Opportunities and Barriers for Small-scale and Community Forestry Access to Carbon Markets: A Literature Review

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ABSTRACT

Carbon markets offer a market-based approach to climate change mitigation. Small-scale and community forestry practitioners are interested in participating in emerging carbon markets. The participation of small-scale and community forestry represents an important opportunity to help compensate landowners and communities for the protection of ecosystem services, as well as sequester carbon, reduce emissions, and promote conservation on a considerable portion of the land base. This paper provides a review of the literature that explores the opportunities and barriers for participation in carbon markets for small-scale and community forestry, including urban forestry. The review also provides a summary of barriers and ways to overcome barriers in wood product and forest certification markets, thereby illustrating parallels between markets. Concluding remarks list possible solutions from the literature for overcoming carbon market barriers. Research has documented significant barriers to accessing other forest product markets for small-scale and community forestry efforts, and initial research indicates that carbon markets are presenting similar barriers. Opportunities for participation in carbon markets include: a growing market, the marketability of forest offsets, the significant acreage represented by small-scale forestry, the need for payment for ecosystem services, co-benefits provided by forests, the cost effectiveness of avoided deforestation, and others. Barriers include: scale vs. cost, lack of technical expertise, complexity and an uncertain market, underdeveloped market, methodological concerns, social equity concerns, and lack of institutional capacity.

ABBREVIATIONS

C	Carbon
ha.	Hectares
MtCO2e	Millions of tonnes of carbon dioxide equivalent
tCO2e	Tonne of carbon dioxide equivalent
tC	Tonne of carbon
TgC	Teragram of carbon
TgCO2e	Teragram of carbon dioxide equivalent

I. INTRODUCTION AND PURPOSE

Global temperatures have been increasing since the mid-20th century (IPCC 2007). As there is now broad scientific consensus that this trend in increased global temperatures is linked to human-induced emissions, the current debate regarding climate change now concerns how to best address the problem. Regulatory policies to address climate change are evolving at the regional, national and international levels. Concurrently, growing awareness has led individuals and businesses to offset their carbon emissions on the voluntary carbon market.

Forests are important to climate stability and climate change mitigation (Watson et al. 2000; Malhi, Meir, & Brown 2003; Malmsheimer et al. 2008, Streck, O'Sullivan, Janson-Smith, & Tarasofsky 2008; Tompkins & Adger 2004). In the last few years, a number of standards, registries, and programs to deal with forest carbon have arisen both internationally and in the U.S. The major carbon marketplaces, both regulatory (i.e., mechanisms under the Kyoto Protocol) and voluntary, have accepted tree planting as a carbon offset and are currently expanding to include forest management and protection projects (Skutsch 2005; de Jong, Masera, Olguin & Martınez 2007; Hamilton, Sjardin, Shapiro & Marcello 2009). Carbon markets offer a market-based approach to climate change mitigation. The sale of carbon credits can be seen as a non-timber product, one for which a premium could exist for credits with a higher production quality. However, the question of who will benefit from carbon markets is subject to debate. Research has documented significant barriers for small-scale forestry in efforts to access other forest product markets, such as sustainably managed forest certification markets (Klooster & Masera 2000; Rickenbach 2002; Molnar 2003; Smith & Scherr 2003; Scherr, White & Kaimowitz 2004; Butterfield, Hansen, Fletcher & Nikinmaa 2005; Kilgore, Leahy, Hibbard & Donnay 2007), and initial research indicates that carbon markets could present the same types of barriers.

Including small-scale forestry in markets to address climate change is important. Though small-scale and community forestry are characterized by local, low intensity/low capital endeavors (Butler 2008; Charnley & Poe 2007), together they represent a significant portion of the global forest land base. Furthermore, project size has been used as a proxy for evaluating a market's ability to contribute to sustainable development at the community level, whereby it is assumed that the inclusion of smaller market participants can increase a market's positive impact within the community (Hamilton et al. 2009). Finally, the alternative presented by large mono-cropped tree plantations of high-carbon varietals is less likely to promote sustainability, local livelihoods, and other co-benefits (Skutsch 2005).

Though carbon markets appear promising worldwide, small-scale projects face significant barriers to accessing them, such as high transaction and start-up costs, access to information, and complex technical requirements (Chomitz, Brenes & Constantino 1999; van Kooten, Shaikh & Suchanek 2002; Smith & Scherr 2003; Skutsch 2005; Boyd, Gutierrez and Chang 2007; Minang, McCall & Bressers 2007; McHale, McPherson & Burkea 2007; Gunn, Price, Battles & Saah 2008). Projects that sequestered less than 5,000 tCO2e/yr[1] represented only 3% of the worldwide voluntary market in 2008 (Hamilton et al. 2009). This is not surprising given the history of

[1] Greenpeace (2003) estimates that an 8,000 tCO2/yr sink project would be between 200 to 1600 hectares, depending on uptake rate.

attempts by small-scale forestry initiatives to access other forest product markets. Historically, most small private landowners do not participate in timber markets (Rosen & Kaiser 2003; Butler 2008). At the same time, small-scale community producers of forest products, particularly the rural poor, have been marginalized by commercial markets, and attempts at creating markets have generally failed to achieve real income benefits (Saunders, Hanbury-Tenison & Swingland 2003; Scherr et al. 2004). This history represents the biggest threat to the social equity of forest-based carbon sinks (Saunders et al. 2003). Indeed, research on carbon sequestration projects in Mexico indicates that, though benefits have accrued to certain sectors of the population, these projects failed to achieve equity across all sectors (Corbera, Brown & Adger 2007; Brown & Corbera 2003; Boyd et al. 2007). In regards to private landowners, the current system of carbon trading has facilitated the development of a market that works for some large-scale forest owners, but still leaves a significant part of the potential forest carbon reservoir outside the system (Bigsby 2009).

This review of the literature explores the opportunities and barriers for participation in carbon markets for small-scale forestry and urban forestry —a sector for which market access has not been extensively studied. The majority of published research applicable to small-scale forestry participation in carbon markets focuses on community forestry projects in developing countries under such schemes as the Clean Development Mechanism (CDM) of the Kyoto Protocol or Activities Implemented Jointly (AIJ) pilot phase of the United Nation's Framework Convention on Climate Change (UNFCCC). There also exists a body of literature that, while much more specific to forestry than the general literature on carbon markets, focuses more on forest land management than on the challenges of including small-scale participants in carbon markets. As yet, there is little published research on small-scale forestry and carbon markets in the U.S. or European countries. However, practical experience tells us that the existing research on forest management and carbon markets does apply, and can be used to increase understanding of how small-scale forest landowners can participate in a global carbon market.

The review also provides a summary of barriers and ways to overcome barriers to accessing wood products and forest certification markets. Parallel lessons can be observed between this body of work and the literature on carbon markets. Finally, concluding remarks list possible solutions from the literature for overcoming carbon market barriers. This review aims to inform researchers and policy makers who seek to help small-scale producers engage in carbon markets.

II. REVIEW OF LITERATURE

II.A Small-scale Forestry Defined

There is a lack of consensus in the forestry community regarding the definition of small-scale forestry (Butterfield et al. 2005). In the context of the U.S., small-scale forestry tends to be associated with non-industrial private forest (NIPF) landowners, woodland owners, or, more recently, family forestland owners (Butterfield et al. 2005). Private ownership also predominates in European countries, where land holdings tend to be very small, averaging 13 hectares (EU 2006; Butterfield et al. 2005). The literature regarding developing countries tends to focus on communally-owned forests or subsistence forestry (Scherr et al. 2004). For the purposes of this review, small-scale forests can be owned either privately or publicly, and small-scale forestry activities can include community-based, urban and family forestry.

Notably missing from this delineation is a size range that might be considered characteristic of small-scale forestry. This is due to the fact that size is a difficult characteristic to define, as "small" is more akin to a set of culturally or historically conditioned perceptions than to an absolute quantity (Harrison, Herbohn & Niskanen 2002). A forest holding of 30 ha. might be considered large by Japanese standards but small by U.S. standards, whereas community-based forest practices in some developing countries are not particularly small in aggregate, though the financial interests of individual participants are small (Harrison et al. 2002). This cultural difference is reflected in the Forest Stewardship Council's size requirements for participation in its Small and Low Intensity Managed Forests (SLIMF) program: worldwide, eligible forests must be 100 ha. or less, whereas in the U.S., they must be less than 1,000 ha. (http://www.fscus.org/standards_criteria/family_forests_program.php).

Size is often not defined in the literature applicable to carbon markets for forestry; however, a few sets of parameters do exist. According to the "Modalities and procedures for afforestation and reforestation project activities under the Clean Development Mechanism" adopted by the United Nations Framework Convention on Climate Change, small-scale sink projects are defined as projects that result in a removal of less than 8,000 tCO2e/yr (UNFCCC 2003). Greenpeace (2003) estimated that an 8,000 tCO2e/yr sink project would be between approx. 200 to 1,600 ha., depending on uptake rate. According to the size limits used in Hamilton et al.'s studies of the voluntary market (2007; 2008; 2009), micro projects are defined as less than 5,000 tCO2e/year (125-1,000 ha., using Greenpeace's estimates), and small projects are defined as 5,000 to 19,999 tCO2e/year (125-1,000 ha. to 500-4,000 ha.). The CCX defines small projects as those producing less than 2,000 tCO2e/year (50-400 ha.), and requires projects producing less than 12,500 tCO2e/year (312-2,500 ha.) to enroll through a registered aggregator (i.e., to be "pooled") (Delta Institute 2009).

Small-scale forestry is distinguishable from large-scale or industrial forestry in more ways than just size. According to Harrison et al. (2002), the differences include serving as a basis for species selection, social and economic objectives and the likely markets for products. Suffice it to say, small-scale forest landowners are extremely diverse in their backgrounds, attitudes and motivations for owning or using forestlands.

II.A.1. Community-based Forestry

While community forestry often involves larger areas of forest as compared to the average size of forest area managed by individual smallholders, the areas are still small relative to most industrial estates (hundreds of hectares compared with thousands of hectares) (Harrison et al. 2002). At the heart of community-based forestry (CBF) is the joint pursuit of social and environmental goals (Charnley & Poe 2007). Beyond this core, CBF projects can have any number of goals, most often including sustainability of ecosystems; economic viability; transparent, participatory decision-making; the meeting of basic needs; poverty alleviation; and collective sharing of labor, knowledge, cost and benefits (Brendler & Carey 1998; Charnley & Poe 2007; Glasmeier & Farrigan 2005; Danks 2009). CBF can span public and private lands as well as rural and urban communities. In developing countries, the literature recognizes a long history of localized, subsistence forestry among indigenous peoples, in addition to the production of forest products to supplement household income (Charnley & Poe 2007). In the U.S., CBF can take the form of community-owned forests such as town forests, forest landowner cooperatives, forest-based community development, community-oriented conservation, and urban forestry (Danks 2009); indeed, "community forestry" is often used in reference to urban forestry.

II.A.2. Urban Forestry

Urban forests are ecosystems characterized by the presence of trees and other vegetation in association with people and their developments where human influences are concentrated (Dwyer et al. 2000).[2] The average percentage of tree canopy cover for both metropolitan areas (33.4%) and urban areas (27.1%) is close to that for all land in the co-terminous U.S. (32.8%), thereby demonstrating that urban areas and areas of influence can coexist with a significant tree canopy (Dwyer et al. 2000). Urban forests and vegetation contribute to air and water quality, energy conservation, recreational opportunities, and community wellbeing. Management of urban forest occurs largely at the local, city-specific scale, where tree and ground cover, buildings, infrastructure, wildlife, and human populations interact across the urban ecosystem (Dwyer et al. 2000).

II.A.3. Family Forestry

Defined as NIPFs that are owned by families, individuals, trusts, estates, family partnerships and similar unincorporated groups, family forests comprise 35% of all forest land in the U.S. (Butler 2008).[3] Family forests vary in size but tend to be small; for holdings larger than 10 acres (92% of forested land) the average size is 58 acres (Butler 2008; Butterfield et al. 2005). While family forest owners tend to favor management strategies that produce public goods – such as scenic beauty and nature protection – over those focused on timber extraction, they are concerned with economic issues such as keeping land intact for heirs and high taxes (Butler 2008; Butterfield et al. 2005). Forest management objectives tend to vary according to the size and production capacity of a forest holding (Butterfield et al. 2005). In the U.S., the percentage of family forest owners who have commercially harvested trees on their land increases dramatically with landholding size (Butler 2008). Seventy three percent of the family forest owners, owning 59% of the family forest land, have their primary residence on or near (within 1 mile) their forest land (Butler 2008). This fact suggests the possible existence of a strong emotional attachment to the land, which may influence preferences and choices (Butterfield et al. 2005).

II.B. Opportunities for Small-scale Forestry Participation in Carbon Markets

> "There is no doubt that both nature and society will in the long run be better served by management and protection of existing forests, than by industrial size plantation projects

[2] The literature used looks at urban forestry based in the U.S.
[3] The literature used looks at family forests in the U.S. and European countries, although the term "family forests" isn't used to describe small landholdings in European countries. Rather, the emphasis is on small private ownership.

designed to sop up as much carbon as possible in the shortest possible time." (Skutsch 2005, pg 6)

By 2020, assuming the implementation of a sufficiently ambitious U.S. federal cap and trade program, the U.S. carbon market could be the largest emissions trading scheme in the world (Point Carbon 2008). While only a small portion of trade dollars will be directed to forestry activities, such numbers have attracted the attention of forestry practitioners and market experts across disciplines. This section lists several of the opportunities found in the literature related to small-scale forestry participation in carbon markets. Categories are: a growing market, the marketability of forest offsets, the significant acreage represented by small-scale forestry, the untapped potential of land-based climate change mitigation, the need for payment for ecosystem services, the importance of considering the co-benefits provided by the existing forest base, and the case of urban forestry. These opportunities suggest that there are good reasons to work to overcome existing barriers small-scale forestry faces to market participation.

II.B.1. A Growing Market

The regulatory carbon market is driven by a cap on carbon dioxide emissions. Under a cap, transactions are "allowance-based," in that firms are given emissions allowances that they can trade with other firms. Today, the Kyoto Protocol, on which the majority of literature regarding forestry participation in markets is based, serves as the foundation for the international regulatory market. The Kyoto Protocol is a legally binding agreement that came into effect in 2005 (comma) under which 37 industrialized countries (as of late April 2009) have agreed to reduce their collective greenhouse gas (GHG) emissions to a level 5.4% below their 1990 emissions levels by 2012 (Labatt & White 2007; Hamilton et al. 2009).

Other countries are considering their own regulatory schemes, such as the Norway Emissions Trading System. Most common, however, are state and regional-level initiatives in the absence of national regulation. An Australian state-level emissions reduction program, the New South Wales GHG Abatement Scheme (NSW GGAS), is the world's second largest regulated cap-and-trade GHG market (Hamilton, Sjardin, Marcelle & Xu 2008). Although the U.S. did not ratify Kyoto and has not adopted federal caps on greenhouse gas emissions, many legally binding state and regional GHG reduction initiatives are coming into existence, including: California's Global Warming Solutions Act (AB 32), the Western Climate Initiative, the Regional Greenhouse Gas Initiative (RGGI), the Oregon Standard and the Oregon Climate Reserve Trust, and the Midwestern GHG Reduction Accord (Hamilton 2006; Hamilton et al. 2009). The only two of these to currently be operating are RGGI and the Oregon Standard/Climate Reserve Trust.

The voluntary carbon market (VCM) is driven by consumer awareness rather than a mandatory cap.[4] Buyers in the VCM are motivated by wanting to manage their climate change impacts, public relations, corporate responsibility, an interest in innovative philanthropy, the need to prepare for (or deter) upcoming regulation, and/or plans to resell credits at a profit (Hamilton et al. 2008; Bayon, Hawn & Hamilton 2007; Labatt & White 2007). Exchanges are

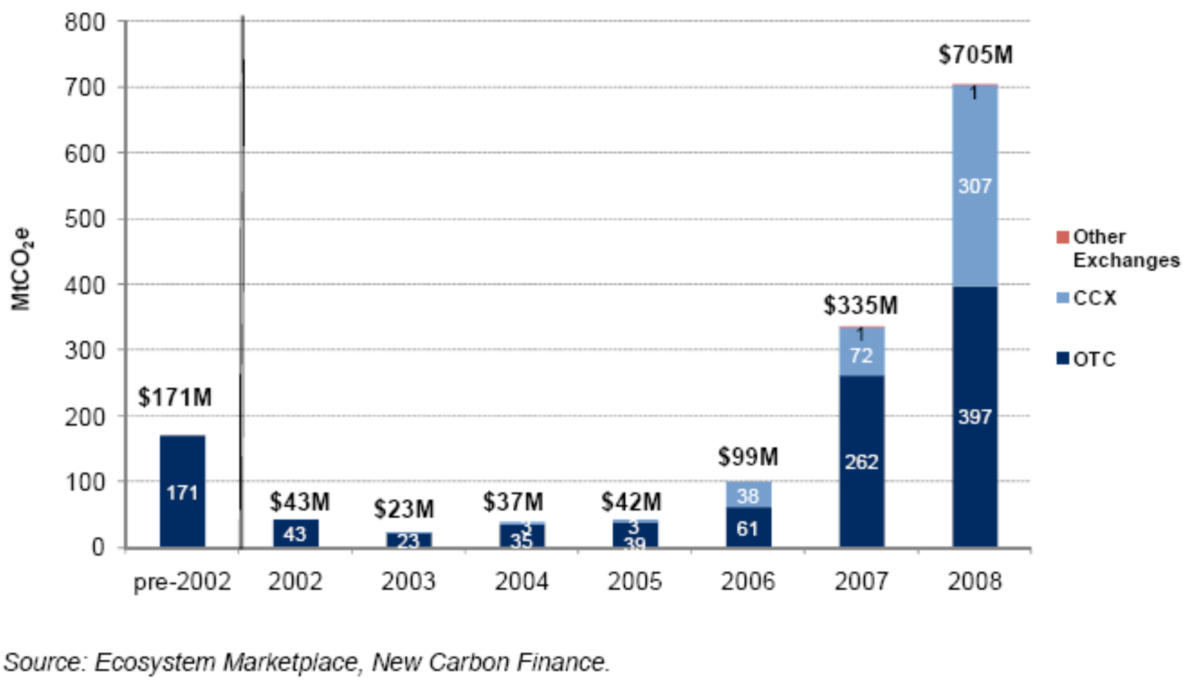
[4] The exception is the Chicago Climate Exchange (CCX), which is a voluntary but legally binding cap and trade arrangement

Figure 1: Worldwide Historic Values for the Voluntary Carbon Markets

"project-based"[5] in that a carbon credit is produced by a project that avoids, reduces or sequesters carbon emissions above and beyond business as usual and is sold to consumers, ranging from the individual to the transnational corporation, through a number of intermediary brokering institutions.

Worldwide, regulatory and voluntary carbon markets have grown rapidly (Figures 1 and 2). The VCM remains only a small fraction of the size of the regulated markets (c.2.9% volume-wise, c.0.6% value-wise), which transacted 4,090MtCO2e, valued at $119,483 million in 2008 (Hamilton et al. 2009). That said, the VCM did experience a higher (volume) growth rate of 86% (compared to 40%) than the regulated markets in 2008 (Hamilton et al. 2009). The potential for further growth is significant in both markets, as investors will be considering the risk of their investments based on a carbon-constrained future (Labatt & White 2007), and future increases in commitments under the Kyoto Protocol will enlarge the global regulatory market significantly. What's more, the current draft of H.R. 2454: American Clean Energy and Security Act of 2009 specifically accepts forestry offset credits (Hamilton et al. 2009) and, if passed, will change the landscape of forestry offset markets in the U.S.

[6]



(Source: Hamilton et al. 2009, pg 32)

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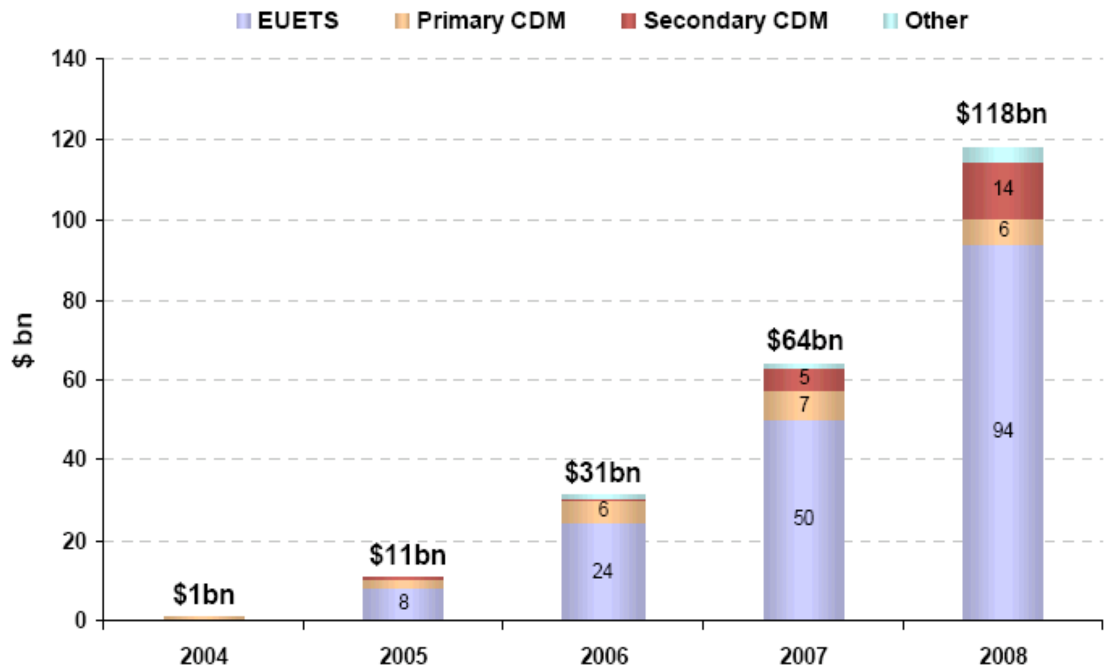
[5] Again, the exception to this is the CCX, under which transactions may be allowance-based or project-based.

[6] The "Over-the-Counter" (OTC) offset market operates largely outside of exchanges. The OTC market includes all carbon offset trades that are not required by regulation and is largely based on bilateral deals. The CCX is not part of the OTC market.

Figure 2: Worldwide Historic Values for Global Carbon Markets



Source: New Carbon Finance

(Source: New Carbon Finance 2008, pg 1)

The VCM's flexibility and, by comparison, lower bureaucratic complexity may be a reason for its higher rate of growth, and a necessary component to a struggling regulatory market. This is certainly true in the case of forest carbon offsets, which have dominated the VCM until recently. The VCM has served as a laboratory for forest carbon offset protocol development, whereas project developers continue to face significant restrictions in the regulatory market. Furthermore, the VCM offers more opportunity for smaller-scale projects, because fewer regulations mean lower transaction costs (Hamilton et al. 2008; Bayon et al. 2007). However, the VCM lacks legitimacy, due to the lack of nationally or internationally accepted standards or regulations; transparency, in pricing as well as regulation; and uniformity. Without a regulatory cap, it is "quite possible to envision an active GHG market in which no climate change mitigation is occurring at all." (Bayon et al. 2007, pg 66). The list of attempts to standardize the VCM is long and growing (see appendix 1). Indeed, 2008 saw further establishment, functionality and consolidation of voluntary offset standards and increased market transparency (Hamilton et al. 2009). Though a combination of voluntary and regulatory markets would most likely be the best option, there is a tradeoff between rigor and flexibility that could raise or lower barriers for small-scale projects.

II.B.2. Marketability of Small-Scale Forestry Credits

The price of forest carbon on the regulatory market is likely to be lower than offsets from alternative energy projects (Smith & Scherr 2003), both as a result of methodological concerns such as permanence and the issuance of temporary credits (Smith & Scherr 2003), and as a result of the relative cheapness of preventing further deforestation as compared with other types of mitigation (Stern 2006; van Kooten et al. 2002). Lower prices could drive up demand; however, lower prices could also mean that most small-scale projects are not economically viable under current institutional arrangements and requirements. New methods and institutions would need to be developed for forestry offsets to reach their potential for cost-effectiveness (Stern 2006) and for small-scale projects to participate (see section II.D. and II.E.).

Forestry offset projects also offer a marketable charisma that could drive demand, particularly on the voluntary market where offset credits of high quality are able to generate higher prices than on the regulatory market (Hamilton et al. 2008). Purchases under a compliance trading scheme such as the European Union Emission Trading Scheme (EU ETS) or the CCX tend to be focused on a commoditized carbon product to meet requirements. Co-benefits are irrelevant to both pricing and purchasing. Research suggests that the story behind the credit—such as how it was generated and its environmental and social co-benefits – is an increasingly relevant component of its value on the voluntary market as consumers become educated about what constitutes a quality carbon offset (Hamilton et al. 2008). One study shows that 40% of European voluntary carbon purchasers would pay a premium for carbon obtained from projects with either environmental or sustainable development benefits (Taiyab 2006). Another survey of more than 70 suppliers to the voluntary carbon market found that social values, additionality, environmental quality, and certification were more influential purchasing criteria than price, advertising, or convenience (Hamilton et al. 2007). Finally, forest-based offsets are generally easier to explain to customers than offsets based on complex technology (Hamilton et al. 2008).

II.B.3. Significant Acreage

Small-scale forestry represents a significant and growing piece of overall forestry both abroad and in the U.S. Thirty five percent of all U.S. forest lands are family forests (Butler 2008), with over 90% of ownerships being less than 41 hectares (Butterfield et al. 2005). Metropolitan areas (or urban counties) support nearly one quarter of the nation's total tree-canopy cover, a figure that is growing (Dwyer et al. 2000); urban areas in the lower 48 United States doubled in area between 1969 and 1994 (Nowak & Crane 2002). The last few decades have seen a dramatic growth in the acres owned and managed by forest communities (Agrawal Chhatre & Hardin 2008; Molnar 2003) to about a quarter of developing countries' forests (White & Martin 2002). Many countries are moving towards greater empowerment of local communities over forests because participatory forestry is thought to be a cost effective and 'fairer' model for forest management than insufficient and inefficient state forest management (Charnley & Poe 2007; Skutsch 2005).

Given the above facts, it's reasonable to say that focusing carbon sequestration management solely on national, state, or large-scale-industrial forests precludes a significant percentage of forestland, comprised of perhaps individually marginal but collectively significant holdings. Conversely, investing in management by small-scale forest landowners and communities, including urban forests, improves the long-term sustainability of significant forest acreages.

II.B.4. Untapped Potential of Land-based Climate Change Mitigation

Land-based activities represent one of the most significant untapped opportunities for mitigating climate disruption (Streck et al. 2008; Malmsheimer et al. 2008). Avoided deforestation has been deemed one of the most cost-effective strategies (despite the high transaction costs), both because of the dual opportunity for reducing emissions and sequestering carbon, and because of the low cost of land and labor as compared to, say, developing a national fleet of hybrid cars (Stern 2006; Malmsheimer et al. 2008). Depending upon the period examined, land use change is estimated to have added 20-30% (Harmon 2009), some say as much as 45% (Malhi et al. 2003), of the increased carbon dioxide in the atmosphere since the dawn of the industrial revolution. In 2007, U.S. forests stored approximately 43,163 Tg C (including aboveground and belowground biomass, dead wood, litter and soil) and sequestered about 910 Tg CO2e, which is equivalent to 12% of U.S. annual emissions from all sectors[7] (U.S. EPA 2009). Globally, changes in forest management could induce future carbon sequestration adequate to offset an additional 15-20% of CO2 emissions (IPCC 2001). Urban trees have an annual sequestration rate of 84 MtCO2/yr[8] (Nowak & Crane 2002), and the potential for expanding urban forests for both direct and indirect benefits on mitigating climate change makes them an increasingly important consideration (McHale et al. 2007; Malmsheimer et al. 2008).

Though forests do not represent a permanent solution to climate change, managing for carbon could buy valuable time as work to find alternative sources of energy progresses (Klooster & Masera 2000). What's more, active forest management for carbon can play a critical role in adapting to climate change by minimizing its negative effects on forests while maximizing positive ones (Malmsheimer et al. 2008).

II.B.5. Payment for Ecosystem Services could Reduce Land Conversion

Lack of payment for ecosystem services can be seen as a major reason why communities and landowners allow their forests to degrade (Klooster & Masera 2000; Skutsch 2005; Bayon et al. 2007; Portela, Wendland & Pennypacker 2008), which, in turn, can be viewed as a failure of policy to correct a failure of markets (Portela et al. 2008). Despite the fact that small-scale and community landowners often retain forests for reasons other than profit, smallholders are more likely to convert forests to other uses than larger landowners or publicly owned forestland in the National Forest System (Malmsheimer et al. 2008). For many private landowners in the U.S., the economic reality of increasing land value and property/inheritance tax favors cutting rather than conserving (Gunn et al. 2008; Malmsheimer et al. 2008). In many places of the world, such as Costa Rica, returns on investment are higher for agriculture than for sustainable forestry (Chomitz et al. 1999). Policy tools that work to incentivize production of goods and services using low-carbon technology, such as a cap-and-trade program (move this up), will result in a higher cost of living and increasing pressure on forests for oil substitutes. These pressures will impact small land-holdings and urban forests most, making them even more susceptible to mismanagement or conversion.

[7] EPA data are reported in teragrams (million metric tonnes) of CO2 equivalent (Tg CO2).

[8] Nowak and Crane indicate that urben trees sequester 22.8 million tC/yr. One tonne of carbon equals 3.667 tonnes of CO2.

Maintenance of forest cover on smaller private properties could provide more carbon offsets per hectare compared to the baseline situation (Chomitz et al. 1999). What's more, carbon markets, in theory, could compensate landowners and communities for using their forests (or tree canopy, in the case of urban forestry) for the global good (Pearce 2000; Portela et al. 2008), as well as help alleviate the cost of mitigation for the community (Klooster & Masera 2000).

II.B.6. Management of Existing Forests Provides Social and Ecological Benefits

Experience so far indicates that afforestation and reforestation projects tend to be low-labor input schemes, owned by a single organization, involving monocultures of fast growing species, and providing little in the way of community or ecological co-benefits (Skutsch 2005; Klooster & Masera 2000). Carbon-related forest activities have been grouped into three categories: those that reduce degradation and deforestation, those that increase the stock of biomass, and those that sustainably produce woodfuel as a substitute for fossil fuels (Skutsch 2005). Under the Kyoto Protocol, "co-benefits" is a term that is applied to all benefits outside the reduction or absorption GHGs. Co-benefits include biodiversity protection, hydrological services, soil formation, community development, subsistence food and timber, social cohesion and identity, economic alternatives to converting forests to pastures and field crops, resistance to extreme weather conditions, and tourism (Chomitz et al. 1999; Klooster & Masera 2000; Pearce 2000; Skutsch 2005; Stern 2006; Hamilton et al. 2008; Portela et al. 2008). While many co-benefits fall outside of carbon-related activities, such as watershed protection, many do not, such as economic alternatives leading to avoided deforestation.

Although afforestation and reforestation projects are cheap and efficient in the short term, avoided deforestation and secondary forest regeneration under the right conditions (move) could be a much more cost effective means of reducing atmospheric carbon in the long run, not only because of the double edge of sequestration and avoided emissions, but also because co-benefits can enhance economic and ecological returns on investment (Klooster & Masera 2000; Smith & Scherr 2003; Skutsch 2005; Stern 2006). Many of these co-benefits can be viewed as ecosystem services (of which carbon is but one) that would be better conserved if the community were reimbursed for their protection (Pearce 2000; Portela et al. 2008). Carbon financing for small-scale forestry could help fund the goals captured in these co-benefits (Klooster & Masera 2000).

Some research suggests that management of existing forests could have a larger sequestration potential than other mitigation land use options, such as reforestation of abandoned agricultural lands or reduced impact logging (Malhi et al. 2003; Groen, Nabuurs & Schelhaas 2006), and twice as much as plantations according to one study (Klooster & Masera 2000).

While both the U.S. and international literature examine the benefits of forest management vs. plantation sequestration, there is a difference between their foci as it applies to small-scale participation. U.S. literature tends to focus on the interplay between ecology and private land ownership and/or conservation. For example, Ruddell et al. (2007) and Malmsheimer et al. (2008) assert that carbon management activities, such as the sale of carbon credits, wood products and bioenergy, can improve forest landowners' returns on their land and bolster interest in forest management, thereby tipping the scale toward more conservation and less parcelization. Malmsheimer et al. (2008) go on to say that traditional silvicultural treatments focused on wood, water, wildlife, and aesthetic values are fully amenable to management for carbon.

The international literature is more focused on the interplay between ecology and equity for forest users. There is an assertion that, without provisions for forest access and/or carbon rights, ownership by forest users, afforestation and reforestation could be the most socially inequitable of all sink possibilities, as they could remove considerable areas of non-forest land from use by local populations for 60 years or more (Saunders et al. 2003; Skutsch 2005; Smith & Scherr 2003). Projects that reduce access to land, food, fiber, fuel, and timber resources without offering alternatives may result in carbon leakage as people find needed supplies elsewhere (Watson et al. 2000). Large-scale plantations and strict forest protection pose the greatest risk to communities (Smith & Scherr 2003). Small-scale, community afforestation/reforestation projects mixed with other land uses (such as agroforestry or forest regeneration (what is it?)) and avoided deforestation through multiple-use forest management possess the greatest potential to provide local benefits, though the enabling environment needs to be carefully considered and crafted, where possible, to produce positive results (Smith & Scherr 2003).

II.B.7. The Case of Urban Forestry

Co-benefits from urban trees are unique. In addition to sequestering carbon and providing renewable biomass fuel, urban trees can help reduce the use of fossil fuel-based energy through shading and blocking wind and leveling out micro-climate variations within cities (i.e., energy savings effect) (Dwyer et al. 2000; Nowak & Crane 2002; Pataki et al. 2006; USDA Forest Service 2007; McHale et al. 2007). However, the literature disagrees on how much carbon can be avoided through the energy savings effect. One simulation suggests that, due to the open structure of urban forests (which fosters larger trees) as well as the energy savings effect, individual urban trees may store about 4 times more carbon than the single forest-stand tree (Nowak & Crane 2002). This simulation did not account for carbon released by management practices, which could transform urban trees into net emitters; on the other hand, the simulation did not account for urban soils, which store carbon as well.

Another study that took fossil fuel emissions from forest maintenance/management into account suggested that avoided emissions due to energy savings equaled only 37% to slightly more than 100% of direct carbon sequestration from growth, depending on location (McPherson, Simpson, Peper, Maco & Xiao 2005). Yet another study found that net energy reduction effects can double or even triple the carbon savings of a tree (McHale et al. 2007). Pataki et al. (2006) warns that many of the calculations behind conclusions on avoided carbon from the energy savings effect are based on model simulations that include untested assumptions about urban vegetation and surface processes. However, the literature finds that at least some carbon benefit does exist beyond strictly biomass sequestration.

II.C. Lessons Learned: Barriers to Access in Forest Certification and Wood Product Markets

The previous section synthesized the recent literature on opportunities for and the benefits of small-scale forestry participation in carbon markets. Markets for ecosystem services are nascent, and researchers point to gaps in knowledge regarding costs and benefits of forestry participation in carbon markets (Richards & Stokes 2004; Skutsch 2005). Furthermore, little published research exists on private, small-scale landowner participation in carbon markets. However, for some time forestry has been used as an economic development and poverty alleviation tool to secure subsistence rights, foster appropriate stewardship and increase household income (Saunders et al. 2003; Charnley & Poe 2007; Scherr et al. 2004). Hence, much can be gleaned from the literature on small-scale and community forestry participation in other forest product markets.

This section provides a summary of barriers to participation in wood product markets and forest certification markets. The literature suggests that there are barriers to participation in large, international markets for small-scale producers. While doing much to strengthen forestry's role in providing a safety net for the poor, forestry development and aid strategies in developing countries have done little to increase local cash income for small-scale producers (Scherr et al. 2004).()In the U.S., most small-scale landowners do not participate in timber markets (Rosen & Kaiser 2003; Butler 2008).

II.C.1. Wood Products

Small forestry enterprises face two general barriers to operational success, namely insufficient market power and underdeveloped marketing expertise and knowledge (Butterfield et al. 2005). Communities and small-scale landowners lack sufficient market power due to external forces such as globalization and industry consolidation, and internal factors such as low harvest volumes/infrequent harvests (sometimes following decades of no harvest) and low economies of scale. On the global scale, lack of market power is related to increased competition from cheaper foreign imports, continued competition with illegal logging, volatile markets, and forest development policy that is macro-economically motivated, favoring an internationally competitive industrial plantation model over environmental or equity considerations (Klooster & Masera 2000; Smith & Scherr 2003; Scherr et al. 2004). These forces shift market power to higher market chain players, such as processors, the export industry or larger producers with greater capital (Scherr et al. 2004; Butterfield et al. 2005).

Communities and small-scale landowners also often lack essential managerial capacity, marketing expertise and knowledge, placing them at a disadvantage in the marketplace (Klooster & Masera 2000; Butterfield et al. 2005). This lack can be linked to limited opportunities for building experience, time constraints, an absence of markets for tree species, lack of knowledge about existing markets, lack of capital and technical assistance, or simply a prioritization of other uses for forests (e.g., subsistence, recreation, or investment). For landowners and communities, these factors may mean that harvest returns are not maximized in a fast-paced, highly competitive, changing market (Molnar 2003; Butterfield et al. 2005). The majority of NIPF landowners in the U.S. do not implement basic practices, such as soliciting competitive bids, when conducting a timber sale and most do not seek professional advice (Rosen & Kaiser 2003). In developing countries, corruption, inequitable power dynamics and lack of internal accountability also plague attempts to build capacity for community enterprises (Klooster & Masera 2000). Key actors and functions in the "value chain" from producer to consumer as well as institutional support may be missing (Scherr et al. 2004).

Attempts to overcome barriers include education and outreach, horizontal integration (e.g., cooperatives), vertical integration (e.g., purchasing portable sawmills or contract cutting), local suppliers partnering with larger private industry (though industry may not always be interested), and identifying and targeting new niches with sufficient buying power (Molnar 2003; Scherr et al. 2004; Butterfield et al. 2005). Forest owner associations, often together with the forest industry, have played important roles such as negotiating sales and logistics on behalf of several forest owners, centralizing purchasing, creating sort yards, or providing information and guidance. One problem with vertical integration is that it requires that the small enterprise must, in turn, develop markets for those products itself (Butterfield et al. 2005), and some suggest that rather than relying on vertical integration, new market trends allow different producers to occupy different parts of the value chain more readily (Scherr et al. 2004; Practical Action Consulting 2009).

Scherr et al. (2004) assert that market conditions facing small-scale producers in developing countries have improved because of new sources of demand for forest products and environmental services; diversified supply chains; small-scale, high-productivity forest harvest and processing equipment; and liberalizing economies. However, for low-income producers to realize their potential, forest business needs to be developed (e.g., forge business partnerships, pursue new financing, encourage business service providers, establish enterprise development programs, target education and research, and work together to overcome value chain "gaps") and policy barriers need to be removed (e.g., secure local rights, reduce regulatory burden, involve producers in policy negotiations, and protect the poorest).

II.C.2. Forest Certification

Experiences with forest certification apply even more so to carbon markets in that they offer lessons on linking small-scale forestry to alternative, nascent markets that encourage ecological enhancement. Forest certification is a market-based, voluntary instrument that was created in the 1990s. It was designed as a means of identifying forest products as sourced from a forest or forestry operation that follows a minimum standard of good practices, including responsible processing of wood harvested from a sustainably-managed forest (Molnar 2003). Certification can increase the sustainability of forest management, create new standards for biological diversity and habitat protection, strengthen land tenure rights and improve worker conditions for indigenous communities, offer a price premium and market access, and give a serious voice in forest policy discussions to indigenous communities and recognition for good forestry practices to landowners who otherwise might be overlooked (Molnar 2003; Butterfield et al. 2005).

Overall, forest certification has had an extremely successful history, if judged by the speed with which institutions have developed and acres have been certified (Molnar 2003). For small-scale enterprises, there are clear examples where certification has not only increased market access but has also resulted in premium prices (Butterfield et al. 2005). However, these examples are not the norm, as most small-scale landowners and communities who have undergone certification are not yet assured of a price premium (Rickenbach 2002), and those who are considering certification face significant barriers. This is especially true in developing countries, despite the fact that many international aid organizations have worked to certify the world's poorest as a way to increase income. Whereas 70% of certified land was located in developing countries in 1996, currently that number is only 8% (Scherr et al. 2004).

The overarching barrier is cost as compared to scale (i.e., intermittent and low-volume harvests). Other barriers include steadily increasing requirements for management plans and extensive recordkeeping, universally applicable procedures that are overly-complex or irrelevant, lack of national or regional institutional capacity to assist small-scale landowners, competition from cheaper plantation wood, reductions in protective tariffs in countries undergoing macroeconomic reforms, lack of a guaranteed price premium to offset costs, and an imposition of "community" on diverse and disconnected groups (Rickenbach 2002; Molnar 2003; Scherr et al. 2004; Butterfield et al. 2005; Kilgore et al. 2007). Many communities and small-scale enterprises lack even the basic requirements for certification (e.g., only 5% of NIPF landowners in the U.S. have a written management plan, although this does not suggest poor management [Rosen & Kaiser 2003]), and many find it difficult to generate missing data to fulfill requirements such as yield and regeneration monitoring or endangered species (Molnar 2003; Butterfield et al. 2005; Kilgore et al. 2007).

Motivation to certify is often lacking because values are not aligned. Certification is premised on the idea that sustainable, long-term management is desirable. For small-scale owners who are oriented toward other objectives, certification's emphasis on sustainable forestry and timber harvesting may make it unattractive or uninteresting (Rickenbach 2002). At times certification can be perceived as controlling and top-down (Kilgore et al. 2007). Further complicating the issue is the fact that the donors who have financed the first generation of certification are phasing out subsidies, creating a pending financial crisis for existing and new certified operations (Molnar 2003). This crisis is related to the challenges of creating a self-sustaining market demand for a product that isn't definable by any visible appearance or physical difference, but is based on significant consumer awareness (Rickenbach 2002). With many supporters of certification promoting the establishment of certified wood as a global market standard (for example, through government procurement policies), certification is inadvertently serving to erect an additional market barrier for low-income producers of wood products (Scherr et al. 2004).

Attempts to overcome barriers have included outreach, education programs, flexible procedures adapted to small-scale and community needs (such as phased certification), labeling of FSC wood products, and group certification (Rickenbach 2002; Scherr et al. 2004; Butterfield et al. 2005; Kilgore et al. 2007). Most countries with high levels of certified small-scale forestlands have very organized regional forest owner administrative structures or associations, which either have enabled thousands of forest holdings to be group certified or have provided support to individual communities to achieve certification (Molnar 2003; Kilgore et al. 2007). Demand from local mills rather than large box stores and foreign markets may create a stronger link to small-scale enterprises (Rickenbach 2002).

Some literature suggests that, though small-scale landowners in the U.S. are interested in forest certification, they do not want to bear the heavy costs (Kilgore et al. 2007). Communities with a vested interest in forest resources tend to manage more sustainably (Charnley & Poe

2007). However, forest certification could be viewed as a long-term gain to be subsidized by society (i.e., payment for ecosystem service) rather than through income generation from wood product markets (Molnar 2003; Portela et al. 2008). Finding ways to enable small-scale forestry to access forest certification is doubly important because certification is often a prerequisite for carbon market participation.

II.D. Barriers to Accessing Carbon Markets

> "The forest carbon emissions market has experienced limited development because of poor understanding of the significant role of forests in climate change, complex and burdensome rules and constraints that limit potential demand, and technical and methodological concerns surrounding the quality of forest carbon" (Portela et al. 2008, pg 15).

The previous section summarized barriers to wood product and forest certification markets for small-scale forestry enterprises. A new market has emerged; small-scale and community forestry initiatives are seeking to capture the potential benefits of a highly competitive market for carbon credits. However, much of the literature has found similar barriers as those experienced in other markets, such as scale, cost, complexity, information, and organizational capacity (Chomitz et al. 1999; Klooster & Masera 2000; van Kooten et al. 2002; Smith & Scherr 2003; Skutsch 2005; Boyd et al. 2007; Minang et al. 2007; Gunn et al. 2008). Market trends thus far seem to confirm the existence of these barriers. For example, the World Bank reported that from 2004 to 2006, the average transaction size increased from 1.24 million tCO_2e to 1.90 million tCO_2e for both markets combined (Bayon et al. 2007). Small sized projects (defined as 5,000 to 15,000 tCO_2e/year) captured only 9% of the VCM in 2008 and micro sized projects (defined as less than 5,000 tCO_2e/year) captured 3% (Hamilton et al. 2009). This section explores these barriers under several categories: scale and cost, lack of technical expertise, complexity and an uncertain market, underdeveloped market, methodological concerns, social equity concerns, lack of institutional capacity, and the case of urban forestry. The categories are interrelated and reinforcing.

II.D.1. Scale and Costs

The largest barrier for small-scale and community forestry is cost as compared to scale (Skutsch 2005; Gunn et al. 2008). Not only do developers on the international regulatory market look for large-scale projects (Taiyab 2006), small-scale sellers are forced out of the market because of high per unit production and transaction costs. Production costs include the cost of preparing the land, planting the trees, and a consideration of opportunity costs of land (Richards & Stokes 2004; Malmsheimer et al. 2008). Transaction costs are the costs of "arranging a contract *ex ante* and monitoring and enforcing it *ex post*, as opposed to production costs, which are the costs of executing a contract" (van Kooten et al. 2002, pg 560). Common examples of transaction costs are related to "search costs" (i.e., searching for buyers, sellers, and relevant information), formulation of a baseline through a forest inventory, verification, forest certification, drafting and implementing conservation easements, developing new accounting mechanisms to track the annual net change in carbon stocks, aggregation or broker fees, monitoring and remeasurement costs, annual reporting expenses, and possible costs of additional insurance policies (Watson et al. 2000; van Kooten et al. 2002; Skutsch 2005; Malmsheimer et al. 2008; Gunn et al. 2008).

Many estimates of the cost of forestry projects do not take transaction costs into account (van Kooten et al. 2002; Smith & Scherr 2003; Richards & Stokes 2004; Malmsheimer et al. 2008). Transaction costs per unit of carbon are higher for forestry offset projects than clean energy technology (Ruddell et al. 2007; Malmsheimer et al. 2008). Furthermore, they are higher for small-scale and community projects or multiple-use forest management than large-scale plantation or strict forest protection (Smith & Scherr 2003). Van Kooten et al. (2002) suggest compensating landowners for practices outside of typical management. Gunn et al. (2008), who developed a pilot project designed to engage small-scale landowners in Maine in carbon markets, suggest that some kind of cost-sharing is absolutely necessary if participation for small-scale landowners is to become feasible.

Because of the lack of federal regulation, the anticipation of regulation in the future, and the need to legitimize transactions on the voluntary market, multiple registries and programs have arisen in the U.S. Each has its own rules for participation (Ruddell et al. 2007; Malmsheimer et al. 2008; Pearson, Brown & Andrasko 2008). These rules are related to establishing carbon baselines, the pools of carbon that can (or must) be registered (i.e., above ground, below ground, or harvested wood products), which types of forestry activities are eligible, monitoring methods, verification rules, and timing of payments. The difference in protocols can raise transaction costs and have a significant impact on profitability for the landowner (Ruddell et al. 2007; Pearson et al. 2008). Pearson et al. (2008) found that protocols requiring a high level of precision (i.e., include all carbon pools, even pools with a smaller carbon content such as understory herbaceous vegetation; and require frequent sampling from multiple non-contiguous plots, thereby increasing logistical costs) were not cost-efficient for landowners, whereas protocols with more flexibility would be. The same study found that applying different protocols to a single project resulted in a baseline estimate of 0–66,690 tCO2e, and final sequestered carbon totals (after 60 years) that varied between 118,044 and 312,685 tCO2e—a factor of 2.5 difference. The authors recognized the ever-apparent tradeoff between precision and lowering barriers to participation, and made suggestions for finding a balance.

The opportunity costs of losing management flexibility to fulfill requirements for permanence may be too high for small-scale or community participants (Smith & Scherr 2003; Ruddell et al. 2007; Bigsby 2008; Malmsheimer et al. 2008). What's more, payback can be delayed years by market instability or protocol constraints. When coupled with the heavy initial investments, ongoing costs and opportunity costs, small-scale project landowners may not have the inclination or the capital to participate. The greater the number of regulatory bodies that need to be involved, such as local, national, and international institutions as in the case of the CDM, the greater the complexity and the higher the cost. In Costa Rica, for example, research shows that many smallholder peasant farmers dropped out of the program—in spite of the penalties—to regain access to their land for other uses that would provide returns in the shorter term (Boyd et al 2007 Gutierrez, 2004).

II.D.2. Lack of Technical Expertise

Enhancement of carbon sequestration to full capacity (i.e., for both adaptation to and mitigation of climate change) depends on active management (Birdsey, Pregitzer & Lucier 2006; Ruddell et al. 2007; Malmsheimer et al. 2008). As stated in previous sections on other markets, in developed countries many small-scale landowners do not pursue commercial forest management as a primary objective (Butler 2008), leading to "management abandonment" (Malmsheimer et al. 2008). This is in part related to values (Rickenbach 2002) and in part related to the difficulty of implementing forest management practices on small tracts (Malmsheimer et al. 2008). In developing countries, communities are lacking in technical expertise and managerial capacity. However, task allocation needs to be carefully considered, as some community capacities are ignored (add) and, instead, outside consultation is used, thereby increasing transaction costs (Skutsch 2005; Minang et al. 2007).

Furthermore, there is a disconnect between existing institutions for sustainable forest management and the 'new global paradigm' of climate disruption. First, the impacts of climate change are not fully understood; without good information about future environmental conditions, it's difficult to make good management decisions for adaptation (Malmsheimer et al. 2008). Second, past silvicultural research has focused on timber production without complete accounting the carbon cycle and other forest ecosystem services, so existing experiments and analyses are inadequate for informing land managers about best management practices for carbon (Birdsey et al. 2006; Streck et al. 2008).

II.D.3. Complexity and Market Uncertainty

Related to a lack of technical expertise is a lack of knowledge of an uncertain market. The price of carbon varies dramatically; in 2007, the price range for an offset from an afforestation/reforestation project was less than $5 to more than $50 on the over-the-counter (OTC – see footnote page 10) voluntary market (Hamilton et al., 2008). The future price of carbon is uncertain; the risk that future liability for forest losses will be higher than what the carbon was sold for may be too high for small-scale land owners. It's also difficult to know when to sell carbon or what silvicultural practices are cost effective to use, as markets are only just developing and current prices may not reflect true value for carbon (Bigsby 2009). The uncertainty surrounding carbon markets hampers the ability of small-scale forestry offset providers to reliably develop cost-effective projects.

Complexity contributes to the uncertainty associated with carbon markets. In a review of cost studies of forest carbon sequestration projects over 12 years, Richards & Stokes (2004) discovered a cost range of $10 to $150 per ton of carbon, but could not compare costs based on face value due to the inconsistent use of terms, geographic scope, assumptions, program definitions, and methods. For producers, cost effectiveness is not only dependant on a highly variable commodity price and variable property characteristics, but also on the regime under which credits are being calculated, whether the project is occurring in a developed or developing country, and what type of forestry is being employed (Chomitz et al. 1999; van Kooten et al. 2002). Chomitz et al. (1999) described Costa Rica's payment for forestry environmental services program, stating that the number of saleable offsets from a parcel is based on deforestation risks (i.e., an assurance of additionality) as well as land characteristics. These risks vary from negligible to high, depending on a multitude of factors, including local agroclimatic conditions, enforcement efforts, access costs, landowner characteristics, and the type of forestry employed. Minang et al. (2007) explored community capacity for implementing CDM forestry projects in Cameroon, and found that the rules associated with determining additionality and social acceptability are unfairly complex, making participation by small-scale producers in the poorest countries an impossibility. Likewise, Gunn et al. (2008) asserted that it is unlikely that a given small family forest landowner in Maine will have sufficient data and historical records to prove additionality under the Voluntary Carbon Standard protocol, one of the more widely accepted protocols internationally.

Cost effectiveness varies widely across forestry activities. In a study in Chiapas, Mexico, de Jong, Tipper and Montoya-Gomez (2000) found that a land-use change from agriculture to carbon sequestration through forestry and agroforestry would be incentivized by a price per ton of carbon of U.S. $5-$15, whereas McHale et al. (2007) found that the cost of sequestering a ton of carbon in an urban tree can exceed its market price by $140 to over $1200, assuming a price of $3 to $13/ton, even with energy savings effects accounted for. Complexity such as this compromises the ability of a small-scale landowner to participate in carbon markets, even with the assistance of mediating institutions.

II.D.4. Underdeveloped Market

While the opportunities inherent in a market growing as fast as present-day carbon markets are undeniable, the largest market (i.e., the regulated market) places land-use projects at a disadvantage. Developing countries are experiencing deforestation at a much faster rate than developed countries, and the flexible mechanism that allows developed countries to purchase offsets from developing countries, the CDM, limits the amount of land-use-based credits that may be purchased to 1% of base year emissions, times 5 (i.e. about one fifth of developed countries' total emission reductions, per year, over the 5 years of the commitment period) from afforestation and reforestation projects only (i.e., excludes offsets resulting from avoided deforestation and forest management). The second flexible mechanism, Joint Implementation (JI), doesn't limit the ability of offsets from forestry to meet commitments and does include forest management. However, JI doesn't accept avoided deforestation, exists only between developed and other developed countries or countries with economies in transition, and the procedures and policies for issuing offsets under JI are still in their infancy (Scholz & Jung 2008).

The GHG emissions reduction strategies of the Kyoto Protocol are designed to focus on energy and industrial emissions. Other regulatory schemes have followed Kyoto's example with regards to forestry offsets. For forest offsets, RGGI accepts afforestation (i.e., does not include reforestation, avoided deforestation, or forest management) for a portion of emissions reductions (3.3% of total emissions) (Gunn et al. 2008; Hamilton et al. 2009). While forestry-based carbon sequestration projects are an accepted source of credits under NSW GGAS, the credits must be sourced from local projects. Thus, outside of Australia, the voluntary markets are the primary source of demand for forest-related sequestration credits and the only source of demand for avoided deforestation credits (Hamilton et al. 2008).

II.D.5. Methodological Concerns

Methodological concerns such as leakage, additionality, permanence, and the fungibility of credits from different markets are all ongoing concerns (Watson et al. 2000; Malhi et al. 2003; Richards & Stokes 2004; Skutsch 2005; Bayon et al. 2007; Streck et al. 2008; Harmon 2009). The underlying concern is that land-use offsets could offer a cheaper but impermanent alternative to changing energy consumption patterns, reducing pressure to invest in energy conservation and renewable energy (Greenpeace 2003; Skutsch 2005; Birdsey et al. 2006; Stern 2006; Streck et al. 2008; Harmon 2009). Related to this concerns is the fear that afforestation/reforestation might lead to the replacement of existing, older growth forest with faster growing, easier to manage, more profitable plantation forest, as discussed in previous sections (Skutsch 2005).

Methodological issues that plague forestry in general apply to community and small-scale forestry as well, in many cases more so. Establishing a baseline and determining what growth is additional to the baseline is not as cut and dry for existing forests, such as urban ecosystems and community forests, as it is for new or replacement forests (Skutsch 2005; Peace 2007; Ruddell et al. 2007). What's more, both the average carbon store and the carbon balance vary over time, in part because of the nature of the carbon cycle in tree biology. Small landowners in particular will be susceptible to a boom and bust cycle, which could affect the desirability of their credits on the market (Harmon 2009).

Combining goals such as economic benefits with the relatively new goal of management for carbon is also tricky. Community and urban forestry are not one activity but a combination of many, and each may have a different effect (positive or negative) on the carbon balance (Skutsch 2005; Harmon 2009). Bigsby (2009) states that the standard approach to carbon trading uses an upfront, single payment that is effectively the permanent transfer of a carbon asset. This either means a loss of management flexibility or represents an assumption that producers have a large enough forest area under management to provide a stable (i.e., permanent) reservoir of carbon over the usual cycle of growth and harvest of an individual forest stand. In other words, the implicit 'optimal' forest owner for participation in carbon markets is an owner who will never harvest, or is analogous to the large forest estate model where there is enough forest to cover multiple land uses. While the issues of uncertainty and risk in the market, high opportunity costs, and loss of management flexibility are common to a range of forest owners, they may be amplified for small forest owners (Bigsby 2009) who simply may not have the acreage. Given the expected low price for temporary carbon credits and the high transaction and opportunity costs, carbon sequestration is not likely to be the main goal of land ownership, so must be considered in the context of a wider set of ownership goals (Birdsey et al. 2006; Boyd et al. 2007).

Because of poor understanding of the subject from the start of international negotiations (Trines 2008; Ruddell et al. 2007), accepted forest carbon accounting principles for additionality, baseline, and permanence under UNFCCC do not adequately address all aspects of using forests to prevent and reduce GHG emissions, such as wood substitution for oil and oil-based products or sequestration in wood products (Ruddell et al. 2007; Malmsheimer et al. 2008). However, there is active work going on to find acceptable forest management and sustainable development criteria for forest offset projects, such as ENCOFOR, Plan VIVO, Social Carbon, and the

CarbonFix. A forest management protocol recently created for the CCX includes wood product sequestration. Multiple protocols are being developed in the U.S.; however, as stated previously, these protocols have widely varying requirements and accounting results.

In the past two years, the desire to halt rapid deforestation has generated interest in including REDD (Reduced Emissions from Deforestation in Developing countries) in post-Kyoto Protocol development (Skutsch 2005; Bayon et al. 2007; de Jong et al. 2007; Hamilton et al. 2009). Skutsch (2005) states that steep increases in future commitments under the Kyoto Protocol will create more room for sinks without compromising energy efficiency and renewable alternatives.

II.D.6. Social Equity Concerns

Another reason for the underdevelopment of the forest carbon offset market is concerns about social equity impacts. What little literature exists from developed countries mainly refers to the inequity of large-scale industrial forest owners having a market advantage over small-scale forest owners because of scale vs. cost (Gunn et al. 2008; Malmsheimer et al. 2008). International literature, on the other hand, contains some of the strongest cautions regarding potential social inequities of forestry participation in carbon markets (Smith & Scherr 2003; Saunders et al. 2003; Skutsch 2005). Over 90% of the world's poorest people depend on forests for their livelihoods (Scherr et al. 2004). On the one hand, carbon projects from agriculture, forestry, and other land uses represent one of the few means by which many of the world's poorest people will be able to participate in and benefit from the global carbon market (Taiyab 2006; Streck et al. 2008). On the other hand, concerns have been voiced about large-scale plantations or pristinely preserved wilderness taking livelihoods away from those without voice or power (Smith & Scherr 2003), and reductions of technological and financial transfers from developed to developing countries (Brown & Corbera 2003).

International regulatory carbon markets are not like standard markets for goods, for which institutional arrangements evolve autonomously over long periods of time, at least theoretically. Rather, they are being established relatively quickly by a set of national and international parties. Because carbon sequestration projects occur where the majority of poor people are concentrated, where conflicts over land and resources are not uncommon, and where livelihood conditions are complex and subject to instability, issues of market efficiency and effectiveness cannot be separated from those of equity (Brown & Corbera 2003; Corbera et al. 2007; Boyd et al. 2007:251). As Saunders et al. (2003:223) put it, "A carbon entitlement will create new property, a new stick to be added to the bundle of rights already associated with forests, a stick that enables one actor to exclude others from the use of the forest." The greater the number of stakeholders in the process, the greater the danger that control and profits will fall into the hands of powerful groups at international, national and local levels (Skutsch 2005).

Carbon sequestration projects started in Mexico under the AIJ pilot phase have been well studied. These studies suggest that although these projects have resulted in benefits accruing to certain sectors of the population, their equity achievements have been disappointing (Brown & Corbera 2003; Smith & Scherr 2003; Boyd et al. 2007; Corbera et al. 2007). Imposed institutional arrangements did not fully take into account local contexts, such as social power relationships between community members and long-established traditional management and property rights regimes, both customary and de facto.

Many authors say protocols have not yet adequately integrated reporting requirements at the international level for forest offset projects to ensure fair and responsible development at the local level (Greenpeace 2003; Smith & Scherr 2003; Skutsch 2005; Corbera et al. 2007). Tradeoffs may often exist between the social co-benefits of projects and their attractiveness to investors (Smith & Scherr 2003). The limited data available so far indicate that large-scale industrial plantations and strict forest protection are more economically viable in carbon markets than most community-based projects, primarily due to the higher transaction costs of projects involving local communities (Smith & Scherr 2003).[9] However, most community forestry development efforts, such as those under the CDM, fail to account for ecosystem services (Portela et al. 2008). Therefore, CDM project host countries may not make the best decisions, as they are not fully awareness of costs and benefits accruing to both the inhabitants of the host country and the world community at large (Smith & Scherr 2003).

II.D.7. Lack of Institutional Capacity

Closely related to equity concerns is a lack of accountability and institutional capacity both in the developed and developing world. National policy frameworks and regulatory support are at times lacking in developing countries. Studies show that bilateral projects are most successful where existing institutions are strong, such as local forest associations or institutions protecting access rights (Brown & Corbera 2003; Smith & Scherr 2003; Boyd et al. 2007; Corbera et al. 2007; Minang et al. 2007). State level institutional capacity in the U.S. is still under development (Gunn et al. (2008).

II.D.8. The Case of Urban Forestry

Due to its distinctive aspects, urban forestry as a method of carbon capture requires understanding and additional measurement, for which the carbon marketplace is not prepared. Though protocols are currently being drafted for documenting urban forestry's ability to offset greenhouse gas emissions (e.g., the Forest Service's Center for Urban Forestry Research, the Climate Action Registry), the institutional challenges of market access have not yet been addressed (USDA Forest Service 2007).

Research has shown that it may not be cost effective for urban forestry to participate in current markets except in very specific cases. McHale et al. (2007) found that a huge range in cost effectiveness exists, and although urban forests are potentially acceptable and marketable solutions to storing carbon, only very few, specifically designed urban tree planting projects would be cost effective under current market prices.

II.E. Overcoming Barriers

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[9] In some communities the costs associated with developing new community-based social structures for forest management under a CDM project run as much as $325 ha/yr (de Jong 2000).

> "It is generally unwise for inexperienced producer groups to "jump" into complex commercial production and marketing enterprises. … Rather, it makes sense to phase market development over time so that producer capacity can develop the skills needed." (Scherr et al. 2004, pg 86).

The literature highlights several opportunities and barriers to accessing carbon markets for small-scale and community forestry projects. The most significant of these barriers is the fact that transaction and opportunities costs tend to outweigh the economic benefits derived from socially and ecologically responsible projects. The public benefits of existing forests have traditionally far outweighed the private benefits (Trines 2008). There exists a need to rethink existing institutional arrangements( ) to allow livelihoods from forests to continue, while compensating forest owners and users for the ecosystem services under their care.

The assumption behind free market economics is often that markets create themselves in the private domain, into which government intervenes only in the event of a problem. Carbon markets illuminate the reality and necessity of "making a market" that is equitable (Brown & Corbera 2003; Scherr et al. 2004). The importance of the policy environment in defining the resource management options available to communities who depend on forest land for livelihoods is well documented in the international community-based forestry literature (Klooster & Masera 2000; Charnely & Poe 2007; Scherr et al. 2004). Therefore, it follows that government has a part to play in setting up the rules of carbon markets for forestry offsets, something that governments are recognizing worldwide (Hamilton et al. 2009). Indeed, the inclusion of small-scale projects in the final decision on land-use, land-use change and forestry under Article 12 (Decision 19/CP.9) of the Kyoto Protocol is meant to assure that low income communities also benefit from projects under the CDM, specifically by broadening the scope of beneficiaries and thereby reducing transaction costs (UNFCCC 2003; Boyd et al. 2007). How the rules of the game are set up will determine if the opportunity costs are too high for small-scale participants (Skutsch 2005).

Below, a number of strategies drawn from the literature for overcoming barriers to market participation are highlighted.

- Technical and business management training for the preparation, implementation and monitoring of carbon sequestration projects is important. Participatory collaborative schemes between research institutions, local NGOs and community organizations as well as community members with professional training and experience outside the community can assist (Klooster & Masera 2000). Carefully consider community capacities so as to reduce transaction costs (add) associated with hiring outside consultation (Skutsch 2005; Minang et al. 2007).

- The central role of non-governmental organizations in developing demand for carbon offset credits from forestry in voluntary markets has been pointed out by Ruddell, Walsh & Kanakasabai (2006). Strategic alliances between government, NGOs and private businesses could create new market opportunities that overcome regulatory constraints and value chain "gaps" (Scherr et al. 2004).

- The economic reality might be that carbon sequestration would work best as an additional non-timber forest product bundled with other marketed products, tipping the economic balance to make overall management worthwhile (Skutsch 2005; Malmsheimer et al. 2008). It will be important to apply methods that allow for flexibility in local land use decisions and still meet contracted project responsibilities (Boyd et al. 2007).

- Horizontal integration of some kind, such as an aggregating process that funnels many small land owners into a large carbon pool or institution, can help alleviate the problem of high transaction costs. Such an aggregator could create one baseline, utilize one certification process, and alleviate the problems related to the boom and bust nature of the carbon cycle (Skutsch 2005; Harmon 2009). Look for complementarity and compatibility with existing institutions, such as forest certification and state or federal conservation programs (Gunn et al. 2008). Chomitz et al. (1999) suggest advantages to maintaining a monopsonistic arrangement, whereby a government "bundles" ecosystem services for landowners by purchasing all the landowner's services and resells them on foreign and domestic markets.

- Rather than treating landowners as individually representing either an increase or decrease in a contained carbon stock, carbon accounting at the landscape scale might be the better option. It would both recognize the nature and high diversity of forest ecosystems and reduce transaction costs. Carbon policies need to look at whole forests over time, not single plots or stands at a point in time; and distinguish between short-term, minor variations in forest carbon versus those caused by changes in policy or long-term changes in climate (Harmon 2009). Aggregate tree cover and levels of carbon sequestration may remain stable even if there are changes in landuse (Smith & Scher 2003; Boyd et al 2007). Furthermore, practices will be specific to site characteristics and local conditions (Birdsey et al. 2008; Gunn et al 2008). Modeling that captures empirically tested, ecosystem-wide conditions, stand types, and growth rates specific to localities might cut down on the scope of, and therefore the transaction costs for, monitoring and verification (Gunn et al. 2008).

- Creating new financial instruments would help to defray initial investment. Under highly competitive market scenarios, incentive and subsidy programs could be needed to build infrastructure (Klooster & Masera 2000; Skutsch 2005; Scherr et al. 2004). Coordination with existing group structures established in a region or state that have protocols or standards for sustainability or conservation could help (Gunn et al. 2008). Using federal and state cost-share programs, tax incentive programs, and certification programs could also help.

- Bigsby (2008) takes the creation of new financial instruments a step further. As opposed to issuing temporary credits, Bigsby (2008) advocates for the use of a carbon rental and banking system. This system transforms the permanent purchase of an asset into an impermanent rental of carbon (sequestration) services on an annual basis, which would provide a reduction of transaction costs and the kind of flexibility required by small forest owners.

- Further cost analyses and research regarding forest carbon management programs and would help practitioners make better decisions.

- Given the lower transaction costs and that investors on the OTC voluntary market may be willing to spend more per credit on projects that contain bundled co-benefits, some advocate that the voluntary market has the most potential growth for forest offsets (Bayon et al. 2007; Streck et al. 2008; Hamilton et al. 2009). As the VCM has diversified into other project types and buyer preferences, the forestry market's share of transactions has decreased from dominating the market until 2004 to 11% of the market in 2008. However, new entities have continued to develop forest-based carbon projects and yearly sequestered MtCO2e continues to rise (3.3MtCO2e in 2004; 5.0MtCO2e in 2007; 5.7MtCO2e in 2008). Furthermore, forestry experienced the largest growth of any registered offset project type on the CCX (0.2MtCO2e in 2007; 7.0MtCO2e in 2008), attributable to the fact that, among other structural changes related to forestry, the CCX added four new forestry project protocols in 2008 (for afforestation, improved forest management, long-lived wood products, and REDD) (Hamilton et al. 2009).

- For more expensive carbon offset projects, such as urban forestry, a way to harness public interest in economic development and social benefits could be to market credits locally. An increasing number of customers in the VCM, especially in the U.S. and Australia, prefer to buy offsets from projects close to home (Hamilton et al. 2008). Municipalities and local governments have set up voluntary offset programs where credits are from local, state, or regional projects that otherwise would not have occurred.[10] By developing local funding streams, offsets benefit the local community through investment in a sustainable future and local jobs.

- To support the welfare of poor forest communities, there is a need for strong governance institutions, property rights, legal and regulatory frameworks, monitoring and enforcement, and consideration of equity (Streck et al. 2008, Smith & Scherr 2003; Corbera et al. 2007; Saunders et al. 2003; Brown & Corbera 2003). Furthermore, before setting up these institutions, there is a need to understand the local context, to release the assumption that "community" automatically means just and democratic, and to recognize that carbon management may or may not be compatible with other community forestry goals (Corbera et. al, 2007; Skutsch 2005; Chomitz et al. 1999; Brown & Corbera 2003).

- It has been suggested that adaptive management strategies (e.g., co-management, collective action) and/or as much flexibility in requirements as possible will enhance both social and ecological resilience in the face of changing climates and ecosystems (Tompkins & Adger 2004; Brown & Corbera 2003).

III. CONCLUDING REMARKS

Barriers to participation in carbon markets by small-scale and community forestry practitioners exist across many scales and domains. In one domain, the need for fast and focused

[10] (http://www.aspenzgreen.com/offsets_projectPortfolio.cfm, http://www.sfgov.org/site/mayor_index.asp?id=72509)

action in the face of imminent climate disruption is urgent. In another domain, a globalized market has created opportunities, but also unequal power dynamics between those with political and economic clout and those without. In still another domain, tensions exist between forest use and forest preservation. Ecosystem services, such as carbon, have yet to be fully understood or recognized in market structures.

Sustainability means holistic thinking. In the new paradigm of globalization and climate change, we cannot afford to dismiss any major players, regardless of their size and make-up. The case for inclusion of small-scale and community forestry has been made. Hence, there is a need for creative and innovative institutions that will assist in overcoming the barriers presented in this literature review. However, if climate change is averted through actions that cause social inequities, such as the displacement of forest peoples, many would say we have not achieved success. Ecosystems function as a whole, a fact that accounting systems will need to take under consideration. The rules of the game will determine if future carbon markets operate efficiently and equitably.

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V. APPENDICES

Appendix 1 – List of Reporting Standards used by the Voluntary Carbon Market

- World Business Council on Sustainable Development/World Resource Institute Greenhouse Gas Protocol (WBCSD/WRI GHG)
- Voluntary Carbon Standard (VCS)
- Greenhouse Friendly
- CDM/ JI Protocol
- Voluntary Emissions Reduction (VER+)
- Social Carbon
- Gold Standard
- International Organization for Standardization (ISO 14064)
- Green E
- CCX
- Climate, Community, and Biodiversity Standard (CCB)
- Voluntary Offset Standard (VOS)