestation participants		7	7	8	18	40
Colonists living adjacent to community border			10			10
Forest users (logging project)			6			6
Total	**9**	**23**	**35**	**11**	**23**	**101**

Table 2: Recomendations issued by "The Advisory Council on Conflict Resolution and REDD+" to the National Land Council Panamanian government (Consejo Consultivo en Resolución de Conflictos en REDD+, 2012).

1. The National Land Council should lead territorial conflict resolution following ANATI`s advises.
2. It is essential to precisely define territorial limits as proof of judicial processes that will determine a relocation and/or evictions decisions. The national Geographic Institute should be responsible for field analyses relying on geographical information, in coordination with the national Limits commission.
3. Where they don't exist, Municipal Courts should be created to manage territorial conflicts and mandate executions in coordination with responsible authorities.
4. It is imperative to harmonize the work of different government entities and clarify the legal context. Legal gaps and overlapping/conflicting legislation needs to be identified and corrected; clear rules defining institutional responsibilities that apply to land conflicts are a must.
5. ANATI should implement an extensive, and in depth, divulgation campaign to present, and clearly explain hierarchical order and institutional Government mandates pertaining to territorial conflict resolution, as well as, the corresponding processes to be followed.
6. The National Land Council should create a Follow up Agreement Commission.

7. The Advisory Council offers that its members be integrated to the Follow-up Agreement Commission because they are personally acquainted with territorial conflicts, they have received training and tools for their resolution through dialog, and have demonstrated genuine interest to reach consensual, and beneficial solutions for all parties involved.

Final Thesis Summary and Conclusions

A recent assessment of anthropogenic carbon dioxide (CO_2) in the atmosphere shows that emissions coming from deforestation and other land-use change represent 9.18% of global anthropogenic emissions (Le Quéré et al., 2015). Forest clearance and degradation also pose tremendous challenges to the provision of ecosystem services globally and locally (Foley, et al., 2007). Since 2005, the design of REDD+, a mechanism that aims to address the role of forests in climate change mitigation, has become strategic under the United Nations Framework Convention on Climate Change.

Through REDD+ implementation, it is expected that developing countries will receive incentives and results-based payments for carbon emission reductions (Angelsen & McNeill, 2012). In order to do so, countries are required to support local-level interventions where local small-medium farming and forest-dependent households and communities change existing practices and adopt practices that sequester carbon and conserve forests (Angelsen & Wertz-Kanounnikoff, 2008; Cronkleton et al., 2011). As land-use practices evolve to become compatible with REDD+, it is important to ensure that changes and interventions be successful at reducing emissions or sequestering carbon while not harming local communities and while respecting their traditional knowledge and livelihood practices as well as their access to land (Atela et al., 2015; Brown et al., 2008).

Discussions about REDD+ in the literature currently focus on analyzing early demonstration actions in order to understand what is enabling or hindering REDD+ implementation (Angelsen & Stibniati, 2009). REDD+ knowledge and advances of countries engaged in REDD+ Readiness or early implementation should indeed ensure a multi-loop learning (Armitage, 2008) that allows for adaptive management while learning-by-doing

(Armitage, 2008; Berkes, 2009; Olsson et al., 2004). Donor countries and developing agencies funding REDD+ Readiness will hopefully adopt flexible programme structures that allow for this approach and ensure building sustained capacities at national and local levels. In this context of intense learning and feedback between early implementation and policy development, my thesis seeks to bridge conservation and rural development by exploring how local communities can reduce emissions from deforestation, and benefit from carbon offset trading while improving local livelihoods.

The lessons accumulated over five years of conducting this thesis include a sense that agroforestry, a traditional livelihood strategy of rural communities throughout Latin America and elsewhere, offers an entry point to REDD+ by providing local and indigenous communities with means to engage in carbon offsetting initiatives without forfeiting access to, or benefits from, forests. Prior to my study, a major limitation to the use of agroforestry as a carbon sequestration strategy was the lack of available data on fruit tree species growth and species specific allometric equations. Recent efforts are expected to overcome this lack of information, for example that of GlobAllomeTree (2014), a platform to share data on allometric equations, which was initiated in 2013. However, most data available do not address fruit tree species. Chapter 1 helps overcome this limitation by modeling tree growth and carbon sequestration capacities of 29 species that are commonly used by small farming households in agroforestry systems. These data will enable projections of carbon sequestration in agroforestry plots in future REDD+ initiatives projects and effectively include agroforestry within REDD+ activities. More data will be needed for REDD+ Phase 3 research that will require measuring carbon outcomes of REDD+. Future research will therefore need to focus on methods and toolkits that allow rapid appraisal of carbon outcomes that assist countries and communities in decision-making, to focus on projections on which REDD+ activities will provide more carbon outcomes (emission reductions and enhancement of carbon stocks) and to calculate and incentive mechanisms accordingly.

After having worked on REDD+ for five years I contend that, if implemented well, REDD+ offers an opportunity for developing countries to benefit from a potential, novel emission trading scheme to increase financial flows that could combine forest conservation and rural development agendas (Agrawal, et al., 2011). Achieving positive carbon outcomes in marginalized rural settings is only one part of the REDD+ equation; delivering co-benefits and determining the right incentives for forest-dependent communities, most often poor, to effectively engage in REDD+ requires a multidisciplinary effort. The framework of best practices and assessment tool of indicators and criteria, developed in Chapter 2, offers a way to bridge these two different but complementary disciplines (forest conservation and rural development). Positive carbon outcomes will not be achieved if REDD+ is not addressed in a holistic way. A unique contribution of my thesis is to have shown how difficult REDD+ implementation is even when landowners have actively decided to protect forests. Land invasions and other institutional failures pointed to governance as the Achilles heel of REDD+.

I found that acknowledging the agents of deforestation – which as we saw in Chapter 3 are not always those actors holding either customary or legal land rights – and their decision-making strategies for land-use and land-use change is as important as understanding the drivers of deforestation. Decision-making processes at the local level are driven by a combination of socio-cultural as well as political and economic factors. These factors and the various land-users should be better acknowledged and understood at a landscape level approach to design sound REDD+ implementation strategies that enable addressing the underlying causes of deforestation and degradation. In fragile states, REDD+ will require designing the right combination of policy measures and incentives that address the underlying causes of deforestation, such as perverse incentives of land tenure (Karsenty & Ongolo, 2012). Further research should seek to understand which set of policy measures and national institutions are needed to ensure that REDD+ implementation at the local level best reconciles national level policies and institutions with local interests. Particularly, research into the right combination of "sticks" and "carrots" as well as capacity needs that lead to positive changes is needed. Further advances in REDD+ research along these lines would assist in tackling the most important ecological challenges of this decade, namely climate change and forest loss.

Further research advances are still needed in order to identify ways in which local and indigenous communities could benefit from implementation of the REDD+ mechanism. It is crucial to acknowledge that implementing REDD+ not only requires addressing equitable benefit redistribution and livelihoods, but demands the adaptation of national institutions that support REDD+ implementation. Research on how different carbon ownership arrangements affect equitable benefit-sharing amongst national governments and local communities is also required for REDD+ (see for example, Corbera et al., 2011; Peskett & Brodnig, 2011).

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Appendix A: Plot Design and Participatory Methods

Establishment of agroforestry systems for carbon sequestration

Prepared by Kirsten Wiens and Ignacia Holmes

To design the agroforestry systems, a participatory capacity building workshop, open to anyone interested in the community, was undertaken with the aim of building capacity in designing and managing agroforestry systems that integrate traditional practices. Each day of the workshop began with a trip to two different agroforestry plots near the community to discuss their characteristics, advantages, disadvantages, similarities and differences. Participants received notebooks in which they wrote observations, drew pictures of the plots and took notes (Figure A.1). They then returned and discussed as a group what was seen in the fields, and a presentation was given related to what was seen that day and how it applied to their own agroforestry systems.

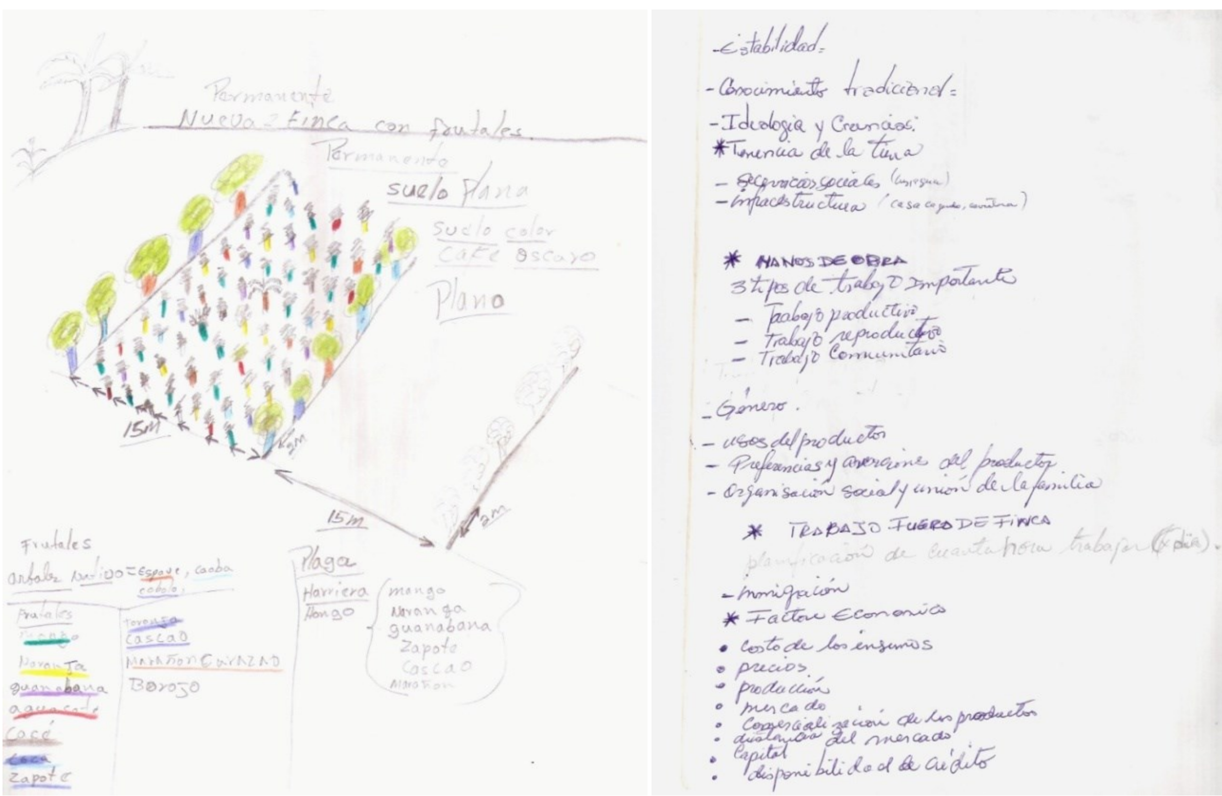


Figure A.1: Samples from notebooks, drawn by participants

At the end of the workshop, participants selected a four-storey agroforestry system - including timber species, fruit trees, palms and understory trees (trees categorized by participants themselves). This system was the best option for sequestering carbon while also being appropriate to the community's cultural practices, as Emberá traditionally maintain agroforests and home gardens. Each participant designed his/her own agroforestry plot in his/her notebook. They were able to look back through their notebooks at what they had seen and learned throughout the workshop about agroforestry and different plots in the community and then decide the tree type and placement on their own plot of land. Criteria were developed with them in the workshop for the kinds of trees they could use and the spacing in their plots. Lists were made of tree species locally planted (Table C.1, see Appendix C). These were classified into wood trees, fruit trees and other uses. To participate in the project participants had to select at least ten different species for their plot. In addition, distances between different types of trees were measured in the traditional systems in the community. It was determined that trees would be place 4m apart, with 12m between each of the wood trees and a variety of species in each row. An example of a notebook design is shown in Figure A.2 below. Of the participants, seven decided to participate in the project. A budget was drawn out with them containing a list of activities and resources needed for the project. Later a calendar was made together to determine dates by which each of the activities had to be completed.

Transect walks were carried out with individual participants to evaluate the characteristics of their plots of land. A transect walk involves walking through the plot with the owner, observing it with them and asking questions along the way (FAO 1997). This includes touching the soil and asking what kind of chemicals have previously been used and what was previously grown there.

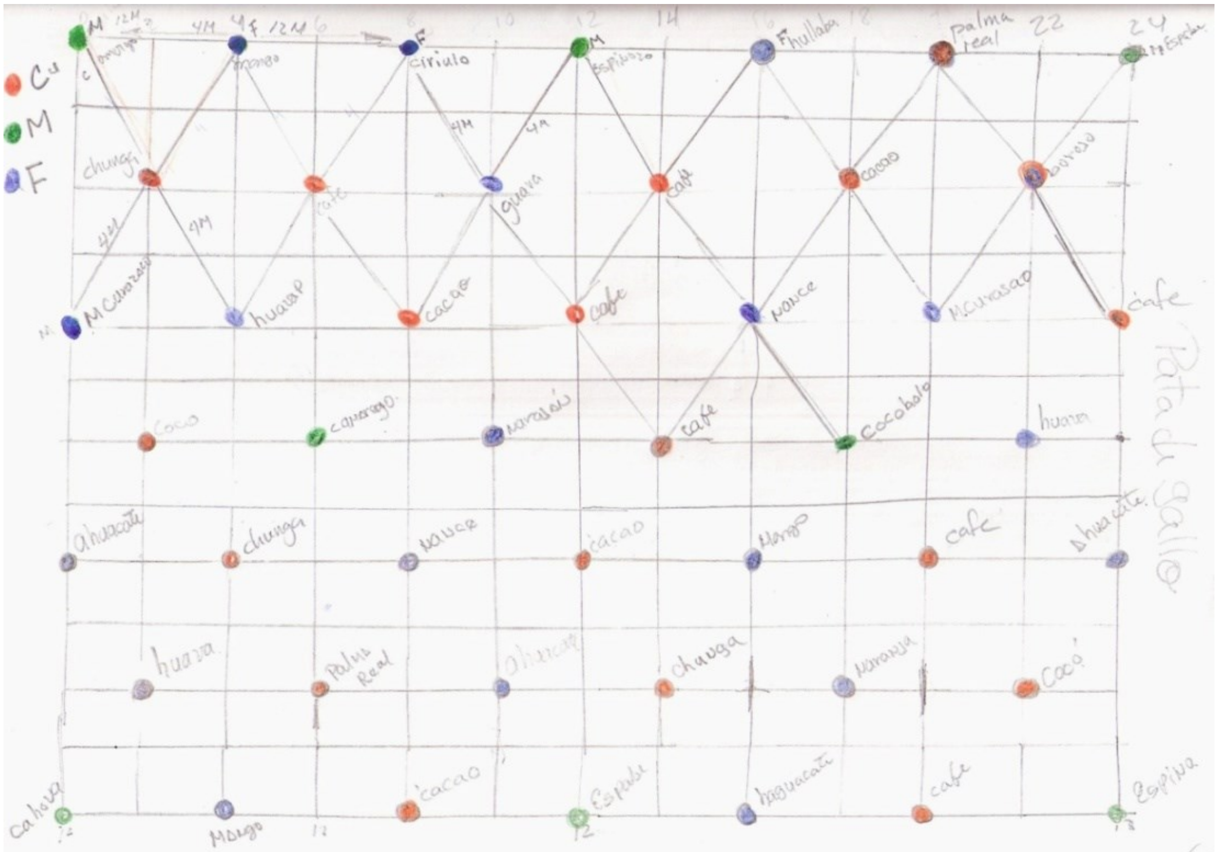


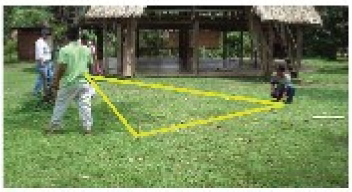
Figure A.2: Sample of plot design, drawn in notebook by a participant

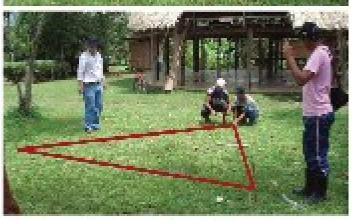
A second capacity building workshop with an agroforestry expert was carried out with the aim of building participants' capacity in measuring distances between stakes and planting the seedlings properly. The workshop involved a discussion and explanation of agroforestry plots and planting and measuring techniques. Participants then formed groups to practise the techniques there on the field. They were given a seeding manual in order to help them with the planting (Figure A.3). The workshop ended with a group discussion in which participants could share thoughts or ask questions.

Manual de siembra

1. Prepare su terreno, esto incluye limpieza, desmalezado. Si usará químicos debe dejar al menos dos semanas antes de poner las plantas, sino éstas se quemarán.

2. Ponga las estacas en el terreno en formato tres bolillos usando el triangulo que preparamos (ver figura).

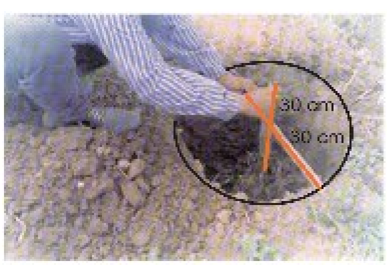




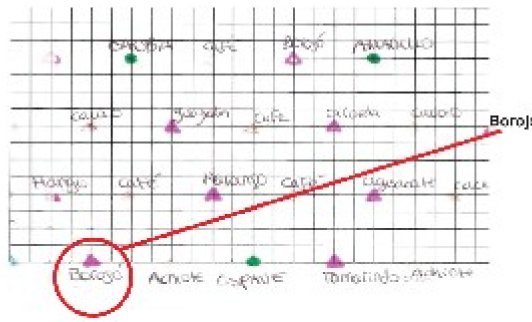
3. Marque las estacas según los colores de su diseño con cinta.

4. Hoyado: comience el hoyado una vez que tenga las plantas en su parcela y vaya haciendo el hoyo a medida que vaya plantando, si hace los hoyos antes perderá mucha tierra.

5. El hoyo debe ser de 30 cms de ancho y de profundidad, para esto es mejor marcar un palo o estaca con el tamaño del hoyo, haga el hoyo dejando la estaca al centro.



6. Identifique en su diseño la planta que le toca poner.



7. Coloque 5 cucharaditas de abono en el hoyo, para los frutales y 3 para los forestales.

8. Llene el hoyo un poco con tierra suelta.

9. Ponga la planta en el centro del hoyo y llene con tierra. Asegurese de que quede a nivel del suelo.

10. 

Apisone para que las raíces de la planta queden en contacto con la tierra.

11. Pase al árbol que sigue en su diseño.

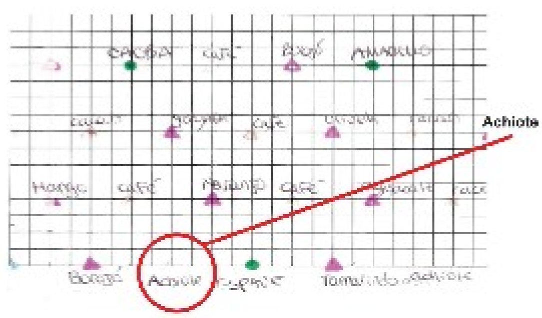


Figure A.3: Seeding manual given to participants

The final step was to transcribe the notebook designs onto maps for the participants. Throughout the course of the project, individual and group discussions took place to better understand how each participant wanted their plot to be and to make sure that they understood everything that was being done. Several species were larger than others or needed more light to grow and thus needed to be spaced carefully in the designs. With the notebooks, conditions made in the original workshop and knowledge gained through participatory measures thereafter, a design was drawn out for each individual participant. Designs were distributed in a meeting of participants in which a final explanation and time for questions and discussion were given.

Each owner was responsible for the cleaning and planting of their plot. Seedlings were distributed directly to each owner. A portion of the seedlings was grown in a community nursery that was cared for by the participants and several community members. The other portion was bought in another nursery and transported to the community. Responsibility was then given to the members of the local NGO to ensure that the rest of the activities set out in the calendar were carried out appropriately and on schedule.

This project is part of a carbon initiative with the Smithsonian Tropical Research Institute. STRI buys 4,620 tCO2e yr^{-1} over a course of three years from the Ipetí community to offset its emissions. About 1320 tCO2e yr^{-1} are from reforestation and about 3300 tCO2e yr^{-1} are from avoided deforestation. The community receives US$100 for each hectare of deforestation avoided each year and US$4500 for each hectare of reforestation with wood tree plantations over 25 years. STRI pays about US$10.22/t CO2 reforestation and the total payment is distributed over the first three years. Originally the community was going to reforest with wood tree plantations. However, they expressed interest in using alternative agroforestry systems with fruit trees instead, as it can improve their livelihood by consuming and selling their products. An agroforestry plot does not sequester as much carbon as a wood tree plot and therefore more hectares are needed to equal the carbon for the agreement with STRI. Using data collected by Kirby and Potvin (2007) it was determined that wood tree plantations sequester about 440 tCO2/ha and agroforestry systems sequester about 125 tCO2/ha. Therefore we need about 1.75 ha agroforestry for each ha of wood trees and STRI will pay an equivalent of about US$2565/ha agroforestry reforestation.

Impact Ladder

The Impact Ladder is a useful method for qualitative comparison of a before-and-after situation according to a specific indicator (Guijt, 1998). This method was used to gather data on the economic impact of agroforestry in terms of income generation at the household level. The exercise was carried out based on the steps suggested by Guijt (1998). First a ladder of ten steps is drawn on paper, step one being the lowest income and step ten the highest income (Figure A.4). The ladder is divided in two vertically, to indicate before and after. Participants are provided with beans and asked where, in terms of income, their family was before and after agroforestry diversification. They place their beans on the ladder and are then asked to expand and clarify their answers.

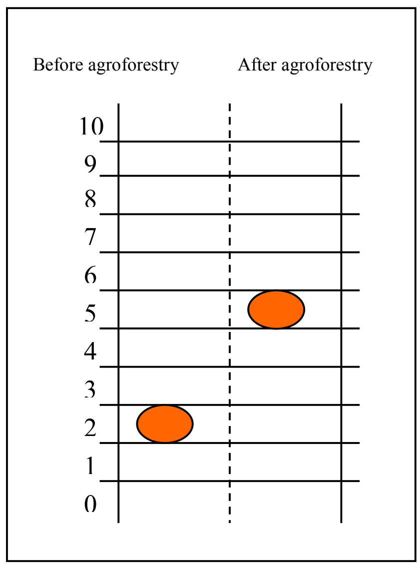


Figure A.4. Example of the Impact Ladder method

Source: Adapted from Guijt (1998, p. 84)

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Appendix B: Calculations – Logistic growth Curves

Diameter at Breast Height (DBH) Logistic Growth Curves

Table B.1: Data used to build the logistic growth curves for all species

Sp	Age	Mean DBH	Data Source*	R2	Growth Rate (a)	Inflection Point (b)	Asymptote (c)
Persea Americana	1	1.124	1	0.997	0.251	11.588	31.156
	3	3.952	1				
	12	16.33	2				
	23	29.5	2				
Cedrela odorata	1	2.085	1	0.992	0.362	9.277	31.439
	3	2.462	1				
	12	23	2				
	23	29.5	2				
	25	33	2				
Bixa orellana	1	1.5338	1	0.985	0.282	6.66	14.898
	3	4.759	1				
	12	12	2				
	36	15	2				
Pachira quinata	1	1.196	1	0.998	0.324	8.684	21.512
	3	3.266	1				
	12	16	2				
	20	21	2				
Anacardium excelsum	1	1.309	1	0.987	0.185	14.392	46.141
	3	4.472	1				
	12	20.333	2				
	20	32	2				
	28	43.666	2				
Annona muricata	1	0.991	1	0.993	0.164	17.949	23.367
	3	2.244	1				
	20	13	2				
	22	16.33	2				
	25	17.5	2				
Inga spectabilis	1	0.656	1	0.992	0.454	6.979	30.307
	3	4.9848	1				
	12	27.333	2				
	22	28.8	2				
	25	31.894	2				
Citrus sinensis	1	0.5	1	0.991	0.282	10.532	16.447
	3	1.922	1				
	15	13.137	2				
	22	14.785	2				
	25	16	2				
	33	17.357	2				
Byrsonima crassifolia	1	1.334	1	0.995	0.314	8.222	25.824
	3	5.033	1				
	12	19.666	2				
	25	25.75	2				
Fam Arecaceae	3	5.17	1	0.999	0.2	9.553	24.524
	20	22	2				
	25	23.125	2				

	33	24.5	2				
Tabebuia rosea	2	3.85	2	0.984	0.1733	13.204	43.056
	3	6.202	2				
	4	7.662	2				
	5	9.523	2				
	6	9.85	2				
	7	11.797	2				
	8	12.071	2				
	9	13.059	2				
	16.5	27.6	2				
Fam Anarcadiacea	1	1.443	1	0.983	0.31	9.848	31.592
	3	3.407	1				
	14	25.066	2				
	25	27.956	2				
	33	32.4285	2				
	36	33.833	2				
Fam Anonaceae	1	0.991	1	0.993	0.164	17.949	23.367
	3	2.244	1				
	20	13	2				
	22	18	2				
	25	24	2				
Fam Bombacaceae	1	1.196	1	0.998	0.324	8.684	21.512
	3	3.266	1				
	12	16	2				
	20	21	2				
Fam Fabacea	1	0.656	1	0.992	0.454	6.979	30.307
	3	4.9848	1				
	12	27.333	2				
	22	28.8	2				
	25	31.894	2				
Fam Meliacea	1	2.085	1	0.992	0.362	9.277	31.439
	3	2.462	1				
	12	23	2				
	23	29.5	2				
	25	33	2				
Fam Myrtacee	1	0.779	1	1	0.79	4.643	14.666
	3	3.2069	1				
	22	14.666	2				
	25	22.5	2				
Coffea spp.	1	0.7	1	0.999	0.351	7.741	7.71
	3	1.193	1				
	12	6.307	2				
	25	7.69	2				
Fam Rubiaceace	1	0.7	1	0.999	0.351	7.741	7.71
	3	1.193	1				
	12	6.307	2				
	25	7.69	2				
Fam Sapotaceae	3	2.6353	1	1	0.284	12.243	39.311
	15	27	2				
	25	38.3	2				
	33	31	2				
eobroma cacao	1	0.651	1	0.999	0.434	7.322	12.474
	3	1.71	1				

	15	12.018	2				
	33	12.5	2				
Melicoccus bijugatus	1	0	1	0.994	0.185	18.056	17.852
	3	1.64	1				
	22	12	2				
	25	14	2				
Terminalia Amazonia	2	1.19	3	0.987	0.344	8.539	34.392
	3	4.03	3				
	4	6.41	3				
	5	8.28	3				
	6	10.97	3				
	7	13.80	3				
	8	15.48	3				
	9	17.28	3				
	16.5	32.50	4				
Dalbergia retusa	2	3.156	3	0.988	0.35	5.974	18.669
	4	6.594	3				
	5	8.508	3				
	6	9.163	3				
	7	10.368	3				
	8	12.238	3				
	9	14.35	3				
	16.5	18.2	4				

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(2) Kirby K.R, Potvin C. (2007) Variation in carbon storage among tree species: implications for the management of a small-scale carbon sink project. Forest Ecology and Management 246: 208-221.

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Fam: Species Family

Table B.2: Details on data used to develop logistic diameter at breast height models for each species. For 27 species, we used data from the study site (Kirby and Potvin 2007). For three species, we did not have local data in which case growth data from a nearby research site (Potvin et al., 2011) or another tropical site (Piotto et al. 2006), were used. For two species, we could not find growth data.

Growth Data details	Common Name	Scientific Name	Family	Species and data source(s) for growth curve
Specie-specific logistic growth model	Aguacate	*Persea americana*	Lauraceae	Species-specific[a]
	Cedro Amargo	*Cedrela odorata*	Meliaceae	
	Achiote	*Bixa orellana*	Bixaceae	
	Cacao	*Theobroma cacao*	Sterculiaceae	
	Café	*Coffea spp.*	Rubiaceae	
	Cedro Espino	*Pachira quinata*	Bombacaceae	
	Espave	*Anacardium excelsum*	Anacardiaceae	
	Guanábana	*Annona muricata*	Annonaceae	
	Guava	*Inga punctata*	Fabaceae-mimosidae	
	Mamón	*Melicoccus bijugatus*	Sapindaceae	
	Naranja	*Citrus sinensis*	Rutaceae	
	Nance	*Byrsonima crassifolia*	Malpighiaceae	
	Amarillo	*Terminalia amazonia*	Combretaceae	Species-specific[b,c]
Family growth curve	Anon	*Annona reticulate*	Annonaceae	*Annona muricata*[b]
	Borojo	*Borojoa panamensis*	Rubiaceae	Coffea spp. [b]
	Caoba	*Swietenia macrophylla*	Meliaceae	*Cedrela odorata* [b]
	Ciruela	*Spondias purpurea*	Anacardiaceae	*Mangifera indica, Anacardium excelsum* and *Syzygium malaccense* (combined) [b]
	Mango	*Mangifera indica*	Anacardiaceae	
	Marañon curazao	*Syzygium malaccense*	Anacardiaceae	
	Coco	*Cocos nucifera*	Arecaceae	*Cocos nucifera* and *Bactris gasipaes* (combined)
	Pifá	*Bactris gasipaes*	Arecaceae	
	Caimito	*Chrysophyllum cainito*	Sapotaceae	*Chrysophyllum cainito* and *Pouteria sapota* (combined)

	Mamey	*Pouteria sapota*	Sapotaceae	*Psidium guajava* and 'Guayabillo' (no-id)
	Guayaba	*Psidium guajava*	Myrtaceae	*Psidium guajava* and 'Guayabillo' (no-id)
	Poma Rosa	*Syzygium jambos*	Myrtaceae	
	Sapote	*Matisia Cordata*	Bombacaceae	*Pachira quinata*
	Tamarindo	*Dialium guianense*	Fabaceae-caesalpinioideae	*Inga punctate*
	Cocobolo [b, c]	*Dalbergia retusa*	Fabacea-papilionoideae	*Dalbergia retusa* for the first 12 years [b] and for *Dipteryx oleifera* for 16.5 years [c]
	Roble [b, c]	*Tabebuia rosea*	Bignoniaceae	*Tabebuia rosea* for the first 12 years [b] and for Jacaranda copaia 16.5 years[c]
Data not available	Fruta de mono	*Garcinia intermedia*	Clusiaceae	NA
	Icaco	*Chrysobalanus icaco*	Chrysobalanus	

[a] Kirby K.R, Potvin C. (2007) Variation in carbon storage among tree species: implications for the management of a small-scale carbon sink project. Forest Ecology and Management 246: 208-221.

[b] Potvin C, Mancilla L, Buchmann N, Monteza J, Moore T, Murphy M, Oelmann Y, Scherer-Lorenzen M, Turner BL, Wilcke W, Zeugin F, Wolf S. (2011) An ecosystem approach to biodiversity effects: Carbon pools in a tropical tree plantation. Forest Ecology and Management: 1614-1624.

[c] Piotto D, Craven D, Montagnini F, Alice F. (2010) Silvicultural and economic aspects of pure and mixed native tree species plantations on degraded pasturelands in humid Costa Rica. New Forests 39-3: 369-385.

Appendix C: Master List of Species

Table C.1: Complete list of species planted, reasons for selecting the species, percentage of participants that planted each species and number of participants that mentioned the species as the most preferred.

CommonName	Code	ScientificName	Reasons to choose (uses)	Number of participants	Percentage c	Most preferred (Freq)	Least preferred (Freq)
Aguacate	AG	Persea americana	HC, ES	11	100	8	0
Amarillo	AM	Terminalia amazonia	W	9	82	1	0
Anon	AN	Annona reticulate	DK	3	27	0	1
Cedro Amargo	AR	Cedrela odorata	W	7	64	1	0
Achiote	AT	Bixa orellana	S	10	91	3	1
Borojo	BO	Borojoa panamensis	HC, ES, M	10	91	7	0
Caoba	CB	Swietenia macrophylla	W	7	64	0	0
Cacao	CC	Theobroma cacao	HC	11	100	2	1
Café	CF	Coffea spp.	HC, ES	11	100	8	1
Ciruela	CI	Spondias purpurea	ES	3	27	0	0
Caimito	CM	Chrysophyllum cainito	HC, T	3	27	0	2
Cocobolo	CO	Dalbergia retusa	W, ES, C, T, H	10	91	10	0
Cedro Espino	EN	Pachira quinata	W	10	91	1	2
Espave	EV	Anacardium excelsum	W	10	91	4	0
Fruta Mono	FM	Garcinia intermedia	T	4	36	0	0
Guanábana	GB	Annona muricata	HC, ES, M	11	100	5	0
Guava	GV	Inga spectabilis	HC	10	91	5	0
Guayaba	GY	Psidium guajava	S, M	3	27	0	2
Icaco	IC	Chrysobalanus icaco	DK	1	9	0	1
Mango	MG	Mangifera indica	HC, S	9	82	0	0

Mamón	MN	Melicoccus bijugatus	HC, S	2	18	0	1
Marañon_curazao	MR	Syzygium malaccense	HC, M, S	6	55	0	0
Mamey	MY	Pouteria sapota	HC, S	3	27	2	0
Naranja	NA	Citrus sinensis	HC, ES	10	91	8	0
Nance	NC	Byrsonima crassifolia	HC, S	6	55	0	1
Coco	OC	Cocos nucifera	HC, S	4	36	2	0
Pifá	PB	Bactris gasipaes	HC, S	6	55	2	0
Poma Rosa	PM	Syzygium jambos	DK	2	18	0	2
Roble	RO	Tabebuia rosea	W	8	73	1	0
Sapote	SA	Matisia Cordata	HC, ES	5	45	5	0
Tamarindo	TA	Dialium guianense	ES	4	36	3	0

Abbreviations: HC: Household Consumption, S: Sell, ES: Easy to sell (i.e., those with better prices in the market or an established local market easy to sell); W: Wood, DK: Don´t Know, T: Traditional, M: Medicinal, C: Construction, H: Handicraft, N: Native; I: Introduced

[b] : Number of participants that planted the species

[c]: percentage out of the number of participants that planted the species n=11

Grey filling shows the most preferred species

Appendix D: Household Demographics and Assets

Table D.1: Demographic and economic characteristics for participants in the agroforestry-carbon offset initiative compared to participants in the timber-carbon-offset project and to non-participants by wealth group and total in 2009 (values shown are mean and (±Standard Deviation- SD, unless stated otherwise). Letters a, b, c indicate significant differences in post-hoc comparison.

	Richer (n =9)	Intermediate (n =8)	Poor (n =11)	Participants-Agroforestry (n=11)	Participants-Timber (n=4)	ANOVA (F-value)
Total Household size [d]	7.44(±4.24)	7.00(±3.70)	5.27(±1.27)	5.81(±3.15)	7.50(±1.73)	0.73
Male labour (15-64 years)	7.44(±4.24)	7.00(±3.70)	5.27(±1.27)	5.81(±3.15)	7.5(±1.73)	1.52
Female labour (15-64 years) [d]	2.11(±1.45)	2.37(±1.59)	1.0(±.044)	1.27(±0.78)	2.5(±1.91)	2.31
Children (<15 years)	2.88(±2.57)	2.87(±2.23)	2.54(±1.50)	2.45(±2.01)	2.00(±1.15)	0.18
Elderly (> 64 years)	0	0.25(±0.46)	0.27(±0.64)	0.36(±0.80)	0.50(±0.57)	4.10 [e]
Age head household	51.11(±10.06)	49.87(±16.96)	46.36(±15.48)	45.81(±13.86)	48.75(±14.52)	0.24
Dependency ratio	0.55(±0.72)	0.85(±0.69)	1.2(±0.91)	1.0(±0.66)	0.75(±0.50)	0.97
Economic						
value of non-land assets ($)[d]	2275.33(±2721.19) A,B	506.13(±424.72) B,C	438.91(±441.65) C	1184.80(±721.46) A,B,C	5431.50(±7847.48) A	5.64*
Value livestock ($)[d]	4683.89(±9869.95) A	316.25(±370.61) A,B	217.73(±290.80) B	212.50(±160.68) B	7278.75(±4879.26) A	4.26*
Value productive capital ($)[d]	463.88(±571.33) A,B	25.00(±70.71) B	90.90(±285.104) B	515.00(±568.77) A	175.00(±350.00) A, B	4.26*

Value consumer durables ($)[d]	1407.56(±2438.66) A	232.38(±143.95) A,B	123.91(±68.64) B	365.30(±487.10) A,B	4322.75(±7715.04) A	4.77*
Total annual income, median ($)	6069 A	2408 A,B	1224 A,B	887.5 B	4043 A,B	4.13*

[a] non-land assets include all household possessions; [b] value of productive capital include all household resources used for productive purposes such as those used in agriculture and commerce; [c] Significance level: * < 0.05, ** < 0.01, *** <0.001; [d] data was log transformed for normality; [e] Non-parametric Kruskal-Wallis test was performed as despite transformation data did not comply with assumption of normality, Chi-Square value is shown

Table D.2: Land holding characteristics of participants in the agroforestry-carbon offset initiative compared to participants in the timber-carbon-offset project and to non-participants by wealth group and total in 2009 (values shown are mean and (±Standard Deviation- SD, unless stated otherwise). Data were log transformed to comply with the assumption of normality.

	Richer *(n =9)*	Intermediate *(n =8)*	Poor *(n =11)*	Participants-Agroforestry (n=11)	Participants-Timber (n=4)	ANOVA (F-value)
Total (ha)	3.74(±0.82)	1.97(±2.12)	1.70(±1.98)	2.53(±20.9)	2.81(±1.89)	1.71
Tall fallow (ha)	1.90(±1.21)	0.75(±1.25)	1.15(±1.38)	1.55(±1.45)	2.33(±1.60)	1.31
Pasture (ha)	12.11(±19.07)	10.11(±14.48)	6.07(±10.45)	3.04(±5.47)	8.04(±10.49)	0.37
Forest (ha)	2.59(±1.35)	1.45(±1.59)	0.86(±1.22)	1.78(±2.04)	1.16(±1.35)	1.62
Cropland/Short fallow (ha)	1.55(±1.40)	0.67(±0.87)	0.48(±1.12)	0.72(±1.26)	0.00	1.69
Plantation (ha)	0.42(±0.59)	0.30(±0.61)	0.28(±0.76)	0.027(±0.061)	0.83(±0.95)	1.41
Forest (%)	44.21(±33.41)	21.27(±31.91)	12.66(±22.16)	31.75(±38.78)	13.84(±17.45)	1.67
Tall Fallow (%)	20.90(±20.95)	7.09(±15.81)	15.32(±20.35)	21.17(±29.78)	38.83(±27.39)	1.46
Cropland/Short fallow (%)	17.04(±28.56)	4.06(±7.38)	4.83(±13.02)	7.32(±18.81)	0.00	1.71
Plantation (%)	2.12(±3.71)	1.03(±2.33)	1.71(±5.22)	0.03(±0.09)	6.09(±7.05)	1.94
Pasture (%)	15.71(±23.59)	16.52(±24.14)	10.91(±18.90)	3.33(±5.82)	16.22(±19.08)	0.43

[a] non-land assets include all household possessions (full list available in Appendix X)
[b] value of productive capital include all household resources used for productive purposes such as those used in agriculture and commerce
[c] Significance level: $^{*} < 0.05$

Appendix E: Application of risk factors to Afforestation/Reforestation

Source: Voluntary Carbon Standard . (2008). Tool for AFOLU Non-Permanence Risk Analysis and Buffer Determination: VCS Association. Page 5

Risk factor Risk - Rating

Project longevity/ Commitment period
Long-term commitment (i.e., many decades or unlimited) with no harvesting **- Low**
Long-term commitment with no harvesting in politically unstable countries - **Medium**
Long-term commitment with harvesting - **Medium**
Medium-term commitment with harvesting - **High**
Medium-term commitment (i.e., a few decades) with no harvesting - **High**
Short-term commitment with or without harvesting - **Fail**

Ownership type and user rights
Established NGO or conservation agency owner; or owner-operated private land - **Low**
Rented or tenant-operated land - **Medium**
Clear land tenure but disputed land-use rights - **High**
Uncertain tenure but with established user rights - **High**
Uncertain land tenure and no established user rights - **Fail**

Technical capability
Proven technologies and ready access to relevant expertise - **Low**
Technologies proven to be effective in other regions under similar soil and climate conditions, but lacking local experimental results and having limited access to relevant expertise - **Medium**

Financial capacity
Financial backing from established financial institutions, NGOs and/or governments - **Low**
Long-term project funding not secured - **Medium**

Management capacity of project developer
Substantial previous project experience (≥ 5 projects) with on-site management team -**Low**
Limited project experience (<5 projects) with on-site management team - **Medium**
Limited project experience (<5 projects) without on-site management team - **High**

Future income
Appropriate management plan, and financial analysis demonstrates that likely income stream(s) will finance future management activities (e.g.,carbon finance to be used for project management, tending operations, etc.) - **Low**
Future costs and revenue stream(s) not documented - **High**

Future/current opportunity costs
Alternative land-uses are unlikely to become attractive in the future - **Low**
Project is competing with other land-uses likely to become more attractive in the future -**High**

Endorsement of project or land-use activity by local population and local/national political establishment
Endorsement given and not likely to change in the future - **Low**
Endorsement given but may be subject to change in the future - **Medium**
No endorsement given -**High**

Table 3: Default buffer withholding percentages for ARR projects

ARR Risk Class	Buffer Range
High	40-60%
Medium	20-40%
Low	10-20%

Appendix F: Detailed Methodology

EXTRACTING BEST PRACTICES FROM THE LITERATURE

To identify best practices regarding implementation of conservation and rural development, a qualitative research synthesis that combines results from several studies in a qualitative fashion was carried out (Howell Major & Savin-Baden 2010). We followed the meta-ethnography approach developed by Noblit and Hare (1988) to conduct a comparative analysis of published studies, using the coding system of Auerbach and Silverstein (2003), together with classification and connection procedures suggested by Dey (1993) (see Figure E.1).

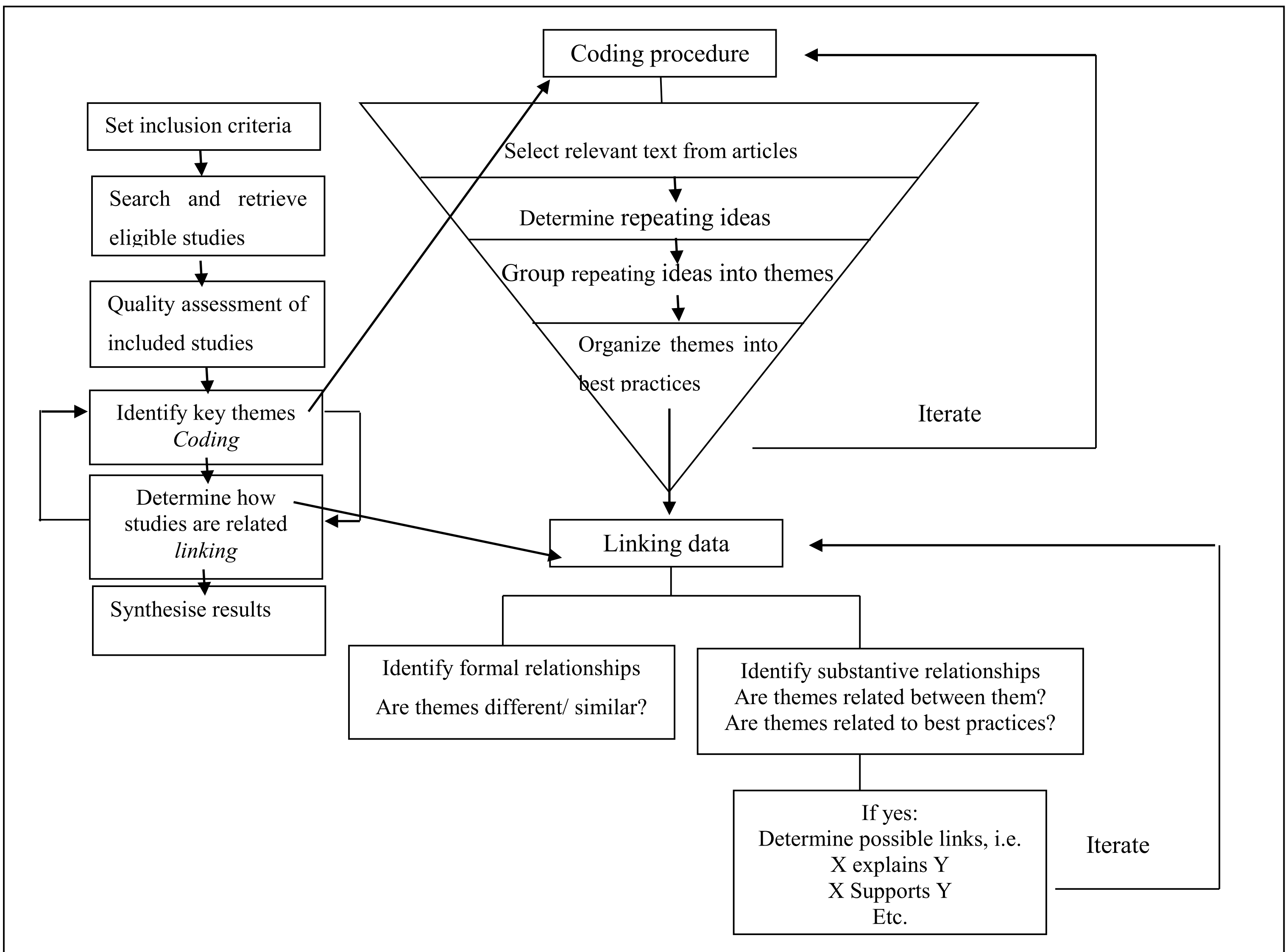

Figure E.1. Qualitative Research Synthesis Approach (adapted from, Auerbach & Silverstein 2003; Dey 1993; Munro et al. 2007; Noblit & Hare 1988)

As the initial step in our analysis, we conducted a broad search of documents informing on best practices when implementing Community Based Conservation, Integrated Conservation and Development, and Rural Development projects, which are hereafter referred to as the 'bodies of literature.' To search and retrieve eligible articles, we used Web of Science, Google Scholar and the McGill University library catalogue. Different combinations of search terms were entered, including success factors, implementation, rural development, and community based conservation, among others. We also checked the references that were cited in the articles, together with who had cited them. Searches were completed by June 2012. Selected documents met several criteria. They had to be (1) written in English, (2) published after 1980, (3) focused on developing countries, and where relevant, (4) pertained to forest conservation. This search produced 95 documents, including articles published in peer-reviewed journals, books and book chapters, and gray literature from global research institutions that had been cited in peer-reviewed documents. We selected 22 of these articles to initiate the analysis.

Coding of documents was achieved by: (1) selecting *relevant text* (verbatim passages from the documents relating to our research questions); (2) identifying *repeating ideas* (phrases from relevant texts that were repeated in at least two documents); (3) grouping ideas into *themes* (common subjects that cluster repeating ideas); and (4) organizing themes into *theoretical constructs,* namely our best practices (see Table E.1 for a coding example) (Auerbach & Silverstein 2003). We also identified factors or conditions that influenced the best practices by developing a logical hierarchy of supra- and sub-categories and determining relationships between the identified themes and best practices (Dey 1993). Theoretical saturation, viz., when the addition of new research samples does not provide new information that would improve our understanding of best practices (Auerbach & Silverstein 2003), was reached after analyzing 19 documents (refer to Table E.2 for the documents that were included in the analysis).

Table A.1: Example of coding

What are best practices for implementing current approaches to conservation and rural development that might be applicable to REDD+?				
Relevant text	Repeating idea	Themes	Theoretical construct Iteration 1	Best practice Final iteration
Experience gained during implementation can provide the necessary information for policymakers to act… An amendment to the project budget included several conditions precedent to deal with such constraints (Gow & Morss 1988, p.1402).	Adapt project strategy based on lessons learnt from implementation	Adaptive management	Adopt an adaptive and learning based approach to project implementation	Adopt an adaptive management approach to implementation
…the members become better at making decisions only through their involvement in a learning by doing process (Haque et al. 2009, p.561)	Decision making based on learning by doing			

Table E.2: Documents included in the qualitative research synthesis by type of document and body of literature

Type of articles	Body of Literature	Number of case studies	References
Theoretical studies	RD	Not applicable	Gow & Morss (1988) Tacconi & Tisdell (1992) Ashley & Maxwell (2001)
	CBC		Seymour (1994) Western (1994) Berkes (2004) Pretty & Smith (2004) Kaimowitz & Sheil (2007)
	ICD		Brown (2002) Garnett et al. (2007)
Field work	RD	30	Uphoff et al. (1998)
		46	Zoomers (2005)
	CBC	1	Thakadu (2005)
	ICD	57	Shahbaz et al. (2011)
Lessons applied to REDD+	CBC	Not applicable	Agrawal & Angelsen (2009) Hayes & Persha (2010) Cronkleton et al. (2011)
	ICD		Brandon & Wells (2009) Blom et al. (2010)

RD: Rural Development; CBC: Community-based Conservation; ICD: Integrated Conservation and Development

We were interested in determining if the three different 'bodies of literature' (as described above) that were included in the analysis concurred on the best practices. We also wanted to test if different types of studies also agreed in terms of the identified best practices. Thus, we further grouped the documents into three types (hereafter 'type of document'): (a) theoretical studies, where documents outlined the principles for successful implementation from the different 'bodies of literature,' but were not themselves based on primary fieldwork; (b) field work, i.e., documents presenting results from case studies (single, multiple, or meta-analysis); and (c) lessons applied to REDD+, i.e., those that described the success factors of the different 'bodies of literature' in the context of REDD+. Once best practices were determined, we used a binary scoring approach where "1" was assigned when documents addressed the best practice and "0" when they did not.

To verify whether a 'body of literature' has an effect on the frequency of addressing the best practices, we performed contingency table analysis and used Fisher's exact test (3 x 2 table), where the rows represented the three different 'bodies of literature' and the column represented Yes or No responses with respect to addressing the best practices. The same procedure was followed to test if the 'type of document' affected the frequency of addressing the best practices. To determine statistically significant associations between the different best practices that were identified, we conducted contingency table analysis and used Fisher's exact test (2 x 2 table) (Conover 1980). All statistical analyses were performed in SAS (SAS Institute 2012).

To determine the relevance to REDD+ of the best practices that we had identified from the literature, we compared them with the social and environmental principles and criteria that had been developed by the United Nations Collaborative Programme on REDD+ (UN-REDD). These principles and criteria are based on safeguards that were outlined in the Cancun Agreement and which provide guidance to REDD+ countries on how to implement REDD+ (UN-REDD 2012).

ADOPTION OF BEST PRACTICES BY REDD+ COMMUNITY PROJECTS

To determine if and how REDD+ projects applied the best practices that had been identified, we created a REDD+ project database synthesizing existing forest carbon project databases (CIFOR 2011; The Ecosystem Market Place 2012; The REDD Desk 2012b). We focused on the Latin America and Caribbean region as it has the greatest total forest area of all developing regions (39%, or 891 million ha (Mha) of 2300 Mha of forests that are found globally (FAO 2011). LAC also has the greatest area of forest under community tenure/administration, totalling 173 million ha, or 57% of community forest in developing regions (Agrawal 2007).

Projects that were included in the database were (1) local-scale initiatives that were (2) aimed at reducing deforestation and forest degradation with (3) explicit carbon emission reduction targets that had been estimated relative to a project baseline scenario (Wertz-Kanounnikoff & Kongphan-apirak 2009; Caplow et al. 2011). Projects were categorized according to the availability of documentation that was relevant to project design and implementation (Yes/No), their implementation status (under development/implementation), location (country, sub-region), project area (number of hectares), and start date. Expected emission reduction targets and the standards that were followed, together with the credited period, were also recorded.

We identified 69 REDD+ projects in LAC countries. Of these, 20 are currently being implemented and have available information regarding project design and some on implementation (Table E.3). Nine of these projects were classified as community-level projects where rural or indigenous communities have customary or statutory tenure and/or usage rights and the REDD+ project intervention directly targeted these communities, both in terms of scale (community-level project) and at the activity level (expected outcomes and activities). We retained only six of these projects as two were undergoing validation and thus the information available was not final (i.e., project documents were still in distribution for comments) and the third did not have sufficient information publicly available to assess the identified best practices (Table E.4).

Table E.3: REDD+ projects in implementation in LAC

Country	Project Name	Tenure/ use right	Project area (ha)	Project Standard	Expected Total Emission Reduction (MT CO_2e)	Project length	Start date	References
Belize	Boden Creek Ecological Preserve	Private reserve	3,980	CCBA/VCS	1,442,957	24	2005	(Forest Carbon Offsets LLC 2012a)
	Rio Bravo Carbon Sequestration Pilot Project	Private reserve	21,000	Joint Implementation	7,624,833	42	1999	(The Nature Conservancy 2012)
	Bull Run Overseas Ltd. Forest Carbon Project	Private reserve	666	CCBA/VCS	268,394	30	2009	(Forest Carbon Offsets LLC 2012b)
Bolivia	Protection of the Bolivian Amazon Forest	Private land	235	CCBA/VCS	176,560	30	2011	(The Climate Community and Biodiversity Alliance (CCBA) 2012b)
	Noel Kempff Mercado Climate Action Project	Community-Protected Area	642,458	Joint Implementation	5,837,341	30	1997	(ConserveOnline 2012)
Brazil	The Juma Sustainable Development Reserve Project	Community-Private reserve	589,612	CCBA	189,767,027	44	2006	(The Climate Community and Biodiversity Alliance (CCBA) 2008b)
	Suruí Forest Carbon Project	Community	31,994	CCBA	7,258,352	30	2009	(The Climate Community and Biodiversity Alliance (CCBA) 2011b)
	Desmatamento de Região da Rodovia Transamazônica	Private farms	31,745	n/a	3,136,953	10	2009	(Instituto de Pesquisa Ambiental da Amazônia (IPAM) 2012)
Chile	Rio Condor carbon project	Logging company	272,880	Joint Implementation	15,469,278	60	1999	(US Initiative on Joint Implementation (USIJI) 2012b)
Colombia	Chocó Darién Ecological Corridor	Community	13,465	CCBA	1,400,000	30	2011	(The Climate Community and Biodiversity Alliance (CCBA) 2011a)
	San Nicolas Carbon Sink and Arboreal Species Recovery Project**	Private farms-local community	9,800	Bio-carbon fund	597,000	-	n/a	(The World Bank (WB) 2011)
Costa Rica	ECOLAND: Piedras Blancas National Park	Private reserve	2,500	Joint Implementation	1,342,733	16	n/a	(Us Initiative on Joint Implementation (USIJI) 2012a)
	REDD on Privately-owned Lands in High Conservation Value Areas	Private reserve	12,000	CCBA	1,500,000	10	2009	(The Climate Community and Biodiversity Alliance (CCBA) 2009)
El Salvador	Avoided Deforestation in the coffee forests	Private farms	160,000	CCBA	3,062,172	17	2007	(The Climate Community and Biodiversity Alliance (CCBA) 2008a)
Mexico	Carbon sequestration in the private reserve el Zapotal	Private reserve	2,358	n/a	11,790	-	n/a	(The REDD Desk 2012a)
	Scolel-Té	Community	9,645	Plan Vivo	1,250,000	25	1994	(Plan Vivo 2012)
Panama	Ipetí-Emberá REDD+ pilot project	Community	23	none	4,600	25	2008	(Holmes et al. 2012)
Peru	Madre de Dios Amazon REDD Project	Logging company	100,000	CCBA	27,304,727	20	2005	(The Climate Community and Biodiversity Alliance (CCBA) 2013)
	Bio-corridor Martin Sagrado REDD+ project*	Community	313,687	CCBA	28,259,000	40	n/a	(The Climate Community and Biodiversity Alliance (CCBA) 2012a)
	REDD en la Reserva Nacional Tambopata y Parque Nacional Bahuaja-Sonene *	Community-Protected Area	572,514.90	CCBA	6,795,075	20	n/a	(The Climate Community and Biodiversity Alliance (CCBA) 2010)

Notes (*) undergoing validation. (n/a) information not available or not applicable; (**) not enough information available to assess best practices

CCBA: Climate Community and Biodiversity Alliance; VCS: Verified Carbon Standard

Table E.4. Summary of community-level REDD+ evaluated projects

Project Name	Project goals	Project approach	Community details	Drivers of deforestation
The Juma Sustainable Development Reserve Project, Brazil (The Climate Community and Biodiversity Alliance (CCBA) 2008b)	Halting deforestation and promoting sustainable development through establishing a protected area for sustainable use	1. Strengthen environmental monitoring and control, 2. Generate income through sustainable business, 3. Community development, scientific research and education 4. Direct payment for environmental services (Bolsa Floresta Program).	About 339 families live in 35 communities and most of these have no land titles. Depend on subsistence and on extractive activities. Income below the average minimum wage in Brazil.	increasing rates of agricultural and cattle production as well as illegal logging and land grabbing
Noel Kempff Mercado Climate Action Project, Bolivia (ConserveOnline 2012)	Mitigating carbon dioxide emissions from the atmosphere, preserving biological diversity and promoting sustainable development in local communities	1. Cease legal and illegal logging and expand the boundaries of the Park by including the newly indemnified concession area 2. Achieve long-term protection and regeneration of the Park expansion area's by working with local communities	The indigenous territory of Bajo Paragua, comprised of four communities, is located in the project area. The territory did not held legal title to the land when the project was initiated. Communities practice subsistence agriculture and the harvest of fruits and timber from the forest. They also hunt and fish.	Logging, anthropogenic fires for agricultural conversion and slash-and-burn agriculture,
Suruí forest carbon project, Brazil (The Climate Community and Biodiversity Alliance (CCBA) 2011b)	Halting deforestation and its associated greenhouse gas emissions and to contribute to the preservation of the Paiter Suruí lifestyle and traditions	1. Forest Protection and Environment 2. Food Security and Sustainable Production 3. Institutional Strengthening 4. Development and implementation of a financial mechanism - Suruí Fund	The Paiter Suruí indigenous people inhabit the project area. Their territory has legal recognition. They are distributed in 24 villages with 1,231 people. Their traditional livelihood strategies include hunting, fishing and harvesting forest products. More recently they began to develop economic productive activities like logging and cattle ranching.	Forest conversion for extensive cattle ranching
The Chocó-Darién conservation corridor, Colombia (The Climate Community and Biodiversity Alliance (CCBA) 2011a)	Preventing global climate Change and Safeguard the ecosystems and Wildlife of the Darién by strengthening the Territorial identity and Governance capacity of the Council of Afro-Colombian communities of The Tolo River Basin (Cocomasur)	1. Building governance capacity 2. Reducing Carbon emissions, 3. Investing in green commodity production	The project is undertaken in the collective lands of COCOMASUR, which received legal recognition to their territory in 2005. The area is managed by the nine Local Councils of Cocomasur, representing a mix of Afro-descendant and mestizo communities from 31 villages (826families, 5,782 people). Most people The Depend on subsistence resources including agricultural products, hunting and fishing.	Conversion of forest to pasture for cattle ranching. To a lesser extent selective logging.
Scolel-Té, Mexico (Plan Vivo 2012)	Carbon sequestration and emission benefits along with environmental and social co-benefits, including biodiversity	Assisting farmers to develop more sustainable land management and better livelihoods through the provision of carbon services.	In 2010 the project involved 2,437direct project participants and in total about 6,400 Mayan and mestizo families, from about 25 communities from 8	Information not available as it depends on the specific circumstances of each participant.

	maintenance and poverty reduction.		ethnic indigenous and groups, are linked to the project	
The Ipetí-Emberá Carbon Project, Panama (Holmes et al. 2012)	Increasing carbon stocks and reducing emissions from deforestation while enhancing participation of local communities in sustainable land management decisions	1. Reforestation with native species and agroforestry systems for enhancing carbon stocks and addressing livelihoods 2. Establish a community patrolling system to reduce deforestation due to invasion	The project is located in the collective land of Ipetí-Emberá, which has no legal title. The population is represented by 71families (550 people). Of these, 22 families are direct project participants. Primary economic activities include subsistence cultivation, cattle ranching, acting as day labourers, and handicraft production.	Conversion of forest to pasture for cattle ranching, slash-and-burn agriculture. Invasion from adjacent colonist population

To understand how these REDD+ community projects are implementing the best practices that were identified from the literature, we developed an evaluation tool that was comprised of indicators of best practices and respective assessment criteria, which were based on factors and conditions identified from the qualitative research synthesis and adjusted to REDD+ projects when relevant, i.e., assessment criteria related to carbon ownership and benefit-sharing, and drivers of deforestation (complete evaluation tool available in Appendix H). There were two types of assessment criteria, some of which represented different levels of achievement for the respective indicator (i.e., ordinal) and others having no particular order (i.e., nominal). The evaluation tool also included a five-point Likert-type items scale (poor, fair, good, very good, excellent) to rate overall project performance for each best practice. Space was provided for comments as needed. We conducted a pre-test of the evaluation tool with five researchers from McGill University (Montreal, Quebec, Canada) and modified the tool according to their recommendations.

Using the snowball sampling technique (Patton 1990), we invited development practitioners and researchers working on REDD+ and community-based conservation to evaluate one of the six community-level REDD+ projects. This approach was taken to ensure that more than one person was evaluating each project and, therefore, increasing rigour of the evaluation of best practices adoption (i.e., triangulation).

Survey participants were invited to analyze available project reports regarding the quality of the REDD+ project´s design and implementation (i.e., Project Design Documents) in meeting the identified best practices and their respective indicators (details in Appendix H). Therefore, we did not conduct an empirical evaluation about how projects addressed the identified best practices in their implementation on the ground; rather, we examined whether and how the available information of these projects addressed these best practices. We sent out 93 invitations; 39 invitees volunteered to participate. We randomly assigned projects to each potential survey participant using a research randomizer (Urbaniak & Plous 2011).

The analysis of the evaluation responses was conducted as follows. For ordinal assessment criteria, we used the mode of the sample to determine the most frequent responses, allowing us to assess the level of implementation of those indicators on the ground. To analyze associations among the different assessment criteria, we conducted contingency table analysis including the calculation of Goodman and Kruskal's *Gamma*, the most common measure of association for ordinal variables (Miller 2002). Responses of the five-point Likert-type items scale were also treated as ordinal data, with "poor" having the lowest value (1) and "excellent" the highest (5). To evaluate whether the overall ratings for each best practice (dependent variable) varied amongst the six selected REDD+ projects (independent variable, treatment factor $k = 6$). We performed the exact Kruskal-Wallis test, including pairwise multiple comparisons when $p < 0.05$ following Conover (1980). For nominal assessment criteria, we also used the mode of the sample to determine the most frequent response. We used contingency table analysis and Fisher's exact tests to determine whether the frequencies of the evaluation responses differed among the different projects and determine associations between assessment criteria (Conover 1980). All statistical analyses were performed in SAS (SAS Institute 2012).

Appendix G: Reviewed Databases and Documents

REDD+ PROJECT DATABASES

CIFOR (Center for International Forestry Research). 2011. Global database of REDD+ projects and other forest carbon projects. Available from http://www.forestsclimatechange.org/redd-map/# (Accessed December 2012).

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Appendix H: REDD+ Project Assessment Tool

Best Practice 1: The REDD+ project that you were asked to assess ensures genuine community participation in all phases of the project. ***Please mark with an X all those that apply.9***

Indicators	Scores	Assessment criteria	YES	NO	Inf. not available
Evidence that communities are involved in project design	5	Broad community participation in project design			
	4	Only local leaders participate in project design			
	3	Broad community consultation of a pre-designed project			
	2	Local leaders consultation of a pre-designed project			
	1	No community participation in project design			
Evidence that communities participate in decision making implementation	5	Broad community involvement in implementation/decision making			
	4	Project participants' involvement in implementation/decision making			
	3	Project facilitators participate in implementation/decision making			
	2	Local leaders' involvement in implementation/decision making			
	1	No community participation in implementation/decision making			
Existence of a project management board (committee) with community representation	nominal	Communities are represented on management boards			
Evidence that marginalized members of the community participate in project design	nominal	The project identifies/mentions marginalized groups as project stakeholders			
	nominal	Mechanism in place for enhancing participation by other marginalized groups			
Evidence that resources have been committed for community in project design and implementation	nominal	Resources are allocated for community participation in project design			
	nominal	Resources are allocated for community participation in project implementation			

Best Practice 1 Overall Assessment: How would you rate this project in regards to ensuring genuine community participation in all phases of the project?

1 - Poor 2 - Fair 3 - Good 4 - Very good 5 - Excellent

Comments:

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Best Practice 2: The REDD+ project is in line with and supported by forest governance framework.
Please mark with an X all those that apply

Indicators	Scores	Assessment criteria	YES	NO	Inf. not available
Communities have statutory land rights	3	Communities hold statutory rights to land			
	2	Communities in process of obtaining statutory rights to land			
	1	Communities have no statutory land tenure rights			
Project support for resolving tenure	nominal	Project assists communities in obtaining statutory rights to land			
National policy frameworks in place to support implementation	nominal	National policy framework in place that defines carbon rights			
	nominal	The government has a conflict resolution mechanism in place that assists project implementation			
	nominal	National policy framework in place for assisting communities in obtaining statutory rights to land			
Communities hold carbon ownership	5	Local communities (or project participants) hold 100% carbon ownership			
	4	Local communities (or project participants) hold 75% of carbon ownership			
	3	Local communities (or project participants) hold 50% of carbon ownership			
	2	Local communities (or project participants) hold 25% of carbon ownership			
	1	Local communities (or project participants) do not hold carbon ownership			
Local authority is strengthened for developing institutions	nominal	Traditional leaders are strengthened for designing, monitoring and implementing local resource use norms and institutions			
	nominal	Community-based organizations are strengthened for designing, monitoring and implementing local resource use norms and institutions			
National agencies to support local enforcement capacities are engaged	3	Project has engaged government agencies and is actively supporting local enforcement capacities			
	2	Project has attempted to engage government agencies to support project area monitoring and surveillance			
	1	Local communities establish monitoring and surveillance systems without government support			
Please identify activities the project has in place to resolve weak governance systems					

Best Practice 2 Overall Assessment: How would you rate this project in regards to being in line with and supported by a decentralized forest governance framework?

1 - Poor 2 - Fair 3 - Good 4 - Very good 5 - Excellent

Co**mments:**

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_____________**Best Practice 3: The REDD+ project objectives are in line with community livelihood priorities.** ***Please mark with an X all those that apply***

Indicators	Scores	Assessment criteria	YES	NO	Inf. not available
Community livelihood priorities have been identified and promoted	nominal	Local livelihood strategies are described for the project area			
	nominal	Alternative livelihoods promoted by the project are consistent with community livelihood priorities			
	nominal	Project participants are involved in deciding alternative livelihood strategies			
	nominal	Project objectives address livelihood security of local communities			
Alternative livelihoods promoted by the project address drivers and agents of deforestation	nominal	Alternative livelihoods are provided for formal forest users			
	nominal	Alternative livelihoods are provided for informal forest users (land grabbers, illegal loggers, migrant colonists)			

Best Practice 3 Overall Assessment: How would you rate this project in regards to having objectives in line with community livelihood priorities?

1 - Poor 2 - Fair 3 - Good 4 - Very good 5 - Excellent

Comments:____
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Best Practice 4: The REDD+ project matches community developmental needs and expectations. ***Please mark with an X all those that apply***

Indicators	Scores	Assessment criteria	YES	NO	Inf. not available
Existence of an equitable benefit carbon-sharing mechanism among project stakeholders	5	All carbon revenues are given to community members			
	4	At least 75% of carbon revenues are provided to community members/groups			
	3	At least 50% of carbon revenues are provided to community members/groups			
	2	At least 25% of carbon revenues are provided to community members/groups			
	1	Community members/groups do not receive carbon revenues			
Developmental community needs are identified and addressed	nominal	Project provides support for health services			
	nominal	Project provides support for education services			
	nominal	Project provides support for water services			
	nominal	Project provides support for electricity services			
	nominal	Project provides support for communication services			
Participating households receive incentives	nominal	Participants receive direct cash incentives			
	nominal	Participants receive non-cash incentives			

Best Practice 4 Overall Assessment: How would you rate this project in regards to matching community developmental needs and expectations?

1 - Poor 2 - Fair 3 - Good 4 - Very good 5 - Excellent

Comments:____

Best Practice 5: The REDD+ project enhances collaboration and coordination between relevant stakeholders. ***Please mark with an X all those that apply***

Indicators	Scores	Assessment criteria	YES	NO	Inf. not available
Relevant project stakeholders have been identified	nominal	Communities are identified as key stakeholders			
	nominal	Government agencies are identified as key stakeholders			
	nominal	Formal forest users are identified as key stakeholders			
	nominal	Informal forest users are identified as key stakeholders			
	nominal	Private sector entities are identified as key stakeholders			
	nominal	Research entities are identified as key stakeholders			
	nominal	Local NGOs are identified as key stakeholders			
	nominal	National NGOs are identified as key stakeholders			
	nominal	International NGOs are identified as key stakeholders			
Partnerships are established among relevant stakeholders	nominal	Partnerships between communities and carbon buyer			
	nominal	Partnerships between communities and carbon sellers			
	nominal	Partnerships between communities and government			
	nominal	Partnerships between communities and local NGOs			
	nominal	Partnerships between communities and national NGOs			
	nominal	Partnerships between communities and international NGOs			
	nominal	Partnerships between carbon sellers and carbon buyers			
	nominal	Partnerships between government and implementing NGO			
	nominal	Partnerships between different communities			
	nominal	Partnerships that have been established enable effective representation of communities			

Best Practice 5 Overall Assessment: How would you rate this project in regards to enhancing collaboration and coordination between relevant stakeholders?

1 - Poor 2 - Fair 3 - Good 4 - Very good 5 - Excellent

Comments:____

Best Practice 6: The REDD+ project adopts an adaptive and learning-based approach to project implementation. ***Please mark with an X all those that apply***

Indicators	Scores	Assessment criteria	YES	NO	Inf. not available
Monitoring and evaluation systems in place	nominal	Socio-economic monitoring that feeds into implementation			
	nominal	Carbon monitoring that feeds into implementation			
	nominal	Biodiversity monitoring that feeds into implementation			
	nominal	Local communities participate in designing and implementing monitoring systems			
Implementation using iterative cycles of learning	nominal	Existence of mechanisms for implementing project corrective actions in place			
	nominal	The project design is adapted in response to local participation			

Best Practice 6 Overall Assessment: How would you rate this project in regards to adopting an adaptive and learning-based approach to project implementation?

1 - Poor 2 - Fair 3 - Good 4 - Very good 5 - Excellent

Comments:____

Best Practice 7: The REDD+ project develop capacities at the local and national levels. ***Please mark with an X all those that apply***

Indicators	Scores	Assessment criteria	YES	NO	Information not available
Evidence that capacity building is a component of the project.	Resources are allocated for community capacity building in areas such as				
	nominal	Leadership development			
	nominal	Conservation practices			
	nominal	Alternative livelihood diversification			
	nominal	Administration and management			
	nominal	Participation			
	nominal	Local Leaders			
	nominal	Monitoring and evaluation			
	nominal	Others, please specify			

Best Practice 7 Overall Assessment: How would you rate this project in regards to developing appropriate capacities at the local and national levels?

1 - Poor 2 - Fair 3 - Good 4 -Very good 5 - Excellent

Comments:____

Overall Comments on projects or (assessment tool):

Appendix I: Details about Evaluation Approach

To conduct the REDD+ project evaluation, we invited development practitioners and researchers working on REDD+ and community-based conservation. This approach was taken to ensure that more than one person was evaluating each project and, therefore, increasing rigour of the evaluation of best practices adoption (i.e., triangulation). We used the snowball sampling method to select evaluators (Patton 1990). We first sent invitations to researchers and development practitioners who were familiar with our investigation and who were working in the fields of REDD+ and community-based conservation or community-based resource management. Further, we asked them to provide us with contacts for people also working in these fields who would be willing to participate. We assembled a list of 93 potential evaluators. Thirty-nine invitees volunteered to participate and we received 29 completed evaluations (90% of the evaluators had first-hand experience with REDD+ and community-based conservation or community-based natural resource management).

The evaluation was completed on the basis of available reports about the REDD+ project's design and implementation. Survey participants were invited to analyze available project reports regarding the quality of the REDD+ project´s design and implementation. Available reports were: Project design documents, validation reports and verification. Of the 6 projects selected for this study only 50% (3) have validation reports available certified by the Climate, Community, and Biodiversity (CCB) Alliance standard; only 1 (17%) has a verification report available issued by Rainforest Alliance; and the other 2 (33%) have not been certified but have project design documents available. Validation reports available for these projects provide checklists of how the project design documents address the criteria proposed by the different standards (i.e., Climate Community and Biodiversity Alliance). However, these validation reports do not expand on specific issues related to all of the best practices we identified from the literature. The project design documents provided more comprehensive information and expanded on different aspects of the identified best practices. Thus, we found that the project design documents were more appropriate for the best practice evaluation, allowing for a more in-depth assessment of the best practices than the validation reports as well as allowing the evaluators to extract the information to complete their assessments.

The analysis of adoption of best practices consisted on requesting the evaluators to examine whether and how the available information of these projects addressed these best practices. Thus, we did not conduct an empirical evaluation about how projects addressed the identified best practices in their implementation on the ground. Once people had agreed to participate, projects were assigned randomly. In one single case, the project that had been assigned was changed as the evaluator was too familiar with this project. We sent out the evaluation tool, together with the project documents to be evaluated. These documents were retrieved from the Internet (see references below). For each project, each evaluator thus received the same materials.

We received a total of 29 responses. Five assessments were completed for each of the following projects: Suruí forest carbon project, Noel Kempff Mercado Climate Action Project, Juma Sustainable Development Reserve Project, Scolel-Té project, and the Ipetí-

Emberá Carbon Project, while 4 responses were received for the Chocó-Darién conservation corridor. Fifty-nine percent of respondents were male (41% female). Affiliation of the respondents varied, including 66% who were affiliated with universities, 28% who were with non-governmental organizations, 3.4% from a private firm working on the valuation of ecosystem services, and 3.4% from a multilateral organization (UN-REDD).

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Appendix J: Results of Kruskal-Wallis for Best Practices

Tables I.1, I.2, I.3, and I.4 show the results of multiple pairwise comparison tests after the exact Kruskal-Wallis, performed following Conover (1980: 229-231) when $p < 0.05$.

Table I.1: Multiple comparison tests after Kruskal-Wallis test for BP1: Participation

Project/Project	1	2	3	4	5	6
A			**			
B			**			**
C				**	**	
D						
E						
F						

** Significant difference

Table I.2: Multiple comparison tests after Kruskal-Wallis test for BP5: Stakeholders Collaboration

Project/Project	1	2	3	4	5	6
A			**			
B			**			
C				**	**	
D						
E						**
F						

** Significant difference

Table I.3: Multiple comparison tests after Kruskal-Wallis test for BP6: Adaptive Management

Project/Project	1	2	3	4	5	6
A						
B			**			
C				**	**	
D						
E						
F						

** Significant difference

Table I.4: Multiple comparison tests after Kruskal-Wallis test for BP7- Enhanced Capacities

Project/project	1	2	3	4	5	6
A				**	**	
B				**		
C				**	**	**
D						
E						
F						

** Significant difference

Table I.5: Stakeholders (STKH) reported in project documents *Mode (%)**

Project	Mean # of STKHs	Stakeholders mentioned in project documents								
		Communities	Govern. agencies	Formal forest users	Informal forest users	Private sector	Research entities	Local community NGOs	National NGOs	Internat. NGOs
A[**] *(n=5)*	7	1 (100%)	1 (60%)	1(100%)	1 (60%)	1(60%)	1(60%)	1(80%)	1 (80%)	1(75%)
B *(n=5)*	4	1 (80%)	0 (100%)	1 (80%)	1[a] (50%)	0 (75%)	0 (75%)	1(75%)	1[a] (50%)	0 (75%)
C *(n=5)*	5	1[a] (50%)	1 (100%)	1 (67%)	0 (67%)	1(100%)	1[a] (50%)	1[a] (50%)	1 (67%)	1(67%)
D *(n=4)*	6	1 (100%)	1 (100%)	1(75%)	1[a] (50%)	1(75%)	1 100%)	1[a] (50%)	1 (67%)	0 (67%)
E *(n=5)*	6	1 (100%)	1(100%)	1(100%)	1 (100%)	1(75%)	1(100%)	1(100%)	1[a] (50%)	1(100%)
F*(n=5)*	7	1 (100%)	1[a] (50%)	1(100%)	0 (67%)	1(80%)	1(100%)	1(100%)	1(100%)	1 (100%)
Overall *(n=29)*	5.83	1 (86%)	1 (62%)	1 (69%)	1 (42%)	1 (57%)	1 (62%)	1 (62%)	1 (57%)	1 (40%)

1 = Yes; 0 = No
a. multiple modes exist. The highest value is shown
* % of number of respondents for project
** The main purpose of the analysis was not to determine which of the projects were doing well or not but to gain a general idea on how best practices are being adopted by the evaluated REDD+ projects. Therefore we have randomly assigned a letter code to each project to maintain their anonymity in the evaluation.

Table I.6: Partnerships established between stakeholders, *Mode (%)**

Project	Partnerships between communities and…							Partnersh
	carbon buyer	carbon seller	Govern.	Local NGOs	National NGOs	Intern. NGos	Other communities	Carbon seller and carbon buyer
A** *(n=5)*	n/a (60%)	n/a (60%)	n/a (40%) [a]	1 (80%)	1 (80%)	n/a (40%) [a]	1 (100%)	n/a (60%)
B *(n=5)*	0 (60%)	0 (60%)	0 (100%)	1 (60%)	1 (40%) [a]	0 (60%)	n/a (60%)	1 (80%)
C *(n=5)*	0 (80%)	0 (80%)	n/a (40%) [a]	1 [a] (40%)	n/a (40%) [a]	0 (60%)	1 (80%)	1 (40%) [a]
D *(n=4)*	n/a (75%)	1 (50%)	1 (50%)	n/a [a] (50%)	n/a (50%) [a]	n/a (50%)	1 (75%)	n/a (50%)
E *(n=5)*	1 (40%) [a]	1 (60%)	1 (80%)	1 (80%)	n/a (40%) [a]	n/a (80%)	1 (100%)	1 (80%)
F*(n=5)*	1 (60%)	n/a (50%)	0 (60%)	1 (100%)	1 (60%)	1 (50%) [a]	n/a (75%)	1 (60%)
Overall *(n=29)*	0 (42%)	0 (43%)	0 (38%)	1 (68%)	1 (48%)	n/a (43%)	1 (60%)	1 (48%)

1= Yes; 0=No; n/a= Information not available
a. multiple modes exist. The highest value is shown
* % of number of respondents for project

** The main purpose of the analysis was not to determine which of the projects were doing well or not but to gain a general idea on how best practices are being adopted by the evaluated REDD+ projects. Therefore we have randomly assigned a letter code to each project to maintain their anonymity in the evaluation.

Appendix K: Interview guides from internships and honours theses.

1. Land-use change and the agricultural frontier in Ipetí-Emberá

(Jenna Whitson & Danylo Bobyk, 2009)

This internship paper mentions interviews but did not include their guide.

2. Living on a modern colonization frontier: an assessment of *Colono* necesseities and livelihood strategies in the buffer zone of Ipetí (Alesne Duchesne & Maxime Lemoyne, 2009)

PARTE I: SITUACION SOCIAL Y FAMILIAR

- ¿De que parte de Panamá vienen? (Área de origen)

-¿Hace cuanto tiempo que están ubicados en esta área?

-¿Cuánta gente forman la familia actual? (composición familiar)

-¿Cuantos viven aquí?

-¿Tienen niños a la escuela? ¿Cual es el más alto nivel de educación en la familia?

-¿Porque emigraron de donde vivian antes?

-¿Se cumplió el propósito (objetivo), por el cual emigraron?

- ¿Dirían que viven bien?

-¿Tienen algunas dificultades diarios?

-¿Cuáles son los planes para la familia en el futuro?

PARTE II: USO DEL SUELO Y NECESIDADES

¿Como usan el suelo de su finca? (ganadería, agricultura, conservación, reforestación, etc.)

-¿Cuántas hectáreas de tierra tienen?

-[¿Tienen titulo de propiedad o tienen derecho posesorio?]

- ¿Que tipo de cultivos hacen? (frutas, arroz, maíz, yuca, ñame, frijoles, verduras, etc.)

- ¿Que animales tienen? (vacas, pollos, puercos, caballos, etc.) ¿En que cantidad?

- ¿Que técnicas utilizan para preparar el suelo? ¿Para fertilisarlo?

- ¿Saben como mejorar los nutrientes en la tierra? ¿Como?

- ¿Han notado degradación en la fertilidad de la tierra con el tiempo? (poco rendimiento de las cosechas, erosión, etc.)

-¿Que opinan ustedes sobre la conservación del ambiente?

-¿Qué opinan sobre no talar los bosques?

-¿Que piensan sobre los cambios del clima? ¿Se han dado cuenta que el
clima esta cambiando negativamente? Conocen los impactos?

-¿Si ustedes recibirían dinero (por ejemplo del gobierno), que harían con el dinero? ¿Que tipo de proyecto interesa a ustedes?

-¿Que quisieran ver desarrollado en su área, que falta?

-¿Si tuvieran la posibilidad de desarrollar un proyecto de reforestación sobre sus tierra con apoyo financiero, estarían interesados?

-¿Para hacer que: agroforestría, reforestación, venta de madera, conservación?

- ¿Otros comentarios?

Gracias y saludos

3. Agroforestry as a way to increase carbon stocks and support livelihoods (Kirsten Wiens, 2009) (No interviews)

4. Evaluating the constraints, opportunities and challenges to the adoption of a reforestation-based carbon sequestration project as a means of conservation and economic development in an indigenous community of eastern Panama (Philippe Brunet & Étienne Lafortune, 2010).

Interview guide for participants that have an agroforestry system:

AGROFORESTRY Theme	**Question objectives**	**Potential questions**
Participant information	Describe participant characteristics -see if there is familial attachment to the land -discover support network for plantations -cultural and familial background	Cuénteme un poco sobre usted y su familia! ¿Cuándo llegó su familia a Ipetí? ¿Cultiva las mismas tierras que sus padres? ¿Cuántas personas viven en su casa? ¿Tiene hijos? ¿Qué edad tienen? ¿Toda su familia vive en la comunidad o hay personas que viven afuera? ¿Hay miembros de su familia que viven en Ipetí pero que trabajan afuera de la comunidad?
	Determine which plots our participants have (agroforestry and/or timber), and how they refer to these plots	¿Cuántas parcelas tiene en el proyecto de STRI? ¿Qué tipo de plantas tiene en esta(s) parcela(s)? ¿Sólo maderables o también frutales, y/o cultivos? ¿Cuántos árboles tiene?
Adoption	Identify factors that have driven participation in the project	¿Por qué había decidido participar en el proyecto? ¿Qué le interesó del proyecto de STRI? ¿Por qué escogió una parcela de *maderables/agroforestal*?
	Describe participant's expectations of project	¿Cuáles eran sus expectativas, sueños del proyecto al principio? ¿Y hasta ahora, el proyecto ha cumplido sus expectativas? ¿Puede explicar?

Participant's perceptions of the project:	Describe participant's general perception of the project	¿Cómo ha sido su experiencia con el proyecto? ¿Puede explicar? ¿Qué les ha gustado del proyecto hasta ahora? ¿Qué no les ha gustado del proyecto?
	-Determine participant's perceptions of the socio- economic consequences of the project	¿Cómo le parece el dinero del carbono? - Monto - Fechas de entrega - De recibirlo en 5 años ¿Le sirve este dinero para manejar su parcela? ¿En que más ha utilizado este dinero? ¿Qué le parece lo del fondo colectivo, en que cree usted que se puede utilizar ese dinero y quien debiera decidir cómo usarlo? ¿Ya ha tenido fruta o cultivos de su parcela? ¿Puesto que el proyecto ha traído muchos cambios a la comunidad, con personas que han recibido dinero, árboles…, otros no, cómo se ve el proyecto en la comunidad, cómo lo ven los que no participan..? ¿El proyecto ha cambiado la comunidad de alguna manera?
	-Determine participant's perceptions of the project's organization and management	¿Qué le parece la organización y el manejo del proyecto por STRI, OUDCIE y ANCON? ¿Hay problemas o cosas que funcionan particularmente bien en la organización y el manejo del proyecto? ¿Cómo se podría mejorar la situación? ¿Tiene alguien que puede contactar si tenga preguntas, problemas? ¿A quién recurren?
	-Determine participant's opinion of the technical support *Find out participants' opinion about the participatory*	¿Cómo le parece ha sido el apoyo técnico del proyecto? ¿Querría tener más apoyo técnico o más talleres? ¿En cuáles áreas? ¿Qué le pareció el taller de agroforestería al inicio para participar? ¿Fue este útil para usted? ¿Qué aprendió? ¿Qué les gustaría aprender?

	approaches previously used	¿Le ha gustado hacer las cosas en conjunto como diseñar su parcela o hubiera preferido que le dieran el diseño de una vez?
	-Determine participant's opinion of the design of the plots and recommendations for future plot design	¿Cómo están plantados sus árboles en la parcela? ¿Cómo todo en línea, o en pata de gallo/tres bolillos? ¿Por qué así? ¿Qué piensa de la manera en la cual los árboles están plantados en la parcela? ¿Cómo le pareció hacer la plantación de esta manera? ¿Se podría mejorar el diseño de la plantación? como la distancia entre los árboles, si sería mejor poner las mismas especies en grupos, etc ¿Como la habría realizado usted? ¿Piensa que los árboles fueron plantados al buen momento del año? ¿Por qué escogió esas especies cuando hizo su diseño de parcela? ¿Hay especies que le gustaría añadir en su plantación? ¿Hay especies que no utilizaría en el futuro? ¿Cuáles especies le recomendaría usted a otros participantes para la plantación de este año? ¿Qué cosas de su conocimiento tradicional como por ejemplo plantar con las lunas usted habría incorporado en la plantación?
Participant's management of the plot	Find out what has been done on the plots since the plantation of the trees	¿Qué tipos de trabajos ha hecho en su parcela desde la plantación de las plántulas?
	Find out how labour-intensive agroforestry is and what labour is involved *calendar*	¿Cuánto trabajo necesita su parcela? Como para limpiarla, controlar los insectos… ¿Qué tipo de trabajo y quiénes lo hacen? ¿En qué fechas se hacen estos trabajos? ¿Riega sus plantas? ¿Cuándo limpia las parcelas? ¿Qué tipo de insumos utiliza? Fertilizantes/abono, insecticidas ¿A qué frecuencia hay que utilizarlos? ¿Cuánto les cuesta?

	Find out how time consuming agroforestry is	¿Cuánto tiempo le toma para ocuparse de su parcela?
	Describe organization/division of work (i.e. Does it involve multiple members of the family? Do different members have different tasks? Is the work done together or individually?)	¿Quién se ocupa de las parcelas? ¿Cómo organizan la división del trabajo? ¿Hay otras personas de la comunidad que les ayudan?
	Determine if agroforestry fits in well in their family life and other activities	¿Con esta parcela y el trabajo que tiene que hacer en ella, alcanza a hacer sus otras actividades? Por ejemplo su familia y trabajo?
Physical condition of the plot	Describe the current state of the plots (Assess the health of the trees; lack of water, too much/ too little sunlight, diseases, soil quality, animal/insect damage ...)	¿Cómo va su parcela? ¿Ha tenido problemas con sus árboles? ¿Cuáles? [insectos, falta de agua, incendios…] ¿Ha podido resolver los problemas que ha tenido con su parcela? ¿Hay algo que se podría hacer para remediar a estos problemas? ¿Cómo se portan las diferentes especies de árboles? ¿Crecen bien? ¿La calidad del suelo parece corresponder bien con las necesidades de los árboles? ¿Ha tenido problemas con la falta de agua?
Innovations in plantation	Identify innovations and management that participants have used to adapt their plots to their needs	¿Ha hecho usted algunos cambios al diseño de la parcela? ¿Ha utilizado su parcela para sus cultivos anuales? ¿Hay otras cosas que le gustaría hacer en su parcela? *¿Qué piensa usted hacer con su parcela?*

Environmental impacts of agroforestry	Identify actual or potential impact of the project in the natural environment (i.e. reduce pressure on natural resources by decreasing slash and burn, improve biodiversity and water? etc)	¿Ha notado cambios en el medio ambiente de su parcela desde la plantación de los árboles, como en el suelo y la erosión, la cantidad de agua? ¿Hay más animales, aves e insectos ahora? ¿El suelo ha cambiado, en términos de la calidad del suelo, de la erosión…? ¿Cómo hacia usted sus cultivos como el arroz, maiz, etc antes de tener su parcela? ¿El proyecto ha cambiado la manera en la cual ustedes cultivan sus cultivos anuales? ¿Ha disminuido la quema desde que tiene su parcela?
Factors that might be important for the sustainability of the project (future plans, economic expectations, etc)	Determine interest in commercialization of products and ways of organizing this commercialization	¿Qué piensa usted hacer con la fruta y los cultivos de su parcela? ¿Cree usted que los pueden vender? ¿Cuáles son sus planes? *[Si hay interés en vender los productos:* ¿Cuáles productos más específicamente podría vender? [plátanos, café, cacao…] ¿Ya tiene una idea de lo que podrían ganar con esto? ¿Cómo ve la venta de sus productos? ¿Hacerla de manera individual? ¿O organizarse en un grupo o cooperativa con otras personas de la comunidad? ¿Dónde se podría vender los productos? ¿Cómo se podría organizar el transporte de los productos?

	Economic expectations: *Create a timeline of the economic potential of the plot with participant [can be done on paper with timeline and drawings]*	¿Cómo ve los ingresos que va a tener con su parcela de agroforestería en los siguientes años? - ¿en el corto plazo, como en los cinco próximos años? [dinero del carbono, venta de frutas y cultivos] - ¿en el medio plazo como en 10-15 años? [frutas, cultivos] - ¿Y en el largo plazo? Como después de los 25 años? ¿Van a talar los maderables? [frutas, cultivos, madera]. Beneficios para sus hijos… ¿A cuánto se vende el cocobolo? El cedro espino? El amarillo? El roble? El espave? El cedro amargo? ¿Estaría interesado en plantar sus cultivos anuales entre los árboles?
	Determine if participant would have participated in the project without carbon credits	¿Ha estado un factor determinante para su participación en el proyecto recibir dinero por el carbono? ¿En otro lugar y otro tiempo, si hubiera habido un proyecto de agroforestería que le hubiera dado las plantas, el apoyo técnico pero no dinero para el carbono, todavía le habría interesado participar?
	Describe participant's satisfaction with the economic benefits generated by the project	¿En general, le parece que el proyecto va a darle suficiente beneficios para el trabajo y la tierra que usted ha puesto en él?
	Determine the participant's opinion of the project all in all	¿Le gustaría agrandar su parcela o añadir otra parcela de agroforestería? ¿Recomendaría usted el proyecto a sus amigos o familiares? ¿Si pudiera volver atrás en el tiempo volvería a participar en el proyecto o no lo haría, y por qué? ¿Qué cosas se pueden cambiar para que el proyecto y su parcela funcionen mejor? (administración, diseño de las parcelas, pago, apoyo técnico, mano de obra…)

	Find potential participants for the future	¿Conoce a algunas personas interesadas en participar?
		¿Tiene algo más que añadir?

Interview Guide for participants that have timber-species plots:

MADERABLE Theme	**Question objectives**	**Potential questions**
Participant information	Describe participant characteristics -see if there is familial attachment to the land -discover support network for plantations -cultural and familial background	Cuénteme un poco sobre usted y su familia! ¿Cuándo llegó su familia a Ipetí? ¿Cultiva las mismas tierras que sus padres? ¿Cuántas personas viven en su casa? ¿Tiene hijos? ¿Qué edad tienen? ¿Toda su familia vive en la comunidad o hay personas que viven afuera? ¿Hay miembros de su familia que viven en Ipetí pero que trabajan afuera de la comunidad?
	Determine which plots our participants have (agroforestry and/or timber), and how they refer to these plots	¿Cuántas parcelas tiene en el proyecto de STRI? ¿Qué tipo de plantas tiene en esta(s) parcela(s)? ¿Sólo maderables o también frutales, y/o cultivos? ¿Cuántos árboles tiene?
Adoption	Identify factors that have driven participation in the project	¿Por qué había decidido participar en el proyecto? ¿Qué le interesó del proyecto de STRI? ¿Por qué escogió una parcela de *maderables/agroforestal*?
	Describe participant's expectations of project	¿Cuáles eran sus expectativas, sueños del proyecto al principio? ¿Y hasta ahora, el proyecto ha cumplido sus expectativas? ¿Puede explicar?
Participant's perceptions of the project:	Describe participant's general perception of the project	¿Cómo ha sido su experiencia con el proyecto? ¿Puede explicar? ¿Qué les ha gustado del proyecto hasta ahora? ¿Qué no les ha gustado del proyecto?
	-Determine participant's perceptions of the socio- economic	¿Cómo le parece el dinero del carbono? - Monto - Fechas de entrega - De recibirlo en 8 años

	consequences of the project	¿Le sirve este dinero para manejar su parcela? ¿En que más ha utilizado este dinero? ¿Qué le parece lo del fondo colectivo, en que cree usted que se puede utilizar ese dinero y quien debiera decidir cómo usarlo? ¿Puesto que el proyecto ha traído muchos cambios a la comunidad, con personas que han recibido dinero, árboles…, otros no, cómo se ve el proyecto en la comunidad, cómo lo ven los que no participan..? ¿El proyecto ha cambiado la comunidad de alguna manera?
	-Determine participant's perceptions of the project's organization and management	¿Qué le parece la organización y el manejo del proyecto por STRI, OUDCIE y ANCON? ¿Hay problemas o cosas que funcionan particularmente bien en la organización y el manejo del proyecto? ¿Cómo se podría mejorar la situación? ¿Tiene alguien que puede contactar si tenga preguntas, problemas? ¿A quién recurren?
	-Determine participant's opinion of the technical support	¿Cómo le parece ha sido el apoyo técnico del proyecto? Eventualmente. *¿Han tenido un taller sobre la plantación de los maderables?* ¿Querría tener más apoyo técnico o más talleres? ¿En cuáles áreas?
	-Determine participant's opinion of the design of the plots and recommendations for future plot design	¿Cómo están plantados sus árboles en la parcela? ¿Cómo todo en línea, o en pata de gallo/tres bolillos? ¿Por qué así? ¿Qué piensa de la manera en la cual los árboles están plantados en la parcela? ¿Cómo le pareció hacer la plantación de esta manera? ¿Se podría mejorar el diseño de la plantación? como la distancia entre los árboles, si sería mejor poner las mismas especies en grupos, etc ¿Como la habría realizado usted? ¿Piensa que los árboles fueron plantados al buen momento del año?

		¿Por qué escogió esas especies cuando hizo su diseño de parcela? ¿Hay especies que le gustaría añadir en su plantación? ¿Hay especies que no utilizaría en el futuro? ¿Cuáles especies le recomendaría usted a otros participantes para la plantación de este año? ¿Qué cosas de su conocimiento tradicional como por ejemplo plantar con las lunas usted habría incorporado en la plantación?
Participant's management of the plot	Find out what has been done on the plots since the plantation of the trees	¿Qué tipos de trabajos ha hecho en su parcela desde la plantación de las plántulas?
	Find out how labour-intensive the timber plot is and what labour is involved *calendar*	¿Cuánto trabajo necesita su parcela? Como para limpiarla, controlar los insectos… ¿Qué tipo de trabajo y quiénes lo hacen? ¿En qué fechas se hacen estos trabajos? ¿Riega sus plantas? ¿Cuándo limpia las parcelas? ¿Qué tipo de insumos utiliza? Fertilizantes/abono, insecticidas ¿A qué frecuencia hay que utilizarlos? ¿Cuánto les cuesta?
	Find out how time consuming managing the timber plot is	¿Cuánto tiempo le toma para ocuparse de su parcela?
	Describe organization/division of work (i.e. Does it involve multiple members of the family? Do different members have different tasks? Is the work done together or individually?)	¿Quién se ocupa de las parcelas? ¿Cómo organizan la división del trabajo? ¿Hay otras personas de la comunidad que les ayudan?
	Determine if the management of their plot fits in well in their family life and other activities	¿Con esta parcela y el trabajo que tiene que hacer en ella, alcanza a hacer sus otras actividades? Por ejemplo su familia y trabajo?

Physical condition of the plot	Describe the current state of the plots (Assess the health of the trees; lack of water, too much/ too little sunlight, diseases, soil quality, animal/insect damage ...)	¿Cómo va su parcela? ¿Ha tenido problemas con sus árboles? ¿Cuáles? [insectos, falta de agua, incendios…] ¿Ha podido resolver los problemas que ha tenido con su parcela? ¿Hay algo que se podría hacer para remediar a estos problemas? ¿Cómo se portan las diferentes especies de árboles? ¿Crecen bien? ¿La calidad del suelo parece corresponder bien con las necesidades de los árboles? ¿Ha tenido problemas con la falta de agua?
Innovations in plantation	Identify innovations and management that participants have used to adapt their plots to their needs	¿Ha hecho usted algunos cambios al diseño de la parcela? ¿Ha utilizado su parcela para sus cultivos anuales? ¿Hay otras cosas que le gustaría hacer en su parcela? *¿Qué piensa usted hacer con su parcela?*
Environmental impacts of timber plot	Identify actual or potential impact of the project in the natural environment (i.e. reduce pressure on natural resources by decreasing slash and burn, improve biodiversity and water? etc)	¿Ha notado cambios en el medio ambiente de su parcela desde la plantación de los árboles, como en el suelo y la erosión, la cantidad de agua? ¿Hay más animales, aves e insectos ahora? ¿El suelo ha cambiado, en términos de la calidad del suelo, de la erosión…? ¿Dónde hace usted sus cultivos como el arroz, maiz, etc? ¿Ha disminuido la quema desde que tiene su parcela?
Factors that might be important for the sustainability of the project (future plans, economic expectations, etc)	Determine interest in commercialization of products and ways of organizing this commercialization	¿Va a talar sus maderables eventualmente? ¿Cuándo? ¿Cuáles son sus planes? ¿Ya tiene una idea de lo que podrían ganar con esto? ¿Cómo ve la venta de sus productos? ¿Hacerla de manera individual? ¿O organizarse en un grupo o cooperativa con otras personas de la comunidad?

		¿Dónde se podría vender los productos? ¿Cómo se podría organizar el transporte de los productos?
	Economic expectations:	¿Cómo ve los ingresos que va a tener con su parcela de maderables? ¿A cuánto se vende el cocobolo? El cedro espino? El amarillo? El roble? El espave? El cedro amargo? ¿Estaría interesado en plantar sus cultivos anuales entre los árboles?
	Determine if participant would have participated in the project without carbon credits	¿Ha estado un factor determinante para su participación en el proyecto recibir dinero por el carbono? ¿En otro lugar y otro tiempo, si hubiera habido un proyecto de plantación de árboles que le hubiera dado las plantas, el apoyo técnico pero no dinero para el carbono, todavía le habría interesado participar?
	Describe participant's satisfaction with the economic benefits generated by the project	¿En general, le parece que el proyecto va a darle suficiente beneficios para el trabajo y la tierra que usted ha puesto en él?
	Determine the participant's opinion of the project all in all	¿Le gustaría agrandar su parcela o añadir otra parcela de maderables? ¿Le gustaría agregar frutales o cultivos también? ¿Recomendaría usted el proyecto a sus amigos o familiares? ¿Si pudiera volver atrás en el tiempo volvería a participar en el proyecto o no lo haría, y por qué? ¿Qué cosas se pueden cambiar para que el proyecto y su parcela funcionen mejor? (administración, diseño de las parcelas, pago, apoyo técnico, mano de obra…)

	Find potential participants for the future	¿Conoce a algunas personas interesadas en participar en el proyecto? >>¿Tiene algo más que añadir?

Interview guide for PPD-GEF:

Guía de entrevista – Programa de Pequeñas Donaciones – GEF-UNDP

Fecha:

Personas presentes:

Iniciativa comunitaria de capacitación para la implementación de proyectos compra-venta de carbono en la comunidad de Ipetí Emberá, Panamá.

Themes/objectives	Potential questions
Determine background information on the Small Grants Program and how they came to be involved with Ipetí-Emberá	¿Desde cuando está en Panamá el Programa de Pequeñas Donaciones del GEF? ¿A qué se dedica el programa? ¿Qué es la primera meta del Programa de Pequeñas Donaciones? ¿Cómo combinan los aspectos de medio ambiente con el desarrollo de las comunidades? ¿Cuándo empezaron a trabajar con la comunidad de Ipetí-Emberá? ¿Cómo empezó la cooperación con Ipetí/OUDCIE? ¿Qué les interesó del proyecto de capacitación comunitaria de la OUDCIE en Ipetí para la implementación de proyectos de compra-venta de carbono? ¿Cómo se enmarca el proyecto del GEF en el proyecto total de STRI de captura y venta de carbono en Ipetí? ¿Cuál es su visión de su proyecto para la comunidad, para el desarrollo de la comunidad? ¿Cómo fue el proceso del desarrollo de la propuesta para la solicitud de fondos del Programa de Pequeñas Donaciones? ¿Quiénes participaron?¿Cuántos años va a durar el proyecto de capacitación de la comunidad y de la OUDCIE para proyectos de venta y captura de carbono? ¿Hubo otros programas de GEF antes de este en Ipetí-Emberá? ¿Hubo otros programas parecidos a este en otros lugares de Panamá que ha apoyado GEF?

Understand the role of the Small Grants Program in the community, and their level of involvement.	¿Cuáles son los objetivos del proyecto en la comunidad de Ipetí? ¿Cuál es el rol del Programa de Pequeñas Donaciones en Ipetí? ¿Con quién trabajan en Ipetí? La OUDCIE, las autoridades, los participantes de los proyectos de compra-venta de carbono, toda la comunidad?
Determine how they monitor the project's advancement	¿Cómo verifiquen el avance de las actividades que se hacen con los fondos de GEF en Ipetí? ¿Se dan todos los fondos de una sola vez, o de muchas veces? ¿Quién maneja los fondos del proyecto?
Determine how they communicate with the community, who they communicate with, and how the funds are handled.	¿Cómo se mantienen en contacto con la OUDCIE? ¿Tienen contacto directo con los participantes del proyecto de compra de carbono del STRI? *Si sí, ¿cada cuánto…cómo convocan?* *Si no, ¿por qué no?* ¿Cree usted es importante? ¿Están en contacto con ANCON?/ ¿Trabajan con ANCON?
Explore past, present and future plans for using the funds from the Small Grants Program See what kind of workshops, if any they are planning to give to the community.	¿La OUDCIE ya ha recibido fondos del Programa de Pequeñas Donaciones o todavía no? ¿Hasta ahora qué actividades se han realizado con los fondos del programa de pequeñas donaciones? ¿Cómo avanzan los objetivos de capacitación de OUDCIE y de la comunidad para la implementación de proyectos de compra-venta de carbono? ¿Qué capacitaciones ve usted son necesarias en Ipetí para que el proyecto avance: - En sistemas agroforestales -En plantaciones de maderables - A la OUDCIE - Manejo de fondo ¿Cómo se va a decidir que aspectos son importantes de capacitar? ¿Cómo se va a realizar estas capacitaciones? ¿A quiénes?

	¿Cual cree usted es el incentivo de las personas de participar en los talleres o en las actividades de capacitación? La propuesta también menciona otras actividades como: Establecimiento de un vivero comunitario- ¿están involucrados en el desarrollo de un vivero comunitario? ¿Con qué fines? ¿Conoce usted del fondo colectivo del proyecto? ¿Cuál es la situación de este fondo? ¿Cuál es su visión del fondo colectivo para la comunidad, cómo lo ven? ¿Se piensa capacitar a OUDCIE sobre el manejo del fondo comunitario? ¿Contempla el proyecto incluir aspectos de comercialización de fruta y la madera de las plantaciones de STRI? ¿Cree usted este es un elemento importante? Respecto a su experiencia, ¿de que manera las comunidades pueden insertarse en mercados de estos productos y cómo el programa los podría ayudar?
Find out what they think the strengths and weaknesses of the OUDCIE-STRI carbon sequestration project are	Acerca del proyecto de STRI de captura y venta de carbono: -En su opinión, ¿cuáles son las fortalezas de este proyecto? -En su opinión, ¿cuáles son las debilidades de este proyecto? - ¿Cuáles son las barreras que todavía hay que superar para el buen desarrollo del proyecto? - ¿Cómo cree usted este proyecto podría mejorar? ¿Le parece a usted que hay más potencial para la reforestación y el desarrollo socioeconómico con los sistemas agroforestales o con las plantaciones de maderables? ¿En su opinión qué factores han determinado la participación de la gente de Ipetí en el proyecto de reforestación? ¿Y en el proyecto de maderables? ¿Cuáles factores hay que considerar para el desarrollo exitoso de un proyecto de compra y venta de carbono? ¿Qué lecciones se han aprendidas de este proyecto?
Determine their opinion of the project's management through the different institutions	*¿Cuáles son los actores involucrados en el proyecto de captura de carbono de STRI?* *¿Cómo es la relación de estos actores entre si?*

	¿Se ha hecho una reunión entre OUDCIE, ANCON, STRI y PPD-GEF? *¿Cree usted se necesita buscar maneras de mejorar la relación entre actores?* *¿De qué manera?*
Does he think these projects are a viable way to slow deforestation on a larger scale? Seems to require rather solid institutional capacity, political stability, good sources of funding, etc.	¿Piensa usted que este tipo de proyecto es una manera viable (eficaz) de capturar carbono en comunidades? ¿Cree usted que pueden ayudar a frenar la deforestación? ¿Cree usted que el pago por servicios ambientales, en este caso carbono, ayuda a la adopción de los proyectos en comunidades? ¿En su opinión, qué factores han hecho que este tipo de proyecto se podía desarrollar en Ipetí? ¿Que lecciones que se puedan llevar a otros proyecto ha aprendido usted a la fecha?

Interview guide for ANCON:

Entrevista con ANCON – Fecha:

Themes/objectives	Potential questions
Background - Find out how ANCON got involved in project	-¿Cómo entró ANCON en él proyecto de venta de carbono de STRI en Ipetí-Emberá? ¿Qué les interesó de este proyecto? -¿Cuál es su papel en el proyecto? -¿Qué interés tiene ANCON a participar en este proyecto?
Find out what they think the strengths and weaknesses of the project are	-En su opinión, ¿cuáles son las fortalezas de este proyecto? -En su opinión, ¿cuáles son las debilidades de este proyecto? - En su opinión ¿cuáles son las barreras que todavía hay que superar para el buen desarrollo del proyecto? - ¿Cómo cree usted este proyecto podría mejorar?
Clarify how often they visit the plots and what they look for, and how this impacts emission of carbon certificates and payments	-¿Emiten ustedes certificados para la captura y la compra de carbono? ¿Cómo se hace eso? -¿Qué miran cuando visitan las parcelas de los participantes? ¿Cómo determinan si un participante puede recibir el dinero o no? -¿Miran las mismas cosas en las parcelas de agroforestería y de maderables? -¿A qué frecuencia visitan las parcelas? -¿Cuándo fueron las últimas veces?
Identify potential communication issues between ANCON and OUDCIE and the participants	-¿Se comunican directamente con los participantes, o más a través de OUDCIE ? - ¿Cuáles son los actores de este proyecto? ¿Cómo es la relación de estos actores entre si? ¿Cómo es la relación de estos actores con ANCON? ¿Cree usted se necesita buscar maneras de mejorar la relación entre actores?

	¿De que manera? ¿Tienen ustedes un contrato escrito con el Smithsonian?
Determine how much and how payments are made to the participants	- ¿Cómo se definió el monto a pagar a los participantes? -¿Qué monto se da por hectárea a los participantes (de maderables/ de agroforestería)? -¿Todos del mismo grupo reciben el mismo monto por área? -¿Cuándo se hacen los pagos? - ¿Dónde se hace el pago? Por ejemplo: ¿Tienen una cuenta bancaria conjunta entre usted y OUDCIE ? ¿Quién maneja el pago a la comunidad y cómo se aseguran que las personas hayan recibido su dinero?
Understand why there has been issues with payments	-Querríamos saber un poco más sobre la situación de los pagos a los participantes. ¿Hemos oído que ha habido atrasos con los pagos? ¿Cuáles son las responsabilidades de los actores en estos atrasos? ¿Por qué ha pasado esto? ¿Cuándo esto ocurre ustedes le explican a los participantes que esto ha ocurrido? ¿Se comunican con ellos o con OUDCIE cuando ocurre esto? -¿Cuál sería una buena estrategia para evitar estos problemas en el futuro?
Identify ANCON's role in managing the collective fund - particularly determine if they withdraw the 20% from the money, and on what grounds they	Acerca del fondo comunitario. ¿Qué es el fondo comunitario? ¿Para qué se usa? ¿Quién lo maneja? ¿Cómo la comunidad puede acceder a esto? ¿Cuál es el rol de ANCON en el manejo de este fondo? ¿Se usa este fondo para pagar aspectos operativos del proyecto? Visitas de ANCON, etc Si no, ¿de qué manera financia ANCON su participación en el proyecto?

release the funds to OUDCIE		Presente:
Determine if ANCON has organized workshops for OUDCIE or for the participants	¿Se hacen actividades de capacitación con la OUDCIE o con los participantes del proyecto, como en temas de fortalecimiento institucional por ejemplo?	
Determine if they are involved in other similar projects and if they have recommendations for future projects >hacer preguntas con una visión de futuro para dar recomendaciones a otros proyectos etc	¿Están involucrados en otros proyectos similares de captura de carbono? ¿Qué lecciones se han aprendido de este proyecto pueden ser útiles para proyectos futuros? ¿Cuáles elementos sería importante considerar para que el proyecto fuera exitoso?	

Interview guide for OUDCIE:

Guía de entrevista – OUDCIE Fecha de la entrevista ::

- *Questions on REDD (p86-87)*

Preguntas sobre REDD

Con OUDCIE y con los participantes todas las preguntas

Con la comunidad en congreso local especialmente para el congreso local **

Invitar Felipe

Preámbulo

**En los últimos 2 anos no se pudo sacar los colonos de la zona de Curti. Entonces la deforestación siga y falta la mitad del carbono para honrar el contrato con STRI. El fracaso de esta parte de nuestro compromiso se debe a la falta de cooperación por parte del gobierno. Podemos hacer algo mas?

**Podemos buscar otro sitio para REDD?

**Cuantas cabuyas de bosque intacto se tumbo este ano?

**Cuantas cabuyas de bosque intacto se tumbo el ano pasado?

**Cuantas cabuyas de bosque intacto se tumbo el ano ante pasado?

**Cuantas cabuyas de rastrojo alto se tumbo este ano?

**Cuantas cabuyas de rastrojo alto se tumbo el ano pasado?

**Cuantas cabuyas de rastrojo alto se tumbo el ano antepasado?

**A que se uso el bosque intacto tumbado?

**A que se uso el rastrojo alto tumbado?

Cuantas familias tumbaron bosque intacto en los últimos 3 anos?

Cuantas familias tumbaron rastrojo alto en los últimos 3 anos?

Porque se necesita tumbar bosque intacto?

Porque se necesita tumbar rastrojo alto?

Es posible hacer sus siembras sin tumbar bosque intacto?

Es posible hacer sus siembras sin tumbar rastrojo alto?

Es posible tener ganado sin tumbar bosque intacto?

Es posible tener ganado sin tumbar rastrojo alto?

Que tierras usan los inmigrantes?

El ano pasada se quemo bosque intacto?

Cuantas cabuyas de bosque intactos se quemaron en los últimos 3 anos?

**Es importante tener bosque intactos en las Tierras colectivas? Porque si o porque no?
**Si sigamos cortando el bosque intacto cuanto bosque intacto quedara para nuestros hijos?
**Aceptaría la comunidad una moratoria sobre la tumba de bosque intacto? Porque si o porque no
**Aceptaría la comunidad una moratoria sobre la tumba de rastrojo alto? Porque si o porque no
**Si se hace una moratoria para no tumbar bosque intacto o rastrojo alto, quien se hará responsable?
**Si se hace una moratoria para no tumbar bosque intacto o rastrojo alto, quien y como se vigilaría?
**Si se hace una moratoria para no tumbar bosque intacto o rastrojo alto, quien y como se compensaría?
**Se pudiera hacer una moratoria sobre tumbar bosque intacto y rastrojo alto para honrar el contrato con STRI?

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Appendix L: Participatory Methods

- *Participant observation* was used throughout the research cycles, since researchers were living and interacting with the research subjects to understand local issues from the inside (Cook, 2005; DeWalt & DeWalt, 2010). For this, each researcher stayed throughout his/her study with a host community family, to build rapport and trust and to get a fuller understanding of the context at the community and household level. This method was mostly used as a way to validate the information gathered through other methodologies, making sure preliminary findings and understandings were correct. Field notes and records were used to record observed data.
- *Transect walks* involve walking through the plot with the owner, making observations and asking questions along the way (FAO, 1990). Transect walks were carried out with individual participants to evaluate plot and land characteristics and to gather information regarding their reforestation and avoided deforestation in their parcels.
- *Timelines* provide a means of capturing the timing of events local people identify as being important in a particular situation (Kumar, 2002). They were used to gather data on major events in the implementation of the carbon-offset contract as well as on land-use conflicts in the area.
- *Resource mapping/sketching* is useful for generating discussion about natural resources and identifying and planning interventions (Kumar, 2002). This method was used with participants to identify possible interventions that could slow or stop land invasion by the adjacent *colono* population.
- Force Field Analysis: The Force Field Analysis is a simple method useful for identifying positive and negative forces affecting a situation (Kumar, 2002). The tool that I used is called balloons and stones method (refer to Figure K.1 below). The exercise consists of having a piece of paper that contains Figure K.1, and participants are asked to visualize the problem situation (i.e. factors influencing agroforestry diversification/adoption) as a state of temporary equilibrium between two sets of opposing forces, namely balloons and rocks. Participants are then asked to write down on sticky notes the driving forces (balloons), and the constraints (rocks), that had influenced the current situation of agroforestry. They then stick the notes with the driving forces above the line and those with restricting forces below it. Once this is done, participants are asked to assign a weighting to each of the forces by placing beans on the sticky notes. Each participant can assign a maximum of four to each force, so that answers will be ranked from one to four in order of importance, one being the less important and four the most important.

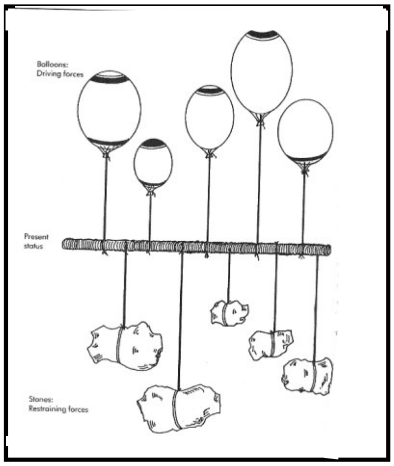

Figure K.1. Force Field Analysis: balloons and stones method
Source: Kurmar (2002, p.276)

- *H-form Exercise:* The H-form exercise was originally developed to assist local people in monitoring and evaluating local environmental management processes (Guy & Inglis, 1999). In this study, this exercise was used to gather information about positives, negatives and potential improvements that could be made in order for agroforestry to be adopted. This could be done with individual participants or as a group exercise. The method involves dividing a large sheet of paper into sections representing the letter H. These sections are used to rank and record the contributions made by groups and individuals (Figure L.2). The exercise begins by placing a leading question on the piece of paper (above the crossbar between the two posts), for example: "How positive has agroforestry been for your household?" Based on this question participants are asked to work through the following tasks:

1) rank from 1 (lowest) to 5 (highest) [1] the contribution of agroforestry to their households.
2) write on sticky notes the reasons why it was not 1 out of 5, identifying the positive contribution of agroforestry to their household.
3) write on sticky notes why it was not 5 out of 5, identifying negative issues about agroforestry.
4) write on sticky notes any improvements that could be made to enhance the contribution of agroforestry to their household.

[1] The scale from 1 to 5 was chosen because it is the normal scale used by Panamanian schools.

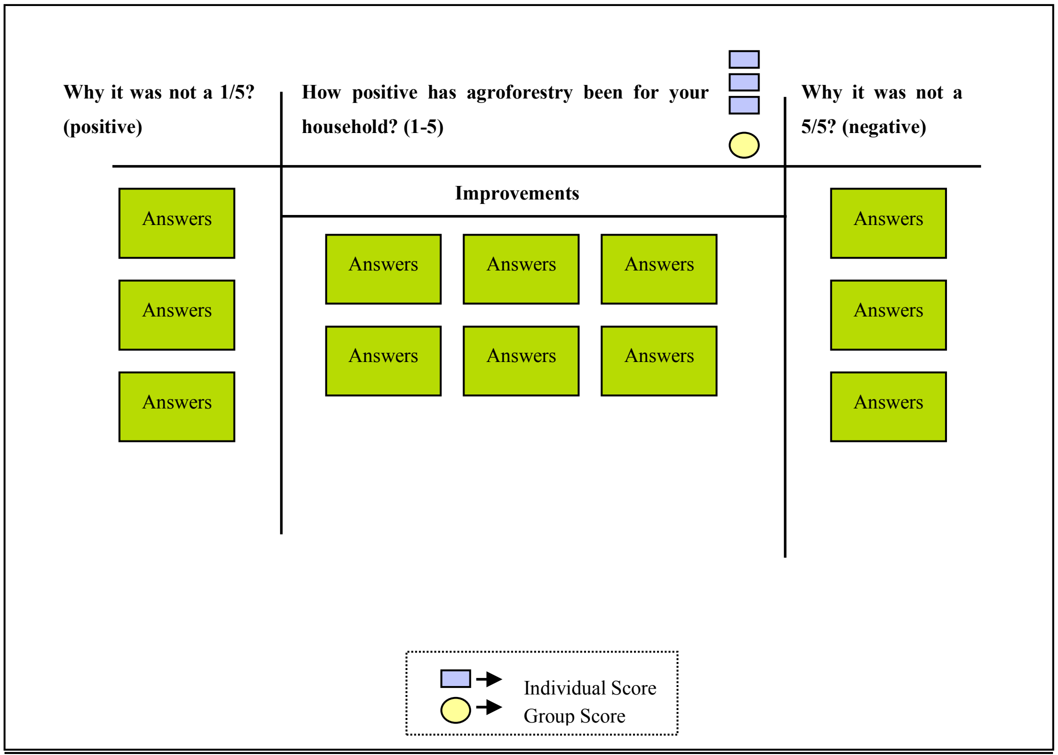

Figure K.2. Example of an H-form exercise

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