CAN PLANTING TREES BRING CO-BENEFITS? SMALLHOLDER TREE PLANTING FOR DEVELOPMENT AND CARBON MITIGATION

by

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B.Sc. Mount Allison University, 2004

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in

The Faculty of Graduate Studies

(Resource Management and Environmental Studies)

THE UNIVERSITY OF BRITISH COLUMBIA
(Vancouver)

October 2010

ABSTRACT

There has been a growing interest in land-use change and forestry activities for advancing the global goals of climate change mitigation and rural development. Because of its links to agriculture, the main livelihood activity of the rural poor in most developing countries, one particularly promising land-use is agroforestry, the use of land for both agricultural and silvicultural activities. The potential for agroforestry to deliver rural development and climate change mitigation benefits is well documented. There is considerable hope and expectation that agroforestry will be able realize co-benefits, where projects seek simultaneous goals of improving human welfare and mitigating climate change. However, it is less clear how and whether both goals might be accomplished in practice. Through an analytical literature review of rural development and carbon forestry literature, and a qualitative case study of participant experiences and understandings in smallholder tree planting initiatives in Uganda, this thesis explored the following overarching research questions:

1. What are areas of likely tension and synergy when smallholder agroforestry projects in developing countries attempt to realize co-benefits for rural development and climate change mitigation?

2. How should smallholder planting projects be designed to effectively maximize the delivery of benefits for both development and carbon goals?

Both the case study and review of the literature suggest that projects seeking co-benefits from smallholder tree planting initiatives will encounter substantial tension between practices best suited to realizing development versus carbon benefits. These projects have considerable potential to fail in meeting expectations. Explicitly seeking ancillary benefits in projects that have primary goals of development or climate change mitigation may be a more effective way to more quickly expand the use of smallholder planting projects and attain both types of benefits, while concurrently providing opportunities to learn from experience and move towards the development of best practice for delivering returns for carbon and development on the ground. Alternative approaches to project design and pathways to deliver development benefits may be more appropriate in smallholder carbon projects to overcome expected tensions in projects attempting to deliver both development and climate benefits.

PREFACE

A version of Chapter 2 will be submitted for publication following submission of this thesis. Design of the literature analysis was a co-effort that evolved through on-going two-way discussions between my supervisor, Hisham Zerriffi, and myself. It was based on an initial research problem identified that I identified. I conducted the literature review, analysis and writing, with editorial and problem-solving guidance from Dr. Zerriffi.

A version of Chapter 3 will be submitted for publication following submission of this thesis. Identification of the research program and design of this study was a co-effort between Dr. Zerriffi and myself, where I identified an initial research problem, which evolved into a full research program and study through on-going two-way discussions between Dr. Zerriffi and myself. I designed the research tools and conducted the fieldwork and analysis, and wrote the paper, with editorial and problem-solving guidance from Dr. Zerriffi. This study was conducted with the approval of the University of British Columbia Behavioural Research Ethics Board, certificate #H09-01729 (see Appendix C for certificate).

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ACKNOWLEDGEMENTS

Thank you first and foremost to my supervisor, Hisham Zerriffi for ongoing feedback and support, and for regularly helping me to make sense out of the confusion of my ideas. Thank you also to Gary Bull and James Tansey, my committee members, for their support and suggestions.

I am grateful for the financial support provided by the Social Sciences and Humanities Research Council of Canada, the Government of British Columbia, and the Faculty of Graduate Studies at the University of British Columbia, and for generous fieldwork funding provided by the Institute for Social Innovation and Sustainability (ISIS) at the Sauder School of Business.

My fieldwork in Uganda was assisted by many people in both Canada and Uganda. Thank you to Joelle and Emma at ISIS for answering my endless questions and organizing many, many receipts. Thank you to Makerere University for hosting me in Uganda, and especially to Shuaib Lwasa who made this happen. I am very grateful for the many organizations that went out of their way to provide time and information to support my research. In particular, I would like to acknowledge the particularly generous in-kind assistance with lodging and research assistance received from Africa Community Technical Service and Lake Bunyonyi Development Company, and with transportation received from the National Forest Authority and Great Woods. I am indebted to the many people who assisted me with translation: Kitareeba Rose, Busingye Dorcus, Twebaze Ben, Uwimaana Kabusingye Sierra. I would like to thank especially Jamen Kasumba, my primary research assistant, whose help was invaluable to this project. Last, but certainly not least, I want to thank everyone involved or connected to tree planting projects in Uganda who gave me some of their time to meet and share their stories and ideas. These people enriched both this thesis and my experience an immeasurable amount.

Finally, I am thankful to have been surrounded by an incredible group of colleagues, family and friends. To the staff and students at IRES: thank you for taking time to answer questions and give me feedback, for providing new perspectives, and for many rejuvenating lunch and coffee breaks that made me look forward to coming to campus. To my housemates: you are a joy to come home to. To my family: thank you for the countless ways you've helped me get here. And to Sam: thank you for keeping me well-fed and feeling loved, even when this thesis was making me more than a little crazy.

To my mom and dad.

1. INTRODUCTION

1.1 Two Challenges to Global Sustainability

Two of the key challenges that need to be addressed for global sustainability are development and climate change mitigation. Sustainability, although an ambiguous term, can be understood to relate to the ability of the Earth's natural and human systems to continue to meet the needs of its inhabitants, to perpetuity. Few would contest that poverty and climate change must be addressed for global sustainability to be realized.

At present, there are an estimated 6.9 billion people in the world (United Nations 2009); approximately 5.7 billion live in less developed regions, and 855 million in the world's Least Developed Countries (LDCs), as defined by the United Nations (United Nations 2009). As indicated by low Human Development Indices[1], many in developing countries, particularly the LDCs, struggle to attain even a very basic standard of living – clean water, adequate nutrition, health, housing, education and income (UNDP 2009). Development, understood broadly to be an increase in standards of living[2], is necessary to bridge massive gaps in wealth and opportunity between the world's richest and poorest people, and to allow every human being their right to have their basic needs met.

Although not the only challenge that must be addressed, development is also a key factor in achieving long-term global sustainability. Long-term sustainability is less likely to be a driver of people's choices when they are preoccupied with survival; for example, people may choose not to use more sustainable land uses like fallowing when land shortages leave them struggling to

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[1] The Human Development Index provides a measure of well-being based on " a composite measure of three dimensions of human development: living a long and healthy life (measured by life expectancy), being educated (measured by adult literacy and gross enrolment in education) and having a decent standard of living (measured by purchasing power parity, PPP, and income)" (UNDP 2009).

[2] Broadly, development can be understood according to the United Nations Development Programme as being "helping people to 'build a better life'", which is accomplished by addressing various types of challenges, including governance, poverty, crisis prevention and recovery, environment and energy, and health (UNDP 2010). A complete list of terms with definitions as they are used in this thesis is included in Appendix A.

grow enough food (e.g. Forsyth 1994; Tadesse 2001). Poverty may also be linked to other human activities counter to global sustainability, like deforestation and conflict (Ikejiaku 2009; Zwane 2007). And, without development and access to knowledge and education, a sizeable proportion of the world's population will be ill-equipped to contribute to finding and implementing sustainability solutions. Without development, long-term global sustainability is unlikely to be achieved.

Climate change mitigation is also a massive challenge for global sustainability. It is now widely accepted that anthropogenic climate change is occurring, and that unmitigated, climate change would "likely exceed the capacity of natural, managed and human systems to adapt" (IPCC 2007, p.73). Mitigation of greenhouse gas (GHG) emissions would help to reduce, delay and avoid impacts, but according to the most recent Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), current mitigation efforts are insufficient, and will result in increased emission rates and continued warming (IPCC 2007). Mitigation activities occurring in the next two or three decades will make the greatest contribution; delayed efforts increase the likelihood of more severe climate change impacts (IPCC 2007). Climate change mitigation must be a global priority if potentially catastrophic impacts on natural and human systems are to be averted.

These two global challenges of development and climate change are linked (Parry 2009). Irrespective of debates over cause and rate, there is now little dispute that the climate is changing, and the effects are being felt. Some of these effects include changes in regional average temperatures, sea level rise, and increased frequency and severity of severe weather events like flooding and storms (IPCC 2007; Woodworth et al. 2008). These changes, in turn, have consequences for people, including changes in ranges and life cycles of food organisms, pests and diseases, damage to and loss of property, crops and resources, and most seriously, displacement and death (Dasgupta et al. 2009; IPCC 2007; Mendelsohn 2009).

To survive and thrive in the face of climate change, people must adapt. Peoples' ability to adapt depends in part on access to wealth and resources, meaning that climate change will likely have the greatest negative impacts on the world's poorest people (Adger et al. 2005; Boyd et al. 2009; IPCC 2001; IPCC 2007). Even small increases in global temperatures are expected to have negative impacts on smallholders and subsistence farmers (IPCC 2007). Standards of living need to be raised to increase resilience and ability to adapt; this is particularly important from an ethical standpoint, given that rapidly industrializing and industrialized countries have been, and continue to be, responsible for the majority of emissions (IPCC 2007; Okereke & Schroeder 2009), meaning that those who will be most affected by the impacts of climate change are the least responsible. But, many researchers believe that adaptation alone will be insufficient, and that climate change mitigation is imperative, particularly to minimize impacts on the poor (IPCC 2007). Development not only increases adaptive capacity and reduces potential impacts from climate change, it also increases people's capacity to contribute to mitigation efforts (IPCC 2007). Because of these interconnections, there is particular interest in activities that have the potential to link mitigation and adaptation.

Climate change mitigation involves two types of activities: reduction of GHG emissions, and removal of GHGs that are already in the atmosphere, primarily through sequestration of carbon. Because the atmosphere is shared and climate change is thus a global phenomenon, GHGs emitted anywhere in the world consequently affect everyone, and conversely, localized emission reductions or removals benefit everyone, irrespective of where they occur. As developed countries and companies operating in developed countries try to reduce their contribution to climate change in a cost-effective manner, many are looking to partner with developing countries where emission reductions and sequestration activities may be accomplished more cheaply; for example, a study of carbon forestry projects suggests that carbon may be sequestered more cheaply in tropical countries (van Kooten & Sohngen 2007).

To facilitate mitigation activities and partnerships between different parts of the world to conduct these activities, various mitigation schemes have been developed. These include, but are not limited to, market mechanisms that facilitate the creation and trade of carbon credits[3]. Market mechanisms fall broadly into two categories: compliance and voluntary. The compliance

[3] A carbon credit is the "right" to emit a ton of carbon or equivalent, because an equivalent ton of emissions has been avoided or removed from the atmosphere through a mitigation activity elsewhere.

market involves credits that comply with specific agreements for mandatory emission reductions. For example, the Kyoto Protocol's Clean Development Mechanism (CDM) allows generation of credits that can be purchased by countries aiming to meet commitments for GHG reductions made as signatories to the Kyoto Protocol. The voluntary market involves credits generated for those who are reducing their emissions voluntarily, such as companies and individuals. Generally, the regulations for credit generation are more flexible and varied in the voluntary market compared to the compliance market (Harris 2007).

In the interests of equity and of advancing adaptation capacity and mitigation, most mitigation schemes operating in developing countries, such as the CDM and the United Nations' Reducing Emissions from Deforestation and Forest Degradation (REDD), seek benefits for both climate and development. To generate carbon credits under market mechanisms like CDM, activities must also contribute to local development goals (UNFCCC 1998, Article 12). Similarly, REDD facilitates the flow of funds towards the adoption of low-carbon development activities by developing countries (UN-REDD Programme 2009).

More than half of people in developing countries - 54% - live in rural areas where they rely on subsistence agriculture on small plots of land for their livelihoods (United Nations 2010). In LDCs, this proportion rises to 72% (United Nations 2010), suggesting that activities that combine mitigation and adaptation in rural areas will be of particular importance. Recently, there has been increasing interest in land-use, land-use change and forestry (LULUCF) activities for combining climate change mitigation with adaptation. LULUCF activities are attractive because of the reliance of rural livelihoods on agricultural and forestland, and because of the sizeable contribution of land-use change to GHG emissions. Between 1850 and 1998, LULUCF was responsible for 33% of global carbon dioxide emissions (Watson et al. 2000). Consequently, more than 120 countries have signed the Copenhagen Accord recognizing "the need to enhance removals of greenhouse gas emission by forests" (UNFCCC 2009, Draft decision -/CP.15). There is widespread hope that LULUCF activities can assist in addressing both carbon and development priorities, dual objectives that will be need to be realized for global sustainability.

1.2 Agroforestry, A Single Solution?

Agroforestry is defined as intentionally combining agricultural crops and/or livestock with woody perennials (trees, shrubs, etc.) in rural landscapes on the same land-management units in "interacting combinations in space or time dimensions" to derive livelihood and environmental benefits (FAO 2010; Nair 1993; Nair 2007, p.1614).[4] Agroforestry is gaining attention as a land-use that has the potential to realize benefits for both development and climate change mitigation.

1.2.1 History of Agroforestry

The practice of growing crops and raising livestock with trees has long been a sustainable agricultural practice used by smallholder farmers in many parts of the world (Albrecht & Kandji 2003). In the 1970's, efforts began to study the science of traditional agroforestry practices in the hopes of finding solutions to some of the negative ecological and social consequences of monoculture production (Nair 2007). Agroforestry practice was institutionalized in 1977 with the establishment of the World Agroforestry Centre (ICRAF) in Nairobi, Kenya (Nair 2007). Agroforestry became an important natural resource management tool for rural development, particularly as preferences shifted towards integrated rather than sectoral development

[4] There is some variation in the definitions of "agroforestry" that are used in the literature. Experience during field research for this thesis suggests that use of this term also varies in practice; the same activities and systems being called agroforestry by participants and implementing organizations in one project were not always called agroforestry in another. A broad definition of agroforestry was therefore adopted for this thesis to include the ways in which rural smallholders were observed to be actively combining tree planting with agricultural practices on the same land when participating in tree planting projects. This definition includes several characteristics found in most definitions of agroforestry in the literature, including those of the Food and Agriculture Organization of the United Nations (FAO) and the World Agroforestry Centre (ICRAF), the main international agroforestry research body, which is cited by the FAO (FAO 2010; ICRAF 2010; Nair 1993). These characteristics include: (1) the mixing of woody plants with agricultural crops and/or livestock on one piece of land, (2) intentional mixing, towards the achievement of desired outcomes (e.g. physical agricultural or tree products, environmental outcomes, etc.), and (3) interactions (economic or ecological) between the woody and agricultural components of the system. A broad range of scales are possible for agroforestry systems under this definition. For simplicity, because this thesis focuses only on agroforestry systems involving smallholder farmers, the term agroforestry is used throughout to refer to smallholder agroforestry.

approaches (Rudebjer et al. 2006). Over the past 30 years, agroforestry has come to be recognized as a sustainable land-use because of its potential production and local environment benefits when systems are appropriately designed (Nair et al. 2009; Oelbermann et al. 2004). It is thought to be a particularly useful tool for working with poor rural smallholders, in part because it supports diversification of livelihood strategies (Boyd et al. 2007; Current et al. 1995; Garrity 2004; Leakey et al. 2005).

Today, agroforestry continues to be used as a tool for rural development. Recently, it has also started to be used in carbon projects. Experience with generating carbon credits through LULUCF activities, and agroforestry in particular, has been limited due to slow integration of these activities into carbon schemes; in 2008, the forest carbon market accounted for only 5 Mt of the total 8700 Mt CO_2 traded (Hamilton et al. 2010; Kossoy & Ambrosi 2010). But, the size of the forest carbon[5] market has been increasing substantially – in 2007, transacted volumes of forest carbon credits rose 228% (Hamilton et al. 2010) – and as demands for resources from rural landscapes increase with population growth, it is expected that agroforestry will become an increasingly important land-use (Dixon 1995; Oelbermann et al. 2004; Pandey 2002).

1.2.2 Agroforestry for Co-benefits

As detailed in Chapter 2 of this thesis, well-designed agroforestry systems have the documented potential to deliver development and carbon benefits. It is thus hoped that agroforestry could deliver co-benefits, where co-benefits are understood to be maximized benefits contributing to the realization of two or more distinct goals that are delivered through a single activity. This would make agroforestry an ideal activity for use in carbon schemes that require the delivery of benefits towards both carbon and sustainable development goals.

However, there are still considerable unknowns with regard to whether and how co-benefits might be achieved. Not all agroforestry systems deliver all types of livelihood and environmental benefits; for example, some agroforestry systems are not carbon sinks (Mutuo et al. 2005) and some systems and practices can reduce agricultural production (Reynolds et al.

[5] Although agroforestry systems are not always included in definitions of "forest" (e.g. FAO 2004), agroforestry land-uses and carbon credits generated through them are generally included in "carbon forestry" and "forest carbon" (Hamilton et al. 2010).

2007; Siriri et al. 2009,). Van Noordwijk et al. (2008) caution that best practice for carbon, isn't always best for rural livelihoods, and several reviews of early experiences with both agroforestry and carbon forestry, and carbon mechanisms more broadly, suggest that efforts to seek co-benefits have had only limited success (Bailis 2006; Boyd et al. 2007; Brown & Corbera 2003; Cosbey et al. 2005; Milne & Arroyo 2003; Murdiyarso et al. 2008; Nelson & de Jong 2003; Sutter et al. 2007; Wittman & Caron 2009).

As interest in carbon forestry activities increases, there is a need for more research on how and whether co-benefits can be realized from agroforestry. Research would be timely to inform project design and help to maximize the ability of this tool to contribute to two global priorities. Much of the literature on carbon forestry focuses on Latin America (Bailis 2006). Little has focused on Africa, as the continent has historically generated only a small share of global forest carbon credits (Hamilton et al. 2010). As of July 2010, Africa had only two of 15 CDM forestry projects registered worldwide, the first of which was just registered in 2009 (UNFCCC 2010). But, a recent report on the state of the forest carbon market suggests that "the dominant source of forest carbon credits appears to have shifted from Latin America in 2007 to Africa in 2009" (Hamilton et al. 2010, p.x), and numerous informants interviewed in Uganda during the course of the research for this thesis indicate that interest has been piqued on the continent. There is particular opportunity in Sub-Saharan Africa to learn from early experience and speak to the many projects that are still in the early stages of design and implementation.

1.3 Thesis: Researching the Potential of Agroforestry to Deliver Co-benefits

This thesis contributes to knowledge on seeking co-benefits through agroforestry projects in developing countries by addressing the following research questions:

1. What are areas of likely tension and synergy when smallholder agroforestry projects in developing countries attempt to realize co-benefits for rural development and climate change mitigation?

2. How should smallholder planting projects be designed to effectively maximize the delivery of benefits for both development and carbon goals?

These questions are explored through an analytical review of recommended and common practices from the carbon forestry and development literature (Chapter 2), and through a case study of participant understandings and experiences of smallholder tree planting initiatives in rural Uganda (Chapter 3). For the purposes of this research, "development" refers to "participatory development"[6], which emphasizes engagement of development beneficiaries (smallholder farmers in the case of smallholder agroforestry) in the development process, as appeared to be the main development perspective adopted by the majority of the literature reviewed and of most smallholder tree planting projects studied. For simplicity, the term development will be used in this thesis to refer to participatory development and its corresponding goals, practices, desired outcomes, etc., unless otherwise specified.

1.3.1 Literature Review to Predict Sources of Tension and Synergy in Co-benefit Projects

Chapter 2 of this thesis reviews the carbon and development literature with a focus on smallholder agroforestry. Recommended and common practices for realizing benefits for carbon and for development were identified in the literature. A framework was then created to organize and analyze these practices to see how recommended project design differs when attempting to realize each type of benefit. Based on this analysis, project characteristics were classified as sources of likely or possible tension, alignment or synergy when seeking co-benefits in an agroforestry project. This analysis was designed to illuminate tensions between best practice for different kinds of benefits and identify likely challenges and reasons for limited success in delivering co-benefits from smallholder agroforestry, towards the design of projects that can better address these challenges in practice.

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[6] Participatory development is an approach to development that saw mainstream adoption in the mid-1990s when it became widely incorporated into the development strategies of many governments and agencies, including the World Bank (Mohan 2007; Williams 2004). There is some variability in how participatory development is defined (Campbell & Vainio-Mattila 2003). The term participation can be used to describe a range of levels of involvement and control over decision-making in a development project (Cornwall 2003; Hayward et al. 2004; Mohan 2007), and participatory development may be used to describe either a means of conducting development or an end, or both (Hayward et al. 2004; Mohan 2007). In general, use of the term participatory development usually implies valuing broad engagement of the intended beneficiaries of development in the development process and seeing this participation as being important to project success (Hayward et al. 2004; Williams 2004). Project characteristics and guiding ideologies seen to facilitate this participation are emphasized, such as valuing local knowledge, building relationships, power-sharing, choice and flexibility, ownership and control over decision-making by local people, and empowerment (Campbell & Vainio-Mattila 2003; Hayward et al. 2004; Mohan 2007). These ideas are generally identified as desirable in the smallholder agroforestry literature reviewed and were valued in the smallholder tree planting initiatives studied.

1.3.2 Case Study of Smallholder Tree Planting Initiatives in Rural Uganda

Chapter 3 of this thesis reports on fieldwork conducted in Uganda to further explore and illuminate findings from the literature review. Data was collected from rural and organization participants in a sample of ten smallholder tree planting initiatives involving some use of agroforestry in their implementation. This sample reflected the range of different smallholder planting initiatives underway in Uganda. Qualitative interview data was analyzed using inductive and deductive coding (Bernard 2006) to explore participant experiences and understandings of agroforestry and tree planting, barriers to smallholder participation, challenges to realizing benefits, distribution of benefits, and the relationships between these factors. This analysis was then used to speak to the additional opportunities, challenges and barriers that may be encountered when carbon is sought in conjunction with development goals.

Chapter 4, the thesis Conclusion, links results from the case study back to the literature review and summarizes findings and their implications for designing agroforestry projects that more effectively deliver benefits to realize climate change mitigation and development goals.

2. SEEING THE TREES FOR THE CARBON: AGROFORESTRY FOR DEVELOPMENT AND CARBON MITIGATION[7]

2.1 Introduction

Land-use change has played a significant role in greenhouse gas (GHG) emissions over the last two centuries. The Intergovernmental Panel on Climate Change (IPCC) estimates that land-use change, primarily conversion of natural systems to agriculture, contributed emissions of 121 Gt of carbon to the atmosphere, or one third of global emissions, between 1850 and 1990 (Watson et al. 2000). Until the 1950's, land-use change was responsible for the highest proportion of global carbon emissions of any source, even ahead of fossil fuel combustion (Lal 2004[b]).

Although it has now been surpassed by energy as the leading source of emissions, land-use change continues to make a large contribution to atmospheric GHGs. Around the world, 17 million hectares are deforested every year, emitting 16 Pg C globally (Lal 2004[b]; Montagnini & Nair 2004;). This is significant, given that forests contain more than half of the world's terrestrial carbon, and account for about 80% of carbon exchange between terrestrial ecosystems and the atmosphere (Montagnini & Nair 2004). Recently, deforestation for cropland has been the largest source of land-use change emissions (Watson et al. 2000), with tropical forest conversion responsible for 25% of CO_2 emissions and up to 10% of N_2O emissions globally (Palm et al. 2004). There are a number of different mechanisms by which deforestation for agriculture can result in carbon emissions. The conversion of forest to high-input cropping systems via slash-and-burn methods has the highest global warming potential of these mechanisms, as a result of lost soil carbon through mineralization and oxidation, carbon release from vegetation burning and decomposition, and nitrogen release from subsequent fertilizer inputs (Palm et al. 2004). Once established, agricultural land-uses can create additional carbon emissions through lost soil organic matter (SOM) when soil is cultivated, fossil fuel use in farm operations, and embodied energy spent in the manufacture of farm products like fertilizers (Niles et al. 2002). As a result, an estimated 88% of a forest's original carbon stocks are lost within 4-12 years after conversion (Sanchez 2000).

[7] A version of this chapter is being submitted for publication following submission of this thesis.

(Niles et al. 2002). As a result, an estimated 88% of a forest's original carbon stocks are lost within 4-12 years after conversion (Sanchez 2000).

Despite their contribution to global climate change, interest in using land-use, land-use change and forestry (LULUCF) activities for climate change mitigation was initially limited (Hamilton et al. 2010; Kossoy & Ambrosi 2010). Possible LULUCF activities to mitigate climate change under the Kyoto Protocol, such as adoption of land-uses to reduce emissions or sequester carbon, are described under Article 3.3 (UNFCCC 1998). Adoption of these activities was hindered because of concerns about problems like permanence[8], leakage[9], and issues with accounting methods (Hamilton et al. 2010; Milne 2002), and because rules for inclusion of LULUCF sink projects (limited to reforestation and afforestation projects only) were not finalized until 2003 (UNFCCCC 2003, Decision 19/CP9). But, some LULUCF activities are now eligible under Kyoto's Clean Development Mechanism (CDM), as well as several other compliance and voluntary carbon schemes; for example, the United Nations Collaborative Initiative on Reducing Emissions from Deforestation and Forest Degradation (REDD) focuses primarily on LULUCF activities (UN-REDD Programme 2009). The annual volume of forest carbon credits traded globally has been increasing since 2007, when volumes jumped 228% over 2006 (Hamilton et al. 2010; Kossoy & Ambrosi 2010). In 2008, 5 Mt of CO_2 were traded, 95% of this on the voluntary market (Hamilton et al. 2010). Most credits (77% in 2008) are generated from projects that include tree planting (Hamilton et al. 2010). Interest in using LULUCF activities for tackling climate change is growing.

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[8] Issues with permanence in carbon sink projects are related to the risk that carbon stored in sinks may be emitted in the future. Whereas an avoided emission is permanently avoided, stored carbon may be emitted, for example, if land-use changed. To deal with this uncertainty, some carbon schemes offer different types of credits, like Kyoto's temporary Certified Emission Reductions (t-CERs).

[9] Leakage in carbon forestry projects refers to the amount of carbon benefit not realized because the project causes increased emissions elsewhere outside the project boundary (Cacho et al. 2004; Murray et al. 2004;). For example, conservation efforts that prevent trees being cut in a protected forest may result in deforestation or forest degradation elsewhere if local needs for wood products are not addressed in other ways, or, decreases in agricultural production as a result of large-scale tree planting could raise prices of agricultural products and push farmers to begin cultivating land currently used for forest or pasture, thereby releasing CO_2 (van Kooten & Sohngen 2007).

There is a burgeoning understanding that it will be inefficient, and likely ineffective, to attempt to independently address global goals of climate change mitigation and sustainable development. In their Commitment to support sustainable land management, the Council of the European Union (2009) stated that "efforts to tackle climate change should be integrated with poverty reduction strategies and/or national strategies for sustainable development". This idea has been echoed by numerous others (e.g. Davidson et al. 2003; Parry 2009), including the signatories of the Copenhagen Accord (UNFCCC 2009). Thus, many carbon credit schemes that facilitate projects in developing countries, like CDM, require that projects contribute to sustainable development in the host country.

To this end, one land-use that is gaining attention is agroforestry. Because of its links to agriculture and forestry, activities central to the livelihoods of many of the world's poorest people, and its potential to mitigate climate change, it is hoped that agroforestry could contribute to simultaneously addressing climate and development goals (Garrity 2004; May et al. 2005; Nair et al. 2009; Pandey 2007; Roshetko et al. 2007; Schroeder 1994; Watson et al. 2000).

This paper will begin with a review of agroforestry and its potential to deliver benefits for development and climate separately. It will then evaluate the potential of agroforestry to deliver co-benefits for these two goals by analysing common practice and recommendations for project design in the literature.

2.2 Agroforestry

Agroforestry is an integrated land-use that purposefully combines tree-growing and conventional agricultural practices (crops and/or livestock) in rural landscapes on the same land-management units in "interacting combinations in space or time dimensions" to generate social, economic and environmental benefits and services from the resulting interactions (FAO 2010; ICRAF 2010; Nair 2007, p. 1614; Nair 1985; Nair 1993; Nair et al. 2009;). Since its adoption by rural development practitioners in the 1970's, agroforestry has come to be recognized as a sustainable land-use because of its potential production and local environment benefits (Nair et al. 2009; Oelbermann et al. 2004). It has become an important natural resource management tool (Rudebjer et al. 2006), and is considered a "best practice crop management"

(Watson et al. 2000). Initially, agroforestry featured in only a very small proportion of carbon projects[10], but interest is increasing, while the use of agroforestry for rural development continues.

Agroforestry systems can be established both on productive and marginal or degraded lands, such as fallows, and wooded grasslands (Dixon et al. 1994). They can differ greatly in size, species, tree density, rotation length, and management intensity (Roshetko et al. 2007). Practices can include a wide variety of activities, ranging from intercropping food crops and trees, to grazing livestock beneath trees, to growing hedgerows and windbreaks around fields, to rotating trees with crops on the same plot of land. As a result, agroforestry has been found to be very adaptable and able to meet the needs of landowners in a wide variety of circumstances (Schroeder 1994).

Agroforestry in developing countries is practiced mainly by subsistence farmers on small landholdings (smallholders) (Nair et al. 2009) managed by individuals or groups (Roshetko et al. 2007). Because it can diversify livelihood strategies and is rooted in traditional practices, agroforestry is believed to be a promising land-use for delivering benefits to marginalized populations, like small-scale, poor farmers and those with access to limited resources and high-risk markets (Boyd et al. 2007; Current et al. 1995; Garrity 2004; Leakey et al. 2005). Agroforestry systems in use by smallholders in the tropics employ a variety of practices (Nair et al. 2009), and tend to be characterized by an emphasis on production rather than profits and subsistence of the land-owner (Nair et al. 2009; Oelbermann et al. 2004).

It is estimated that about 1.2 billion people in developing countries rely on products and services from agroforestry for their livelihoods (Watson et al. 2000), with about 1023 million hectares of land being used for agroforestry globally (Nair et al. 2009). It is thought that there are between 585 to 1215 million ha of land suitable for the establishment of agroforestry systems, with much of this being in industrializing nations (Dixon et al. 1994). It is expected that agroforestry use will increase to meet the needs of rapidly growing populations and their

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[10] Community forestry and agroforestry projects combined represented only 15% of the land area being used for CDM LULUCF activities up to the year 2000, and stored only 20 Mt of carbon (Watson et al. 2000).

demands for resources, like agricultural land and wood products (Oelbermann et al. 2004; Pandey 2002).

2.2.1 Potential Rural Livelihood Benefits

At present, agroforestry projects targeting rural development tend to have a combination of objectives falling under broader goals of local environment and human welfare improvement, including rural poverty alleviation, soil quality improvement, nutritional security, and mitigating local environmental degradation (Fischer & Vasseur 2000; Nair 2007). They are generally started by a variety of agencies, including both government and non-governmental, and operating at different scales.

Agroforestry is a land-use that is structurally and functionally more complex than either crop or tree monocultures, which can allow for more efficient capture and use of resources (Nair et al. 2009). This, in turn, can result in a number of direct benefits for local people and the local environment when the right practices are used (Current et al. 1995). Direct benefits for local people include resources for household use or sale (Current & Scherr 1995), and income generation and employment (Current & Scherr 1995; Current et al. 1995; Pandey 2007; Sanchez 2000), leading to reduced poverty (Leakey et al. 2005) and increased income security (Jama et al. 2006). Agroforestry systems can also provide opportunities for income diversification, which is desirable to improve livelihoods and increase the resilience of smallholders in rural tropical areas (Current et al. 1995; Garrity 2004; Schroeder 1994). Non-timber forest products provide additional income that can be particularly important for poor and marginalized people (Leakey et al. 2005). Secondary livelihood improvements have also been observed, such as increased dignity (Sanchez 2000) and health (Leakey et al. 2005).

It is widely agreed that agroforestry systems can improve local environments (Current & Scherr 1995; Leakey et al. 2005; Nair 2007). Because the livelihoods of rural farmers are highly dependent on the local environment, environmental benefits in turn benefit local people. For example, trees on the boundaries of crop fields can improve the microclimate, with observed increases in soil quality and crop production (Albrecht & Kandji 2003; Fischer & Vasseur 2002; Pandey 2007; Schroeder 1994). Consequently, some agroforestry systems have been observed to lead to significant improvements in food security (Jama et al. 2006; Leakey et al. 2005;

Pandey 2007; Sanchez 2000; Schroeder 1994). Agroforestry can also reduce the use of unsustainable land-use practices: for example, a 20% reduction in the use of slash-and-burn agriculture was reported when agroforestry was adopted by farmers in Panama (Fischer & Vasseur 2002).

A summary of documented development benefits that can result from agroforestry adoption is presented in Table 2.1.

2.2.2 Potential Climate Change Mitigation Benefits

Agroforestry tends to be used in carbon projects seeking co-benefits, since conventional forestry projects can sequester more carbon than agroforestry (Watson et al. 2000), and are therefore preferable when seeking a primary goal of carbon sequestration. Projects have been started by entities seeking to generate carbon credits for sale on international markets, and those looking to offset their own emissions. Agroforestry has also been used in carbon forestry projects in an attempt to diffuse deforestation pressure and prevent leakage in surrounding communities (Brown et al. 2000). Agroforestry is believed to be a financially viable (Sathaye et al. 2001), and even cost-effective activity compared to other mitigation options (Albrecht & Kandji 2003; Dixon 1995; Dixon et al. 1994; Schroeder 1994).

Numerous studies suggest that some agroforestry systems can mitigate climate change (e.g. Nair 2007; Pandey 2007; Schroeder 1994; Watson et al. 2000). This can happen through carbon sequestration and through avoided emissions. Potential benefits of agroforestry for climate change mitigation are summarized in Table 2.1, alongside potential benefits of agroforestry for development.

In the tropics, the main carbon sequestration potential of agroforestry systems is expected to be in vegetation (Mutuo et al. 2005). Although there is considerable variation between systems, studies suggest that many agroforestry systems are intermediate between forest and cropland or pasture in terms of sequestration potential (Mutuo et al. 2005; Nair et al. 2009; Niles et al. 2002; Palm et al. 2004). This is because trees can increase carbon stocks in biomass (Mutuo et al. 2005) and can promote higher soil sequestration compared to crop and grazing land (Palm et al. 2004).[11] Although there is not a simple relationship between tree planting and carbon sequestration, and not all agroforestry systems are carbon sinks (Mutuo et al. 2005), it is estimated that when the right practices are used, land-use conversion to agroforestry has an estimated average potential carbon sequestration rate of 3.1 t C/ha/yr, the highest potential rate of any land-use change option described by the IPCC, apart from restoration of forestland (Watson et al. 2000).[12] Because a large amount of the soil organic carbon (SOC) pool has been lost, soil carbon is expected to make up a significant proportion of this sequestration potential (Lal 2004[b]), through practices that restore degraded cropland and prevent erosion (Albrecht & Kandji 2003). Some agroforestry systems have been found to store SOC at a rate of 80-100% that of natural forest, compared to croplands at 50% (Palm et al. 2004). Agroforestry systems can be a desirable land-use compared to conventional agricultural systems from the perspective of climate change mitigation.

There is also evidence that agroforestry has the potential to reduce emissions of GHGs. Some agroforestry systems have been found to have N_2O emissions similar to natural forests and lower than cropping systems (Mutuo et al. 2005; Palm et al. 2004), and it is thought that certain systems can act as CH_4 sinks (Mutuo et al. 2005; Schroeder 1994). There is also speculation that agroforestry can avoid GHG emissions by averting deforestation and forest degradation (Albrecht & Kandji 2003; Appiah et al. 2009; Current et al. 1995; Dixon 1995; Montagnini & Nair 2004; Nair 2007; Pandey 2007; Schroeder 1994; Watson et al. 2000) and by substituting fossil fuels and fossil-fuel intensive materials (Nair et al. 2009; Watson et al. 2000). Because of

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[11] The IPCC suggests that generally, agroforestry systems can regain 35% of the overall carbon stock of a cleared forest, compared to 12% on cropland or pastureland (Watson et al. 2000), and estimates that agroforestry systems can have 80-100% of the below-ground carbon stocks of undisturbed forest (Watson et al. 2000). However, the carbon sequestration potential of an agroforestry system depends on the practices used, (Albrecht & Kandji 2003) such that some systems, including many livestock-based systems, may actually be emission sources (Dixon 1995).

[12] Nair et al. (2009) suggest that estimates of carbon sequestration potential for agroforestry are not rigorous, such that these figures should be used with caution. The average sequestration potential for agroforestry reported by the IPCC is included here to give a sense of the hoped-for potential contribution of agroforestry to climate change mitigation relative to other LULUCF activities, which is one of the motivations for increased interest in agroforestry as a mitigation option.

difficulty in accurately estimating the area under agroforestry, it is hard to determine the exact effect of agroforestry on deforestation (Montagnini & Nair 2004; Nair et al. 2009). The IPCC estimates that the substitution of renewable biomass, like wood products, for fossil fuels could avoid about 3.5 Gt carbon/yr of emissions from fossil fuels, equivalent to more than half of current fossil fuel emissions (Watson et al. 2000). Although there has been little conclusive research, the contribution of agroforestry to climate change mitigation through avoided emissions is potentially significant, and could be higher than the contribution of agroforestry through sequestration (Schroeder 1994).

Agroforestry systems have the potential to contribute to climate change mitigation through carbon sequestration and through avoided emissions. Given estimates of the amount of land suitable for agroforestry globally, agroforestry could be one important tool for climate change mitigation.

Table 2.1. Potential benefits of agroforestry adoption for development and climate

	Benefits	References
Development	Resources – Tree products for household use and sale • Fuel • Food • Building materials and other wood products	Current & Scherr 1995; Dixon et al. 1994; Fischer & Vasseur 2002; Montagnini & Nair 2004; Pandey 2007; Schroeder 1994; Watson et al. 2000
	Income & Employment • Reduced poverty • Income security • Income diversification	Bognetteau et al. 2007; Current & Scherr 1995; Current et al. 1995; Jama et al. 2006; Leakey et al. 2005; Montagnini & Nair 2004; Palm et al. 2004; Pandey 2007; Sanchez 2000; Schroeder 1994
	Secondary livelihood benefits • Resilience • Dignity • Health & nutrition	Current et al. 1995; Garrity 2004; Leakey et al. 2005; Sanchez 1999, 2000;
	Local environment improvement • Restoration and improvement of soil • Reduced soil erosion • Conservation and improvement of water resources • Increased biodiversity over monocrop systems • Animal habitat and wildlife corridors • Reduced use of unsustainable land-use practices	Albrecht & Kandji 2003; Current & Scherr 1995; Current et al. 1995; Dixon 1995; Fischer & Vasseur 2002; Nair 2007; Noble & Dirzo 1997; Pandey 2007; Schroeder 1994; Watson et al. 2000
	Livelihood benefits from environment improvement • Increased crop production and food security • Improved water use efficiency • Support of biological pest control	Albrecht & Kandji 2003; Dixon 1995; Fischer & Vasseur 2002; Jama et al. 2006; Leakey et al. 2005; Pandey 2007; Sanchez 1999, 2000; Schroeder 1994; Watson et al. 2000

	Benefits	References
Climate	Carbon sequestration • Biomass – above and below ground • Soil • Durable wood products • Potential greater than cropping systems	Albrecht & Kandji 2003; Dixon 1995; Lal 2004[b]; Montagnini & Nair 2004; Mutuo et al. 2005; Nair et al. 2009; Niles et al. 2002; Oelbermann et al. 2004; Pandey 2007; Palm et al. 2004; Roshetko et al. 2002; Sanchez 2000; Schroeder 1994; Watson et al. 2000
	Lower GHG emissions compared to cropping systems • N_2O emissions similar to natural forests • CH_4 sinks	Mutuo et al. 2005; Palm et al. 2004; Schroeder 1994; Watson et al. 2000
	Avoided emissions • Substitution of fossil fuels and fossil fuel-intensive materials • Alternative sources of tree products → avoided deforestation and forest degradation • Alternative to higher-emission land-uses	Albrecht & Kandji 2003; Appiah et al. 2009; Current et al. 1995; Dixon 1995; Montagnini & Nair 2004; Nair 2007; Nair et al. 2009; Noble & Dirzo 1997; Palm et al. 2004; Pandey 2007; Schroeder 1994; Watson et al. 2000

2.2.3 Possible Synergy from Carbon Finance

Because of documented potential to deliver development and carbon benefits, it is hoped that agroforestry can be used in co-benefit projects. The Organization for Economic Co-operation and Development workshop defined co-benefits as "effects that are taken into consideration as an explicit (or intentional) part of the development of GHG mitigation policies" (Jochem and Madlener 2003). Although not always explicitly defined in the literature (e.g. Aunan et al. 2004; van Vuuren et al. 2006), use of the term co-benefits usually signals that two or more outcomes or goals are desired from a single project or policy.

As detailed above, agroforestry has the potential to deliver certain livelihood or climate benefits. But, notably, not all systems will deliver all or any of the benefits described, and the adoption of certain systems may actually be a source of costs from a development or carbon perspective. For example, not all agroforestry systems are beneficial from a climate perspective: some are not sinks (Mutuo et al. 2005), like those involving livestock, which are likely significant sources of GHG emissions (Dixon 1995). Some systems and practices have been found to have potential livelihood costs, like negative effects on crop production (Reynolds et al. 2007; Siriri et al. 2009). The potential of agroforestry to deliver certain desired development and/or climate benefits depends on how agroforestry systems are designed (Albrecht & Kandji 2003; Current et al. 1995). In this paper, while acknowledging that every agroforestry system does not automatically deliver any or all types of benefits described, we focus on situation where benefits can be reasonably expected or hoped for, and on the potential of smallholder agroforestry projects to deliver certain benefits for development and carbon mitigation. We focus on this potential in order to explore how and whether agroforestry projects might be designed to effectively deliver these two different types of benefits simultaneously, as is hoped for in co-benefit projects for rural development and carbon mitigation.

When implementing projects, certain practices will be better suited to realizing and maximizing certain outcomes. In the case of co-benefit projects, practices best suited for realizing and maximizing one goal may or may not be the same as or compatible with practices best suited to realizing and maximizing the other. Where practices are not compatible, it may be necessary to make trade-offs between kinds or amount of benefit. For a given characteristic of co-benefit project design, several outcomes are possible when best practices for realizing more than one desired goal are compared:

Likely Tension – Recommended or widely adopted practices for a given project characteristic are in conflict to realize and maximize each goal.

Possible Tension – Recommended practice for a given project characteristic may be in conflict. This is either because the characteristic is emphasized and specified in the literature for only one type of benefit and not for the other, or because significant variation of this characteristic with project context is possible. In the latter case, tension is possible depending upon how projects are developed and implemented.

Alignment – Recommended or widely adopted practices for a given project characteristic to realize and maximize one goal are not expected to interfere with practices to realize and maximize the other.

Synergy – Recommended or widely adopted practices for a given project characteristic to maximize one goal compliment practices to realize and maximize the other, such that greater benefits may be realized for one or both goals than is possible when each goal is sought separately.

Desired outcomes for co-benefit agroforestry projects are, not surprisingly, a combination of the outcomes desired from development agroforestry and carbon agroforestry projects. Both types of benefits are valued, and maximization of benefits is desirable. Although both types of desired outcomes include social and environmental components, it is worth noting that they are quite different on several fronts (Table 2.2); most desired development outcomes are local with a stronger social focus, while desired carbon outcomes tend to be primarily global and have a stronger commercial or monetary orientation. There will be considerable tension and co-benefits will be difficult to realize in practice if maximizing desired outcomes for development and carbon requires significantly different project designs.

Table 2.2. Desired outcomes from agroforestry projects for development and carbon

	Development	Carbon
Primary Outcome	Short and long-term improvements in local environments and rural livelihoods	Long-term global environment benefits and reductions in social impacts of climate change; financial gains for international investors
Scale	Local	Local -> Global
Orientation of Primary Targets	Social	Commercial
Tree Products	Tangible goods	Less tangible carbon credits
Agricultural Products	Varied	Limited

It is hoped that synergistic benefits can be realized from carbon agroforestry projects for both people and the environment. There is particular hope that agroforestry will allow delivery of benefits from carbon projects to local smallholders, in contrast to conservation and large-scale commercial forestry projects that restrict access to land that smallholders might have used, making "their contribution to local livelihoods and thus sustainable development questionable" (Roshetko et al. 2007). There are considerable opportunities for land-use conversion to agroforestry in developing countries; it is estimated that about 250 Mha of deforested land in the humid tropics could be converted to agroforestry at a rate of 3% per year, plus an additional

20% of the 15 Mha deforested annually (Watson et al. 2000). It is thought that carbon projects could create new opportunities for building infrastructure and for income generation and rural poverty alleviation for subsistence farmers via carbon payments (Montagnini & Nair 2004; Nair et al. 2009; Smith & Scherr 2002). It is also speculated that carbon funding could offset cost barriers to uptake of agroforestry, like start-up costs and time to returns, and could provide opportunities to leverage additional funding or institutional support (Palm et al. 2004). It is further hoped that carbon agroforestry could deliver synergistic environmental benefits if carbon funds are used to offset incentives for deforestation (Palm et al. 2004). At $10 per tonne of carbon, Niles et al. (2002) estimate that carbon credits could be worth $16.8 billion between 2002 and 2012 to tropical and developing countries, suggesting that the potential synergistic effects from carbon finance could be important.

Many believe that carbon agroforestry is a tool with significant unrealized potential (Montagnini & Nair 2004; Nair et al. 2009; Oelbermann et al. 2004). But, the United Nations Food and Agriculture Organization has warned that poor land users will not automatically benefit from carbon payments (Boyd et al. 2007), and modeling suggests that best practices for realizing carbon benefits will not always be best for realizing livelihood benefits (van Noordwijk et al. 2008). As noted above, key differences in desired outcomes for development and climate change could be sources of tension when attempting to design projects that seek these goals simultaneously. Through a review of recommendations and common practices in the literature, this paper explores how and whether co-benefits might be achieved through agroforestry in developing countries.

2.3 Synergies and Tensions When Attempting Co-Benefits

We reviewed both academic and grey literature on agroforestry, rural participatory development, carbon forestry, and carbon projects to examine which project characteristics can be expected to be sources of Likely Tension, Possible Tension, Alignment or Synergy when agroforestry is attempted for co-benefits for carbon and development. Recommended and common practices for realizing development and carbon benefits described in the publications were compiled, then put into a table based on the characteristics of project design the practices were addressing (e.g. project size, flexibility of design, etc.). These project characteristics were then organized into three broad categories: Enabling Conditions, Basic Project Characteristics, and Project Characteristics for Overcoming Barriers and Sustaining Participation.

Enabling Conditions
Enabling Conditions are a set of pre-existing political, social, economic and environmental site conditions that facilitate the realization of a successful project. Conditions having influence over the potential project area can operate at various scales: local, regional, national and international. These conditions include the availability of resources necessary for project success, including both physical and intangible resources, like information and skills.

Basic Project Characteristics
Basic Project Characteristics describe the who, what, when, where and how of the project: who is participating and the relationships between participants, length and size of the project, what end products the project is hoping to achieve, and the planned methods for directly achieving them.

Project Characteristics for Overcoming Barriers and Sustaining Participation
One subset of project characteristics comprises the elements of project design put in place to facilitate the support and participation of local people in the project. Local support and participation is necessary for long-term project sustainability, for both development and carbon benefits. In the case of carbon projects, it will also be important to secure the sustained participation of project investors and buyers.

Recommended and common practices from the literature for achieving carbon and development benefits were compared for each project characteristic and then classified according to whether they could be expected to be of Likely Tension, Possible Tension, Alignment, or Synergy, according to the definitions of these terms given in Section 2.2.3 above. To assist in summarizing and communicating results, project characteristics were grouped into three broad categories using bottom-up hierarchical coding methods often used with qualitative data (Bernard 2006). A summary of results is presented in Table 2.3, with a more detailed discussion following in Section 2.4, including descriptions of the three project characteristic categories.

Table 2.3. Predicted tensions and synergies in project characteristics when agroforestry is attempted for co-benefits for climate and development

	Development	Climate	Tensions and Synergies in Realizing Co-Benefits
Enabling Conditions	Supportive government, policy and socioeconomic environments; emphasis on secure land and tree tenure and sufficient resources to support land-use change	Supportive government, policy and socioeconomic environments; emphasis on secure land and tree tenure and sufficient resources to support land-use change	**Alignment**
Basic Project Characteristics	**Participants and Partnerships:** Social NGOs, Multi-stakeholder partnerships **Project Timeline:** Longer term projects; Shorter term or flexible contracts; Short-term returns to farmers are emphasized **Project Size:** Small scale, small farm size **Financing:** Primarily donor funds. Farmers need access to upfront credit, financial incentives or markets	**Participants and Partnerships:** Technical NGOs **Project Timeline:** Longer-term projects; contract terms long enough to meet certification requirements; Short-term returns to investors are emphasized **Project Size**: Large scale, large farm size **Project Location:** More developed countries favoured **Financing:** Carbon finance available	**Likely Tension:** Contract length, project size **Possible Tension:** Participants and partnerships, project location, financing, agroforestry practices, end products, time to returns, monitoring **Alignment:** Agroforestry practices **Synergy:** Financing, agroforestry practices, end products, time to returns; project length

	Development	Climate	Tensions and Synergies in Realizing Co-Benefits
Basic Project Characteristics	**Agroforestry Practices:** Mixed species, context-matched agroforestry practices **End Product:** Tangible products for local and regional consumption and sale **Monitoring:** Involve community to lower costs	**Agroforestry Practices:** High carbon systems **End Product:** Intangible carbon credits for sale on international markets **Monitoring:** Extensive monitoring to ensure credit validity	

	Development	Climate	Tensions and Synergies in Realizing Co-Benefits
Project Characteristics for Overcoming Barriers and Sustaining Participation	**Focus**: Sustained participation of local farmers **Project Design:** Flexible, participatory design and implementation that responds to local needs and conditions **Recommendations**: Preliminary site assessments, on-going education and technical support, active interaction with project context to improve enabling conditions, integration with other development activities, facilitating access to markets for tree products, participatory demonstration farms, short-term returns to farmers. **Decision-making:** Bottom-up, community-driven	**Focus:** Reducing financial risk of investors and generating valid, competitive carbon credits. **Project Design:** Rigid, standardized design and implementation **Recommendations and common practices:** Top-down management, long-term contracts, minimal education and technical support provided, centralized carbon broker to access carbon markets, short-term returns to investors. **Decision-making:** Often top-down and may involve only a few people.	**Likely Tension:** Interaction with project context; community participation and flexibility of project design; choice and decision making; provision of education, training and technical support; facilitating access to markets **Possible tension:** Preliminary site assessments, integrating with other development activities; demonstrating benefits **Synergy:** Integrating with other development activities to diversify funding

Sources: Albrecht & Kandji 2003; Appiah et al. 2009; Ashley & Carney 1999; Bognetteau et al. 2007; Boyd et al. 2007; Bull et al. 2008; Chivinge 2006; Current & Scherr 1995; Dixon 1995; Dixon et al. 1994; Dolan 2006; Fischer & Vasseur 2000, 2002; Garrity 2004; Harris 2007; Jama et al. 2006; Lal 2004[a], 2004[b]; Leakey et al. 2005; Macqueen 2009; Makundi & Okiting'ati 1995; Milne & Arroyo 2003; Montagnini & Nair 2004; Mutuo et al. 2005; Nair et al. 2009; Nelson & de Jong 2003; Niles et al. 2002; Noble & Dirzo 1997; Oelbermann et al. 2004; Palm et al. 2004; Pandey 2007; Roshetko et al. 2007; Rudebjer et al. 2006; Sanchez 1995; Sathaye et al. 2001; Schroeder 1994; Seeberg-Elverfeldt et al. 2009; Shiferaw et al. 2009; Watson et al. 2000

2.4 Discussion of Project Characteristics and Predicted Tension and Synergy

2.4.1 Enabling Conditions

Broadly, enabling conditions are likely to align in co-benefit projects. A supportive policy and government environment, and addressing land and tree tenure issues are emphasized for the realization of both development and climate benefits (Gong et al. 2010; Niles et al. 2002; Palm et al. 2004; Roshetko et al. 2007), as are favourable socioeconomic conditions (Roshetko et al. 2007; Pagiola et al. 2005). For co-benefits, the need for adequate livelihood assets is emphasized, in particular "higher level" benefits, like off-farm employment and education, over and "basic" benefits, like food security and peace (Palm et al. 2004). For all types of benefits, agroforestry must be a viable and attractive option compared to other land-uses; in other words, the opportunity cost of switching to agroforestry must be low (Albrecht & Kandji 2003; Cacho & Lipper 2007; Dixon et al. 1994; Fischer & Vasseur 2000; Milne & Arroyo 2003; Shiferaw et al. 2009). In many cases, this means that markets must be available and accessible for tree products (Boyd et al. 2007; Palm et al. 2004;), whether they are physical resources such as timber or fruits, or intangibles like carbon credits.

In terms of environmental conditions, underused, low opportunity-cost and low biomass land-use systems, such as degraded, non-productive land, permanent agriculture or pasture and short fallow agriculture systems, are considered good options for smallholder agroforestry projects (Cacho & Lipper 2007; Roshetko et al. 2007; Schroeder 1994; Torres et al. 2010). Degraded land offers good opportunities for carbon projects because it will allow a high potential increase in carbon stocks, since degraded land stores little carbon in soil and biomass (Dixon 1995; Lal 2004[b]; Montagnini & Nair 2004; Niles et al. 2002; Roshetko et al. 2007; Van Vliet et al. 2003). A shift to agroforestry from these land-uses can result in sequestration that is three times higher than what is possible on crop or grassland (Sanchez 2000). Degraded land is also not highly productive, making it a top candidate for agroforestry because there are few competing land-use options that can deliver livelihood benefits, and therefore low opportunity cost (Cacho & Lipper 2007; Dixon

1995; Nair 2007; Schroeder 1994). Co-benefit agroforestry projects are also favoured where high rates of deforestation have resulted from high demands for agricultural lands and wood products, because agroforestry is a more realistic land-use option for storing carbon while also meeting these resource needs (Palm et al. 2004).

Overall, the enabling conditions that favour the success of development and carbon projects are largely in alignment, and align with recommendations for co-benefits. Enabling conditions are therefore not expected to be a significant source of tension in co-benefit projects.

2.4.2 Project Design: Basic Project Characteristics

2.4.2.1 Participants and Partnerships

Project participants are a source of possible tension in co-benefit projects. Carbon projects tend to partner with technical NGOs, whereas partnerships with social and development NGOs are recommended for co-benefits (Boyd et al. 2007). This tension could be easy to resolve by including both types of NGOs as partners. A greater source of possible tension lies in the breadth of partners included, and in recommendations for how relationships between partners are facilitated. For development and co-benefits, there is an emphasis on the intentional building of good, flexible relationships with good communication between multiple partners (Appiah et al. 2009; Bognetteau et al. 2007; Boyd et al. 2007; Bull et al. 2008; Fischer & Vasseur 2002; Leakey et al. 2005; Milne & Arroyo 2003; Roshetko et al. 2007; Shiferaw et al. 2009). For development benefits in particular, it is recommended that funders and strategic industry partners are included and consulted, and that communication is actively facilitated between partners operating at different scales (Garrity 2004; Macqueen 2009; Noble & Dirzo 1997; Rudebjer et al. 2006). For co-benefits, there is an emphasis on equality and building trust in transparent relationships (Bull et al. 2008; Niles et al. 2002; Roshetko et al. 2007).

By contrast, carbon projects do not always emphasize multiple stakeholders, communication or intentional relationship-building, possibly because of the potential additional costs these would likely imply.[13] But, this tension could be resolved if broader partnerships and collaboration compensate for additional costs by reducing costs in other areas (Boyd et al. 2007). For example, the program manager of a carbon forestry project in Costa Rica said he worked closely with farmers to ensure long-term commitment to the project and reduce costly contract violations (Milne 1999). In the first CDM project, a forestry project in China, low levels of trust in relationships between land-owners and commercial partners was identified as an obstacle to project success (Gong et al. 2010). Increasing trust and engagement is also identified by Vatn (2010) as a means of reducing transaction costs in payment for environmental service schemes, suggesting that relationships between partners may be important to success in projects with both carbon and development goals. It is also speculated that partnerships with existing farmers' organizations to provide technical training could reduce costs associated with knowledge transfer (Nelson & de Jong 2003), and partnerships with NGOs already working with landowners in a project area could reduce the costs of contacting farmers and negotiating participation, and potentially increase the quality of development benefits generated in a co-benefit project (Milne 1999). Thus, with thoughtful project design, possible tensions in this area could likely be minimized or avoided.

[13] For example, coordinating larger groups of stakeholders operating at different scales and implicated in the project in different ways would be expected to be more complicated than smaller groups operating at similar scales, and would thus require greater investments of time and resources to accomplish effectively. Similarly, actively facilitating communication and meetings between participants would be expected to require more time and resources than doing nothing to facilitate these relationships. Boyd et al. (2007) suggest that agroforestry and community projects often have higher transaction costs, in part because they require working with multiple stakeholders. Similarly, smallholder carbon projects are noted to have higher transaction costs (Cacho et al. 2002; Roshetko et al. 2007; Smith & Scherr 2003). These additional costs are more challenging in carbon projects, which already face high transaction costs related to requirements for project registration and credit validation (Cacho et al. 2002). Further discussion of transaction costs appears in Section 2.4.2.5.

2.4.2.2 Project Timeline

Broadly, project timeline is the different phases of project development that occur from initiation to completion. Specific projects will have different phases. In the case of carbon projects, phases will depend in part on what market the project is targeting and the regulations of the certifying body. There were three main aspects of project timeline that were frequently discussed in the literature reviewed: total project length, contract length, and time to returns. These aspects have the possibility of being sources of likely tension, alignment and synergy.

Project length constitutes the total duration of a project from start to finish, and is one area of likely alignment when seeking co-benefits. Long-term projects, with long-term commitments by project funders and stakeholders, are preferable for realizing development benefits because they allow sufficient time for building good relationships between local people and organizations and for building the local skills and capacity that facilitate long-term sustainability of benefits (Dolan 2006; Fischer & Vasseur 2002). Although in the past, CDM projects in particular have tended to be shorter to allow them to be completed within Kyoto's 2012 timeline to minimize risk to investors associated with uncertainty surrounding what will replace Kyoto (Harris 2007), in general, longer-term projects are desirable for carbon credit permanence.

Within projects, implementing organizations and local participants may sign contracts stipulating that certain practices will be carried out for certain periods of time; for example, contracts often specify how long trees will be kept in the ground. Contract lengths within projects could be a source of tension that is difficult to resolve. For development benefits, short, flexible contracts are favoured to allow local people to change their livelihood strategies as needed to adapt to changing conditions and needs (Roshetko et al. 2007; Chapter 3). Most carbon projects, however, have longer, more rigid contracts to meet carbon certification requirements. Standardized contracts may also be used to reduce project costs (Gong et al. 2010). Contract length and flexibility have been found to be a source of tension in smallholder planting initiatives, some targeting voluntary and others compliance markets, in China, Ecuador and Uganda (Gong et al. 2010; Milne & Arroyo 2003; Chapter 3).

Time to returns is the amount of time it takes for a project to deliver benefits, monetary or otherwise. Time to returns could be a source of either possible tension or synergy in co-benefit projects. For development benefits and co-benefits, it is important for farmers to have access to up-front credit, financial incentives or markets (Fischer & Vasseur 2002; Roshetko et al. 2007; Sathaye et al. 2001). Short-term economic returns can help to sustain farmer participation (Fischer & Vasseur 2002; Gong et al. 2010; Shiferaw et al. 2009; Torres et al. 2010). Returns demonstrate for farmers that an activity is worth the risk of their continued investment of resources, and can give them sufficient resources to continue participating (Ashley & Carney 1999; Dixon et al. 1994; Fischer & Vasseur 2002; Shiferaw et al. 2009). This is important, as most rural smallholders do not have sufficient resources in reserve to be able to sustain a long-term reduction in returns, even if their long-term gain would be greater (Shiferaw et al. 2009). By contrast, payment upon delivery of services (i.e. when trees are grown and carbon credits assured) is often preferable to intermediaries (who buy credits from credit producers and sell them on carbon markets) because it reduces their risk (Harris 2007). Payment upon delivery of services is common in carbon projects (Kossoy & Ambrosi 2007). But, if the time to receiving carbon payments is too long, the usefulness of alternative land-uses or activities that can provide earlier payments may make generating carbon credits less attractive than these alternatives to farmers (Gong et al. 2010). This could be an important source of tension in designing co-benefit projects: for example, in China, lack of up-front payments is thought to be a contributing factor to stalled planting in a CDM forest project (Gong et al. 2010).

But, time to returns could also be a source of synergy where carbon finance allows farmers to realize benefits faster than they would have otherwise (Sathaye et al. 2001). This could allow more farmers to participate who otherwise would not have sufficient resources to wait for the long returns from tree planting. But, based on a review of the literature on smallholder agroforestry, Roshetko et al. (2007) suggest that co-benefit projects should be socially and economically viable outside the generation of carbon revenue, which could reduce the potential for synergy through using carbon funds to overcome barriers to participation in agroforestry.

In project timelines, overall project lengths align. But, interactions between contract lengths and time to returns make it difficult to predict the potential of timelines to deliver tension or synergy overall. Carbon finance could potentially reduce time to initial returns, which could benefit smallholders; but, reluctance to pay farmers before delivery of carbon credits, and long inflexible contracts that lengthen time to returns from forestry products like timber could be less beneficial to smallholders. Whether carbon finance can deliver synergy in carbon projects will likely depend on interactions between factors like the price of carbon, the overall payout schedule, and local context, including farmer needs and desires with respect to wood products.

2.4.2.3 Project Size

Project size will also likely be a source of tension. Boyd et al. (2007) argue that small projects can better-accommodate the livelihood strategies used by the rural poor, are more easily designed to be adaptable and flexible in order to respond to changing needs and markets, and are more easily integrated with other development activities and land-uses; they are thus recommended for the delivery of development benefits. But, smaller projects could compromise the amount of carbon benefit realized, because transaction costs have been found to decrease as project size increases (Torres et al. 2010), such that profitability per hectare of carbon projects increases with project size (Cacho et al. 2004). Larger scale carbon projects can allow greater standardization and lower transaction costs, which lower risks to investors (Cacho & Lipper 2007; Harris 2007; Leach & Leach 2004; Skutsch 2004; Smith & Scherr 2003). Under CDM, it is thought by some experts that the carbon credit volume limit of 8,000 tons of CO_2 may be only just enough to make these projects economically viable (Haupt & von Lüpke 2007).

A subset of project size is farm size – the amount of land included in the project by each individual participant. In carbon projects, larger farm size is favoured to keep projects economically attractive: Cacho & Lipper (2007) found that transaction costs increased exponentially for intermediaries selling credits on carbon markets when farm size dropped below one hectare. Conversations with rural participants in smallholder tree planting initiatives in Uganda suggest that this could be a source of tension in smallholder co-benefit projects where broad participation is desired for development benefits. Farmers reported that land shortages were a problem, and many in the community, fearing agricultural production losses, had difficulty setting aside even a hectare or less for tree-based land-uses.

In carbon projects, minimum economically viable total project size and farm size are affected by the price of carbon credits on carbon markets: smaller project and farm sizes are possible at higher carbon prices (Cacho & Lipper 2007).

Reducing transaction costs (for example, by lowering monitoring costs – see Sections 2.4.2.5 and 2.4.2.8) could help to reduce tensions related to size in co-benefit projects by lowering minimum viable project sizes (Cacho & Lipper 2007). Grouping smallholders together in a single project is recommended to increase project size to economically feasible levels in smallholder projects (Cacho & Lipper 2007), which could reduce tensions in this area. It may be difficult to completely eliminate tensions in this manner, however, if transaction costs are increased, for example, if monitoring costs increase because participants are widely dispersed (Cacho et al. 2004), or if farmer transaction costs are increased by participation in a collective scheme (Cacho & Lipper 2007). Tensions surrounding farm size may be more difficult to resolve in practice, particularly in areas where farmers are experiencing land shortages and are reluctant to commit larger tracts of land to tree-based land-uses.

2.4.2.4 Project Location

On the international scale, project location is an area of possible tension. CDM carbon projects tend to be located in more developed countries to reduce risk to investors and transaction costs (Harris 2007; Kossoy & Ambrosi 2010). However, the least developed countries arguably have the greatest need for development activities and could benefit most from leveraging carbon funds for development. Nevertheless, the highest rates of potential carbon accretion in biomass are in tropical regions (Dixon et al. 1994), where a large number of developing countries are located. This tension may be resolved if interest in using agroforestry for co-benefits drives the initiation of more projects in less developed countries. This may already be happening, as volumes of forest carbon credits generated in Africa increased considerably in 2009 compared to 2007 (Hamilton et al. 2010).

2.4.2.5 Financing

Financing is both a source of possible tension and synergy. Financing is the source of some of the greatest hopes for synergy when seeking co-benefits. It is thought that co-benefit projects could harness carbon finance to fund development and overcome conventional barriers to agroforestry adoption (Harris 2007; Palm et al. 2004). For example, returns in tree-based systems are often long; it is thought that even small early carbon returns that come prior to returns from tree products could provide additional incentives for the adoption of tree-based systems (Cacho et al. 2004) and be important sources of early revenue for project developers (Van Vliet et al. 2003). In carbon forestry projects in Asia, it was found that carbon finance can add about 20% in revenues to a project (Haupt & von Lüpke 2007). Co-benefit projects could also provide unique opportunities to overcome funding challenges by combining carbon with other development and research objectives to diversify funding opportunities (Roshetko et al. 2007).

But, seeking co-benefits could also increase funding challenges by increasing project transaction costs. Transaction costs in a project are the “costs of doing business” (Milne 1999), and include costs such as those of seeking out project sites and establishing relationships with potential participants, negotiating contracts, implementing and managing the project, and monitoring (Cacho & Lipper 2007; Cacho et al. 2005; Jindal et al. 2008; Milne 1999). If total project costs are too high for any party, the project will be economically unattractive. In the case of farmers, if the opportunity cost of alternative land uses plus their physical project costs plus the costs of risk associated with switching land-uses are greater than the expected benefit from participating in the agroforestry project (e.g. returns from carbon paid to them), they will not participate (Cacho et al. 2005; Gong et al. 2010). In the case of carbon projects where intermediaries are buying credits from farmers to sell on carbon markets, intermediaries will only participate if the current market value of the carbon credits generated is at least as great as the amount they pay farmers for the carbon sequestered plus their transaction costs associated with designing and implementing the project (Cacho & Lipper 2007). Overall, for agroforestry carbon projects to be viable, the costs of sequestering carbon must be less than the market price for carbon (Cacho et al. 2005).

As mentioned, smallholder and community-based forestry projects often have high transaction costs (Boyd et al. 2007; Harris 2007; Roshetko et al. 2007; Smith & Scherr 2003). For example, community-based projects with smallholders usually have higher initial costs associated with meeting local land-owners to disperse information and assess the needs and priorities of potential participants, and negotiating with individuals (Cacho et al. 2005; Milne 1999;). Seeking to generate carbon credits in a smallholder project adds additional costs associated with project registration (which usually includes establishing baselines and proving additionality[14]), carbon monitoring, and credit validation (Cacho et al. 2002; Jindal et al. 2008; Leach & Leach 2004; Lile et al. 1998; Milne 1999; van Noordwijk et al. 2006). Although smallholder carbon forestry projects can be competitive in terms of the cost of carbon sequestration in these projects, transaction costs may be a

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[14] Establishing additionality means proving that the emissions reductions from the project are additional to those that would have happened in the absence of the project (Milne 2002); i.e. the project would not have happened without the benefits of the carbon mechanism (Van Vliet et al. 2003). In the case of CDM forestry projects, additionality can be shown by demonstrating that the project would be unlikely to occur without carbon incentives, either by showing that a proposed project would not be the most financially or economically attractive land-use, or that the project would be unable to overcome legal, technological or ecological barriers without the carbon income (Haupte & von Lüpke 2007).

sizeable barrier (Cacho et al. 2005). Considerable variability has been found in the transaction costs of small carbon projects (Cacho & Lipper 2007; Cacho et al. 2005), which have been found to be sensitive to various factors including project type and size (Cacho & Lipper 2007), and social capital (Gong et al. 2010). Cacho et al. (2005) provide a tentative preliminary estimation of transaction costs for four smallholder agroforestry projects in India ranging from 6-45% of total project costs. Monitoring is an important part of transaction costs in carbon projects, which will be discussed in more detail in Section 2.4.2.8. In general, forestry projects have high initial costs and delayed returns (Haupt & von Lüpke 2007). Higher transaction costs are expected in carbon projects seeking to deliver substantial sustained benefits to local people (Milne 1999). High transaction costs can be challenging in carbon projects because to remain viable, project costs must be kept down such that the prices of carbon credits generated through land-use change are competitive with credits generation through other kinds of projects (Nair et al. 2009).

To overcome funding challenges successfully, funding mechanisms will need to be developed through forums such as multilateral assistance, private trusts, and government (Roshetko et al. 2007). Transaction costs, particularly fixed costs, will also need to be reduced, as this is important for smallholder participation in carbon markets (Cacho & Lipper 2007; Gong et al. 2010; Jindal et al. 2008) and for the transfer of benefits to landowners (Torres et al. 2010). Project-level strategies to address transaction cost barriers include focusing on the voluntary carbon market (Harris 2007; Torres et al. 2010)[15], off-setting costs by generating additional project revenue from timber and other tree products (Van Vliet et al. 2003), targeting farmers who will only need to make a partial rather than full land-use conversion to adopt the desired agroforestry system (Torres et al. 2010), grouping smallholders and/or projects, using existing management infrastructure or cooperative

[15] Generating credits on the voluntary market is usually cheaper because it is less regulated and more flexible (Harris 2007). Torres et al. (2010) estimate that fixed transaction costs are 77% higher for CDM projects compared to voluntary market projects.

community structures, choosing project sites where smallholders have already participated in planting and/or development projects, and involving farmers in monitoring (see Section 2.4.2.8) (Cacho & Lipper 2007; Cacho et al. 2005; Gong et al. 2010; Grieg-Gran et al. 2005; Milne 1999; Smith & Scherr 2003). Additional recommendations for actions primarily outside of project control that could help co-benefit projects to address cost and administration barriers include improving the availability of information (e.g. about monitoring methods, connecting credit buyers and producers, etc.) (Milne 1999), developing mechanisms to ensure that a sufficiently high price for carbon is being paid (Palm et al. 2004), negotiating higher carbon prices (Torres et al. 2010), clearly defining property rights and strengthening social capital (Gong et al. 2010), increasing institutional capacity (Jindal et al. 2008), standardization of baselines (Milne 1999), and diversifying the market to create more opportunities for viable carbon projects through the creation of new types of carbon credits, like soil carbon and avoided deforestation (Lal 2004[b]; Niles et al. 2002).

2.4.2.6 Agroforestry Practices Used

The agroforestry practices used in a project can be a source of possible tension, alignment or synergy when seeking co-benefits. For development and co-benefits, it is recommended that tree species and site selection for agroforestry should be matched to local environmental conditions, labour availability and socioeconomic context (Roshetko et al. 2007). For carbon benefits, it is still important to match practices to local conditions, but since not all agroforestry practices mitigate climate change (Dixon 1995; Mutuo et al. 2005), there is a focus on systems that improve on carbon storage (Albrecht & Kandji 2003). Practices that favour carbon storage include perennial systems, harvesting a low proportion of the biomass produced by the system (i.e. focusing on production of non-timber forest products rather than wood products), avoiding using livestock, long rotations, higher tree density, and using species with longer rotations and higher carbon storage (i.e. not banana or coconut) (Montagnini & Nair 2004; Nair et al. 2009; Roshetko et al. 2007).

Co-benefits will require agroforestry systems that can deliver high livelihood benefits and high carbon sequestration simultaneously. Systems that improve soil quality and meet multiple needs to reduce leakage are recommended (Lal 2004[b]; Nelson & de Jong 2003). But, livelihood needs and desired benefits vary between communities and regions, and practices that improve carbon storage may or may not align with agroforestry practices and species favoured for development benefits in a given area. For example, Palm et al. (2004) found that systems with long fallows store more carbon than short fallow systems, but that long fallows may not be feasible in areas with high population densities. Some tension could also arise surrounding organic inputs to agroforestry systems because high quality inputs are favoured to maximize crop yields for development benefits, while lower quality inputs are favoured for soil carbon storage to reduce emissions from decomposition (Mutuo et al. 2005), such that Batjes & Sombroek (1997) note that policies for improving soil carbon sequestration may be counter to social policies for increasing food production and decreasing rural poverty. For carbon benefits, it has also been recommended that crop cultivation be limited in the first 3 years (Roshetko et al. 2007), which could create tension if this compromises farmers' ability to realize immediate livelihood benefits from their land.

But, alignment is also possible. For example, mixed species systems are desirable for development benefits, and, although species diversity can increase carbon-monitoring costs (Cacho et al. 2004), it may be more efficient than monocultures for delivering carbon benefits in some contexts (Montagnini & Nair 2004; Roshetko et al. 2007). Good soil management and sustainable agriculture practices, like reducing tillage and fertilizer use, favour both development and carbon benefits. This is because increased soil organic matter in well-managed soil is associated with increased soil carbon and also favours higher crop yields (Lal 2004[a]; Roshetko et al. 2007). Synergy is possible where tree planting increases both carbon sequestration and yields.

Agroforestry practices in co-benefit projects will be a source of tension if those that bring desired livelihood benefits in a given area do not align with those desirable for carbon sequestration, leading Boyd et al. (2007) to suggest that "discussion is warranted on the uncertainties and possible trade-offs that can arise if livelihood-related interests in trees...conflict with the maintenance of carbon-fixing thresholds." But, in cases where high carbon practices deliver desired livelihood benefits, realization of co-benefits and even synergistic effects may be possible.

2.4.2.7 End Products

The target end products of co-benefit projects may be a source of possible tension or synergy. For development, a variety of tangible tree products may be targeted for household use or sale in local or regional markets. For both development and co-benefits, product diversification is emphasized to promote farmer resilience (Garrity 2004; Roshetko et al. 2007), as is focusing on products with stable market prices for development benefits (Leakey et al. 2005). The best tree products to deliver development benefits will vary from site to site based on local needs and market conditions (Boyd et al. 2007; Dixon et al. 1994). By contrast, the end products in carbon projects are carbon credits, a specialized product for global carbon markets that may be less tangible for rural people who may be less versed in climate change and carbon markets. Attempting co-benefits means that an agroforestry project is attempting to generate both tangible and intangible products targeting markets ranging from local to global. This adds complexity to the project, and could be an additional challenge. For some buyers, the attractiveness of carbon credits generated depends in party on the permanence of carbon storage, which depends in part on the end-use of tree products generated by carbon trees (Montagnini & Nair 2004; Oelbermann et al. 2004): for example, timber used for building stores carbon considerably longer than fuelwood. Even where end products are not an issue for credit generation, carbon credit schemes usually require certain rotation lengths. These rotation lengths may exceed the growth time needed for tree products desired by local people. For example, in the Plan Vivo carbon agroforestry project near Bushenyi, Uganda, trees must be allowed to grow for 20 years, whereas trees may be the appropriate size to cut for building poles after five to seven years, or for hydro poles after ten to fifteen years. Tension could arise where local needs and desires for tree products do not coincide with those that provide long-term carbon storage or that are generated by rotation lengths specified for carbon certification. But, where locally desired tree products coincide with those desirable for carbon storage, there is a potential for synergy from increased benefits for local people from carbon income.

There is a real possibility that attempting to generate two very different types of end products and reconciling time to returns for farmers and investors in co-benefit products could be a significant source of tension that may be difficult to resolve. But, where locally desired tree products align with carbon goals, returns from carbon credit sale have the potential to increase the overall income from tree growing for local farmers.

2.4.2.8 Monitoring

Monitoring is important for ensuring that projects are delivering the benefits they set out to deliver (carbon sequestration, increased income, etc.), while remaining accountable and valid. In the case of co-benefit agroforestry projects, it is possible that challenges and tension could arise in terms of what measures are used for monitoring, and the extent and distribution of effort and resources that are committed to this aspect of the project. Monitoring costs are a component of overall project transaction costs (Cacho & Lipper 2007; Cacho et al. 2005). Because they are seeking to deliver a larger, more diverse range of benefits than a project with a single goal, monitoring in co-benefit projects is likely to be challenging and more expensive, due to the number and diversity of measures of success, accountability and validity that need to be monitored (Milne 1999). Carbon projects incur costs in demonstrating that changes in carbon stocks are really occurring, are the result of the project, and additional (i.e. would not have occurred in the absence of the project) (Cacho & Lipper 2007; Cacho et al. 2005). Ensuring that carbon credits are legitimate requires expensive monitoring and enforcement, particularly in the compliance market (Harris 2007; Leach & Leach 2004), which greatly increases transaction costs (Cacho et al. 2005; van Kooten & Sohngen 2007). Although costs may drop as a project progresses, monitoring in carbon sequestration projects usually require site visits, which raise costs (Milne 1999). Certification and verification of carbon stocks is estimated to cost $10 000 per year, and can be higher when international experts are needed or if sampling projects sites are far apart (Cacho & Lipper 2007).

Through economic modeling and sensitivity analysis, Cacho et al. (2004) showed how annual monitoring costs in carbon forestry projects depend on the number of plots sampled for monitoring on project area, and have a fixed component (independent of the number of plots sampled) and a variable component (dependent on the number of plots sampled). Monitoring costs were found to be highly dependent on the number and diversity of trees and diversity of landscapes in the project. High diversity means more plots are required to achieve a given level of monitoring accuracy, while many trees make each plot more expensive to sample which raises variable costs. Size was also found to be important, with smaller projects tending to have higher monitoring costs.

Cacho et al. (2004) found, in agreement with their review of the literature on carbon monitoring costs, that smaller projects, projects involving dispersed landholders, and more heterogeneous projects tend to have higher monitoring costs. This may make some smallholder co-benefit projects economically unattractive, particularly if smaller project sizes are favoured for delivery of development benefits (Boyd et al. 2007). High monitoring costs could also leave less project funds available to use for some of the possibly more costly project elements recommended for ensuring development benefits, like ongoing training and facilitating good relationships between organizations and local people. In a smallholder forestry project in Chiapas, Mexico, Nelson & de Jong (2003) found that project technicians were engaged exclusively in administration and monitoring; field visits and technical support were discontinued because carbon income was not sufficient to support them. If monitoring costs are too high, a project may become economically unattractive (Cacho et al. 2004).

Experience from development suggests that monitoring costs can be reduced by involving local people in monitoring and giving them ownership over project outcomes (Boyd et al. 2007; Smith & Scherr 2003). Some of the carbon literature also suggests that, while likely having higher up-front costs, training farmers to value and monitor their own trees could be a worthwhile investment to reduce carbon monitoring costs (Cacho & Lipper 2007; Cacho et al. 2005; Milne 1999). Monitoring costs may also be reduced by basing monitoring on existing social structures (Cacho et al. 2005). With these strategies, possible tensions in monitoring may be reduced or resolved, if project implementers are able to accommodate higher initial costs.

2.4.2.9 Summary

Overall, basic project characteristics are expected to be sources of likely tension, possible tension and synergy. With appropriate project design, some synergy may be possible, primarily through carbon finance and related to end products, time to returns, project finance, and agroforestry practices. But, there is also tension inherent in basic project characteristics when seeking co-benefits. For many characteristics that could cause tension – participants and partnerships, project length, project location and monitoring – potential solutions are apparent. However, resolving tensions that arise related to contract length, project size, agroforestry practices and end products may be more difficult.

2.4.3 Project Characteristics for Overcoming Barriers & Sustaining Participation

Overcoming barriers to allow people to participate initially, and then sustaining their participation, is important in agroforestry projects. In the case of development projects, this is obvious, since the main target recipients in these projects are local people. It is important to engage local stakeholders and sustain their participation, as local people will benefit less if they don't participate, and the project will be less successful in delivering development benefits. However, this is less obvious in the case of carbon projects, which could hypothetically take place in areas from which local people are excluded. But, the importance of sustained participation is arguably still valid for carbon projects, because issues like monitoring and leakage are often more effectively addressed with local support and participation (Boyd et al. 2007; Nelson & de Jong 2003; Smith & Scherr 2003). Sustained participation is especially important in the case of carbon agroforestry projects because interest in using agroforestry for carbon projects centres on its ability to deliver benefits to smallholders; the exclusion of local people from carbon agroforestry is likely to be rare or non-existent. Thus, designing projects to encourage and sustain the participation and support of local people is expected to be important for the success of agroforestry co-benefit projects.

Barriers and challenges to initial and sustained participation in agroforestry are rooted in the contexts of potential smallholder participants. Boyd et al. (2007) characterize the rural poor as follows. They tend to live and subsist on marginal agricultural land that is far from transportation and urban infrastructure. They are exposed to hazards like droughts, pests and disease, and often need to hyper-exploit available resources in order to survive. Most rural poor depend on multiple livelihood strategies for survival (e.g. they might work for wages while growing their own food and hunting). Usually the entire family is involved in livelihood activities. They live in countries where government social systems are minimal or non-existent to provide support when livelihood strategies fail. They have no control over markets and pricing. Because of these characteristics, they are particularly vulnerable to environmental stressors. As a group, they often have more experience with failed rural development projects than successful ones. These characteristics shape how rural smallholders approach opportunities like agroforestry adoption, and suggest some of the barriers that will need to be overcome to secure their participation.

Considerably more discussion was found in the reviewed development literature about overcoming barriers and sustaining participation of rural people in agroforestry and forestry projects, as most of this literature appeared to be written from an implied participatory development perspective. Participatory approaches to development value broad engagement of the intended beneficiaries of development (Hayward et al. 2004; Williams 2004), and emphasize project characteristics and guiding ideologies seen to facilitate this participation, such as valuing local knowledge, building relationships, power-sharing, choice and flexibility, ownership and control over decision-making by local people, and empowerment (Campbell & Vainio-Mattila 2003; Hayward et al. 2004; Mohan 2007). Project characteristics identified as important in the reviewed literature for sustaining participation in smallholder projects included the amount of flexibility and community input incorporated into the project design, access to resources, and demonstration of expected benefits.

2.4.3.1 Preliminary Site Assessments

Preliminary site assessments are a source of possible tension. Site assessments are emphasized for development and co-benefits to determine site suitability and allow a project to be adapted to local site conditions (Boyd et al. 2007; Fischer 1998; Milne & Arroyo 2003). But, although contextual conditions are identified as being important to carbon projects (e.g. Montagnini & Nair 2004; Nair et al. 2009; Oelbermann et al. 2004), preliminary assessments are not emphasized, perhaps due to added costs. However, this tension will likely not be significant in co-benefit projects if preliminary site assessments can recover additional costs by facilitating selection of more suitable sites with the potential for greater carbon returns.

2.4.3.2 Interaction with Project Context and Integration with Other Activities

Ideal enabling conditions will not always be present at every project site, which can equate to barriers to participation. A project may engage with its context to improve enabling conditions and overcome barriers; the type and amount of interaction could be a source of possible tension or synergy in co-benefit projects.

The degree to which a project interacts with its context is a possible source of tension. For development and co-benefits, there is emphasis on actively engaging with the project context to facilitate enabling conditions (Bognetteau et al. 2007; Boyd et al. 2007; Fischer & Vasseur 2002; Leakey et al. 2005; Sathaye et al. 2001). This engagement could increase costs, a possible source of tension. Access to resources is an aspect of project context, and a common barrier that was identified by agroforestry participants in Uganda. The degree to which a project provides resources to overcome this barrier could likely be a source of tension: experience from development suggests that in-kind inputs should be limited (Current & Scherr 1995; Fischer & Vasseur 2000, 2002), whereas for carbon benefits, inputs of labour and capital are recommended (Palm et al. 2004).

A project's context also includes other development needs and activities occurring in and around the project area. The degree to which an agroforestry project integrates with these other development activities is a source of possible tension or synergy. Linking to other development activities is recommended for realizing development and co-benefits (Boyd et al. 2007; Nelson & de Jong 2003). For co-benefits, it is recommended that stakeholders interested in carbon credits should keep broader goals in mind and not assume the carbon market will meet all farmers' needs, and that projects should build on synergies with other development activities (Nelson & de Jong 2003). This requires project designs that are collaborative and flexible, and that meet broad community needs and allow the generation of multiple products and services by the same system (Roshetko et al. 2007). However, this flexibility and collaboration can be costly (Boyd et al. 2007), and is less desirable for maintaining carbon credit validity (Harris 2007). Carbon forestry projects are not always linked to other development activities to reduce costs, and tend to focus on carbon sales rather than broad community development goals (e.g. Nelson & de Jong 2003; Nishiki 2007; Olsen 2007).

But, linking to other development and research activities could create further opportunities to diversify funding for co-benefit projects (Roshetko et al. 2007), and could reduce transaction costs and leakage (Milne 1999). Opportunities for diversifying funding may also be possible where project outcomes align with the goals of other international agreements, such as the Convention on Biological Diversity (Cacho et al. 2005). Additional funding and reduced project costs could offset the additional costs of integrating with other activities, and could potentially even be a source of synergy where diversified funding exceeds the costs of integrating with other activities.

2.4.3.3 Flexibility and Community Participation in Project Design

The amount of flexibility and local community participation in a project's design is a source of likely tension when seeking co-benefits. Flexibility and local community participation in project design allows a project to respond to stakeholder feedback and changing conditions, needs and desires (Bognetteau et al. 2007; Boyd et al. 2007; Current et al. 1995; Fischer & Vasseur 2000; Shiferaw et al. 2009). Context-specific, participatory, collaborative, adaptive and flexible project design and implementation are recommended for maintaining local participation and achieving development and co-benefits, and it is recommended that local participants be involved at all stages of project design, development of project tools, project implementation and monitoring (Appiah et al. 2009; Bognetteau et al. 2007; Boyd et al. 2007; Chivinge 2006; Current et al. 1995; Dolan 2006; Fischer & Vasseur 2000, 2002; Leakey et al. 2005; Milne & Arroyo 2003; Roshetko et al. 2007; Rudebjer et al. 2006; Sanchez 1995; Shiferaw et al. 2009). Context-specific project design involves the incorporation of traditional knowledge and local culture, and local needs for various goods and services, and designing a project to compliment and work with existing farming practices and community structures (Bognetteau et al. 2007; Fischer & Vasseur 2002; Leakey et al. 2005; Shiferaw et al. 2009). Responding to local needs usually means that project objectives, activities, responsibilities and benefits are negotiated, not unilaterally set (Brown et al. 2000). Flexibility in contracts is also favoured to lower risk to local participants, allowing them to alter or discontinue their participation if their needs, markets or opportunities change such that they could benefit more by using their resources in other ways (Roshetko et al. 2007). Participatory project design is expected to increase the buy-in of local people, which is also important to sustaining their participation (Boyd et al. 2007; Leakey et al. 2005).

By contrast, for carbon projects, standardization of project design and more rigid, inflexible project designs are favoured (Harris 2007). More rigid, less participatory project designs can reduce costs, and make carbon credit validity less difficult and costly to establish (Boyd et al. 2007; Harris 2007; Smith & Scherr 2003). Strict review and certification procedures are required to address the potential for fraud and fluctuating circumstances outside project control in CDM projects (Van Vliet et al. 2003). Conversely, a more participatory project design will likely require more meetings between project managers and farmers and therefore have higher transactions costs, which may lead project implementers to prefer to limit the involvement of smallholders in carbon project design and implementation (Milne 1999). Nevertheless, inclusion of smallholders in project design, although more expensive initially, could reduce the need for spending money later on to sustain the participation of smallholders because they might better understand the value of participating (Milne 1999). Cacho et al. (2005) also suggest that including smallholders in project design and implementation could decrease transaction costs, and Haupt & von Lüpke (2007) stress the importance of considering local interests in project planning.

It seems apparent that incorporating smallholder participation into co-benefit project design and implementation has the potential to both negatively and positively impact project costs. The amount of flexibility and community participation in project design and implementation has the potential to be an important source of tension in designing co-benefit projects.

2.4.3.4 Choice and Decision-Making

Another source of likely tension that is related to flexibility and local participation in project design involves decision-making and choice. Participatory, community-driven decision-making that retains ownership, power and control at the community level and empowers local people is recommended for development and co-benefits (Boyd et al. 2007; Leakey et al. 2005; Roshetko et al. 2007). This can be very important for local buy-in to the project, and thus sustained local participation (Boyd et al. 2007; Leakey et al. 2005). To accomplish this, participatory, bottom-up project design is repeatedly emphasized, as are transparency, participatory processes, negotiation, and providing farmers with choices[16] within the project (Bognetteau et al. 2007; Current et al. 1995; Dolan 2006; Fischer & Vasseur 2000, 2002; Garrity 2004; Leakey et al. 2005; Roshetko et al. 2007; Sanchez 1995; Shiferaw et al. 2009). For co-benefits, it is suggested that farmers be allowed to negotiate the terms of their contract to limit their risk and increase their benefits (Roshetko et al. 2007). But, although community involvement in decision-making may also reduce project enforcement costs (Milne 1999), many carbon projects, particularly compliance market projects, are seen to take a more top-down approach to decision-making to increase control over the project by intermediaries who sell credits on carbon markets to ensure carbon credit validity and lower their costs (Boyd et al. 2007).

2.4.3.5 Education, Training and Technical Support

Provision of education, skills training and technical support is a likely area of tension in co-benefit projects. On-going knowledge and skill transfer, with a focus on community capacity-building, is important for realizing sustained development benefits from agroforestry (Boyd et al. 2007; Current & Scherr 1995; Dolan 2006; Fischer & Vasseur 2002; Roshetko et al. 2007). It is recommended that farmers be given enough information to make an informed choice to participate (Current et al. 1995), and that education and training should be participatory, regionally appropriate, community-based, and linked to research (Chivinge 2006; Current & Scherr 1995; Fischer & Vasseur 2002; Roshetko et al. 2007; Rudebjer et al. 2006; Shiferaw et al. 2009). For sustained realization of benefits, initial education and training should be followed up by continued knowledge and skills transfer by trained local providers (Fischer & Vasseur 2002). Similarly, for co-benefits, sustained education and technical support are thought to be important for project

[16] Notably, limiting choice sometimes can be desirable for project success. For example, limiting the amount of land farmers can dedicate to project activities can help to maintain landscape diversity, and ultimately, environmental sustainability, which is necessary for long-term project success (Nelson & de Jong 2003). However, overall, it is recommended that farmers be given choice and participate in project decision-making (Current et al. 1995; Leakey et al. 2005; Shiferaw et al. 2009).

success (Milne & Arroyo 2003; Nelson & de Jong 2003). It is further suggested that co-benefit projects should focus on strengthening community capacity for negotiating, planning and leadership, and emphasized that farmers need to understand the projects and the carbon services they are providing (Roshetko et al. 2007).

The Scolel Te carbon forestry project in Mexico, suggests that, in carbon projects, training and education can be minimal, and/or may be short-term to save money, as technical support was discontinued because it was too costly to sustain while keeping the project financially viable (Nelson & de Jong 2003). Reduced technical assistance due to resource shortages was also found in a forest carbon project in Costa Rica (Milne 1999). Tension may arise in co-benefit projects when trying to decide how to available allocate funds and the extent to which education, training and support will be provided.

But, it is possible that providing information to smallholders could lower project costs (Cacho et al. 2005). To provide on-going knowledge and skills cost-effectively, and take advantage of possible opportunities to reduce project costs, intentional efforts need to be made to reduce the cost of making information accessible to local people (Roshetko et al. 2007). One possibility is to partner with existing farmer organizations that are capable of providing training and support to their members without relying project funds (Nelson & de Jong 2003). Information could also be disseminated through partnerships existing extension services, NGOs and research centres (Cacho et al. 2005).

2.4.3.6 Demonstration of Benefits

Demonstration of benefits is important to motivate many farmers to participate in a development initiative (Roshetko et al. 2007). This is another source of possible tension. Participatory demonstration farms are desirable for realizing development benefits because they allow farmers to experiment and adapt technologies and techniques to better suit their needs, and see results thereby reducing their risk before they commit resources to participating (Ashley & Carney 1999; Dixon et al.

1994; Fischer & Vasseur 2000; Roshetko et al. 2007). Demonstration of benefits is not emphasized for carbon projects. Establishing demonstration farms takes time and resources, which could increase project costs and lengthen project duration, likely making this less desirable for carbon projects and a possible source of tension when co-benefits are attempted.

2.4.3.7 Market Availability and Access

A final project characteristic likely to cause tension when seeking co-benefits is access to markets. Ensuring market availability and access is important for sustaining participation in development projects producing tree products destined for sale, and for all carbon projects. For both development and co-benefits, support for market access for tree products by local people is recommended (Leakey et al. 2005; Palm et al. 2004; Roshetko et al. 2007). This can mean facilitating the development of new markets, helping farmers access existing markets, or assisting with marketing activities, like the formation of farmer marketing associations (Bogneteau et al. 2007; Boyd et al. 2007; Fischer & Vasseur 2000, 2002; Macqueen 2009; Roshetko et al. 2007; Sathaye et al. 2001). In the case of carbon markets, farmers often don't have sufficient information and resources to access international markets themselves, so often a centralized carbon broker is used (Nelson & de Jong 2003). Although carbon brokers facilitate access to carbon markets and can help reduce transaction costs (Vatn 2010), Nelson & de Jong (2003) found that in a project in Mexico, they removed decision-making control from the local level and placed final decision-making power into the hands of a few who were outside of the community, rather than sharing it with community as is recommended for development benefits (Boyd et al. 2007; Jama et al. 2006; Macqueen 2009; Leakey et al. 2005; Nelson & de Jong 2003). Broadly, payment for environmental services schemes like carbon projects often give considerable power to intermediaries (Vatn 2010). Connecting local people directly to international markets and maintaining local control of decision-making would likely be complicated and costly, making market access a likely source of tension in co-benefit projects.

2.4.3.8 Summary

Project characteristics to overcome barriers and sustain participation of local people are largely expected to be sources of tension when attempting co-benefits from smallholder agroforestry. In particular, tension is likely when choosing project practices related to community participation and flexibility in design, choice and decision-making, and education and training. Some likelihood of overcoming tensions was identified for site assessments and education and training. The possibility for synergy only appears to exist where linking to other development activities provides opportunities to diversify funding.

2.4.4 Summary of Tension and Synergy Expected in Co-benefit Projects

This review suggests that when attempting co-benefits for development and carbon from agroforestry projects, enabling conditions will likely be in alignment and some opportunities for synergy exist; however, many characteristics of project design are expected to cause tension.

Key opportunities for synergy lie in promotion of agroforestry practices that increase soil quality, and in increasing funding both through carbon finance and through expanded partnership and funding opportunities. Additional project financing could be used to overcome conventional barriers to tree planting and increase returns from tree planting to local people.

However, these synergies will be difficult, if not impossible to realize if the many likely and possible tensions inherent in co-benefit project characteristics are not addressed. In some cases, possible solutions for resolving or minimizing tensions with good project design are apparent. However for many design characteristics, in particular many project characteristics for sustaining participation, it appears tensions will be challenging to resolve, making it difficult to maximize benefits for carbon and development in the same project in practice.

2.5 Discussion and Implications for Agroforestry Project Design

There are many likely sources of tension in co-benefit projects, particularly related to project characteristics associated with removing barriers and sustaining participation. These tensions exist largely because sustaining participation is associated with high project transaction costs (Cacho & Lipper 2007). Costs are a key challenge to realizing carbon benefits, because carbon projects already face additional cost barriers over conventional forestry projects associated with intensive administration required for establishing additionality and permanence and project registration, and monitoring, preventing leakage and measuring carbon stocks for credit validation (Cacho et al. 2002; Leach & Leach 2004; Lile et al. 1998; van Noordwijk et al. 2006). To be competitive in carbon markets, agroforestry projects must be able to generate carbon credits at a cost lower than the market price of carbon (Cacho et al. 2005).

These tensions may be difficult to resolve because the core factors that appear to be driving most choices of practices in project design and implementation in carbon and development projects are not well-aligned. According to the implicit participatory development approaches to development taken by the majority of the literature on smallholder development through agroforestry and forestry, the success of development projects is rooted in sustained participation in and on-going support of the project by local people, which tends to require projects to be context-specific and community driven. Although, as argued earlier, sustained participation is important to carbon projects, especially agroforestry projects that are focused on smallholders, these projects must also place a strong emphasis on carbon credit validity, which relies on international standards and verification. Many of the factors that favour achieving sustained participation and those that favour achieving valid carbon credits are in tension. Many of the factors that favour sustaining local participation and community ownership of a project - flexibility, adaptability, participation, shared decision-making - tend to increase project costly to implement, making projects less attractive as carbon projects, which are trying to produce carbon credits that are competitive on global carbon markets by keeping the cost of producing credits below the market price of carbon (Smith & Scherr 2003). Many of these tensions in seeking co-benefits from agroforestry can be reduced down to a central challenge: maintaining financial viability and validity of credits, while facilitating the conditions necessary for sustained community engagement and participation.

Several authors have reviewed some of the first co-benefit projects, including many carbon forestry and agroforestry projects, and concluded that these projects were largely unsuccessful in delivering co-benefits, with a number of these authors concluding that development goals were not being met, or met in what was deemed to be an unsatisfactorily limited way (Bailis 2006; Boyd et al. 2007; Brown & Corbera 2003; Cosbey et al. 2005; Milne & Arroyo 2004; Murdiyarso et al. 2008; Nelson & de Jong 2003; Nishiki 2007; Olsen 2007; Sutter & Parreño 2007; Wittman & Caron 2009). Many made recommendations on how to improve co-benefit projects. As is evident from the discussion in Section 2.4 above, the majority of these recommendations align with recommendations for how to achieve development benefits, and few address the tension between keeping project costs down to keep carbon credit prices competitive, and facilitating community involvement in project design and implementation. In the few cases where it is suggested that community involvement might lower costs, little evidence is given. This raises the question as to what extent these recommendations, many of which are in opposition to what is widely practiced in many successful carbon forestry projects, can actually realize substantial carbon benefits. Arguably, considerable room to improve best practice for co-benefit projects remains.

2.5.1 Re-Thinking Our Approach to Realizing Dual Goals

To effectively deliver development and carbon benefits in the same project, project designers will need to think carefully about how to overcome inherent tensions when different kinds of benefits with different requirements for success are sought together. A possible solution for addressing tensions is to consider the pursuit of ancillary benefits rather than co-benefits.

Use of the terms "co-benefits" and "ancillary benefits" in the carbon project and policy literature is often ambiguous; these terms are commonly used undefined, or used interchangeably (e.g. Aunan et al. 2004; Pittel & Rübbelke 2008). For the purposes of this discussion, a co-benefit project is understood to be seeking and maximizing dual development and climate priorities, as is generally implied in many carbon credit generation schemes like the CDM. An ancillary benefit project would have a primary goal of either climate change mitigation or rural development, and would then generate ancillary benefits for the other. Generation of ancillary benefits can either be passive, meaning that their generation is purely coincidental and not considered at all in project design and implementation, or active, meaning that project design and implementation includes intentional consideration of opportunities to take advantage of synergistic effects and generate ancillary benefits. We argue that the latter, where both benefits are sought intentionally but not necessarily co-maximized, could be a more useful approach to achieving benefits for both development and carbon.

For example, an agroforestry project may be designed primarily to deliver livelihood improvements to local people, but include carbon credit generation to bring additional income and earlier returns to farmers. By contrast, a larger scale carbon forestry project could use money generated from carbon finance to fund community development activities in surrounding communities to promote community support for the project and reduce leakage. In each case, the project is designed for success in the area of primary interest; any conflict between best practices for each type of benefit is resolved in favour of the primary goal. But, where practices are not in conflict, the project is designed to take into consideration and then capitalize on opportunities for synergy with development or climate interests to deliver ancillary benefits in these areas. In either case, carbon credits generated with development benefits could potentially target premium credit markets, or form part of portfolios for carbon investors with credits delivering different levels of development benefits, one solution suggested for increasing development benefits from carbon projects (Harris 2007). Future projects could be designed with a primary goal and ancillary benefits in mind; development and carbon agroforestry project practitioners should consider how their existing project structures might be complimented by adding carbon credit generation or delivery of rural development benefits.

Both the climate change and development agendas are time sensitive, and seeking ancillary benefits rather than co-benefits could simplify project design, potentially allowing project designers to get more projects off the ground faster by minimizing conflict and reducing hesitation in implementing new projects that may be occurring in the face of criticism of initial carbon forestry efforts. Focusing on a single goal could reduce tension and facilitate project approval and implementation, while still allowing projects to capitalize on synergies between both goals. Facilitation of a greater number of projects more quickly could realize more benefits overall, and would provide more learning opportunities to improve the delivery of both climate and development benefits with smallholder agroforestry.

More projects would also provide opportunities to explore what overall approach would best serve climate and development agendas. Both human development and climate change mitigation goals are of incredible global importance, and it would be hard to argue that one should supersede the other. The fact that development and carbon priorities are interconnected suggests that seeking co-benefit projects would be most effective and efficient at addressing these challenges in the long term. But, there may be situations where maximizing total benefits in an absolute sense would not actually be most desirable, since maximization does not take into consideration factors like thresholds and priorities based on values. By resolving tensions in characteristics in favour of maximizing co-benefits, we might be making sacrifices we don't actually want to make. It may be that an ancillary benefit approach to project design is in fact, a more beneficial for realizing benefits from carbon and development from smallholder agroforestry.

Further, for projects prioritizing carbon goals in particular, it may be prudent to consider whether adopting an alternative approach to development would be beneficial. As mentioned, most of the literature reviewed on achieving development through smallholder agroforestry and forestry projects took an implicit participatory development perspective, which generally values broad participation (Hayward et al. 2004; Williams 2004). Alternative pathways to development and goals for delivery of benefits to smallholders, such as focusing on increasing income flowing into a country or region rather than on broad participation, might allow for project designs that are in greater alignment with those that favour carbon credit generation, and could potentially change the way benefits are delivered but facilitate the delivery of more benefits overall. An analysis of different approaches to development and their compatibility with carbon credit generation could be beneficial.

More research is needed if agroforestry is to effectively deliver benefits for rural development and global climate in a manner that is equitable, effective, and acceptable to all stakeholders. Research is needed not only to determine how best to resolve tensions inherent in project characteristics when seeking both types of benefits, but also, to determine whether seeking ancillary or co-benefits is the best approach to realizing benefits for development and climate from smallholder agroforestry, and how development is best approached in these projects to accomplish desired development outcomes and priorities. As a first step, it seems that climate and development goals would be better addressed through the simplification offered by designing agroforestry projects to seek intentional ancillary benefits rather than co-benefits. Ancillary benefit projects could potentially making larger, more timely contributions to addressing climate change mitigation and human development priorities, while providing valuable opportunities to learn and improve on the design of smallholder agroforestry projects with multiple goals having different beneficiaries at different scales.

3. SMALLHOLDER CARBON TREE PLANTING PROJECTS: NEW BARRIERS TO TREE PLANTING OR NEW OPPORUTNITIES FOR RURAL DEVELOPMENT?[17]

3.1 Introduction

Tree planting has a largely successful history of use for rural development. In developing countries, use of agroforestry techniques occurs in most smallholder tree planting programs. Agroforestry is the intentional combining of trees with agricultural practices to produce interactions in time and/or space dimensions on the same land management units (FAO 2010; ICRAF 2010; Nair 2007). Agroforestry practices can include intercropping[18], hedgerows[19], boundary planting along the edges of fields and grazing land, planting trees near the homestead, and rotating plots of land between crops and woodlots.

This integration of agriculture and forestry can be particularly useful for subsistence farmers with low cash flows who are relying on their land to provide the vast majority of resources they require to sustain their livelihoods (Boyd et al. 2007; Current et al. 1995; Garrity 2004; Leakey et al. 2005). Agroforestry was used in traditional practices in many parts of the world, and was then institutionalized and widely adopted by development practitioners in the mid-1970's to address resource depletion in the face of increasing population growth and deforestation (Nair 2007). Until the 1990s, almost all smallholder tree-planting programs had a primarily social focus, usually having some combination of rural livelihood and local

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[17] A version of this chapter is being submitted for publication following submission of this thesis.
[18] This can be either be on-going, when trees are spaced more widely and crops are planted underneath seasonally for the life of the trees, limited to the years while seedlings are small and the canopy is still open, when trees are planted closer together in plantations or woodlots.
[19] Hedgerows are rows of smaller trees that may be planted between plots, or along the edges of terraces to reduce soil erosion. Often, nitrogen-fixing species are used to enhance soil fertility.

social focus, usually having some combination of rural livelihood and local environment goals. These conventional projects principally target poor rural landholders with small landholdings.

There is the potential to realize both costs and benefits when switching to an agroforestry land use. From the perspective of rural smallholders, adopting certain agroforestry systems may be costly, such as systems that negatively affect agricultural production (Reynolds et al. 2007; Siriri et al. 2009). Some agroforestry systems may be costly from a climate perspective, as some systems may be significant emission sources (Dixon 1995). There is considerable variation in agroforestry systems; the ability of a system or project to deliver specific desired benefits will depend on how the system is designed (Albrecht & Kandji 2003; Current et al. 1995). In this paper, we focus on situations where benefits for rural development and climate change are reasonably expected or hoped for.

As confirmed by the research in this paper and documented in the included references, with the right design and implementation, smallholder agroforestry has the potential to deliver certain benefits to farmers. Common livelihood benefits from agroforestry include:

- **Physical Resources** – e.g. timber, fruit and firewood. Resources may be kept for personal use or sold for income
(Current & Scherr 1995; Dixon et al. 1994; Fischer & Vasseur 2002; Montagnini & Nair 2004; Pandey 2007; Schroeder 1994; Watson et al. 2000)

- **Indirect Livelihood Benefits** – Resources can contribute to additional development benefits, such as reduced poverty, income security, and improved nutrition, education and health
(Current et al. 1995; Current & Scherr 1995; Garrity 2004; Jama et al. 2006; Leakey et al. 2005; Montagnini & Nair 2004; Palm et al. 2004; Pandey 2007; Sanchez 2000; Schroeder 1994)

- **Local Environmental Benefits** – e.g. erosion control and soil improvement (Albrecht & Kandji 2003; Current & Scherr 1995; Current et al. 1995; Dixon 1995; Fischer & Vasseur 2002; Nair 2007; Noble & Dirzo 1997; Pandey 2007; Schroeder 1994; Watson et al. 2000)

- **Livelihood Benefits from Environmental Improvement –** e.g. increased production from improved soil
  (Albrecht & Kandji 2003; Dixon 1995; Fischer & Vasseur 2002; Jama et al. 2006; Leakey et al. 2005; Pandey 2007; Sanchez 2000; Schroeder 1994; Watson et al. 2000)

Smallholder agroforestry projects where benefits to farmers can be reasonably expected can also have barriers to participation and challenges that prevent the realization of benefits. Barriers commonly identified by participants in this study and in the literature include:

- **Land shortages and land tenure issues** (Fischer & Vasseur 2000; Palm et al. 2004; Roshetko et al. 2007)
- **Cost and availability of seedlings and other planting materials** (Fischer & Vasseur 2000; Palm et al. 2004; Potter & Lee 1998; Roshetko et al. 2007)
- **The time it takes to get returns from trees** (Fischer & Vasseur 2000; Palm et al. 2004; Shiferaw et al. 2009)
- **Knowledge and experience related to tree planting and the uses of trees** (Palm et al. 2004; Potter & Lee 1998;Roshetko et al. 2007)
- **Policy and project design disincentives** (Fischer & Vasseur 2000; Potter & Lee 1998; Roshetko et al. 2007; Shiferaw et al. 2009)
- **Social and cultural disincentives** (Palm et al. 2004)

Some of these barriers, like land shortage and knowledge, may not actually prevent participation, but instead act as challenges that impede the realization of any or the full potential benefit that could be realized. Challenges to smallholder agroforestry identified by participants in this study and in the literature include:

- **Cost of labour for seedling maintenance** (Palm et al. 2004)
- **Pests and disease**
- **Sabotage by neighbours**
- **Drought and other environmental phenomena**
- **Access to and availability of markets to sell tree products** (Fischer & Vasseur 2000; Potter & Lee 1998; Roshetko et al. 2007; Shiferaw et al. 2009)

Recently, agroforestry has begun receiving more attention for its climate change mitigation potential. Some agroforestry land uses are able to sequester carbon in biomass and soil (Albrecht & Kandji 2003; Nair et al. 2009; Olsson & Ardö 2002), and it is thought that agroforestry adoption has the potential to reduce deforestation and forest degradation by providing alternate sources of forest products like firewood (Current et al. 1995; Dixon 1995; Noble & Dirzo 1997;

Makundi & Sathaye 2004). The Intergovernmental Panel on Climate Change (IPCC) believes that agroforestry systems on croplands and grasslands represent the largest potential carbon sink available through land use change (Watson et al. 2000).

Consequently, there is interest in using agroforestry to realize co-benefits for rural development and climate change mitigation. Although often not explicitly defined in the literature (e.g. Aunan et al. 2004; van Vuuren et al. 2006), the term co-benefits is generally used to imply that projects are aiming to achieve (and often maximize benefits for) two or more different goals. Agroforestry has been promoted as a "win win" option that has the capacity to address both environmental and human welfare goals (Cairns and Meganck 1994; Garrity 2004; Leakey et al. 2005; Franzel and Scherr 2002; Lal 2004[a]; Palm et al. 2004; Kandji et al. 2006; Rice 2008).

But, although agroforestry evidently has the potential to provide climate change and rural livelihood benefits, it is less clear how and whether co-benefits can be realized. It is possible that including carbon in smallholder tree planting initiatives could create synergistic effects for development through the addition of carbon finance and the development of new skills and attitudes. But, it also makes these projects more complex on several fronts, including the knowledge and understanding required, the administration needed for project certification and credit verification, the need to connect with international markets and buyers, and uncertainties associated with the international carbon market.

Carbon tree planting projects in this study demonstrated some of the ways in which carbon projects can be more complicated than non-carbon projects. To participate effectively and equitably in a carbon tree planting project, participants at all levels needed to have at least a basic level of knowledge and understanding about carbon sequestration and climate change, in addition to the knowledge requirements of a conventional planting initiative. Carbon projects also required additional and generally more rigorous organization and administration related to project registration, carbon accounting and credit validation. The administration was often complicated, and required time, money and knowledge (which in turn required even more time and money to acquire). Meeting rigorous requirements of international standards for carbon credits seemed to sometimes impose more rigid constraints on carbon project design. Finally, because most carbon credits generated in developing countries will be traded in international markets, carbon projects generally required a higher minimum number of main players, some of who were operating at an international scale. In all cases, carbon brokers were relied on to link local carbon credit generators to international buyers; this is common in carbon projects, as it lowers transaction costs (Vatn 2010). All of these factors can make carbon projects more complex to execute than conventional tree planting projects, and could add additional project costs. Carbon projects employed various strategies to address this complexity and keep projects financially viable. As demonstrated by the study projects (Table 3.1), carbon projects often adopted a stronger commercial orientation, and/or had minimum resource commitment requirements for participation not commonly found in conventional smallholder tree planting projects. Both the complexity itself and project strategies to address the complexity appeared to create new barriers and challenges, and exacerbate existing ones. This could affect who can and does participate.

A review of the rural development and carbon forestry literature suggests that the tensions between project characteristics that lead to success in carbon forestry versus development projects could make it difficult to realize co-benefits in practice (Chapter 2). This is evident in analyses and reviews of some of the first attempts at forestry activities for co-benefits. Brown et al. (2004) identify tradeoffs between carbon sequestration, and local development and economic wellbeing. In analysing the first CDM-like forestry projects, many authors concluded that many to most pilot sink projects have fallen short of their equity and/or local development goals (Bailis 2006; Boyd et al. 2007; Cosbey et al. 2005; Murdiyarso et al. 2008; Nishiki 2007; Olsen 2007; Wittman & Caron 2009). Analyses of the Fondo Bioclimatico project, a voluntary market project in Chiapas, Mexico concluded that, despite initial intentions to balance development with carbon, funding challenges resulted in a project that focused on the generation of carbon credits, with benefits accruing disproportionately to those participating in carbon planting, rather than to the community at large as was originally intended (Nelson & de Jong 2003), and that middle income producers may be benefiting most from carbon payments (Brown & Corbera 2003). Milne & Arroyo (2003) analysed a carbon forestry project in Ecuador and concluded that although locals felt they were benefiting from the project, they predicted the 99-year contracts signed in the project would ultimately be negative in the long-term for the communities, whose primary interest was income generation. Experience suggests that when carbon is included in a forestry project, rural development goals being sought concurrently may be subjugated to carbon goals. As a result, review of the literature leads to the conclusion that seeking a primary goal of either climate or development along with ancillary benefits for the other could be more beneficial in terms of facilitating ease of design and feasibility to allow projects to unfold in a timely manner and meet expectations.

To further explore this possibility, a qualitative case study of carbon and non-carbon smallholder tree planting initiatives was conducted in Uganda. This paper will present some results from this study, focusing on participant experiences and understandings of barriers to participation, challenges to realizing benefits and achieving success. Discussion will focus on how including carbon goals in a project impacts these factors, to both generate new opportunities and also create and exacerbate barriers and challenges. This is followed by a discussion of possible strategies and recommendations that emerge from the study for addressing barriers and challenges and achieving success in seeking carbon and development benefits from smallholder tree planting.

3.2 Study Background

3.2.1 Study Region

Sub-Saharan Africa was chosen as the study region, in part because this continent is emerging as an important provider of forest carbon credits (Hamilton et al. 2010)[20]. There is a particular opportunity to learn from first experiences and inform the design of early projects, which will be important for addressing initial challenges associated with implementing carbon forestry projects (Haupt & von Lüpke 2007). Uganda was chosen as a case study country due to its history of using agroforestry for rural development and local environment improvement, and because East Africa is the site of most of the recent investment in carbon forestry on the continent (Jindal et al. 2008). Uganda has a variety of tree-based smallholder carbon initiatives presently underway, including the first forestry CDM project to be registered in Africa.

Uganda is a land-locked country in East Africa that is defined as a Least Developed Country by the United Nations, meaning that it has low gross national income per capita, high human resource weakness based on indicators of nutrition, health, education and adult literacy, and high economic vulnerability (UN-ORLLS 2002-2005). Uganda has an estimated population of 34 million, nearly 87% of which is rural (United Nations 2009; United Nations 2010). The country is experiencing high population growth, the population having nearly doubled in the last 20 years (United Nations 2009). Uganda has a total estimated land area of 19 710 000ha, of which 12 812 000ha was estimated to be agricultural land and 3 454 200ha forestland in 2007 (FAO Statistics Division 2010). Since 1990, agricultural land has increased 7.1% in area, while forestland has decreased 29.8% (FAO Statistics Division 2010). Study participants described increasing population pressures, reduced sizes of land plots, localized wood fuel shortages, and widespread shortages

[20] Africa doubled its market share as a provider of carbon credits in 2009 to 7% (Kossoy & Ambrosi 2010), and replaced Latin America as the "dominant source of forest carbon credits" in the developing world between 2007 and 2009 (Hamilton et al. 2010, p.x).

in wood products like large timber and poles. Several participants reported widespread deforestation since the country's independence from Britain in 1962.

3.2.2 Study Projects

A sample of ten rural smallholder tree planting initiatives in rural Uganda were visited in early 2010. Projects varied in terms of scale, the nature of participating organizations, and project goals (Tables 3.1 and 3.2).

Four carbon projects were sampled (Table 3.1):

- National Forestry Authority (NFA) – Rwoho National Forest Reserve
- Global Woods
- Ecotrust
- TIST (The International Small Group and Tree Planting Program)

These carbon projects represent four of five smallholder carbon forestry projects started in Uganda, as identified by the UCB, a national entity facilitating carbon project development and implementation in the country. Community members receive carbon payments directly in the TIST, Ecotrust and NFA-Rwoho projects. The Global Woods project would like to include community planting in carbon credit generation, but has so far been unsuccessful; company revenue (which will eventually come partly from carbon) is instead used to fund community development initiatives. In two projects, TIST and Ecotrust, participants generate carbon credits through plantation on their own land. In the NFA-Rwoho project, although tree planting on private land is supported, community participants only generate carbon credits from their planting on designated forest reserve land.

Six non-carbon projects were also sampled (Table 3.2):

- ACTS (Africa Community Technical Service)
- TFTF (Trees for the Future)
- AHI (African Highlands Initiative)
- LBDC (Lake Bunyonyi Development Company)
- SPGS (Sawlog Production Grant Scheme)
- NFA (National Forest Authority) – Mabira National Forest Reserve

Table 3.1. Characteristics of sampled smallholder carbon tree planting projects

	NFA – Rwoho	Global Woods	Ecotrust	TIST
Summary	The first CDM forestry project registered in Africa. Working with the World Bank, the NFA, a federal government body, generates tCER carbon credits through plantation forestry in Rwoho National Forest Reserve. In a 100m band along the edge of the reserve, the NFA partners with a local CBO, who plant in the band to generate carbon credits, for which they will receive payments. Intercropping is practiced in the band while seedlings are small.	Global Woods is a private company based in Germany that engages in commercial plantation forestry on land in Kikonda National Forest leased from the NFA to generate voluntary market credits and timber. Global Woods runs a planting program with smallholders in communities surrounding the reserve.	An agroforestry carbon project using the Plan Vivo framework for community-based carbon land-use projects. Ecotrust, a Ugandan non-profit environmental conservation organization, implements the project with support from ICRAF. Ecotrust works with smallholders to develop individual land-use plans that sequester carbon on their land through tree planting to generate voluntary market carbon credits, which are paid to the farmers.	A smallholder carbon tree-planting program in East Africa and India implemented by an American NGO and a public charity. TIST works with small groups of farmers and integrates tree planting with other development activities. Farmers receive income per tree planted from voluntary market carbon credits sold by Clean Air Action Corporation.

	NFA – Rwoho	Global Woods	Ecotrust	TIST
Goal(s)	Improve reserve management Conservation: diverting pressure on reserve through sources of alternative livelihoods for communities Organizational capacity-building – carbon demonstration project	Profit from carbon credit and timber sales, then climate and community benefits	Conservation - taking pressure off protected areas Livelihood improvement – emphasis on benefits to the poor	Income generation for low-income communities Carbon sequestration
Primary Orientation	Commercial, with smallholder participation	Commercial, with smallholder side-project	Smallholders	Smallholders
Types of Partners	National government, Intergovernmental organization, CBO; Work with SPGS to provide seedlings, District government	International private company, CBOs, Ugandan university, International universities; Beginning to work with other NGOs to deliver development benefits	Ugandan NGO, International NGOs and initiatives, CBOs; Work with District government	International NGO, Farmer groups; Works with District government

	NFA – Rwoho	Global Woods	Ecotrust	TIST
Scale*	**Forest reserve** – 2137ha: 1827ha planted by NFA, 310ha planted by 84 community participants in 100-200m band along edge of reserve; **Planting on private land:** 500-700 participants	**Commercial plantation:** 12,186ha of forest reserve, 250-500 employees **Community program**: about 230 participants in 20 villages located in 5km belt around reserve	Sites in 3 districts **Sample site** – 215 participants in 2 sub-counties	Sites in 5 districts **Sample site** – 70 groups clustered around one commercial centre, planting around 90,000 trees
Minimum Requirements to Participate	Must buy shares in carbon plantation to participate in carbon planting program	None	Need to plant 400 trees (about 1ha) to participate	Minimum 6 households per farmer group; Group must have 500 trees planted in first year; Each farmer must have at least 100 non-fruit trees or 20 fruit trees in first year

	NFA – Rwoho	Global Woods	Ecotrust	TIST
Funding Sources	Government, World Bank; CDM carbon credits; SPGS provides seedlings for community planting	**Start-up**: Global Woods with support from German Ministry of Cooperation and German Development Aid; **Present:** 100% Global Woods; **Future**: carbon finance and timber sales	**Start-up:** Private donors **Present:** Ecotrust, International organization (ICRAF & PRESA programme)	Donors and carbon credit sales, managed through CAAC and a public charity
Support to Smallholder Participants	Seedlings Land Training and education Conditional use of forest reserve – e.g. firewood, honey, mushrooms Follow-up and monitoring	Seedlings Training and education Follow-up and monitoring	Training and education Loans to purchase seedlings Follow-up and monitoring	Training and education Follow-up and monitoring
Carbon Payments	CDM (compliance market) carbon income to NFA and community planters, starting after 3 years	Carbon Fix (voluntary market) carbon income to Global Woods	Plan Vivo (voluntary market) carbon income to community participants for first 10 years, starting in year 1	CAAC (voluntary market) carbon income paid annually per tree for 20 years, starting in year 1

	NFA – Rwoho	Global Woods	Ecotrust	TIST
Planting Practices	**Reserve:** Plantation with intercropping before canopy closes in community band, grazing under more mature trees; **Planting on private land:** Mixed practices, woodlots encouraged;	**Commercial Plantation:** Plantations, grazing under mature trees **Community Program:** Mixed practices, intercropping discouraged, woodlots encouraged	Mixed practices, primarily woodlots and boundary planting	Mixed practices; Some plantations planted by wealthiest participants
Tree Species	Exotic commercial species	99% exotic tree species	Native or naturalized species, some exotics with environmental benefits Emphasis on planting mixed species	Exotic and native species, except Eucalyptus
Integration with other Development Activities	Not in sample community; NFA does bee-keeping and other income generation activities in other project areas	Conservation in reserve; Global Woods conducts activities in surrounding communities related to water, education; Expansion of activities planned	Relationship between CBO and Ecotrust started with activities involving capacity building, energy, agriculture	TIST runs activities in agriculture, energy, leadership and capacity building

	NFA – Rwoho	Global Woods	Ecotrust	TIST
Project Timeline	2003 – Start of community planting in Rwoho 2009 – Start of Rwoho carbon planting; First NFA carbon project 60 year contract on reserve land, 20 year rotations	2002 – Start of commercial plantation 2005 – Start of community program 49 yr lease on reserve, 3 rotations of 12-14 yrs	2006 – Start of carbon planting in sample community, First Ecotrust Plan Vivo project 20 year contracts	2003 – Start of TIST 2003-9 – Sample community group start dates 20 year contracts

CBO – Community-based Organization; NFA – National Forest Authority; ICRAF – World Agroforestry Centre; tCER – Temporary Certified Emission Reduction

* Information in this table is a compilation of information provided by project participants and implementing organizations through conversations and organization materials. In some categories, information provided is not directly comparable across projects because different projects use different measures and project structures.

Table 3.2. Characteristics of sampled smallholder non-carbon tree planting projects

	ACTS	TFTF	AHI	LBDC	SPGS	NFA - Mabira
Summary	Agroforestry programs initiated by a small Canadian NGO working only in Uganda. Agroforestry is one of a suite of development activities related to health, energy, agriculture and poverty alleviation that compliment community water projects.	A US-based organization implementing agroforestry programs in countries in Africa, Asia, and Latin America. In Uganda, a central coordinator partners with individuals, groups, organizations and institutions to support smallholder tree planting.	An international research network focusing on natural resource management supports a tree planting initiative with KADLACC (Kapchorwa District Land Care Chapter), a chapter of the Africa Landcare Network, part of Landcare International, a professional association focused on conservation and improvement.	An agroforestry program for local environment and livelihood improvements working in communities around Lake Bunyonyi. LBDC is a local Ugandan NGO supported by profits from a tourist camp operated on Lake Bunyonyi.	An, initiative under the NFA's jurisdiction, but with independent funding and management that supports private sector commercial sawlog production in Uganda through grants. A complimentary smallholder planting program is run in communities surrounding supported commercial plantations.	To take pressure off of natural forest in Mabira Reserve, the NFA, a federal government body, runs planting programs in surrounding communities that support planting on smallholder land and in a band around the edge of the reserve that is loaned to community members by the NFA.

	ACTS	TFTF	AHI	LBDC	SPGS	NFA - Mabira
Goal(s)	Local environment improvement, Rural livelihood improvement	Livelihood improvement through sustainable land management	Conservation of natural resources, Improving rural livelihoods	Erosion control Livelihood improvement	Timber self-sufficiency in Uganda Forest conservation Community support for commercial plantations	Improve reserve management, Natural forest conservation – taking pressure off reserve by providing alternative livelihood options
Primary Orientation	Smallholders	Smallholders	Smallholders	Smallholders	Commercial, with smallholder side-project	Smallholders

	ACTS	TFTF	AHI	LBDC	SPGS	NFA - Mabira
Types of Partners	Small international NGO, CBOs, Church of Uganda; Work with other NGOs, government	International NGOs; CBOs, International government programs, individuals, local institutions, Ugandan NGOs, Ugandan Kingdom	International research network, International professional association, CBOs; Work with national park, government, local and international organizations and NGOs	Local Ugandan NGO, CBOs, individuals, Church of Uganda; Work with government, international NGOs	Intergovernmental organizations, National government, Commercial growers ; CBOs and individual smallholders	National government, CBOs; Work with SPGS to provide seedlings, sometimes work with international NGOs and organizations (not a present)

	ACTS	TFTF	AHI	LBDC	SPGS	NFA - Mabira
Scale*	5 sites **Study site:** About 70 households	50-70 project sites in Uganda **Study site**: School with 200-300 students + CBO with 20-30 community members	22 CBOs in the larger umbrella organization; 200 members	384 participants in 42 villages around the lake	200 commercial growers; 4-500ha planted in 48 communities around commercial plantations **Study site:** 240ha; plantation owner working with 28-member CBO	**Study site** – 76 members
Minimum Requirements to Participate	None	None	None	None	Minimum 25ha for commercial plantation support; Minimum 20 per group community participants	None

	ACTS	**TFTF**	**AHI**	**LBDC**	**SPGS**	**NFA - Mabira**
Funding Sources	Donor and government funds through ACTS	Donor funds through TFTF	International research network (AHI), International grants	**Start-up:** International NGO **Present:** Profits from tourist resort run by LBDC;	Intergovernmental organizations, International governments; NFA – land and resources for community projects	Government, SPGS provides seedlings; Sometimes partnerships with international NGOs and national initiatives

	ACTS	TFTF	AHI	LBDC	SPGS	NFA - Mabira
Support to Smallholder Participants	Seedlings Training & education Potting materials Follow-up and monitoring	Seedlings Training & education Funding for tree nursery Follow-up and monitoring	Seedlings Training and education Funds to purchase new technologies Follow up and monitoring	Seedlings Potting materials Training and education Follow-up and monitoring	**Commercial program**: Training and education Networking Reimbursement of about ½ plantation establishment costs **Community program:** Seedlings Training & education Limited follow-up and monitoring	Seedlings Payment for maintaining reserve boundary maintenance Conditional use of forest reserve Follow-up and monitoring

	ACTS	TFTF	AHI	LBDC	SPGS	NFA - Mabira
Planting Practices	Mixed practices; Commercial and non-commercial exotic species	Mixed practices; Native species, and exotic species with no environmental consequences – "agroforestry trees" Pine and Eucalyptus discouraged	Mixed practices – mostly woodlots; Mostly exotic species	Mixed practices; Mostly exotic species	**Commercial plantation:**, Commercial exotic species; **Community program**: Mixed practices – plantation and woodlots encouraged, intercropping and grazing discouraged but practiced; Commercial exotic species	**Reserve:** Intercropping in boundary until canopy closes; **Private planting:** Mixed practices – woodlots encouraged; Exotic species

	ACTS	TFTF	AHI	LBDC	SPGS	NFA - Mabira
Integration with other Development Activities	ACTS runs water projects integrated with activities in health, energy, agriculture, poverty, education and capacity-building activities	Partner with organizations engaged in other types of development activities	Multiple activities in the area of sustainable natural resource management	LBDC runs activities in agriculture, poverty, health, education, water safety, capacity building	Promotion of commercial forestry in Uganda; integration with other rural development activities very limited	**Study site:** NFA conducts activities in bee-keeping, ecotourism, craft making, conservation
Project Timeline	1993 – Start of ACTS tree planting 2001-6 – Supported tree planting project at study site	2009 – Start of TFTF in Uganda 2008 – Start of planting in sample community	2005 – Start of planting in sample community	1993 – Start of LBDC planting 1993-present – Start of planting in sample communities	2003 – Start of commercial planting (SPGS and sample site) 2005 – Start of community program	2004 – Start of planting at sample site

CBO – Community-based Organization; NGO – Non-governmental Organization

* Information in this table is a compilation of information provided by project participants and implementing organizations through conversations and organization materials. In some categories, information provided is not directly comparable across projects because different projects use different measures and project structures.

All project sites sampled are located in the southern two thirds of Uganda (Figure 3.1), which enjoys relative social and political stability and environmental conditions generally favourable to agriculture. All sites are within two hours drive of a commercial centre, though differing levels of difficulty related to market access for tree products were reported. Project sites have different challenges and assets. For example, some communities were near National Forest Reserves and National Parks; others were in very hilly areas experiencing reduced productivity due to soil erosion; others were in areas experiencing especially high population pressure.

Adapted from: United Nations 2003.

Figure 3.1. Map of Uganda showing approximate locations of sampled smallholder tree planting projects

Project participants in all projects were typical of participants in smallholder tree planting initiatives in developing countries. Most participants had low-income and were relying on small plots of land to provide for their household needs. In some projects, middle-income participants were also involved. Generally, participants were relying on diversified livelihood strategies; specialization was rare, and usually limited to those with larger holdings of land that exceeded their need for crop production. People with larger land holdings were often older men, linked to cultural norms surrounding inheritance, and were engaging in commercial enterprise. Agroforestry practices adopted reflected individual situations; for example, those with more land, with tracts of marginalized land unsuitable for crop production, or having more resources at their disposal (and therefore less risk) were more likely to plant woodlots. Although it was widely agreed that land ownership and size of land were barriers, most people felt that even the very poor and land poor could participate in tree planting, particularly with support, though they might realize more limited benefits.

Some programs allowed plantations, large tracts of land used exclusively for trees. Plantations were usually owned and managed by wealthier men. In many cases, even plantations involved agroforestry crops being planted with seedlings until the canopy closed, and/or animals being grazed below the plantation trees. Although plantations were generally managed commercially, it was not common for smallholders to manage tree planting as a business. Three projects, Global Woods, NFA-Rwoho, and SPGS, purposefully combined larger-scale plantation forestry having an explicitly commercial focus with smallholder tree planting initiatives. Organizational collaborators included local, national and international NGOs, all levels of government, and commercial planters.

3.2.3 Methods

Ten smallholder planting projects were included in this study. In the absence of a formal project registry, a rapid survey of smallholder tree planting initiatives was conducted that included internet research, email inquiries and meetings with key informants in the sector. Ten projects were chosen to reflect the diversity of smallholder planting initiatives currently underway in Uganda, primarily in terms of project scale, project activities, primary project goals, and characteristics of the implementing organization. Projects self-identifying as “tree planting” projects were included with those specifically identifying as “agroforestry” projects because it was found that in all projects, at least some smallholder participants were engaging in agroforestry practices, even when agroforestry was actively discouraged.

Interview and focus group design was inspired in part by the mental modeling technique described in Morgan et al. (2002)[21]. Semi-structured interviews were conducted with key informants from implementing organization(s) who were involved with the projects at various administrative scales. Semi-structured interviews and focus group interviews were conducted with project participants. In total, 15 people were interviewed representing organizations, 10 participants in the tree planting programs were interviewed individually, and 182 participants contributed via 12 focus groups. For one project, access to the community was blocked due to the community feeling "over-researched", so relevant information was gathered from a community-reviewed report based on an independent study conducted in early 2010 on similar topics to this study (Heifer International 2010).

All sampled planting initiatives except Global Woods and LBDC have implemented planting projects at more than one site in Uganda. One study site was chosen to represent each planting initiative, in consultation with the primary implementing organization. Study sites were chosen such that they were all within two hours travel by vehicle of a commercial centre, and to be representative of what organization representatives understood to be a "typical experience" in the project. At each study site, multiple communities were participating in the planting program. Sample community groups and individuals were chosen in consultation with local key informant(s) to represent "the full range of participant experiences".

Additional information was collected to assist in contextualizing qualitative data. Observations were made during site visits to all ten project sites. Eleven additional informal meetings were conducted with organization representatives and one with farmers. Nine meetings and interviews were also conducted with key informants working in the forestry and carbon sectors in Uganda.

Interview data and meeting notes were transcribed and analyzed qualitatively using Nvivo software. Qualitative coding and analysis methods were based on approaches

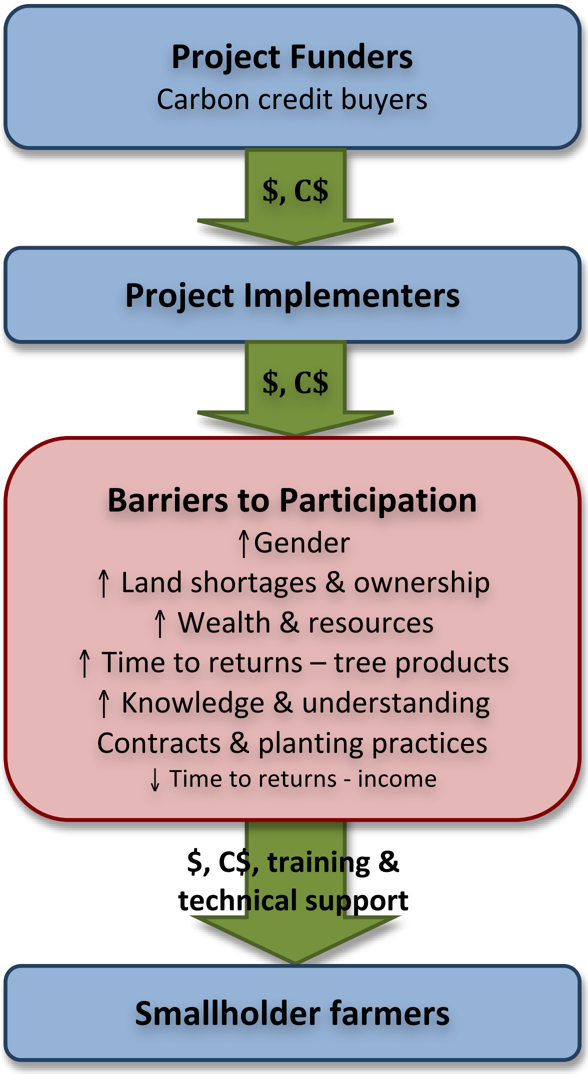
[21] Interview and focus group protocols can be found in Appendix B. Research ethics approval for this study can be found in Appendix C.

described in Bernard (2006). A combination of inductive and deductive coding was used. Interviews and focus groups were coded inductively initially to identify themes and ideas and the relationships between them. Codes were then grouped or renamed where appropriate to reflect categories from the review of project characteristics described in Chapter 2 in order to highlight alignments and dissonance with findings from the literature review.

3.3 Potential Opportunities from Including Carbon Credit Generation in Smallholder Tree Planting Initiatives

Themes in the qualitative data suggest that including carbon credit generation in smallholder tree planting initiatives is understood to have the potential to have both positive and negative effects on the structure of smallholder planting projects, primarily on barriers to smallholder participation, challenges to realizing benefits, and products and outcomes of the project. The main effects that were described are summarized in Figures 3.2 and 3.3.

In agreement with the literature (e.g. Harris 2007; Palm et al. 2004), several participants believed it is possible that including carbon credit generation in smallholder tree planting could create new opportunities for sustainable rural development. Two main avenues were identified: additional funds from carbon finance to overcome barriers and challenges, and equipping farmers and communities with useful skills, resources and perspectives.

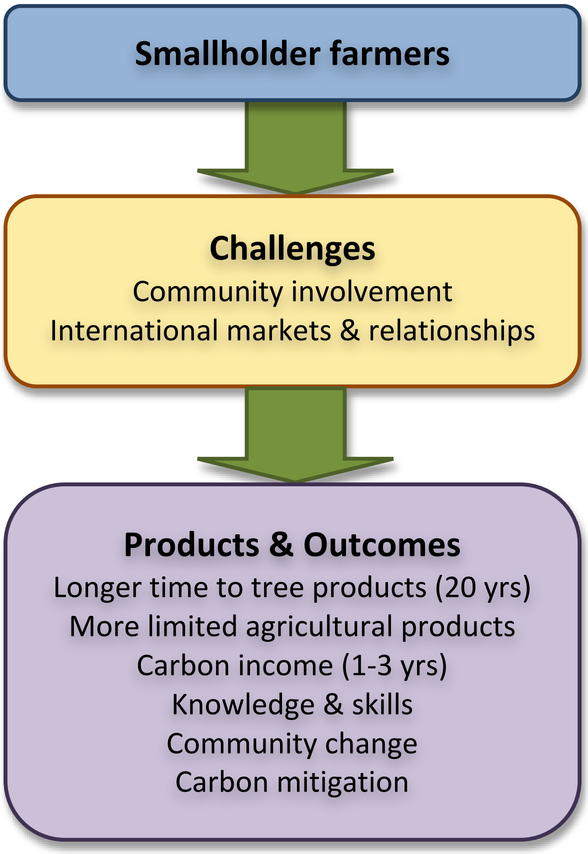


Funding in both carbon and non-carbon projects comes from international donors, government, and/or commercial returns from wood products. Carbon projects have an additional potential source of funds (C$), from the sale of carbon credits to buyers. Project implementers are NGOs, government, and/or private companies.

In carbon projects, some barriers found in non-carbon projects – gender, land size and ownership, wealth, time to returns from tree products and knowledge and understanding – are exacerbated. There are new barriers related to contracts and planting practices. Barriers related to time to returns from income can be reduced compared to non-carbon projects, due to carbon income.

Figure 3.2 Summary of the implications of including carbon credit generation in smallholder planting projects, Part 1

This flow chart summarizes the flow of resources through a generalized smallholder planting project, from funders to farmers, and indicates the ways in which carbon planting projects differ from non-carbon planting projects, according to this study. Carbon income flowing through carbon projects is a key difference between carbon and non-carbon planting projects. In both carbon and non-carbon planting projects, resources flow from funders to project implementers. They are then intended to then flow to farmers, but various barriers (red box) may prevent farmers from participating in the project, and thus receiving the flow of resources. Seeking to generate carbon credits in a smallholder planting project can exacerbate barriers that exist in non-carbon planting projects, and create additional barriers. One barrier in non-carbon planting projects, time to returns from income, is reduced in carbon projects.



Carbon projects can have additional challenges related to community involvement and international markets and relationships.

In carbon projects, it is generally longer until tree products can be harvested due to contracts specifying rotation lengths. Agricultural products may also be more limited. But, carbon income can come earlier than income from tree products. Knowledge and skills acquired from participation in a carbon project are understood to be higher. In addition, a carbon project may induce community change, and contributes to carbon mitigation.

Figure 3.3 Summary of the implications of including carbon credit generation in smallholder planting projects, Part 2

This flow chart summarizes the flow of resources through a generalized smallholder planting project, from farmers to products and outcomes, and indicates the ways in which carbon planting projects differ from non-carbon planting projects, according to this study. If farmers overcome barriers and are able to participate in the tree planting project, they may encounter challenges (yellow box) that prevent them from realizing the full extent of benefits possible from their participation. Carbon projects have additional challenges compared to non-carbon projects. Generating carbon credits also affects the products and outcomes generated by the planting project. The products and outcomes generated are affected, as well as the time it takes to realize certain types of products.

3.3.1 Carbon Finance to Overcome Barriers and Challenges

It is widely hoped that carbon finance could play an important role in developing countries in terms of bringing new opportunities for infrastructure development, income generation, and poverty alleviation (Montagnini & Nair 2004; Nair et al. 2009; Smith & Scherr 2002). This study suggests that carbon funds could help to overcome some of the biggest barriers to participation and challenges to realizing benefits by rural smallholders in conventional tree planting: time to returns, and sufficient money and resources to initiate and sustain a planting initiative.

All rural participants and almost all organization key informants identified time to returns as a barrier to participation in tree planting by rural people. In comparison to crops, trees take a long time to provide usable and sellable resources. Even in a tropical country like Uganda where growth rates are considerably faster, participants report it takes 4-5 years for a fast growing tree like Eucalyptus to produce building poles and firewood, the first tree products generated. Timber can take 20 years or longer. Even a small delay to returns is significant when people are struggling to meet basic needs:

> *People who are willing to invest in long-term projects are not many, because survival is what is very important. People need their means of sustenance. Somebody who does not have enough money for his children for school fees will not invest in planting trees that are going to bring returns after 20 years. (TIST participant)*

Time to returns in tree planting is also an issue because life expectancy in Uganda is relatively low (53 years for women and 51.8 years for men, according to the United Nations in 2010). Several participants suggested that for those not participating, the possibility that they might not live to get returns from the trees was a major deterrent. Participants described how *"When they see us planting, they ask 'Will you really get the dividends out of these trees? You will have perished! These are long-term things.'" (NFA – Rwoho participant)*

Those who were participating in tree planting saw trees as an investment in the future, either for their own retirement or for their children, but still identified time to returns as a significant challenge.

Carbon finance could help to overcome this barrier by providing earlier returns than conventional planting projects, *"because forestry is generally long-term. So even long term carbon brings intermediate revenue compared to if you are to wait for the first thinnings, second thinnings " (NFA)*. In Rwoho, participants receive their first payment after 3 years. In the Ecotrust and TIST projects, first payments are received after 1 year, much earlier than the first returns from tree products.

These returns can help overcome barriers and challenges to planting related to wealth and resources for rural participants, who described how carbon finance can help to recoup startup costs, provide funds for maintenance of trees, and act as collateral for loans. This is in line with observations in the literature that short-term returns will be important to sustain the participation of rural smallholders in agroforestry and forestry (Fischer & Vasseur 2002; Gong et al. 2010; Shiferaw et al. 2009; Torres et al. 2010).

But, even with earlier returns expected from carbon, time to returns remained a challenge. Participants in the NFA-Rwoho project noted that they were struggling to cover the initial and on-going costs of planting and maintenance in the three years before the first carbon returns were expected, while participants in the Ecotrust project noted that shorter times between carbon payments would be helpful. And, even with shorter time returns, several participants were still concerned that they might not live long enough to see benefits:

> *When doing the carbon, some of us are aged, over 70. Now, do I expect to get some money really from my trees which I planted before I pass away? I have come to the point of despairing because I am growing too old. I might die before I get something. We need something just to make us survive a bit. (NFA – Rwoho participant)*

To further overcome barriers for farmers, will be important to continue to look for ways to shorten the time to initial returns and regularize the time between payments in carbon planting projects. Emphasis on projects like the Ecotrust and TIST projects that provide early payments – i.e. *ex ante* payments that come prior to the delivery of credits – will likely be most helpful to rural participants. This finding supports similar findings in the literature (e.g. Torres et al. 2010).

Carbon funds could also help organizations to overcome barriers and challenges related to funding and project sustainability. The NFA described how in the Rwoho project, "*carbon is the one which is bringing the intermediate funds. By the end of the first rotation, we will have recovered the costs of establishing carbon" (NFA).* Carbon funds could also facilitate long-term sustainability of planting projects by substituting donor funds. UCB described how many international NGOs have realized that, with carbon finance, they can design a project

> *'..that has a chance to keep going. Far better than a one-off forestry scheme.' When it dies, there's a big gamble as to whether anyone is going to run the nursery afterwards, whether they'll be able to sell the seedlings. Mostly, these things collapse on a regular 5 or 10 year cycle. Whereas with the carbon finance, there's a little motor running away there, not just waiting for the trees to be mature and the first thinnings. The next thing is to use the carbon market as a much stronger incentive, replacing donor money. So like Plan Vivo now in the Bushenyi project, requires no donors. The donor money was in there to create the opportunity, and it now runs itself with the cycle of 'I produce a tree and a carbon credit. So this is exactly the holy grail that people have been looking for development projects.* (UCB)

Start up costs and resources – primarily seedlings and planting materials – were widely identified as a barrier to tree planting by smallholders. Smallholder planting initiatives often provide seedlings and other resources to help offset these costs, but, as described by a UCB representative, many then fail to continue once an organization leaves the area because smallholders find resource barriers are too large to be overcome without assistance. It is hoped that carbon finance could provide continuous funds to sustain on-going planting even after an implementing organization leaves the community.

3.3.2 Equipping Rural Participants

Participants described how participation in carbon planting projects could better-equip rural participants to escape poverty and secure sustainable livelihoods by giving them additional resources and skills, and by giving them a new perspective. The potential for gaining additional resources from carbon projects was widely understood by participants, in both carbon and non carbon projects. Participants in non-carbon projects expressed hope that they might be able to tap into carbon funds in the future with their planting, while participants in carbon projects all noted that the carbon funds, no matter how small, were appreciated. In the Ecotrust project, it was found that carbon payments were initially used for tree maintenance (overcoming resources barriers to participation), but that as people gained knowledge and experience in caring for their trees, this money was often freed up and invested, or put towards other activities that improved livelihoods. An Ecotrust participant described how

> *When that money comes, it becomes something great in a home. It saves people. You can use it for school fees, those who have children going to school. Some use it to buy more pieces of land, some use it to build some houses or improve on their houses. And some buy some other domestic animals like cows and goats. There is something at least when one gets that amount, you buy something. Then you can spend others in another way.*
> *(Ecotrust participant)*

Several organizations also described the potential beneficial changes in the community at large from carbon payments. Generally, a carbon project brings an influx of more money into the community from carbon benefits. This can happen even where local people do not directly receive carbon payments: Global Woods hires all of their contract workers from surrounding communities, and say that most of the money paid to workers in salaries goes into the local economy. In the Ecotrust project where participants are encouraged to open accounts in village banks, community benefits potentially go deeper, because the increase in accounts and money in the bank from participants in the carbon project provides the bank with increased potential for providing loans to the community at large.

But, it will be important to be careful to maintain realistic expectations about carbon income. Almost all rural participants surveyed had heard of climate change, and many had heard that it is possible to get money for planting trees and were excited about this prospect. Many organizations running non-carbon projects were receiving questions about carbon planting. But, as all those receiving carbon payments noted, this money is low. Based on their extensive experience working in the carbon sector, the UCB cautions that rural participants need to have goals for tree planting in addition to carbon, warning that

> *as long as there's a financial angle, a lot of people are falsely encouraged by the lure of carbon finance thinking they've grown trees for carbon finance, and my first put down is to say 'No, you have to be growing trees for a forestry purpose, or a scenic purpose, or some other reason, and the carbon finance is enough to tip you into doing something, or to overcome a barrier that you're facing, but you aren't going to make a fortune out of the carbon finance.'*
> *(UCB)*

Because meeting expectations is necessary to build trust in relationships, which is necessary to the success of smallholder projects, both according to participants and the literature (Niles et al. 2002; Roshetko et al. 2007), it will be important to communicate and establish realistic expectations for both organizations and farmers about what carbon finance can be expected to accomplish, both in terms of overcoming barriers, and equipping farmers with additional resources.

Key informants at the organizational level in the Ecotrust also thought that skills and attitudes acquired and honed through participation in a carbon planting project could better-equip rural farmers at both the level of individuals and the community.

Tree planting in general requires a certain level of organization and planning. Many projects can only be accessed by organized community groups rather than individuals, and the length of time to returns in tree planting requires a certain degree of planning for the future. Organization representatives at Ecotrust believe that participation in a carbon project emphasizes development of these skills even more so than conventional planting projects. With carbon, an Ecotrust representative describes how rural participants find *"you're changing me [the* *participant] from the way I manage my land to this other new way that even includes* writing *and bank accounts, and counting trees and measuring trees…" (Ecotrust)*. Because they are more administratively complicated due to project registration and credit validation processes, carbon projects require a higher level of planning and organizational skills. Carbon projects could also promote a different set of skills than many conventional projects, because of their commercial focus. In Rwoho, it was explained to participants by an implementing organization representative *"that the carbon project is a business. That's what he told us. He said it is a business, and therefore you must be business-minded."* This lead participants to develop a share-holding structure, where community members wanting to participate bought shares in the carbon initiative, which generated revenue to allow the community to purchase supplies to plant and maintain the trees.

It was also suggested that participation in a carbon project could lead to a change in perspective, in part by developing a more future-oriented outlook through participation in formal banking. To manage delivery of carbon payments, some projects, like the Ecotrust project, encourage participants to get village bank accounts, which can promote money management practices like saving and borrowing. The Ecotrust representative described how one participant invested a small amount of carbon money, which eventually grew sufficiently to help her to move from a very modest two room apartment, to building her own three bedroom house and a school. It is thought that changed outlooks and new skills could, in turn, make a participant to be more willing to embrace innovation and experimentation, thereby allowing them to take advantage of even more potential opportunities for improving their livelihoods. A higher prevalence of organizational skills and innovative attitudes could translate into benefits at the community level if they empower communities and give them the tools to develop a more unified voice to help them access markets and increase their bargaining power.

More research is needed before it can be concluded to what extent carbon projects can equip rural participants with beneficial skills and attitudes. There are two key issues that need to be resolved. First, although several implementing organizations observed favourable skills and attitudes in project participants, it is unclear whether the skills and attitudes developed primarily as a result of participation in the project, or whether participants were already exceptionally apt, allowing them to take advantage of the opportunities presented by planting projects. Comments by several organization key informants suggest it may in fact be the latter. In the Global Woods project, participants in the community planting program were generally found to be "*the better-organized ones. In general, the farmers that do tree planting now, before that, they had a rather well-organized farm*." An NFA staff member said that the community at Rwoho was specifically chosen to pilot the carbon project because "*we found them already organized actually before we started. So that was an almost opportunistic choice*," and added that in general,

> *the community dynamics themselves, sometimes favour those who are able to take initiative, those who are slightly privileged within the communities, and sometimes those are the ones who are organized to negotiate with the NFA, compared with the actual people who deserve to be the ones being assisted. (NFA)*

Even in the Ecotrust project, a founding member described how they looked for participants, at least initially, with a good track record and social cohesion. Likely, it is a two-way relationship: more research is needed to understand causal relationships between project participation and farmer skills and attitude.

Secondly, as noted, all planting projects tend to require at least some organizational skills and future planning to succeed. If it is shown that participation in planting facilitates the development of beneficial skills and attitudes, it is still unclear whether carbon projects better-facilitate these benefits. It may also be that additional barriers from administration and knowledge inherent in carbon projects exclude a higher proportion of the community than conventional projects in practice, which could outweigh these potential benefits if broad participation is one of the project's development goals.

3.4 Additional Barriers to Participation in Smallholder Carbon Tree Planting

Barriers are those things that stop people from participating in a smallholder planting initiative in the first place. When carbon is included in a smallholder planting project, participants in Uganda described how existing barriers linked to gender, land ownership, and wealth and resources can be exacerbated. They also identified new barriers related to knowledge and understanding about climate change and carbon markets, and the planting practices and contract lengths favoured by carbon projects.

3.4.1 Gender

Gender is an existing barrier to tree planting in Uganda according to many participants. Although some participants noted this is changing and "varies with the culture of the place," many participants described how women do not usually inherit or own land in Uganda.

> *You know, women don't own land in most cultures so if you don't have land, you can't plant. Sometimes, even where you are married and have children, you have been there for many years, some men would not even allow you to plant trees on the family land. They say "You are a woman." Maybe his children can plant, but not you.*
> *(NFA)*

Even when women are the ones expending the majority of effort to look after trees that have been planted by a household, men are the landowners, and often make. the final decisions about land and resource use for the family. A participant in the LBDC project described how in that part of Uganda, *"the man is the head of the family, so he is the one who plans for the family. You meet the woman planting, but she is under the man's program"*. Even when a woman is widowed, the family land may go to her oldest son instead of her. A number of participants said that it can be difficult for a woman to participate in tree planting, even if she has the knowledge and desire.

> *When the father and mother are both sensitized and they have changed their mindset about tree planting, that's when it can work. If you get the man alone, for him he can influence the family. But if you get the lady, well she can*

attempt, but she has no say. "I would have loved to, but my husband is not convinced because he has not been coming for the meetings."
(NFA)

Experience with other carbon agroforestry projects suggests that including carbon credit generation in a planting project has the potential to exacerbate this barrier. In a carbon agroforestry project in Mozambique, Hegde (2010) found that women-headed households experienced few benefits from the project. This study supports this finding. In several projects, participants said that agroforestry involves men and women equally; sometimes, women were even seen to be more active participants. But when asked about larger-scale commercial planting on woodlots or plantations[22], men were identified as being more likely to participate. More broadly, men were seen to dominate commercial income-generating ventures in Uganda.

According to our culture, many women will keep at home tending the young ones and looking after the sick and the aged, the animals and so on. Men are breadwinners at the end of the day.
(TIST)

Carbon projects tend to favour larger scale projects and farm sizes[23] and often have a commercial orientation where farmers are receiving payments for carbon credits generated. These conditions could tend to favour the participation of men. The NFA described how in their experience, those most likely to have sufficient resources to participate in tree planting "*are predominantly men, the people whose other sources of livelihood are fairly secure. They have food. They probably have some little income to look after their families."* This suggests that larger projects that require larger

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[22] Participants used the term "woodlot" to describe a smaller area of land (usually no more than 2 acres) planted with trees intended for home use and/or limited small-scale sale. The term "plantation" was used to describe a larger area of land, planted with commercial intentions.
[23] Larger project sizes are favoured in carbon projects because transaction costs are lower per carbon credit generated (Cacho & Lipper 2007; Harris 2007; Torres et al. 2010), meaning that the profitability per hectare increases with project size (Cacho et al. 2004). Similarly, transaction costs are higher when the amount of land included in the carbon project by each individual farmer (farm size) is smaller (Cacho & Lipper 2007). For a more detailed discussion of project size and transaction costs, please see Sections 2.4.2.3 and 2.4.2.5 in Chapter 2.

investments of resources will further favour the participation of men over women. Participants in the NFA-Mabira project observed that, in their community, those with the largest scale planting initiatives are "*mostly aged people, and men, because it is those having a big land.*"

This gender barrier could be further exacerbated by the additional knowledge and administrative skill requirements of carbon projects, since education rates are still higher among men compared to women in Uganda.[24] This may be happening in Rwoho where participants say that *"it is normally the leaders, the men who are there"* participating in the carbon planting project.

3.4.2 Land Ownership and Amount of Land Owned

Land ownership isn't only an issue for women. "Shortage of land" was identified as a barrier, in many cases, the biggest barrier, by every participant interviewed in all types of planting projects. Even some who have access to land are only tenants. In Mabira, the landowner decides how land will be used, and has rights to tree products produced on the land.

> *There is having the land, and having a plot. So those people who used to own land, they are the one who used to have trees. And you, the one on the plot, you were not allowed to plant a tree that would take long. And usually here, we had some different types of trees or tree species which take long, like Mahogany, and so many of them. So the owner of land could not allow you to plant that tree on his land. And once you do that, it was of his or her.*
> *(NFA-Mabira participant)*

For those that do own land, the size of land is seen to be a considerable barrier. "*There are those who don't have land, like a piece. And then there are those who have a piece, but that piece, she is not going to plant everything that she needs. It is too small" (ACTS)*. As in many developing countries, Uganda has a high rate of population growth. Participants described how family land is divided between large numbers of children, such that each generation, *"the land is becoming smaller" (TIST participant)* and increasingly fragmented. Even where people were able to plant

[24] According to the United Nations, women made up only 38.4% of those reaching tertiary education in 2004 (United Nations 2010).

trees, the degree to which people were able to realize benefits from trees was limited, such that no rural participants ranked trees first in importance in terms of their livelihoods. Participants in the LBDC program noted that they had already planted as many trees as possible on their limited land. Their benefit from the tree planting project was maximized, such that they need a different type of development program, such as one targeting livestock, to realize any further significant improvements to their livelihoods.

When land is small, people may perceive the opportunity cost of using land for trees to be too high. Participants described how if a smallholder was choosing between trees and crops on a small piece of land, crops almost always won out because they provided more regular and immediate returns and were necessary for survival.

> *Most people fear that they have small lands. And the tree planting takes a long time. So you wanted to use this small land for just crops. That is the thing that most stops them from growing trees. They are not ready to compete crops and trees on their small land.*
> *(NFA – Mabira participant)*

However notably, many felt that barriers linked to size of land were more a barrier of understanding than real opportunity cost, because, with the right knowledge, it was understood that trees and crops could be grown together to realize benefits from both.

Economies of scale can help carbon projects to compensate for high transaction costs, associated with activities like project registration and credit validation (Cacho & Lipper 2007; Harris 2007; Jindal et al. 2008). As mentioned in the previous section, larger farm size is favoured to lower project costs (Cacho & Lipper 2007). Barriers of land size and ownership could be exacerbated in carbon planting projects with larger scales. A representative of the NFA working with carbon projects suggests that to benefit from carbon, you need at least 500ha. Most smallholders do not have this much land. As a result, the carbon projects studied allowed for lower commitments of land from participating farmers. Still, carbon projects involving rural smallholders planting on their own land had minimum land commitments to participate; non-carbon projects, by contrast, generally did not. Farmers had to commit to planting a minimum of 400 trees in the case of Ecotrust, or 600 trees between six people in the case of TIST. Participants said that it takes about one hectare to plant a woodlot of 100 trees (more when you are intercropping trees with crops). Land size is thus likely to be even more of a barrier in carbon planting projects in places like Uganda, where household holdings are reportedly shrinking and participants described how others in their community had trouble finding land to commit to tree planting, even when there were no minimum requirements.

3.4.3 Wealth and Resources

A final barrier that can be exacerbated by the inclusion of carbon in a smallholder planting project is the wealth and resources required to participate in tree planting. Even when sufficient land is available, it was generally acknowledged by both farmers and organizations that planting is an expensive endeavour. Seedlings are often prohibitively expensive for rural smallholders with limited cash flow, and ongoing inputs of labour and resources are needed to maintain the trees. Because trees take several years to begin providing tree products that can be used by the household or sold for income, it takes farmers a long time to recoup their investment costs in conventional planting. Participants reported that many farmers cannot afford this initial investment, even when returns start after the first year, as with some carbon projects. A staff member at the LBDC project described how

> *When we were selling the seedlings, people were few. But now they are knowing that it is free, even the poor ones come and pick. The time back, it was for the people who have money.*
> *(LBDC)*

Tree planting thus requires the ability to take a risk and invest time, effort and resources. As mentioned, this means that generally, participants need to be food secure, have sufficient income, and have additional land not needed for food production.

> *People who plant and can marshal benefits have to have some income, at least better than $500/ha. That has to be disposable income, because priorities go to food and health and education and families. So anybody must be slightly above that, or willing to sacrifice the other parts.*
> *(NFA)*

Larger-scale participation in planting requires a greater investment of wealth and resources. Where carbon projects have minimum required investments of land, seedlings, or as in the case of Rwoho, require initial investments to purchase shares in order to participate, wealth barriers will likely exclude even more people than in conventional planting projects, which often don't have minimum investment requirements for participation. Carbon projects also require more administration, which requires additional investments of time and resources. As noted by the NFA, even when individuals could form partnerships to try to overcome scale barriers in carbon projects, additional administration costs can still be a barrier.

> *The individuals who have 100 ha, 50 ha, who could combine and form a good group, do not like to spend some little money to prepare the paperwork. The effort to reach that [carbon] money is the barrier. The transaction costs. Those who have few trees on their farm ask you "What do we do?"*
> *(NFA)*

Larger farms sizes in carbon projects could also present barriers in terms of markets. In many development planting projects, the primary goal is to produce environmental benefits and/or products for household use, rather than products for sale. In these projects, access to and availability of markets for tree products are much less important to project success. At the scales required for participation in many carbon projects, it would be necessary to have commercial goals for the trees planted, as generally there would be too many for a single household to use. This means that markets must exist for the tree products being produced by the entire project in the area, and farmers must have access to these markets. This could be an additional barrier to participation in carbon projects, particularly for farmers living far from markets for tree products.

3.4.4 Knowledge and Understanding

Knowledge and understanding about tree planting and the uses of trees were widely identified by participants as barriers to participation in tree planting. In carbon projects, there are additional knowledge requirements about carbon markets and climate change, both about what they are and, in the case of markets, how to access them and participate. This knowledge and understanding is important for effective and equitable participation because it allows farmers to make an informed choice as to whether or not they want to participate in carbon schemes; however, it also appears to be an additional barrier and challenge to carbon planting.

Several participants described how carbon projects require administration-intensive project registration and credit validation procedures. This requires a certain degree of understanding about carbon markets, as well as a certain level of general administrative knowledge and understanding. A representative of the NFA noted that *"carbon tree projects are not clear to them and what they expect to get out"* and *"the smaller ones are not so sure about the paperwork involved"*. Some of this administrative burden could be taken on by the organization, but not all.

Some understanding of carbon cycling and climate change is also important to help participants understand how carbon sequestration works, and why people are willing to pay for it. This knowledge is a prerequisite to participation, as participants noted that, given past experiences with failed development initiatives, people can be reluctant to participate in new projects, particularly when they don't understand how and why they will benefit. This knowledge is also important to allow people to make an equitable and informed decision to participate. But, as noted at Ecotrust, *"It's a very complicated exercise. Eventually, everybody who can grow trees joins. But still, they take a bit of time to even understand how it works, to build the trust and so on and so forth."*

Education can be used to help overcome this barrier for some people in rural communities. But, effectively delivering knowledge can evidently be challenging, given the intangible nature and global scale of many of the relevant ideas. This is likely especially true in rural areas, where education is often low. Many participants, both farmers and organizations, confused climate change and ozone depletion, and made little distinction between local and global climate variation.

> *There are changes in the climatic condition that we lack water, because if water is around us then we can water our plants and our nursery beds. So it is hard to water a large portion when climatic changes are there. Therefore, there is no rain and there is no water.*
> *(AHI participant)*

> *Due to climate change, and the high rate of emissions in air, they have realized that it is very important to plant trees in order to get shade and even fresh air.*
> *(TFTF participant)*

> *Climate change benefits are most important because trees attract rainfall. Way back, they cut all the trees and it becomes so much sun in the area, and people started complaining that without trees, everything's going to be worse.*
> *(SPGS participant)*

When justifying their ranking of the importance of the climate change mitigation benefits of tree planting, many participants talked about oxygen and indicated limited understanding of the links between atmospheric carbon and climate change.

> *Without trees, the exchange of carbon dioxide and oxygen, we would fail to be alive. If you do not have trees, you fail to get the oxygen.*
> *(Ecotrust participant)*

> *It reduces emissions in the air. It has been taught from way back and even the children who are in schools are taught that planting trees is more important because they get oxygen in the air when they plant.*
> *(TFTF participant)*

> *The industrialized countries are polluting the air. The air is being taken away, the pollution is being taken by oxygen.*
> *(TIST participants)*

In the carbon projects studied, participants demonstrated many of the same confusions and knowledge gaps to those in non-carbon projects, suggesting that these projects have so far not been entirely successful in conveying carbon and climate change understanding. In the Ecotrust project, understanding of carbon credit generation was identified by participants as a barrier to participation because people in the community believed that if they planted trees, the government or people from other countries would come and take the trees themselves later, because they had paid for them. This seemed to be a lingering uncertainty, even with those who had decided to participate.

Carbon knowledge is a barrier to participation, and a challenge to those already participating. In Uganda, participants noted that this barrier exists at the level of communities, organizations and government: *"In the communities, there's zero knowledge about it. In the country there is ok knowledge, but still not that much" (Global Woods).* This lack of knowledge and capacity is though to be the reason for the under-representation of less developed countries in the CDM carbon market (Haupt & von Lüpke 2007). Overcoming knowledge and capacity barriers for implementing projects is believed to be possible, but to have high initial costs (Torres et al. 2010). For example, CDM forestry projects have challenging administrative and knowledge requirements that often require the input of experts and qualified consultants to prepare (Haupt & von Lüpke 2007). At the UCB, they noted that

> *There's a lot of interpretation of what the rules mean, and if we haven't got it in our head locally, if we have to hire somebody, that could be 500-1000 Euros a day for that expertise. So it comes back to money again.*
> *(UCB)*

Expenses associated with acquiring required knowledge could be an additional barrier to carbon projects at the organization level. Although an extremely detailed understanding of climate change and carbon sequestration is likely not necessary for informed participation, the knowledge and understanding of local people and host countries could be a key challenge to the success of smallholder carbon projects considering that the equity of conducting carbon projects in developing countries to primarily offset the emissions of developed countries has been questioned (Bachram 2004; Corbera et al. 2007; Okereke & Schroeder 2009; Sathaye et al. 1999). Many participants noted that to overcome this barrier, *"more knowledge is needed, and that knowledge must be very very clear, down to in the community" (SPGS participant).* How to effectively convey this knowledge, particularly to farmers with limited formal education, appears to be an important topic for future research.

3.4.5 Planting Practices, Products and Contracts

Additional barriers to rural smallholders in carbon planting projects lie in planting practices and tree products produced, and length of contracts. Planting practices for increasing carbon storage and producing marketable products may not favour smallholders. Agroforestry is generally useful to smallholder farmers because it allows diversification of livelihood strategies, which is desirable because it increases resilience, or the ability of smallholders to withstand shocks (Garrity 2004). However, participants interviewed with forestry training acknowledged that cost-effective commercial production tends to favour intensive single-species planting. Three of the four carbon projects studied encouraged plantations and/or woodlots over other practices, and in the fourth, a participant noted that significant benefits from carbon could only be realized in this project with plantation-scale planting. A TIST participant described how in tree planting,

> *We are talking about two groups. There are those ones who do it for commercial purposes, and there are those ones who do it for the purpose of survival. Those who do it for survival are almost all poor people, where you find somebody, has got a banana plantation, he has got fruit trees, there are trees for shade, there are animals, and so on. Then there is a group who plant purposely for commercial reasons. So you find you have huge plantations. Not huge in the sense of the one in Canada we learned about. But when you get somebody who has got 10 ha of plantation, for us here, it is big, and one has that one specifically for commercial reason.*
> *(TIST participant)*

As noted in Section 3.4.3 above, larger-scale planting also tends to imply that commercial tree products will be generated. In commercial projects like Global Woods and SPGS, agroforestry practices were often discouraged because it was felt that they interfered with the quality of the tree products produced; for example, a commercial planter in SPGS said that in his experience, allowing grazing under trees compacted soil over tree roots and reduced growth rates.

Tree species desirable for commercial products may also differ from those most desirable for diversification of livelihood strategies. Commercial exotic species like *Pine spp.* and *Eucalyptus spp.* were not favoured by many farmers for agroforestry as a result of experiences of negative impacts on soil and nearby crop production, but were universally used by projects with a more commercial orientation (Rwoho, Global Woods and SPGS). A participant in TIST described this challenge:

> *If you get* Eucalyptus *and you plant it near a field,* Eucalyptus *will definitely out-compete it and the crops will not do well. We have a number of cases where a neighbour planted* Eucalyptus *near one's crops and the crops failed, and they are in court.*

Indeed, experience from CDM forestry in China suggests that "poorly-designed plantations can cause harmful environmental and socio-economic impacts" (Haupt & von Lüpke 2007). But, commercial production of indigenous species, many of which are thought to be more conducive to intercropping, was trialed by Global Woods, but the experiment was considered unsuccessful because high-quality seed stock is not available for these trees, and they thus failed to consistently produce the straight, even growth required for commercial sawlog production.

A final additional barrier is related to requirements for rotation and contract lengths. To generate carbon credits in carbon schemes, most carbon projects require certain rotation lengths for trees. Contracts are often used to ensure that trees stay in the ground for the required time period (Milne 1999). All carbon projects studied have rotation lengths of 15-20 years. Farmers doing carbon planting on their own land in the Ecotrust and TIST projects indicated that they would prefer to have the flexibility to change their land use from tree planting before the allotted time, and indicated concern that they would not be able to harvest their trees if their situation changed and they needed immediate returns, or if the opportunity cost of their land changed and it become more profitable to use their land another way. In the first CDM forestry project, taking place in China, planting was stalled in part because landowners were no longer happy with the income sharing arrangements of their contracts when land values in the area rose (Gong et al. 2010). For smallholder farmers, flexibility and the ability to adapt in response to changing conditions is important to their resilience and survival (Garrity 2004). This is illustrated by an analysis of a smallholder carbon planting project in Ecuador thus concluded that long-term contracts would ultimately have a negative impact on local farmers (Milne & Arroyo 2003).

Required rotations and contract lengths, less common in conventional smallholder planting programs, could be an additional barrier in carbon projects. Required rotation lengths can limit the tree products that might be generated from a tree. In the carbon projects studied, rotation lengths mean that trees are almost exclusively destined to be sawlogs, meaning they will be cut into timber. At the scales required for participation in the carbon projects, most of the timber produced is intended for commercial sale. A commercial planter in the SPGS program described how the poor can be excluded from commercial planting for timber due to initial expenses and the rotation length required to produce timber:

> *A poor person cannot plant trees in a commercial sense. It is costly, right from the beginning, even getting land, seedlings, preparing land, planting, wait for years and years. When you are doing that maintaining the plantation, you have to weed, you have to do a lot of work. Very expensive. The poor can do small stands, but they harvest them when they are in infant stages. Within one year, someone says 'I need money. I need firewood.' They want to use it.*
> *(SPGS participant)*

Contracts can reduce the ability of farmers to adjust their land-use strategy to changing conditions and income needs. Even if someone manages the initial investment in planting trees, rotation and contract lengths could still exclude the poor in the community.

3.5 Additional Challenges to Succeeding in Smallholder Carbon Tree Planting

According to both project participants and organization representatives, the factors described above have the capacity to prevent participation by rural smallholders in carbon planting projects. In some cases, these factors may not always prevent participation altogether, but may still act as challenges to realizing benefits. Other factors rarely prevent participation and act primarily as challenges to successful tree planting over the long term. Challenges prevent a participant in rural tree planting from realizing any or the full extent of benefits they could get from participating. Participants in Uganda indicated how including carbon in smallholder planting projects can exacerbate existing challenges related to incorporating community consultation and participation into project design and implementation. They also described a largely novel challenge connected to international markets and subsequent implications for relationships between project participants.

3.5.1 Community Consultation and Involvement

For success in smallholder development initiatives, it is repeatedly emphasized, particularly in the participatory development literature, that projects should be flexible, adaptable and participatory in both design and implementation in order to give local people ownership over the project, allow the project to respond to changing local desires and needs, and ultimately, ensure sustained participation of community members (Ashley & Carney 1999; Bognetteau et al. 2007; Boyd et al. 2007; Current et al. 1995; Dolan 2006; Fischer & Vasseur 2000, 2002; Garrity 2004; Shiferaw et al. 2009). This idea was supported by many tree-planting participants in Uganda, both organizations and participating farmers: *"You want the community to be the people designing [the program], designing with them, and then implementing with them" (TFTF).*

The importance of community involvement was mentioned by participants in all projects in this study, and explicitly identified as a factor in project success in most. An LBDC staff worker said *"If you start a project and the people don't like what you are doing, you will be doing nothing. You will fail."* The NFA said *"We have stopped thinking for communities."* An ACTS staff member described how community involvement allows a project to respond to community needs:

> *We can come with our idea that 'Why can't we give goats to the widows in Rubingo, or to the community?" Then they may say 'For us, we don't have enough land where to graze goats. So why don't you give us chickens?' Because you can't give something what people cannot manage. (ACTS)*

Involving the community in project design and implementation requires flexible project designs that allow projects to be adapted in response to community feedback and changing community needs and desires (Bognetteau et al. 2007; Boyd et al. 2007; Current et al. 1995; Fischer & Vasseur 2000; Shiferaw et al. 2009). Both farmers and organizations emphasized the importance of follow-up, listening to communities, and not *"dictating what they are going to do" (Ecotrust)*. Farmers in TFTF said that *"The reason why the program is doing well, [the project coordinator] has involved the communities in all aspects, and she has not abandoned them to stop planting their trees."* A participant in Ecotrust explained that farmers *"need constant monitoring, because for them, they plant, and when you don't visit them, they say 'This project is no longer there.' So they quickly give up."* Several organizations pointed out that good community consultation can take time to do well: *"If you are a valuable extension agent, you have to, of course, move at people's pace. Don't force them to move to your speed" (NFA)*. Arranging and implementing community consultation and involvement will therefore require an investment of time and resources.

Involving the community in project design and implementation may be more of a challenge in projects with a stronger commercial orientation. Many development projects have funding allocated to support more participatory project designs, because these have been found to be desirable for delivering development benefits, and community involvement is understood to be important to project success (Bognetteau et al. 2007; Boyd et al. 2007; Chivinge 2006; Current et al. 1995; Dolan 2006; Fischer & Vasseur 2002; Leakey et al. 2005; Rudebjer et al. 2006; Sanchez 1995; Shiferaw et al. 2009). Good relationships with community and community participation are actively pursued with project resources. By contrast, most commercial initiatives do not have donor funding, and project expenditures must be recouped by product sales. Although community relationships were understood to be important to project success by both SPGS and Global Woods, community involvement is not a primary goal. There is a stronger focus on reducing project costs to maximize returns. As a result, it may be more difficult for these projects to effectively engage communities while keeping projects financially viable, and resources may be committed to other objectives more directly related to the primary commercial goals. This may be a particular issue in carbon projects, which can have high transaction costs due to requirements for project registration, carbon monitoring and credit validation (Cacho et al. 2002; Jindal et al. 2008; Milne 1999).

Experiences of smallholder participants in the SPGS project allude to some of the potential problems if a project is less willing or able to allocate resources to support community involvement. The community reported that SPGS did not follow up after delivering seedlings to the community, and didn't provide many opportunities for learning. Contact of SPGS with the communities it supported was so infrequent that community participants did not even recognize the name of SPGS as the implementing organization. Further research would be required to determine conclusively if community consultation and involvement is less prevalent in commercially oriented planting initiatives than community-oriented initiatives, and in smallholder carbon forestry projects compared to non-carbon projects.

But, staff at the NFA hope that involving the community in implementing carbon projects like the NFA project at Rwoho could also reduce costs, *"Because it is very expensive to look after forests without participation of the community."* The NFA then described how the TIST program involves farmers in measuring carbon sequestration to lower transaction costs:

> *Because it knew the transaction costs would be very high, [TIST] taught the farmers to plant and measure the tree. So it gives them the GPSs, it gives them the diameter tapes. You measure with the diameter tape. The GPS number is in the computer, the computer picks it up, and throws it up. And the number can be seen by anybody in Australia or in Canada.*

The notion that community involvement could potentially lower transaction costs, particularly in monitoring and enforcement, in carbon forestry projects is also suggested in the literature (Boyd et al. 2007; Cacho & Lipper 2007; Cacho et al. 2005; Milne 1999; Smith & Scherr 2003).

3.5.2 International Markets and Relationships

Carbon credits generated in developing countries are mostly sold through international carbon markets. As previously described, this adds a challenge related to knowledge and understanding because rural participants must be able to access and navigate these markets, either directly themselves, or, in most cases, through an intermediary or broker. This, in turn, creates additional challenges connected to relationships between project actors.

Rural participants in Uganda confirmed recommendations in the development literature about the importance of relationships to project success (Boyd et al. 2007; Fischer & Vasseur 2002; Roshetko et al. 2007), saying that they are important for both organizations and rural participants, for maintaining hope and building trust, encouraging farmers, sustaining participation, and ultimately, for ongoing project success. They confirmed that relationships require contact between participants and stakeholders operating at different scales, honesty and kept promises, and time (Bognetteau et al. 2007; Dolan 2006; Fischer & Vasseur 2002; Garrity 2004; Leakey et al. 2005; Macqueen 2009; Noble & Dirzo 1997; Rudebjer et al. 2006).

Relationships between stakeholders have the potential to be more complicated in carbon projects compared to non-carbon projects. Where conventional smallholder planting projects can aim to generate products and outcomes for household use, or for sale on local markets, the carbon projects studied all involve sale of credits on international markets. There is thus a need to interact with buyers in these international markets who are far removed from, and may have very limited understanding of, the contexts, needs and desires of local participants, and vice versa. Decisions that affect how the carbon markets will function, carbon pricing, and approval of methodologies are generally made at the international scale, while carbon sequestration happens at the local scale. Global woods noted that marketing of carbon credits *"is something that is far beyond the horizons of the community itself. It always so far has to be an organization somehow internationally set up."*

Intermediaries are common in payment for environmental services (PES) arrangements, like carbon projects (Vatn 2010). An intermediary (or carbon broker, in the case of carbon projects), such as an organization or a private company like Global Woods, can help to connect local carbon credit generators to international buyers. In the case of smallholder carbon forestry projects, intermediaries are usually involved in arranging the carbon credit generation scheme and coming to agreements with smallholders to participate in sequestration activities. They make the arrangements to sell the credits generated on carbon markets, and pay a portion of the income to the smallholders. Because transaction costs in these projects tend to be high, intermediaries are often the "dominant agent" in PES schemes; they often define the good that will be sold (in this case, the characteristics of the credits that will be generated), establish the buyers and sellers, and often, set prices (Vatn 2010, p.1247). Consequently, it has been found that intermediaries can take decision-making power out of community hands (Nelson & de Jong 2003).

This is an important consideration given that community control over decision-making has been identified as a factor in the success of smallholder planting projects (Current & Scherr 1995; Dolan 2006; Garrity 2004; Jama et al 2006; Macqueen 2009; Shiferaw et al. 2009). A representative at the World Agroforestry Centre working on carbon forestry noted that honest intermediaries, those that are *"really, genuinely interested in investing into the community welfare, even environmental benefits" [Ecotrust representative],* are not common. The Ecotrust representative went on to say that most carbon brokers tend to be profit-oriented and that rigid project structures required by compliance schemes like CDM can make relationships between brokers and communities difficult, because *"by the time you get the first money disbursed, you have probably even lost the trust, because the people have waited for this forever."*

In Uganda, relationships with international buyers were seen as an area that needs improvement by both organizations and farmers. A representative of the NFA expressed concern about equality in the relationship between local credit generators and international buyers:

> *The buyers and sellers, there is an impression in the North that the carbon credits from tree planting should be cheap. And then this side, we expect that it will be a liberator, where everybody now is following the genuine price. When it doesn't happen, it is as if this despite is intentional. So we resent it a lot and we think it is one of the negative aspects of climate change. And it is a big argument in the negotiation that we are having. People are looking at REDD as one of the things that can be done quickly and cheaply. And we don't like hearing the word cheap. Our belief is if you buy this cup of tea for $1, and yet this same cup of tea could be also $5, then in the middle, someone has taken away the $4. So these $4 in the middle, they can be taken away. If you make an international agreement based on the cheapness of labour, that becomes a bit tough for the preservation of livelihoods and communities. To me I look at that as if they prefer that those communities stay that way. And governments who look after their people, aspire that their people become like others. That is the dilemma.*
> *(NFA)*

A representative of Ecotrust expressed frustration with the perception of local farmers by international buyers, saying

> *I wish the international community could just change its attitude towards the rural farmer, as in thinking that they are too rural to understand how [carbon] works, and thinking that they don't have interest in improving the environment. Especially that issue of permanency, it's really assuming that the farmers have no use for trees and therefore that they can't invest, and also assuming that the farmers, there's no language that can make them understand it.*

The lack of trust of the international community in farmers' ability to understand and commit to long-term planting was seen to be a barrier to higher carbon prices being paid for forestry projects. As indicated in Section 3.4.4, this is likely a genuine concern. However, this knowledge barrier is not specific to forestry projects; it will need to be overcome in every type of smallholder carbon project, and current confusion about carbon sequestration and climate change should not be understood in the international community to indicate a lack of desire or capacity to learn. A representative of the UCB also spoke about frustration related to the international community's lack of acceptance of carbon forestry, describing how some international organizations and government initiatives that promote the buying of CDM credits but will not fund carbon forestry initiatives, despite their inclusion in CDM. Hesitance to invest in carbon forestry is generally based on concerns about permanence of credits, leakage, and issues with accounting methods (Hamilton et al. 2010). As a result, carbon forestry accounted for only 5 Mt of a total of 8700 Mt CO_2 traded in 2008 (Hamilton et al. 2010; Kossoy & Ambrosi 2010), and carbon forestry credits are often of lower value (Haupt & von Lüpke 2007).

Challenges surrounding relationships could be particularly important to address in the case of smallholder carbon planting projects. Carbon and climate change are relatively new and complicated ideas. Relationships could well be the key to securing the trust of local people that will be required for sustained, widespread participation in smallholder carbon planting initiatives.

3.6 Addressing Barriers and Challenges

As described by participants in smallholder tree planting initiatives in Uganda, seeking to generate carbon credits in a project could be an opportunity to overcome barriers to conventional planting or realize additional benefits, or it could be a source of exacerbated and additional barriers and challenges.

If barriers and challenges to smallholder carbon tree planting can be adequately addressed, it may be possible to take advantage of opportunities created when carbon credits are sought in smallholder agroforestry projects. Potential solutions identified by participants may be found or required at various scales. At the level of the project, the smallholder planting projects studied in Uganda have attempted to address some of these barriers and challenges, with some success. But, as a representative of Global Woods pointed out, *"as much as we can do or we want to do on the project level, sometimes, it's simply a problem that you cannot solve from the project level."* Smallholder agroforestry projects are merely one tool in an array of actions and policies that will needed at multiple scales to achieve desired development outcomes; smallholder tree planting projects in isolation will not be capable of solving many, or any, broad development issues. For example, this study highlights how, while certain characteristics of the design of a tree planting project have the potential to exacerbate or reduce barriers to accessing tree planting programs for women, the broader issue of gender equity will not be resolved by tree planting projects. Some challenges and barriers to participation in smallholder tree planting will need to be addressed at levels outside of direct project control, through action and policy implemented nationally and/or internationally.

3.7.1 Local or Project Level Solutions

At the project level, solutions were attempted for addressing barriers and challenges related to wealth, land size and ownership, and knowledge and understanding.

Several projects use partnerships between community members to help overcome barriers related to scale and amount of land needed to participate. Grouping smallholders is a commonly-suggested strategy for reducing costs in smallholder projects (e.g. Grieg-Gran et al. 2005; Milne 1999). At the site studied, Ecotrust works with a community organization of 215 carbon project participants, but each participant only needs to have 1-5ha to participate. Each participant also designs his or her own land management plan, which gives farmers the flexibility to choose practices that are best-suited to their individual circumstances.

> *It doesn't really matter so much how little land you have or how much land you have because you can even just join by planting trees at the boundary of your land. You can still access the carbon financing. So there are different options that people take depending on how much land they have.*
> *(Ecotrust)*

TIST also uses partnerships between community members, requiring community members to form groups representing at least six different households to join. Similar to Ecotrust, TIST also incorporates flexibility in their participation requirements to help overcome barriers land size, by having minimum planting requirements that are lower if participants plant fruit trees.

The NFA CDM project in Rwoho is an example of a project that addresses scale barriers through a partnership between a government body (NFA) with a community organization in Rwoho. Although CDM projects are usually *"*too *rigid for communities" (Ecotrust)*, the community at Rwoho is able to participate in a CDM project by piggybacking on the larger NFA plantation. The NFA donates use of the land to the community, who then take all responsibility for plantation and maintenance. As a large organization looking at getting larger returns from their carbon plantation, the NFA (with help of a loan from the World Bank) covers the costs associated with project registration and credit validation, making it possible for the community to participate and benefit from carbon finance in a CDM project.

Some projects overcome barriers from wealth and land ownership by providing land for planting and/or seedlings, while others, like the Ecotrust project, support participants with loans. Both farmers and organizations in most projects indicated that support in the form of money or resources is important for project success. Both the NFA and SPGS hoped that loaning government land to participants could also help to address barriers to equal participation of women in tree planting, although this has not been entirely successful, particularly where gender inequalities had deep cultural roots, as is illustrated by the following story told by an NFA staff member:

> *There was a couple. They have separated. The woman came because we allocated plots for establishment of woodlots by the communities. Each individual has a plot. So this lady who was separated from her husband got a plot. But when the man heard she had got a plot, he came back and reconciled and took her away. He didn't want her to participate in tree planting because, to him, that meant emancipation, you know? She was going to make money, and become rich.*
> *(NFA)*

However, gender barriers may resolve themselves with time, as participants at a number of project sites reported that gender equality is improving in their area, and that women are beginning to inherit land and get involved in commercial planting activities.

In several projects, participants indicated that integration of tree planting with other community development initiatives was important for project success, and may help to address wealth barriers. This is also recommended in the participatory development and co-benefit literature for realizing benefits to smallholders (Boyd et al. 2007; Nelson & de Jong 2003), and likely increases efficiency, given that many activities are interconnected[25]. Partnering with other development activities could potentially equip more farmers with the resources needed to be able to take the risk and invest in tree planting, and could give a planting project the potential to benefit the poorest and landless in the community.

Many projects were also addressing barriers in knowledge and understanding. Organizations and farmers emphasized the importance of knowledge and understanding to initial participation, and the importance of training and follow-up for project success. Increasing participation reported by key informants from implementing organizations in both carbon and non-carbon projects suggests that the study initiatives in Uganda were having success in overcoming knowledge barriers through education and training. In the case of carbon projects, this indicates that farmers are getting sufficient carbon and climate change knowledge to motivate some to experiment in carbon credit generation.

However, ongoing confusion about carbon and climate change suggests that this is still a challenge in carbon projects that needs to be addressed. Increased knowledge about climate change is still identified as a need by many, even where they have already received education, at both organization and community levels. More than one organization identified distribution of knowledge as an equity issue, suggesting that the international community needs to be more open with carbon and climate knowledge, and more willing to trust community members with this knowledge and allow them to participate more directly in carbon transactions. A representative of the NFA believes that "*All you need is just disclosure and openness",* going on to explain how TIST involves community members in measuring carbon, noting that it is

[25] For example, tree planting is connected to rural energy because most rural households in developing countries rely on woodfuel as their primary source of energy.

> *Nothing complicated. The man does it in the village who is normally a school teacher. And the women and the other old man who didn't go to school can do it. So it is not something that should be mysterious.*
> *(NFA)*

Effective means of communicating information about climate change and carbon markets to rural people, respecting their educational background, indigenous knowledge, and daily contexts are needed. Although farmers were most articulate about their desire for carbon knowledge in the carbon projects studied, other rural participants also expressed a desire to understand climate change and carbon planting. Rural people want to know and understand and participate in carbon markets. In the Ecotrust project, a participant said, *"Teach me how to calculate by myself. I would be able to know that these 10 trees, I will get 1 million, 2 million."*

3.6.2 National Level Solutions

Some challenges and barriers to participation in smallholder tree planting will need to be addressed outside the project scale with national-level initiatives.

In general, rural and organization participants agreed on the importance of a supportive government context to project success, which agrees with the literature (Palm et al. 2004; Roshetko et al. 2007). Participants described how countries can use national level policy to create a favourable enabling environment, both by addressing specific barriers to planting, and more broadly, through policies that support shifting smallholder practices towards tree-based land uses.

Specific barriers to carbon planting that could benefit from national level initiatives include gender equity. Gender barriers to land ownership can sometimes be addressed sufficiently at the project level to allow for women to participate more equitably, for example, by giving women rights to use land. But, as described above, this alone will not solve gender equity issues in general, and may not even be enough to overcome gender barriers to participation in planting. National efforts for promoting gender equality throughout Ugandan society will likely be necessary. For example, policy to address gender barriers will need to make opportunities equally accessible to women in terms of participation in commercial activities and land ownership. Policy will also need to promote equal opportunities for education to ensure women have the skills to be able to take advantage of these opportunities. But, as suggested by the experience in the NFA where a woman was prevented from using loaned land by her estranged husband, this barrier will not be fully overcome by the availability of opportunities. Policies will also need to be put in place that support women's rights to participate in these opportunities, as well as policies and education campaigns that encourage changes in public perceptions and norms, such that women aren't prevented by individuals from taking advantage of available opportunities.

Barriers to smallholder tree planting connected to land size and land ownership may also be addressed at the project level by giving people land to plant. But, again, tree planting projects are not equipped to address the root causes of these barriers. Drivers of decreasing household holdings and increasing fragmentation will also need attention at the national level if it is to be fully overcome. For example, if population continues to increase, land shortages and fragmentation of family holdings described by participants will increase, and land available to project implementers to loan to participants will decrease. A representative of Global Woods described how population growth is linked to barriers of land size and opportunity cost:

> *You have a close link to one of the other big problems in Uganda, in many other African or developing countries, and that is population growth. I think if we are not there already, the country will rather soon come to a point where we say 'Ok, if we plant trees on a certain part of the land, then it's missing somewhere for food.' That again is the point where you are at the problem that you cannot solve at the project level.*
> *(Global Woods)*

National education campaigns and policies to reduce population growth would likely assist in addressing planting barriers related to size of holdings.

Broadly, a more favourable environment for shifting to more tree-based land-uses would include national policies and programs could disseminate information about the benefits of tree-based land-uses, or provide incentives or support smallholders for the adoption of tree planting. Consideration of policies in sectors like forestry and agriculture will likely be important to mitigation efforts (Cacho et al. 2005). Some policies are already in place: for example, the Uganda Farm Income Enhancement and Forest Conservation (FIEFOC) program run by the federal Forest Services Support Division (FSSD) provides seedlings to rural farmers, which lead a TIST participant to note that *"Central government, local government, at all levels people are being encouraged to do planting."*

But, many participants felt that there is considerable room for improvement in Uganda, and several recommendations by both farmers and organizations focused on government. Global Woods said that, encroachment of communities into their carbon plantations, which affects the ability of projects to deliver climate change mitigation benefits and get carbon revenue to support community development projects, is an

> *issue for high level politics. Land-use is such a core thing that the central government would have to tackle. Where they have good policies, it all comes from the government, because there has to be somebody who says 'This land is for forestry. This is for agriculture. And we have a land registrar.' Things like that. 'And this land belongs to person A, this land to person B.' But that's simply not done here. [For project success], you should be in a country that is rather stable and has a rather well functioning government at all levels. I would say Uganda is somehow at the edge. If you don't have the political framework that gives you the basis to do tree planting, you can't really work. So I would say the political framework, that's the number one issue.*
> *(Global Woods)*

There is conflict within the government, with the NFA describing general inefficiencies in government structures, corruption, and federal directives restricting their ability to overcome barriers to planting. For example, there

> *was the ban by the President on giving more land to tree farmers. In some places in Uganda, I understand some people abused the program. After abusing the program, then the President said "No. No more giving land to tree farmers." That's one challenge. Because now I have a lot of demand, but there is that ban.*
> *(NFA)*

Another representative of the NFA also understands many of these issues to be a problem in NGOs, saying *"You will find that what you have wanted to give the people* *of Rwoho is going back to the rich."* A number of rural participants suggested that the government was also falling short of their expectations of support in the form of resources and information, or by helping them to link to programs. An AHI participant said that *"There are programs there, but these government workers they do not educate us. If someone goes there they just ignore you. People have ignored us."*

Key informants at the FSSD and NFA suggest that these shortcomings are in part due to resource shortages, which will have to be overcome if the government is to effectively assist in the creation of a good enabling environment for smallholder tree planting. An NFA staff member suggested that government resource shortages that prevent it from facilitating the overcoming of barriers to planting for smallholders could be addressed, at least in part, through partnerships with international organizations, and through collaboration between different levels of government. But, broader issues related to corruption and conflict within the government will ultimately have to be addressed. Supportive policies and good governance will be needed in both governments and organizations if they are to successfully fulfill the roles they need to play in overcoming barriers and challenges to smallholder carbon planting.

3.6.3 International Level Solutions

Some barriers and challenges cannot be addressed effectively or completely at the project or national levels, and so will need solutions implemented at the international level.

A key challenge in carbon projects that will need attention at the international level relates to relationships between local planters and international credit buyers. Both farmers and organizations described inequities in this relationship.

Some perceived inequalities related to carbon pricing. At both the level of organizations and rural participants in the carbon study projects, it was felt that the price of carbon is too low. According to a report on the state of the forest carbon market (Hamilton et al. 2010), market prices for forest carbon credits have historically ranged from US\$0.65/tCO_2 to over \$50/tCO_2, with a volume-weighted average price of \$7.88/tCO_2. Prices in the compliance market have generally been higher (volume-weighted average price of \$10.24/tCO_2); however, average prices for tCERs, like those being generated in the Rwoho project, have been less than half, around \$4.76/tCO_2. Carbon credits generated through TIST are currently sold for \$10/tCO_2.

But, usually, not all of this income reaches smallholders, the carbon credit generators; some of it goes to intermediaries. Reviewing carbon forestry in Mexico, Corbera et al. (2009) found that a substantial portion of project income was going to intermediaries and credit verifiers, sometimes as much as 50%. In the case of TIST, only a very small amount reached farmers: about 2 cents per tree per year. This amount was perceived as being very low. In the Ecotrust project, individual farmers received money based on a price for carbon negotiated based on the market price of carbon at the time they signed their contract; each farmer was receiving a slightly different price. Farmers in Rwoho had yet to receive their first payment. They were aware of the market price of tCERs, but had no idea how much money they were likely to receive. Nevertheless, they considered the market price to be low.

The price paid for carbon was at the root of some relationship challenges. A TIST participant said, *"I have no problem with TIST. It's doing a good job. The only problem is with the one who are buying the carbon who are paying too small, too little money for the work that farmers are doing here."* As described earlier, a representative of the NFA suggested that inequalities were due to conflicts of interest between developed countries looking to mitigate emissions cheaply, and the desires of developing countries to take full advantage of carbon funding for development.

Beyond the potential impacts of inequalities on relationships and subsequent participation, low carbon pricing is also understood to be a barrier to carbon projects generating opportunities to overcome barriers to planting through carbon finance. Carbon money alone was rarely seen to be sufficient to motivate planting. The price of seedlings, labour costs, and the time to returns were still seen as significant challenges by participants in carbon planting projects. In the case of TIST, one participant suggested that carbon money really only benefited those with large plantations; it wasn't enough to make a significant contribution to the livelihood of a smallholder. If carbon finance is actually to be a source of opportunity in smallholder planting projects, the price paid for carbon credits to smallholders in these projects will need to be high enough to overcome barriers to planting. It is recommended that efforts be made to reduce transaction costs where possible, but in carbon projects, there will be a limit to how much is possible, given costs associated with measuring carbon, verification, etc. (Torres et al. 2010). Therefore, higher carbon prices may be needed, estimated to be in the range \$20-\$40/tCO_2 to cover project costs (Torres et al. 2010).

Some wanted to see the price paid for carbon credits to reflect the effort put into maintaining trees, saying "*we feel that what we are paid is less. If we can be paid highly, because these trees they take, you put in a lot of effort to make it start" (Ecotrust participant).* Some carbon project participants wanted the ability to communicate directly with buyers to negotiate what they felt was a more equitable price. Participants in the Ecotrust project wanted to meet buyers face to face *"To bargain. Now we have Ecotrust in the middle. Ecotrust looks for the buyers. But, we want the buyer to come and see me who is producing so we can negotiate!'"* However, it has been questioned whether linking donors directly to sellers would be sustainable (Milne 1999).

One study participant suggested an emphasis on premium credits that deliver documented development benefits; perhaps additional development of a separate premium credit market would help in this respect. To accomplish this, carbon brokers who are genuinely interested in development and environmental benefits are needed, as emphasized by representatives of ICRAF and Ecotrust. Premium credit systems already exist, such as Gold Standard Certification (www.cdmgoldstandard.org), that certify credits based on their delivery of both carbon and development benefits. Creating markets for premium credits will only be successful if additional costs associated with monitoring additional parameters to meet certification requirements are worthwhile in relation to the increase in price garnered by premium credits (Cacho & Lipper 2007).

Another perceived inequality related to understanding of the distribution of responsibility for climate change. It was widely understood by both farmers and organizations in both carbon and non-carbon projects that developed countries have much greater responsibility for global climate change, and therefore benefit more from climate change mitigation from tree planting.

> *The developed countries are so industrialized they have destroyed their own environment. Now they are depending on us. They are milking us and even scheming us. Everything is benefiting them. Although we are also benefiting, but the developed countries are gaining more than us.*
> *(NFA-Rwoho participant)*

A representative of LBDC, a Ugandan NGO, went on to describe how inequalities exist not only in terms of responsibility, but extend to impacts from climate change.

> *We are being punished sometimes of what we have not done, because the developed countries, they cut the trees, they have all emissions from the factories, and then the biggest catastrophe is coming to us Africans.*

Determining the extent to which the described inequalities, particularly with respect to carbon pricing, are real or perceived is beyond the scope of this study. Either way, to effectively secure long-term participation of developing country participants in carbon planting, these inequalities will need to be addressed. Part of addressing these inequalities will likely involve improving relationships and understanding of context between international buyers and carbon credit generators at the local and national levels, and improving understanding and expectations about the carbon market and carbon planting. In particular, improved understanding of additionality and what activities qualify for carbon credit generation would likely help in clarifying some misunderstandings, as indicated by this statement by a carbon project participant:

> *I think that the countries responsible for the carbon emissions benefit more than the persons who are not responsible, because people here are planting*

trees for other reasons, and those trees are happening to take carbon, which nobody pays for.

Related to inequality and distribution of benefits, the UCB – in a position to comment on the broad state of affairs of carbon forestry in Uganda – suggests that a serious barrier to carbon forestry at the international level is the time it is taking to access international funds that will allow more carbon projects to get off the ground, and reluctance to specifically fund carbon forestry projects. A UCB representative described how the start up phase of a carbon forestry project is time and resource intensive. Most carbon schemes do not pay for carbon credits up front, but instead pay upon measured sequestration of carbon. The length of time to returns in tree-based initiatives means that carbon money is not capable of compensating for these high startup costs, such that donor investment is usually required as well. This is reflected in reviews of other carbon forestry initiatives (e.g. Corbera et al. 2009; Milne 1999). A representative of the UCB explained that

> *To actually keep a group like ours moving, we've been using donor funds, and this is non-traditional for donors. We're having to explain to the program officers in these agencies what's global warming, what's climate change, and what's a carbon credit*

Consequently, investment in carbon forestry initiatives has been slow to materialize, a massive source of frustration.

> *What is the huge frustration is how to get demonstration activities going to show people it works. A ridiculous amount of our time is spent currently hawking around trying to find some money to get these things going. We have lots of opportunities on the ground. I'm almost in tears of frustration. We have a good set of relationships with international agencies. We're slowly being recognized, but the timescales in which the donor fraternity work is truly unimaginable compared to the urgency of keynote speakers like Al Gore, and Nick Stern and Desmond Tutu, and Jane Goodall, and Richard Branson, and these kind of popular personalities that we met in Copenhagen. How can we go to these meetings understanding that we've got about 5 years left to do something serious for the planet, but then when we come home here, it's months and months and months? I'm paying [UCB] salaries from my pocket. But it shouldn't be like that, not when you hear these stratospheric numbers that are being mentioned. It is hugely frustrating, because we know if that money is put in the right hands, we could already be in demonstration*

activities, learning things. We were told at Bali 'Go out and try anything.' But with what? Where are the resources?
(UCB)

The UCB representative went on to describe how these funding challenges are exacerbated in the case of planting projects, because, as described earlier, there is a widespread reluctance with international donors to invest in carbon forestry projects in particular.

UCB hopes that the CDM's newly implemented Program of Activities (PoA) could be a partial solution. PoA is expected to make CDM accessible to a wider range of participants by allowing smaller participants to avoid most administration costs by joining an already registered CDM project, and make it easier to implement new projects.

But, it will also be imperative to increase flows of donor funding to initiate new projects, and in particular, carbon forestry projects. Several organizations noted that this will require a change in attitude towards carbon forestry by international funders. Brown and Corbera (2003) suggest that one problem in co-benefit projects is that little attention has been paid to how global and local priorities interact and how costs and benefits are shared across scales. Changes in attitude could be facilitated in part by improving understandings and relationships between carbon credit generators at local and national levels, and international funders and buyers.

Securing funding and increasing the speed of project implementation is particularly important, given the time sensitivity of the carbon agenda mentioned by those at UCB, and given that participants repeatedly described how adoption of tree planting by smallholders can be very slow at the start of a project, usually only increasing once people start to see the successful results of the first participants' efforts. In the case of tree planting, this can take several years. It is therefore imperative to get demonstration projects off the ground if smallholder carbon planting is going to make a significant contribution to climate change mitigation, or development, in a timely manner.

3.7 Achieving Co-Benefits for Carbon and Development

Although they are not all explicitly seeking co-benefits, all carbon projects studied have both social and carbon goals. But although most were described as successful by participants, the projects studied seem to be having only limited success in realizing their own goals and the co-benefits for climate and development hoped for in the literature. More in-depth research of each project would be needed to make decisive conclusions about how benefits are flowing to various participants and through communities, how carbon is implicated in this distribution, and the extent to which benefits for each goal are being realized and maximized overall. Nevertheless, this study suggests that projects may be falling short of their own goals for carbon or development.

For example, although a more intensive study of methodologies, baselines and additionality in the project would be needed to say conclusively, understandings of participants in the TIST project suggest that the project may not be fully realizing its carbon mitigation goals. Participants reported that the money paid for carbon is too low to motivate people to plant trees who wouldn't have otherwise, saying

> *What is unfortunate, that they are not supporting us to plant trees and absorb the carbon dioxide. What they are providing under TIST is too small to induce anyone to do planting purposefully for carbon sequestration.*
> *(TIST participant)*

It is possible that carbon income, when added to existing incentives to plant trees, might be sufficient to tip the balance and induce at least some additional planting. However, the implication was made by more than one participant that carbon income was simply seen as a welcome bonus, but that people were not planting trees they would not have planted anyway. One participant explicitly questioned the additionality of the TIST project. This brings into question the extent to which additional carbon sequestration is occurring, in relation to the amount of carbon that is being calculated and sold by TIST.

Exacerbated barriers in carbon projects related to initial investments of money and land required to participate and less flexibility in time to returns of income and tree products mean that the poor are more likely to be excluded from carbon projects than conventional planting projects. The Rwoho and Mabira projects run by the NFA are very similar in that both support community planting in a band along the edge of the reserve. But, in the Rwoho project, farmers must buy shares to participate in carbon planting, such that benefits are mainly flowing to those who can afford to purchase shares, identified to be mainly men and community leaders. By contrast, in Mabira, there is no requirement to buy shares, and participants described how the poor and landless in the community were able to plant on plots along the reserve boundary. This suggests that the carbon boundary planting in Rwoho may be less successful than the non-carbon planting in Mabira at decreasing pressure on the reserve, since the Rwoho project is less likely to be providing an alternative livelihood to the reserve for the poorest in the community.

Although participants did not identify barriers to the poor to participation, it is possible that there may be a similar issue with the Ecotrust project, which has minimum planting requirements of 400 trees per participant. The poorest members of the community may not have the land to commit to this volume of planting, and could face additional barriers to participation related to education and literacy due to extensive forms that must be filled out in order to participate. Added and exacerbated barriers and challenges in carbon planting projects in many cases mean that benefits will likely be less evenly distributed, and less likely to reach the less advantaged in the community compared to non-carbon planting projects. It is possible that the Ecotrust project may not be fully realizing the development benefits intended by the project, particularly in the case of its funding from ICRAF, which is linked to "Pro-Poor" benefits from environmental services like carbon sequestration. This would be in line with conclusions of Brown & Corbera (2003) about a similar project in Mexico, where benefits are seen to be flowing mainly to middle-income farmers. Similar trends have also been found in the literature more broadly. Tschakert et al. (2007) conclude that economic benefits from carbon sequestration are likely to have uneven distribution in communities, while Wunder (2008) suggests that increasing regulation of PES schemes in general is likely to limit their effectiveness in delivering pro-poor benefits. Experiences from these smallholder carbon planting projects in Uganda suggest that consideration of alterative approaches to smallholder carbon agroforestry may be useful

Limited success in realizing concurrent benefits for climate and development in smallholder tree planting can be linked back to exacerbated and additional barriers and challenges. Some barriers and challenges are exacerbated because of tensions in project characteristics between best practices for realizing carbon benefits and best practices for realizing development benefits. For example, flexibility is favoured for development benefits (Roshetko et al. 2007); rigid contract lengths are required for carbon projects. When dual goals are sought, tension arises. Where contracts are imposed, potential participants who can't risk the length of time to returns imposed by the contract face barriers to their participation. This tension can even have implications for project success, as it has in China, where planting in the first CDM forestry project has been stalled in part due to restrictive contractual rules (Gong et al. 2010).

To take advantage of the potential to mitigate carbon through smallholder planting activities and the potential opportunities to use synergy from carbon finance to further development goals, it will be important to overcome barriers to planting and challenges to success, particularly those that are added or exacerbated when carbon goals are included in a smallholder planting project. More broadly, project sustainability and ability to attract and sustain funding and participation of smallholders will be compromised if projects fail to meet expectations or are unclear about their goals and what they are actually achieving. Corbera & Brown (2008) suggest that "an overemphasis on co-benefits" can lead to a decrease in investment in REDD projects, and suggest simplifying where possible.

Simplification in smallholder planting projects and establishing realistic expectations about what projects can accomplish could be achieved in part by explicitly seeking ancillary benefits rather than co-benefits. Seeking co-benefits, where two or more goals are equally important and sought concurrently, implies potentially complicated evaluations of trade-offs between different objectives that may be realized at different scales, and may be prioritized differently by different stakeholders. Trade offs would have to be evaluated and made for all project characteristics in tension for delivering development and carbon benefits, likely a complicated process given the number of projects that may be in tension (Chapter 2). Seeking intentional ancillary benefits implies focusing on one goal, but intentionally making choices to improve the delivery of the secondary goal(s) whenever it doesn't interfere with realization of the primary goal. By focusing on a primary goal of either development or climate, tensions could be more easily resolved, facilitating project design, and the development and communication of realistic expectations for project outcomes. This recommendation is consistent with others in the PES literature: for example, Wunder (2008) notes that the welfare impacts and contribution to poverty alleviation of PES schemes will remain small, and that PES schemes should therefore focus on the environment rather than poverty. Simplifying smallholder planting projects by explicitly seeking ancillary benefits could offer advantages over co-benefits. Focusing on a single goal could speed the implementation of new projects, and more effectively deliver on expectations, important where transparency and meeting expectations are important for securing funding and sustaining participation, and where prioritizing action is important given the time-sensitive nature of both carbon and development agendas. Implementing more carbon forestry projects would increase available opportunities to learn about how smallholder projects deliver both types of benefits, allowing project designers and implementers to continuously improve the ability of agroforestry to realize carbon and development benefits.

Seeking ancillary benefits may not only be a way of resolving tensions quickly to get projects implemented; it may also be a more desirable approach to designing smallholder agroforestry projects in the long term. Although likely interconnections between development and climate priorities suggest that working towards effective co-benefit project designs to maximize overall benefits would be most efficient in realizing both goals, more benefit in absolute terms isn't necessarily the best strategy for achieving specific priorities within development and climate agendas. The trade-offs required to resolve tensions for co-benefits could result in sacrifices for either climate or development that are undesirable, given our values about what objectives are most important in realizing these goals. More research is needed to determine whether tensions in project characteristics can be resolved satisfactorily for co-benefits in practice. In the meantime, ancillary benefit projects offer an opportunity to simplify projects, speed implementation, and learn from experience to improve our ability to deliver carbon and development benefits.

A focus on ancillary benefits could help to simplify trade-offs and clarify expectations in smallholder tree planting projects; alternative approaches to project design and the delivery of benefits could also be useful. A participatory development approach that values broad participation of the intended beneficiaries of development in the development process (Hayward et al. 2004; Williams 2004) and emphasizes the importance of ideas like empowerment, power-sharing and giving control over decision-making to local people (Hayward et al. 2004; Mohan 2007), would tend to suggest that direct participation of a broad spectrum of rural smallholders in carbon markets and credit generation is desirable. Many of the interviewed in Uganda and many authors writing about smallholder projects encountered in the development literature appear to support this approach. However, this study suggests that including carbon credit generation in smallholder planting projects may exacerbate barriers to participation, particularly for women and the poor in the community. Overcoming barriers to create opportunities for broad participation in smallholder carbon planting projects will likely be even more difficult than it already is in non-carbon projects. Consideration of alternative project designs and pathways to delivering development benefits through projects may be beneficial. In particular, it may be useful, given the more commercial orientation of carbon projects observed, to look to models from other sectors where smallholders are already engaged in successful commercial enterprise.[26]

Global Woods provides an example of a project seeking ancillary benefits for development in a carbon project that uses an alternative pathway to deliver benefits to smallholders compared to the other carbon projects studied. Although this model decreases the direct participation of smallholders in carbon credit generation, it could potentially provide a more equal distribution of benefits from carbon forestry in the community. Originally, this project intended to include smallholders directly in the generation of carbon credits on their own land. Although the possibility hasn't been completely discounted, cash flow is low and barriers of land tenure and complicated certification to get such a project registered and producing verifiable credits have lead Global Woods to change their tactics for delivering development benefits alongside carbon benefits. The project prioritizes carbon credit generation on the company's plantation in Kikonda reserve, but with an understanding that ancillary benefits for surrounding communities will be important to building good relationships and project success. They employ almost exclusively workers from the surrounding communities to facilitate a flow of money from the project back into those communities. Benefits from employment may be more easily accessed by poorer members of the communities than benefits from participation in a planting project, since access to employment benefits is less likely to be correlated to the amount of land owned and resources possessed. Global Woods also uses company funds to support a development program that started with tree planting in the community, and is gradually expanding the extent of their social support in partnership with other organizations with primary goals of development. Although communities do not directly receive carbon money, a recent independent evaluation suggests they can nevertheless experience livelihood benefits from having a carbon project operating in their area (Heifer International 2010). Because non-planting development activities are being initiated alongside planting, and because planting

[26] This idea arose from comments from James Tansey, a committee member, at my thesis defense.

in the community does not face constraints such as minimum rotation lengths common in carbon planting, it may be that a broader spectrum of the community is benefiting from the carbon project than might be if community members were participating directly in carbon planting. On-going encroachment by community members into Global Woods' plantations suggest that there is considerable progress to be made in this project model. Nevertheless, it will likely be useful to continue watching how this project unfolds, as it is one potential alternative model for delivering development benefits to smallholders through carbon projects.

3.8 Conclusions

Interest in carbon tree planting has been piqued, and there is considerable hope that smallholder tree planting projects could bring both development and carbon benefits. To do this well will require continued learning from initial efforts.

This study of smallholder planting projects in rural Uganda suggests that including carbon credit generation in smallholder tree planting initiatives could create additional opportunities for advancing rural development. But, carbon also adds an additional layer of complexity that can create and exacerbate barriers to participation and challenges to success. If carbon is to be an opportunity rather than a hindrance in smallholder tree planting projects, these challenges and barriers will need to be effectively addressed. Study participants provided some initial ideas for how this might be accomplished through activities at the project, national and international scales. Nevertheless, carbon projects studied were not realizing co-benefits in practice, and there is evidence that they may be falling short of their own development and carbon goals. Simplification of projects by seeking intentional ancillary benefits appears to be more realistic, practical, and possibly more fruitful desirable in the short term, and may be preferable to seeking co-benefits in the long term. Alternative approaches to project design and pathways to the delivery of benefits may also be useful for generating specific development and climate benefits through smallholder carbon tree planting initiatives.

4. CONCLUSION

4.1 Summary of Findings

Both a review of the literature and case study support the conclusion that development and carbon are two very different types of objectives that often favour different practices and project designs to realize through agroforestry projects in practice. Review of the carbon and development literatures suggests that many project characteristics for most effectively delivering benefits for carbon and development in agroforestry projects will be sources of tension when seeking co-benefits for both objectives concurrently. A case study of projects in rural Uganda highlights how planting project characteristics identified as being likely sources tension in co-benefit projects work to exacerbate and create additional barriers to smallholder participation and challenges to project success when carbon credit generation is included in smallholder planting initiatives.

Although both the literature review and case study suggest that seeking development and carbon goals concurrently could create opportunities for synergistic effects, tensions between desirable project characteristics for realizing each goal and exacerbated challenges and barriers appear to make the realization of true co-benefits from smallholder agroforestry difficult in practice. Seeking co-benefits for such different goals is complicated, such that solutions to overcoming many of the identified tensions and challenges to maximize both development and carbon goals in smallholder agroforestry are not immediately apparent.

4.2 Implications for Agroforestry and Carbon Project Design

Findings from the literature review and case study suggest that it may be beneficial to re-frame how we talk about what we intend to accomplish with agroforestry projects, and in many cases, how projects are designed to contribute to both development and climate goals.

4.2.1 Ancillary versus Co-Benefits

Seeking intentional ancillary benefits[27] from smallholder planting projects may be more useful than seeking co-benefits,[28] likely in the short term, and possibly in the long term.

Maximizing co-benefits is complicated. The literature (Chapter 2) and experience from early carbon forestry projects suggests that successful co-benefit project design will be difficult in practice. A project with a single, clear primary goal is greatly simplified. Seeking intentional ancillary benefits instead of co-benefits simplifies choices between practices when designing projects, and allows tensions inherent in co-benefit projects to be more easily resolved. Deciding between various aspects of project design is easier because the primary goal drives decisions. Rather than trying to make trade-offs across a range of project characteristics to maximize co-benefits overall, the primary goal drives the decision between practices for project characteristics where there is tension between best practices for carbon and development. But, rather than being treated as completely coincidental and outside the sphere of consideration, project designers and implementers are aware of potential ancillary benefits for the secondary goal. Consequently, when practices are not in conflict, design and implementation decisions are made to maximize ancillary benefits wherever possible.

Given limited success in realizing co-benefits with carbon projects in general, and carbon forestry specifically (Bailis 2006; Brown & Corbera 2003; Boyd et al. 2007;

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[27] Ancillary benefits are understood to be benefits other than the primary project (or policy) goal. In the case of projects where these benefits are not given any consideration in project design and implementation, they can be completely unintentional and coincidental. Alternatively, projects can take ancillary benefits into consideration in project design and implementation, and where it does not affect outcomes for the primary project's primary goal, choose design characteristics that favour these side benefits. We argue for the latter, intentional consideration of ancillary benefits.

[28] Co-benefits are understood to be benefits contributing to the realization of two separate goals, both of which are intended to be maximized through project design and implementation.

Cosbey et al. 2005; Milne & Arroyo 2003; Murdiyarso et al. 2008; Nelson & de Jong 2003; Nishiki 2007; Olsen 2007; Sutter & Parreño 2007; Wittman & Caron 2009), the proposed simplification offers two key advantages: it could facilitate the generation of more realistic and realizable expectations of what projects can and will deliver for carbon and development, and allow projects to get off the ground more quickly and stay on track to realize these expectations. Having a single goal makes it simpler to define expectations, and simplified decisions between trade-offs should make it easier to show how these expectations will be realized through project activities.

Examples in the literature (e.g. Brown & Corbera 2003; Nelson & de Jong 2003) and the case study projects in Uganda suggest that projects seeking benefits for both carbon and development often fall short of their own goals. Meeting expectations is important to maintaining trust, which is necessary to maintain good relationships between different types of project participants and stakeholders (Fischer & Vasseur 2002). This will be important in securing necessary funding and investment. A single goal and simplified decisions between trade-offs should also make it easier to translate goals into actions, and easier to communicate this whole process to funders. This could ultimately facilitate more projects happening on the ground more quickly. Given the time sensitivity of both development and climate agendas, there is an impetus to move the spread of agroforestry-use from discussion to implementation quickly. The world's poor should not have to wait to attain basic needs and equal access to resources and opportunity, and climate change mitigation needs to happen sooner rather than later to avoid potentially catastrophic implications for natural systems and human society (IPCC 2007). Given time constraints, some benefits are better than no benefits, suggesting that a "learning through doing" approach might best serve both climate and development agendas. Ancillary benefit projects could make it easier to initiate more projects that deliver some of both kinds of benefits, while facilitating realistic expectations about what is actually being accomplished. At the same time, these projects would provide opportunities to learn and improve on delivery of these benefits, both primary and ancillary.

Interconnections between climate and development goals and interactions between activities to realize these goals, at first glance, suggest that seeking co-benefits would be most efficient in the long run, implying that ancillary benefit project design should only be used as a stepping-stone towards perfecting successful co-benefit agroforestry project design. But, this may not be the case: project designs seeking ancillary benefit designs may actually be more advantageous overall for delivering benefits for carbon and development from smallholder agroforestry. For example, where seeking co-benefits is understood to imply some notion of trying to maximize benefits, a co-benefits approach may actually be less useful. Because maximizing absolute benefits does not take into account factors like thresholds and our priorities within climate and development agendas, it may not actually be the most desirable strategy for addressing climate and development goals.

More research would be needed to determine whether ancillary benefit design is a more beneficial approach to agroforestry project design in the long term. At present, this research suggests that designing smallholder planting projects to seek intentional ancillary benefits rather than co-benefits may better-serve climate and development goals.

4.2.2 Alternative Project Designs and Pathways to Benefits

Apparent tensions in project characteristics for effectively delivering climate and development benefits, as well as the apparent exacerbation and creation of barriers and challenges by the inclusion of carbon credit generation in smallholder planting initiatives, suggests that alternative project designs and pathways to deliver certain types of benefits may be useful. For example, where equitable distribution of development benefits across a broad spectrum of the community is desired, carbon planting projects may be able to avoid tensions in project design to better distribute benefits to poor or marginalized members of the community by excluding smallholders from direct participation in carbon credit generation, and instead, using carbon project resources to conduct separate development activities tailored to be broadly accessible in surrounding communities. The Global Woods carbon forestry project in Uganda is one potential example of this kind of model. Alternatively, if empowerment and capacity building in the area of carbon forestry is a prioritized outcome, projects will need to involve smallholders in credit generation. Where tension in project design characteristics exacerbates barriers to participation, parallel pathways to deliver development benefits to a wider cross-section of the community could be incorporated into projects. For example, benefits might be delivered through a community development fund supported through carbon finance, or through partnerships with other development initiatives. Although not addressing questions of equal access to all types of benefits, parallel pathways could increase the distribution of carbon benefits, while still facilitating the development of increased capacity in carbon forestry in developing countries. This trade-off could be beneficial in terms of the overall benefit realized from carbon forestry if this capacity allows for more carbon forestry projects to be conducted in developing countries with less involvement of developed countries.

Where smallholders are participating directly in carbon credit generation, it may be useful to consider alternative inspirations for project design. Many smallholder agroforestry projects described in the literature, and many of the non-carbon projects in Uganda, were targeting local environment benefits and tree products for household use or very limited sale on local markets. The carbon planting projects studied tended to have a stronger commercial orientation. As such, it may make more sense to model smallholder carbon planting projects on successful smallholder commercial activities in other sectors, than to base them on conventional planting projects with less commercial goals.

4.3 Strengths and Limitations of Research

This was a work of primarily exploratory research, intended to generate initial recommendations for design of co-benefit agroforestry projects. In this respect, it is most useful for directing future research and speaking to broad philosophies for approaching the use of agroforestry to generate benefits for development and climate. It is not intended to generate specific recommendations for project design to maximize co-benefits from smallholder agroforestry.

4.3.1 Key Strengths

Chapter 2 provides the basis of a new tool for analysis of smallholder agroforestry projects in the form of a framework that facilitates comparison between different types of projects. This framework could assist in analysing the potential feasibility of designing projects to address multiple goals. It could also assist in project design by highlighting likely areas of tension and synergy in project characteristics, which could help designers to better-address tensions and capitalize on opportunities for synergy.

Chapter 3 provides a rapid survey of projects. A pre-test of this sort has advantages, in that, with a minimal investment of time and resources, issues likely to be key in understanding co-benefit delivery in smallholder agroforestry projects were identified. This could help to focus future research efforts onto the most important subjects, potentially avoiding wasted time and resources. A more extensive project gathering data about the range of ideas and issues that this project covered would have been very time consuming and resource-intensive: to get a more complete sense of community dynamics and the nuances of project implementation and the relationships between project stakeholders in each community, to understand the breadth of community experiences in projects working in multiple communities, and to build sufficient trust with community members to facilitate more open responses in interviews and focus groups, a considerable amount of time would need to be spent in each community. Participation in both interviews and household surveys would be necessary, adding additional time requirements, and necessitating additional commitment from community members. This project provides a snapshot of a wide variety of experiences with a minimal investment that should help to improve the efficiency of research investment.

This research also adds to the body of research on carbon forestry on Sub-Saharan Africa, an area of the world likely to play an increasingly important role in climate change mitigation in the future. The case study provides early data on several different designs of smallholder carbon tree planting projects, and incorporates perspectives from several levels of project implementation, including capturing the perspectives of rural participants. It is hoped that this early opportunity to learn from experience will be valuable to project implementers and designers in improving existing and designing better smallholder carbon agroforestry projects.

It is expected that findings from both the literature review and case study can be generalized. The literature review should be broadly applicable to smallholder agroforestry in developing countries, as it incorporates research based on projects and experiences all over the world. Given that the projects sampled in Uganda represent a variety of characteristics common to other smallholder planting projects, and the general alignment of data from the sample projects with experiences from other smallholder planting projects documented in the literature, it is hoped that some generalization to smallholder tree planting initiatives in general is possible. This is likely particularly true for other countries in East Africa, and to other Sub-Saharan African countries having socioeconomic, political, historical, and cultural similarities to Uganda. Results may also be transferable to other types of smallholder carbon projects, such as community forestry, REDD projects, and rural energy projects, many of which likely share common project characteristics, challenges and barriers to smallholder planting projects. Case study results may be generalizeable to other projects where project characteristics and contexts are similar, and could help to illuminate additional challenges, barriers, benefits, alternative solutions to problems, etc., that might not otherwise have been considered.

4.3.2 Limitations

The literature review conducted was constrained to development and carbon literature. Although several relevant papers were read from fields like political ecology to help provide contextual understanding, extensive review of literature from other fields was not conducted. It may be that including literature from additional fields could provide additional insight into the question of how co-benefits might be realized from smallholder initiatives in developing countries. Literature specifically on carbon agroforestry projects was also quite limited, as use of agroforestry in carbon projects has only recently begun to expand. Although, based on the few agroforestry projects in the literature and the smallholder planting projects (all of which involved at least some elements of agroforestry) observed in Uganda, it is expected that similar conclusions would be reached for agroforestry carbon projects in general.

The main limitations of the case study conducted lie in sampling and the amount of supporting demographic data that were collected. Ideally, community data would have been collected via random sampling of individuals in participant communities, including households not participating in the tree planting initiative. Ideally, more than one participant community would have been sampled for each project, and detailed demographic data would have been collected for the sample communities.

This was not done due to time and resource constraints. Instead, focus groups were conducted with self-selected participants in the program from a participating community recommended by a key informant involved in the project at the organizational level as a community "representative of a typical participant experience." Those helping with focus group mobilization were asked to, as much as possible, assemble a group that represented the diversity of participant experiences and characteristics in their community group; however, in the absence of random sampling and more extensive demographic data, it is it is difficult to know to what extent this was accomplished, and to what extent the data collected provides a complete picture of the community.

Detailed demographic data would also help to put community responses in context and could corroborate and compliment some of their responses regarding participant characteristics, barriers and flows of benefits. This could potentially confirm or refute tentative speculations in this research, such as speculation in Chapter 3 that the poor are more extensively excluded in Ugandan carbon planting projects, compared to non-carbon projects. Some demographic data was collected at the start of focus group and individual interviews; this data presents a general snapshot only, and precludes hard conclusions. Ideally, additional research assistants would have been hired to conduct separate household surveys in the sampled communities to collect more extensive data.

4.4 Future Research Needs

This thesis suggests several future research needs. A priority involves further research into how to design smallholder agroforestry projects to best realize and maximize ancillary benefits.

Experiences from the Ecotrust project studied in Uganda and others in the literature suggest that even in projects seeking ancillary benefits, initial project priorities can get side-tracked, particularly where a project with development priorities seeks to generate carbon credits. In the case of the Ecotrust project, which is targeting primarily local development and local environment goals, the project ended up almost entirely focused on carbon credit generation. Recommendations for co-benefits from the literature suggest that to get benefits for development, you need to focus on project characteristics that favour development (Boyd et al. 2007). Given that carbon credit generation takes a massive investment of time and resources for project registration and credit validation, it is likely challenging to keep carbon consistently relegated to being only a side goal of the project. This suggests that increasing understanding of how to seek carbon credit generation in projects focused on development should be a priority.

But, further research will also be beneficial in helping to effectively realize ancillary benefits from agroforestry projects with a carbon focus. The Global Woods project has had some success seeking a primary goal of carbon credit generation from plantations on government reserve land, with ancillary benefits for the surrounding communities. But, continued encroachment of the community into the reserve, suggests that there is still considerable room for improvement to this model. More detailed and on-going evaluation of smallholder planting projects will be needed to understand what models for delivering ancillary benefits already exist, to suggest alternative models for project design, and ultimately, to understand how to more effectively seek intentional ancillary benefits through agroforestry, particularly when development is the primary project focus.

Further research will also be useful in exploring alternative project designs and pathways for delivering benefits to rural smallholders through tree planting projects, given different development priorities and approaches. Likely, it will be useful to look to fields beyond smallholder agroforestry for inspiration.

This project also indicates a set of more broad research needs. One broad research need indicated by the case study in particular relates to smallholder carbon projects in general. Participants in this case study suggest that the carbon and climate knowledge of smallholder participants is at best inaccurate and at worse, precluding their equitable participation in mitigation activities by limiting their ability to make an informed choice to participate (Current et al. 1995). Further, lack of knowledge may be contributing to perceived inequalities by participants that are potentially interfering with the creation of effective relationships between carbon credit generators and international buyers, a potential issue for long-term sustained participation of both parties in carbon planting. This study indicates that local farmers desire this knowledge and understanding. Thus, a more detailed evaluation of the state of carbon and climate knowledge held by smallholders, particularly carbon project participants, is indicated, as well as further research into how this knowledge can and should be transferred to rural smallholders.

A second broad research need involves institutional, structural, political and social barriers to project implementation. Smallholder agroforestry projects are only a tiny piece of the development puzzle; they will not solve or even address all development challenges. However, as described in Chapter 3, the ability of smallholder agroforestry projects to deliver benefits is linked, in part, to other broader development issues such as gender equity. Research into other development challenges that affect smallholder agroforestry projects will likely be beneficial to these projects. As mentioned above, time pressures inherent in development and climate change mitigation agendas mean that a key challenge in smallholder agroforestry projects is the need to design and implement good projects quickly. An institutional challenge of particular significance identified primarily by organization representatives was related to accessing international funds to overcome high start-up cost barriers in carbon forestry. At the national level, significant barriers were identified in terms of gender and land tenure. More in-depth analysis of these and other national level policies and regulations that can impact agroforestry would be beneficial. Smallholder agroforestry projects cannot realize their hoped-for potential to deliver benefits for climate and development if these barriers are not addressed. Continued research will be needed into the nature of broader institutional and governance barriers at both national and international levels.

4.5 Conclusion

It appears that agroforestry has potential to make meaningful contributions, as one tool in a suite of tools, towards realizing both development and mitigation goals. Development and climate change mitigation priorities overlap and activities to realize them interact, suggesting that projects that deliver co-benefits would best serve global sustainability by allowing us to take into consideration these overlaps and interactions to most effectively and efficiently deliver benefits to dual goals. However, this research suggests that tensions and complications when seeking co-benefits from agroforestry are likely mitigating its ability to fully realize its potential to deliver benefits for both development and climate. Ancillary benefit project designs appear to be preferable to co-benefit designs in the short-term, if not overall, for facilitating the initiation of more projects, which will be valuable opportunities to learn from experience. Experiences and understandings of participants in smallholder tree planting initiatives in Uganda highlight how inclusion of carbon credit generation in these project can exacerbate and create barriers to participation and challenges to realizing benefits, suggesting that alternative project designs and pathways for delivering benefits could improve the realization of some development priorities in carbon projects.

More research is needed, in particular, to learn from experience with existing and nascent smallholder tree planting projects, and to explore what inspiration for project design might be gained from initiatives with smallholders in other areas. Initiating new projects and welcoming innovation in project design will likely be important for agroforestry to be most effective as a tool for contributing to addressing two global sustainability priorities, rural development and climate change mitigation.

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APPENDICES

Appendix A: Abbreviations & Definitions of Terms

A.1 List of Abbreviations

CDM	Clean Development Mechanism
FAO	Food and Agriculture Organization of the United Nations
GHG	Greenhouse gas
HDI	Human Development Index
ICRAF	World Agroforestry Centre
IPCC	Intergovernmental Panel for Climate Change
LDC	Least Developed Country
LULUCF	Land-use, Land-use Change and Forestry
NFA	Uganda National Forest Authority
REDD	Reducing Emissions from Deforestation and Forest Degradation
UCB	Uganda Carbon Bureau

A.2 Definitions of Terms

Term	**Definition**
Additionality	Establishing additionality means proving that emissions reductions in a project are additional to any that would have occurred in the absence of the project (Milne 1999). For example, in the case of CDM forestry projects, additionality can be shown by demonstrating that the project would be unlikely to occur without carbon incentives, either by showing that a proposed project would not be the most financially or economically attractive land-use, or that the project would be unable to overcome legal, technological or ecological barriers without the carbon income (Haupt & von Lüpke 2007).
Agroforestry	Intentionally combining agricultural crops and/or livestock with woody perennials (trees, shrubs, etc.) in rural landscapes on the same land-management units in "interacting combinations in space or time dimensions" to derive livelihood and environmental benefits (Nair 2007, p.1614; FAO 2010; Nair 1993). For simplicity, because this thesis focuses on smallholder agroforestry only, the term agroforestry is used to refer to smallholder agroforestry throughout.
Ancillary benefit	Side benefits generated by a project or policy for a secondary goal. Ancillary benefits may be intentional or coincidental.
Carbon credit	A carbon credit is the "right" to emit a ton of carbon or

Term	Definition
	equivalent, because an equivalent ton of emissions has been avoided or removed from the atmosphere through a mitigation activity elsewhere.
Co-benefits	Two or more benefits or goals desired from a single project or policy at the same time. Maximization of benefits is implied in some cases.
Commercial planting	Tree planting where the primary goal is sale of tree products, rather than subsistence or home use
Compliance market	Involves trade of carbon credits that comply with specific agreements for mandatory GHG emission reductions, such as the Kyoto Protocol.
Development	Broadly, development is understood to be "helping people to 'build a better life'"(UNDP 2010). In this thesis, "development" refers to "participatory development" unless otherwise specified.
Forest	"Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use." (FAO 2004)
Leakage	Occurs when an emission-reductions project causes increased emissions outside the project boundary (Cacho et al. 2004).
Participatory development	A widely-adopted approach to development (Mohan 2007; Williams 2004) that emphasizes the broad engagement of development beneficiaries (smallholder farmers in the case of smallholder agroforestry) in the development process (Hayward et al. 2004; Williams 2004).
Plantation	A stand of trees, native or exotic species, that is established through planting or seeding for the provision of wood or non-wood goods, or for the provision of services (FAO 2004). Participants in the study in this thesis generally used the term plantation to refer to a larger area of land that was planted with commercial intentions.
Voluntary market	Involves trade of carbon credits generated for those who are reducing their GHG emissions voluntarily, such as companies and individuals.
Woodlot	Participants in the study in this thesis used this term to refer to a smaller area of land (usually about 1-2 acres) planted with trees intended for either small-scale commercial or household use.

Appendix B: Interview and Focus Group Protocols

B.1 Interview Protocol: Perceptions & Experiences of Agriculturalists

Introduction

We are doing a study about agroforestry and tree planting. We are from the University of British Columbia in Canada. Are you willing to be interviewed? The interview takes about 1 hour. You are welcome to stop any time or to choose not to answer a question if you are not comfortable doing so. Your identity will be kept anonymous. Do you mind if I record the interview? This will make the interview go faster because I will not have to write as much during the interview.

The interview will start with some questions about you and your household. Then I will ask about agroforestry and tree planting in general and about your specific experiences with agroforestry and tree planting.

Record for each participant:

- Community
- Gender
- Date, time & setting of interview

I. Background Information & Context

1. What is your age?

   ○ Under 20 ○ 20-35 ○ 35-50 ○ 50-65 ○ Over 65

2. How many adults live in your household? __________ How many children? _________

3. How does your household get income? Please check all that apply.

   ○ Running your own business
   ○ Regular employment in your community
   ○ Regular employment outside your community
   ○ Odd jobs or occasional employment
   ○ Selling crops that you grow
   ○ Selling products that you make
   ○ Other – Please describe: -
   ____

4. What resources do you get from your land? Please check all that apply.

   ○ Timber and poles for building
   ○ Firewood

○ Crops
○ Fodder for animals
○ Medicines
○ Other – Please describe: ________________________________

5. Which of these do you use yourself?

○ Timber and poles for building
○ Firewood
○ Crops
○ Fodder for animals
○ Medicines
○ Other – Please describe: ________________________________

6. Which of these do you sell?

○ Timber and poles for building
○ Firewood
○ Crops
○ Fodder for animals
○ Medicines
○ Other – Please describe: ________________________________

7. How does your household get other things that you need? Please check all that apply.

○ Gathering on communal/community land
○ Agriculture on communal/community land
○ Trading or buying
○ Other – Please describe: -
____

8. Does your household do agroforestry or tree planting? [*Prompt for rotational woodlots]*

○ Yes ○ No

If no, please skip to question 12.

9. How long has your household been doing agroforestry/tree planting?

○ Less than 1 year ○ 1-5 years ○ 5-10 years ○ Over 10 years

10. What practices does your household use? Please check all that apply.

○ Intercropping trees with food crops

○ Hedgerows
○ Windbreaks
○ Growing trees on grazing land
○ Rotational woodlots
○ Other – Please describe: - ____

11. What products do you get from agroforestry or tree planting? Please check all that apply.

    ○ Timber and poles for building
    ○ Firewood
    ○ Food for people
    ○ Food for animals
    ○ Medicines
    ○ Other – Please describe: - ____

12. What products do you use in your own household? Please check all that apply.

    ○ Timber and poles for building
    ○ Firewood
    ○ Food for people
    ○ Food for livestock
    ○ Medicines
    ○ Other – Please describe: - ____

13. What products do you sell or trade? Please check all that apply.

    ○ Timber and poles for building
    ○ Firewood
    ○ Food for people
    ○ Food for livestock
    ○ Medicines
    ○ Other – Please describe: - ____

14. Do you participate in a formal agroforestry/tree planting program?

    ○ Yes ○ No

    If yes, please skip to question 13.

15. Do you know someone else who participates in an agroforestry/tree planting program?

○ Yes ○ No

If no, skip to question 14

16. How long has your household or the person you know been participating in the program?

○ Less than 1 year ○ 1-5 years ○ 5-10 years ○ Over 10 years

17. How did you learn about agroforestry/tree planting?

○ Family members
○ Other community members
○ A program or workshop run by the government
○ A program or workshop run by an NGO
○ Other – Please describe: -
____

18. How important is agroforestry/tree planting to you compared to other things you do to make a living?

○ Very important
○ Important
○ Somewhat important
○ Not very important
○ Not important at all

19. Since you started doing agroforestry/tree planting, how important has this been in improving the way that you and the members of your household live?

○ Very important
○ Important
○ Somewhat important
○ Not very important
○ Not important at all

II. Mental Mapping and Experiences of Agroforestry

This section will be completed orally.

a. General Ideas About Agroforestry

20. If someone asked you "What is agroforestry?" what would you tell them?

Tutorial: For this interview, when we talk about agroforestry, it can include any farming practice where the same land is used for both trees and crops or livestock. This can happen at the same time, or the land can be rotated between agriculture and trees.

21. In general, can you tell me about the kinds of places where agroforestry/tree planting is useful? [*Prompt for characteristics of places – environmental, social, cultural*]

22. Can you tell me about that kinds of people that participate in agroforestry/tree planting? [*Prompt for a variety of stakeholders, characteristics of stakeholders e.g. gender, poor/rich, size of holding, culture; can everyone?*]

23. What kinds of organizations start agroforestry/tree planting programs?

b. Barriers to Participating

24. Is there anything that stops people from participating in agroforestry/tree planting?

25. Who is prevented from participating? [*Ask about all barriers identified in question 19*]

26. How can these barriers be overcome?

c. Benefits

27. I would like to make a list of all the benefits of agroforestry/tree planting that you can think of. Can you think of any others? Are there benefits for the organization running the program? Are there benefits for anyone else outside the community? Are there benefits for the environment? [*Prompt for effects on both people & environment and at different scales; make a list; prompt for how AF provides these benefits if unclear*]

28. How important is each of these benefits? Can you put them in order for me?

29. Do some people benefit more than others? [*Prompts and probes: Do some people in the community benefit more than others? Do some people in a household benefit more than others? Do some stakeholders in the agroforestry/tree planting project benefit more than others? Who should benefit most?*]
30. Who is it most important for agroforestry/tree planting to benefit?

31. Have you heard of doing agroforestry/tree planting to store carbon to help fight climate change? [*If no, give tutorial*]

Tutorial: Humans do many things that put carbon in the air, like driving cars, burning, and hoeing fields. Having too much carbon in the air contributes to climate change. Climate change has many consequences, which include changes in the weather (like changes in when the rain comes) and in the temperature. Trees and plants can take carbon out of the air and store it so that there is less climate change. Trees can take more carbon out of the air than crops. Some people want to start programs to do agroforestry in countries like Uganda to take carbon out of the air to reduce climate change.

32. Do you think reducing climate change is an important benefit of agroforestry/tree planting? Why or why not? In your list, where would you put reducing climate change?

33. Who do you think benefits from taking carbon out of the air by doing agroforestry/tree planting?

34. Can you tell me about a time when agroforestry made your life, or the life of someone you know, better?

    Possible Prompts & Probes:
    How does agroforestry compare to other changes you've made in how you use your land?
    What were the consequences of these improvements on your life? [If people just list direct benefits of agroforestry, prompt for indirect benefits, e.g. how people use extra time they save by not collecting firewood far away]
    Was it only you that experienced this benefit/improvement? How did other people in your household benefit?

d. Negative Consequences

35. Are there any negative consequences of agroforestry/tree planting? What are they?
    [*Prompt for effects on both people and environment and at different scales. If any are listed, prompt for details -*

Of the negative consequences you listed, which are the worst? Can you rank them for me?
Who do these negative consequences affect? (NGOs, govt, people in the community, people in the household)
Can you walk me through an example?

36. What are the challenges you face doing agroforestry/tree planting?

37. Can you walk me through an example of a challenge you have faced? How are you overcoming this challenge?

e. Policy and Program Design

38. Can you tell me about how you made the decision to [not to] participate in agroforestry/tree planting?

    Possible Prompts & Probes:
    How did you expect to benefit? Have you benefited in the ways you expected? Why or why not?
    How important was seeing/experiencing vs. knowledge?
    Would it change how you feel about participating if you knew the project was a carbon agroforestry project? Would it change your decision to participate?

39. Can you tell me about the agroforestry/tree planting program in your community?

    Prompt for:
    Program goals; part of larger initiative?
    Stakeholders
    Support – what support is given and how it is distributed
    Timeline
    Training – kind, amount, follow up, where to go if problems

40. Can you tell me about how decisions are made in this program? [*Prompt for who participates in decision-making and how – negotiation, one person, etc.]*

41. Do you feel this program is successful? How do you measure success? Can you tell me about an experience that has shaped your opinion of this program?

    Possible Prompts & Probes:
    Why do you think the [government/NGO etc.] is running this program?
    What do you think should be the goals of an agroforestry program?
    Do you think that the program is fair? Why [not]?

42. From your experience, can you tell me about some things that make an agroforestry/tree planting program successful? [*Probe*: *Which are the most important aspects? Would these change if C was/wasn't a goal?]*

43. How would you change the program in your community to make it better?

44. Anything else we haven't talked about that you would like to add?

B.2 Interview: Perceptions & Experiences of Organizations Involved in Agroforestry

Record for each participant:

- Organization
- Gender
- Date, time & setting of interview

Introduction

I am from the University of British Columbia in Canada. We are doing a study about agroforestry and tree planting in industrializing countries. As such, we are interested in speaking with you about agroforestry and treeplanting and your organization's involvement in these practices. Are you willing to be interviewed? The interview takes about 1 hour. You are welcome to stop any time or to choose not to answer a question if you are not comfortable doing so. Your identity will be kept anonymous, unless you give explicit written permission for it to be disclosed. Do you mind if I record the interview?

The interview will start with some background questions about you and your organization. Then I will ask about agroforestry and tree planting in general and about the specific experiences of you and your organization with agroforestry and tree planting.

I. Background Information & Context

1. What is the name of your organization?
   ____

2. What is the size of your organization (# of employees)?

   ○ Under 10 ○ 10-50 ○ 50-100 ○ 100-200 ○ Over 200

3. How many employees are involved in this program?

   ○ Under 10 ○ 10-50 ○ 50-100 ○ 100-200 ○ Over 200

4. Is agroforestry/tree planting integrated with any other development activities? Please check all that apply.

   ○ Agriculture Improvement
   ○ Carbon Forestry
   ○ Microloan
   ○ Education and Empowerment
   ○ Energy
   ○ Water

○ Health and Sanitation
○ Other – Please describe: -

____

5. How many agroforestry/tree planting projects is your organization involved with in industrializing countries?

____

6. Please list the details of these projects below. (Similar projects in the same country may be grouped by indicating the number of sites in the "Project" column)

Project	**Location**	**Size of Project Area**	**Number of Local Participants**
1.			
2.			
3.			

7. What kinds of partners do you work with in these projects?

○ National Government
○ Local or Regional Government
○ International NGOs
○ National NGOs
○ Local NGOs
○ Community-Based Organizations
○ Local Individuals
○ Other – Please describe: -

____

8. [If no NGOs were selected in 7, please skip to question 9]. What is the focus of the NGOs that you work with? Please check all the apply.

○ Social
○ Technical
○ Economic
○ Conservation

○ Other – Please describe: - ______________________________

9. How are your agroforestry/tree planting projects funded? Please check all that apply.

   ○ Private Donations
   ○ Corporate Sponsorship
   ○ Government
   ○ Endowment
   ○ Other – Please describe: - ______________________________

10. How long has your organization been involved in agroforestry/tree planting?

    ○ Less than 1 year ○ 1-5 years ○ 5-10 years ○ Over 10 years

11. What proportion of your organization's initiatives involve agroforestry?

    ○ Less than 20% ○ 20-40% ○ 40-60% ○ 60-80% ○ 80-100%

12. What agroforestry and tree planting practices does your organization promote? Please check all that apply.

    ○ Intercropping trees with food crops
    ○ Hedgerows
    ○ Windbreaks
    ○ Growing trees on grazing land
    ○ Rotational woodlots
    ○ Other – Please describe: - ______________________________

13. How did you personally learn about agroforestry? Please check all that apply.

    ○ In your role with your organization
    ○ In school
    ○ Friends or family
    ○ Media
    ○ Other – Please describe: - ______________________________

II. Mental Mapping and Experiences of Agroforestry

This section will be completed orally.

a. Role of Interviewee

14. What is your role in your organization?

15. What is your role in your organization's agroforestry projects?

b. General Ideas About Agroforestry

16. If someone asked you what the term agroforestry meant, what would you tell them?

Tutorial: For this interview, when we talk about agroforestry, it can include any agricultural practices where the same land is used for both trees and crops or livestock. This can happen at the same time, or the land can be rotated between agriculture and trees.

17. Can you tell me about the kinds of places where agroforestry/tree planting is useful? [*Prompt for characteristics of places – environmental, social, cultural*]

18. Can you tell me about what kinds of people participate in agroforestry/tree planting projects? [*Prompt for a variety of stakeholders, characteristics of stakeholders e.g. gender, poor/rich, size of holding, culture*]

19. What kinds of organizations get involved in agroforestry/tree planting?

c. Barriers to Participating

20. Are there any barriers that prevent people or organizations from participating in agroforestry/tree planting? [*Make a list*]

21. Who is prevented from participating? Why? [*Ask about all barriers identified in 16]*

22. How can these barriers be overcome?

d. Benefits

23. Now I would like to make a list of all the benefits of agroforestry/tree planting that you can think of. Can you think of any others? Are there benefits for the organization? Are there benefits for anyone else? Are there benefits for the environment?

[*Prompt for effects on both people & environment and at different scales; make a list; prompt for how AF provides these benefits if unclear*]

24. How important are each of these benefits from the perspective of your organization? Could you rank them for me?

25. Do some people benefit more than others? [*Prompts and probes: Do some people in the community benefit more than others? Do some people in a household benefit more than others? Do some stakeholders in the agroforestry/tree planting project benefit more than others? Who should benefit most?*]

26. Is it more important for some stakeholders to benefit more than others?

27. Have you heard of doing agroforestry/tree planting to mitigate climate change? [*If no, give tutorial*]

Tutorial: Opportunities to mitigate climate change through land-use change are increasingly topics of climate change discourse. There is evidence that agroforestry/tree planting can sequester more carbon than conventional agricultural practices.

Alternative Tutorial: Humans do many things that put carbon in the air, like driving cars and hoeing fields. Having too much carbon in the air contributes to climate change. Climate change has many consequences, which include changes in the weather (like changes in when the rain comes) and in the temperature. Trees and plants can take carbon out of the air and store it so that there is less climate change. Trees can take more carbon out of the air than crops. Some people want to start programs to do agroforestry in countries like Uganda to take carbon out of the air to reduce climate change.

28. Do you think climate change mitigation is an important benefit of agroforestry/tree planting? Why or why not? In your list, where would you rank climate change mitigation?

29. Who do you think benefits from climate change mitigation from agroforestry/tree planting?

30. Can you walk me through an example of the positive impact that agroforestry/tree planting has had in one of the communities where your organization works?

    Possible Prompts & Probes:
    How does the impact of your agroforestry projects compare to other types of rural development projects your organization is involved in?

What were the consequences of these positive impacts? [If people just list direct benefits of agroforestry, prompt for indirect benefits, e.g. how people use extra time they save by not collecting firewood far away]
Is this story typical?

e. Negative Consequences and Challenges

31. Are there any negative consequences of agroforestry/tree planting? What are they?
    [*Prompt for effects on both people and environment and at different scales. If any are listed, prompt for details -*
    Of the negative consequences you listed, which are the worst? Can you rank them for me?
    Who do these negative consequences affect? (NGOs, govt, people in the community, people in the household)
    Can you walk me through an example?

32. What are the challenges your organization faces in implementing agroforestry/tree planting?

33. Can you walk me through an example of a challenge or problem with an agroforestry/tree planting project that you have encountered?

    Possible Prompts & Probes:
    What causes these challenges and problems?
    How are you addressing these challenges?
    What unique opportunities and challenges do you feel carbon agroforestry projects [would] pose?

f. Policy and Program Design

34. Can you tell me about how your organization made the decision to get involved in agroforestry/tree planting?

    Possible Prompts & Probes:
    What outcomes did you expect for your organization and for other stakeholders? Have your expectations been met? Why or why not?
    What kinds of things might lead your organization to decide to stop being involved in agroforestry projects?
    Why carbon? Or, Would your organization consider participating in carbon agroforestry projects? Why or why not?

35. From your experience, can you tell me how farmers make the decision to participate in agroforestry/tree planting? [*Probe: importance of experiencing/seeing benefits vs. knowledge]*

36. How do your organization's programs work?
    Prompt for:
    Program goals; part of larger initiative?
    Stakeholders
    Incentives to participate, Support – what support is given and how it is distributed
    Timeline
    Training – kind, amount, follow up, where to go if problems

37. Can you tell me about how decisions are made in these programs? [*Prompt for who participates in decision-making and how – negotiation, one person, etc.]*

38. Do you feel your organization's program is successful? How do you measure success? Can you tell me about an experience that has shaped your opinion?

39. From your experience, can you tell me some things that make an agroforestry/tree planting project successful? [*Possible Prompts & Probes: Which are the most important aspects? Would these change if C was/wasn't a goal?*]

40. How would you improve the program?

41. Anything else that we haven't talked about that you would like to add?

B.3 Focus Group Protocol: Agriculturalist Perceptions & Experiences

Record for each group:

- Community
- Number of participants
- Date, time & setting of focus group

To protect the privacy of participants with respect to information that they may not be comfortable sharing with the group (e.g. income), this section will be administered individually to focus group participants as they arrive. If it is appropriate to collect this information in writing (adequate literacy, culturally appropriate), this section of the interview will be administered on paper. If written administration is not appropriate, this section will be administered orally by a research assistant to each participant separately.

a. Introductory Blurb

We are from the University of British Columbia in Canada. We are doing a study about agroforestry. Are you willing to participate in this focus group to discuss agroforestry? It will take about 2 hours. The first section will be done individually and then we will do the second section together as a group. You are welcome to stop any time or to choose not to answer a question if you are not comfortable doing so. Do you mind if I record our discussion? This will make our focus group go faster because I will not have to take as many notes.

I. Background Information & Context

45. What is your gender?

○ Male ○ Female

2. What is your age?

○ Under 20 ○ 20-35 ○ 35-50 ○ 50-65 ○ Over 65

46. How many adults live in your household? __________ How many children? _________

47. How does your household get income? Please check all that apply.

○ Running your own business
○ Regular employment in your community
○ Regular employment outside your community
○ Odd jobs or occasional employment
○ Selling crops that you grow

○ Selling products that you make
○ Other – Please describe: -
____

48. What resources do you get from your land? Please check all that apply.

○ Timber and poles for building
○ Firewood
○ Crops
○ Fodder for animals
○ Medicines
○ Other – Please describe: ______________________________

49. Which of these do you use yourself?

○ Timber and poles for building
○ Firewood
○ Crops
○ Fodder for animals
○ Medicines
○ Other – Please describe: ______________________________

50. Which of these do you sell?

○ Timber and poles for building
○ Firewood
○ Crops
○ Fodder for animals
○ Medicines
○ Other – Please describe: ______________________________

51. How does your household get other things that you need? Please check all that apply.

○ Gathering on communal/community land
○ Agriculture on communal/community land
○ Trading or buying
○ Other – Please describe: -
____

52. Does your household do agroforestry or tree planting? [*Prompt for rotational woodlots]*

○ Yes ○ No

If no, please skip to question 12.

53. How long has your household been doing agroforestry/tree planting?

○ Less than 1 year ○ 1-5 years ○ 5-10 years ○ Over 10 years

54. What practices does your household use? Please check all that apply.

○ Intercropping trees with food crops
○ Hedgerows
○ Windbreaks
○ Growing trees on grazing land
○ Rotational woodlots
○ Other – Please describe: -
____

55. What products do you get from agroforestry or tree planting? Please check all that apply.

○ Timber and poles for building
○ Firewood
○ Food for people
○ Food for animals
○ Medicines
○ Other – Please describe: -
____

56. What products do you use in your own household? Please check all that apply.

○ Timber and poles for building
○ Firewood
○ Food for people
○ Food for livestock
○ Medicines
○ Other – Please describe: -
____

57. What products do you sell or trade? Please check all that apply.

○ Timber and poles for building
○ Firewood
○ Food for people
○ Food for livestock
○ Medicines

○ Other – Please describe: -

____

58. Do you participate in a formal agroforestry/tree planting program?

○ Yes ○ No

If yes, please skip to question 13.

59. Do you know someone else who participates in an agroforestry/tree planting program?

○ Yes ○ No

If no, skip to question 14

60. How long has your household or the person you know been participating in the program?

○ Less than 1 year ○ 1-5 years ○ 5-10 years ○ Over 10 years

61. How did you learn about agroforestry/tree planting?

○ Family members
○ Other community members
○ A program or workshop run by the government
○ A program or workshop run by an NGO
○ Other – Please describe: -

____

62. How important is agroforestry/tree planting to you compared to other things you do to make a living?

○ Very important
○ Important
○ Somewhat important
○ Not very important
○ Not important at all

63. Since you started doing agroforestry/tree planting, how important has this been in improving the way that you and the members of your household live?

○ Very important
○ Important
○ Somewhat important
○ Not very important

○ Not important at all

II. Mental Mapping and Experiences of Agroforestry

a. Introductory Blurb

We are from the University of British Columbia in Canada. We are doing a study about agroforestry. Are you willing to participate in this focus group to discuss agroforestry? It will take about 2 hours. You are welcome to stop any time or to choose not to answer a question if you are not comfortable doing so. Does anyone mind if I record our discussion?

I cannot promise that everything that is said today is kept confidential because I can't control what people say once they leave the focus group. But, I would ask that we all try to respect each other by not discussing the things that people say in this group outside of the group. Being part of a focus group like this one can be a good opportunity to learn from each other. In the first part of this focus group meeting, we will work together to agree on a list of other rules that will help us to do this well.

Then we will do some activities and have some discussions. I will ask questions both about agroforestry in general and about your specific experiences with agroforestry.

b. Introductions and Setting Focus Group Ground Rules

[*Prompt everyone to introduce themselves*]

What rules should our focus group meeting follow to make sure we respect each other and everyone feels comfortable?
[*Prompt for a list that includes at least the following ideas:*
Listen to others when they are speaking.
Respect the right of others to have and express opinions different from yours.
Wait for others to finish speaking before you start speaking.
Give everyone equal opportunity to speak.
Refrain from insults and putdowns.
Respect other peoples' time by staying on topic.
Respect the facilitators' efforts to guide the meeting.]

b. General Ideas About Agroforestry

[*If it is appropriate (based on literacy levels), responses in this section will be recorded for reference in list form on paper visible to all participants*]

1. If someone asked you "What is agroforestry?" what would you tell them?

Tutorial: For this focus group, when we talk about agroforestry, it can include any farming practice where the same land is used for both trees and crops or livestock. This can happen at the same time, or the land can be rotated between agriculture and trees.

2. In general, can you tell me where agroforestry is used? Are there some places where it is not used? [*Prompt for characteristics of places*]

3. Can you tell me about who participates in agroforestry? In the agroforestry program in your community, are there people who are involved in the program who do not actually do agroforestry? Who are they? How are they involved? [*Prompt for a variety of stakeholders, characteristics of stakeholders*]

b. Barriers to Participating

[*If it is appropriate (based on literacy levels), responses in this section will be recorded for reference in list form on paper visible to all participants*]

4. Is there anything that stops people from participating in agroforestry?

5. Who is prevented from participating? [*Ask about all barriers identified in question 19*]

c. Benefits

[*If it is appropriate (based on literacy levels), the first part of this section (questions 5-7) may be conducted in small groups with each group working on paper with pens, making a list of benefits, ranking them as a group, then connecting them to stakeholders; different groups can then present their ideas to the group*]

6. Can you tell me about the benefits of participating in agroforestry? Can you think of any others? [*Prompt for effects on both people & environment and at different scales; keep a list*]

7. How important is each of these benefits? Can you put them in order for me?

8. Who does agroforestry benefit? [*Prompt for all benefits listed in question 21*]

9. Do some people benefit more than other people?

10. Do different kinds of agroforestry provide different benefits? Please explain.

11. Is it more important for agroforestry to provide benefits for certain people? [*Prompt for importance of stakeholders – can give examples: e.g. farmers or the government*]

12. Have you heard of doing agroforestry to store carbon to help reduce climate change? [*If no, give tutorial*]

Tutorial: Humans do many things that put carbon in the air, like driving cars and hoeing fields. Having too much carbon in the air contributes to climate change. Climate change has many consequences, which include changes in the weather (like changes in when the rain comes) and in the temperature. Trees and plants can take carbon out of the air and store it so that there is less climate change. Trees can take more carbon out of the air than crops. Some people want to do agroforestry to take carbon out of the air to reduce climate change.

13. Do you think this is an important benefit of agroforestry? Why or why not?

14. Who do you think benefits from taking carbon out of the air by doing agroforestry?

15. Can you tell me about a time when agroforestry made your life, or the life of someone you know, better?

    Possible Prompts & Probes:
    How does agroforestry compare to other changes you've made in how you use your land?
    What were the consequences of these improvements on your life? [If people just list direct benefits of agroforestry, prompt for indirect benefits, e.g. how people use extra time they save by not collecting firewood far away]
    Was it only you that experienced this benefit/improvement? How did other people in your household benefit?

d. Negative Consequences

[*If it is appropriate (based on literacy levels and cultural appropriateness), the first part of this section (questions 16-18) may be conducted in small groups with each group working on paper with pens, making a list of consequences, ranking them as a group, then connecting them to stakeholders; different groups can then present their ideas to the group*]

16. Are there any negative consequences of participating in agroforestry? What are they? [*Prompt for effects on both people and environment and at different scales. Keep a list.*]

17. Of the negative consequences you listed, which are the worst? Can you put them in order for me?

18. Who do these negative consequences affect? [*Prompt for all negative effects listed in 31*]

19. Do some people experience more negative consequences than other people?

20. Do different kinds of agroforestry have different negative consequences?

21. Do some kinds of agroforestry have more negative consequences than others? Please explain.

22. Can you tell me about a time that you had a negative experience with agroforestry?

    Possible Prompts & Probes:
    What causes these challenges and problems?
    Do you think this is fair?

e. Policy and Program Design

23. Can you tell me about how you made the decision to [not to] participate in agroforestry?

    Possible Prompts & Probes:
    Are you happy with your decision? Why [not]?
    When you decided to participate in agroforestry, how did you expect to benefit? Have you benefited in the ways you expected? Why or why not?
    If you were making the decision again today, would you decide to participate? Why [not]?
    What might change your mind about agroforestry? What kinds of things might make you decide to [not] participate?
    Would you encourage people you know to participate in agroforestry? Why [not]?
    Would it change how you feel about participating if you knew the project was a carbon agroforestry project? Would it change your decision to participate?

24. Can you tell me about the agroforestry program in your community?

25. Can you tell me about how decisions are made in this program? [*Prompt for who participates in decision-making]*

26. What support do participants get from the program?

27. Can you tell me about an experience that has shaped your opinion of this program?

    Possible Prompts & Probes:
    Why do you think the [government/NGO etc.] is running this program?
    What do you think should be the goals of an agroforestry program?
    How can you tell if a program is successful?
    Would you encourage people you know to participate in this program? Why [not]?
    Do you think that the program is fair? Why [not]?

28. From your experience, can you tell me about some things that make an agroforestry project successful?

29. How would you change the program in your community to make it better?

Appendix C: Certificate of Research Ethics Approval

The University of British Columbia
Office of Research Services
Behavioural Research Ethics Board
Suite 102, 6190 Agronomy Road,
Vancouver, B.C. V6T 1Z3

CERTIFICATE OF APPROVAL - FULL BOARD

PRINCIPAL INVESTIGATOR:	INSTITUTION / DEPARTMENT:	UBC BREB NUMBER:
Hisham Zerriffi	UBC/College for Interdisciplinary Studies/Liu Institute for Global Issues	H09-01729

INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT:

Institution	Site
UBC	Vancouver (excludes UBC Hospital)

Other locations where the research will be conducted:

Various locations in rural Uganda: Focus groups with rural agriculturalists will be conducted in community meeting places such as schools and churches, with permission from community leaders. Interviews will be conducted in subjects' homes. Field sites will be chosen in Uganda in consultation with in-country informants involved in the agroforestry sector. Field sites will be in rural locations where agroforestry projects are underway. Some sites may be chosen in advance based on information from key informants in Canada and based on internet information. The majority of field sites will not be chosen in advance of arrival in Uganda, as it is felt that communication constraints (e.g. lack of internet and telephone access for some agroforestry projects) might skew selection of study sites by including a disproportionate number of project sites with good internet/telephone access to advertise their project. Some carbon-forestry projects may be included to provide more data, as it is expected that many of the challenges of carbon-agroforestry projects will be similar to carbon-forestry projects. Regional and international organizations in Uganda and other countries, to be determined: Expert interviews with other agroforestry project key informants will be held in public meeting places, in the informant's office or over the phone if face-to-face meeting is not possible.

CO-INVESTIGATOR(S):

Emily K. Anderson

SPONSORING AGENCIES:

UBC Sauder School of Business

PROJECT TITLE:

In Search of Co-benefits for Climate Change Mitigation and Rural Development: Understanding stakeholder expectations in industrializing country agroforestry projects

REB MEETING DATE:	**CERTIFICATE EXPIRY DATE:**
January 14, 2010	**January 14, 2011**

DOCUMENTS INCLUDED IN THIS APPROVAL:	**DATE APPROVED:**
	January 28, 2010

Document Name	Version	Date
Protocol:		
Research Proposal	N/A	December 10, 2009
Consent Forms:		
Agriculturalist Interview Consent	N/A	December 10, 2009
Organization Consent	N/A	January 25, 2010
Agriculturalist Focus Group Consent	N/A	December 10, 2009
Advertisements:		
Recruitment Poster	N/A	January 25, 2010
Oral Announcement Script	N/A	January 25, 2010
Questionnaire, Questionnaire Cover Letter, Tests:		
Interview Script - Organization	N/A	December 10, 2009
Focus Group Script	N/A	December 10, 2009
Interview Script - Agriculturalist	N/A	December 10, 2009
Letter of Initial Contact:		
Organization Contact Letter	N/A	December 10, 2009

The application for ethical review and the document(s) listed above have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human subjects.

Approval is issued on behalf of the Behavioural Research Ethics Board and signed electronically by one of the following:

Dr. M. Judith Lynam, Chair
Dr. Ken Craig, Chair
Dr. Jim Rupert, Associate Chair
Dr. Laurie Ford, Associate Chair
Dr. Anita Ho, Associate Chair