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Institutional Determinants of Success Among Forestry-Based Carbon Sequestration Projects in Sub-Saharan Africa

TRAVIS W. REYNOLDS *
Colby College, Waterville, USA

Summary. — This paper contributes to the debate on the economic and social implications of carbon forestry through the study of 42 programs in Africa using carbon offset payments to fund tree-planting activities. Such projects may be understood as multi-layered collective action problems: growing trees for carbon offsets requires not only international financial incentives to plant trees, but also local institutions to monitor, impose sanctions, and distribute benefits. Consistent with economic theories, large projects appear to realize economies of scale. Contrary to expectations, community-based projects on lower-quality sites often successfully generate and sell offsets, while private for-profit initiatives appear susceptible to collapse.

Key words — common pool resource, collective action, carbon offset, ecosystem service, forest, Africa

1. INTRODUCTION

Over the past two decades communities in low-income countries have increasingly participated in international markets for ecosystem services, including the sale of carbon dioxide emissions offsets generated through forestry initiatives (Corbera & Brown, 2010; FAO, 2004; Jindal, Swallow, & Kerr, 2008; Streck, 2008). Growing forests sequester–durably store–carbon in the form of biomass in wood, leaves, and soil organic matter (FAO, 2005). Forests can, therefore, mitigate global warming by serving as "sinks" that remove carbon dioxide from the atmosphere (Lal, 2004; UNFCCC, 2002). Early estimates suggested tropical and sub-tropical regions might reduce the atmospheric greenhouse gas burden by 2.3 billion metric tons of carbon (Niles, Brown, Pretty, Ball, & Fay, 2002). More recent estimates suggest forestry worldwide could contribute an average 6.7 billion tons of emissions reductions annually, with over two-thirds coming from tropical nations (Sohngen, 2009). These facts, combined with scientific and economic arguments that "it doesn't matter to the atmosphere where carbon is removed, so it makes sense to remove it where costs are lowest," have led to the emergence of a variety of projects to offset carbon emissions through reforestation in the developing world (Baldwin & Richards, 2010; UNFCCC, 2007).

Today a vast international carbon offset market brings together states, companies and communities in low-income nations selling emission reductions from tree-planting activities to industries, governments, and private citizens in developed countries (Corbera & Brown, 2010). The climate negotiations in Copenhagen further advanced the international status of forestry *vis à vis* climate policy, with donor nations committing $3.5 billion to increase carbon sequestration in the world's forests (Sohngen, 2009; USDA, 2009). Yet in spite of the proliferation of offset-generating initiatives there remains much uncertainty—and little theory—surrounding how to implement and manage forestry-based carbon sequestration (henceforth "carbon forestry") in the developing world (Corbera & Brown, 2010; Boykoff *et al.*, 2009; Bumpus & Liverman, 2008). Payments for tree planting, laws restricting forest access, and informal norms against cutting trees might all provide incentives for improved forest management (Taylor & Singleton, 1993). But existing research provides little guidance on the relative importance of these tools—financial incentives, institutional rules, and norms when an exogenous "carbon payment" is introduced.

To better understand these issues this paper examines the structure and implementation of afforestation and reforestation projects using payments for carbon sequestration to finance some or all of their tree-planting activities. Such projects are conceptualized as multi-layered collective action problems (Olson, 1965; Ostrom, 1990): carbon forestry requires not only global institutions channeling financial incentives from overseas buyers to discourage tree harvesting, but also local institutions to monitor forest management, administer sanctions, distribute benefits from offset sales, and communicate project results to funders and other stakeholders (Corbera & Brown, 2008). Neoclassical economics and institutional theories provide predictions of which project types, in terms of contextual characteristics and management approaches, are likely to successfully use international payments to generate reliable, low-cost carbon offsets in forests. This paper summarizes and evaluates these predictions through a review of the design and performance of carbon forestry initiatives in Sub-Saharan Africa—an under-studied region with a rapidly expanding carbon forestry sector (Chomba & Minang, 2009; Chénost & Gardette, 2009). [1]

While previous studies have provided descriptive or case study data on carbon forestry initiatives (Corbera, Brown, & Adger, 2007; Jindal *et al.*, 2008; Rinaudo, Dettman, & Tofu, 2008; Shames & Scherr, 2010; Walker, Pearson, Munishib, & Petrova, 2008) none to date have sought to develop a deductive framework that can be applied across programs to explore questions about program design and effectiveness. This paper takes a step in this direction by generating and testing hypotheses that can be applied across diverse programs, drawing on economic and institutional theories. A focus on African carbon forestry projects in particular allows us to observe substantial variation in local, project-level, and national institutions while avoiding some of the confounding variations

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in ecological and economic contexts that might impede meaningful comparisons across a global review.

The paper proceeds as follows. Sections 2 and 3 explore the nature of forest management challenges in the developing world, outlining how economic and institutional theories contribute to understanding carbon forestry projects at the community, project, and national/international levels. Section 4 develops a set of hypotheses from the theory, and Section 5 examines these hypotheses using data on a sample of 42 carbon forestry projects in Sub-Saharan Africa. Section 6 summarizes the findings and outlines an agenda for future inquiry.

2. PUBLIC GOODS PROBLEMS, COMMON POOL RESOURCE DILEMMAS, AND SUCCESSFUL CARBON FORESTRY PROJECTS

From an economic perspective, international markets for forestry-based carbon offsets are desirable because they reduce the global costs of sequestering carbon. Namely, the relatively low cost of land and labor in low-income nations makes forestry-based carbon sequestration far more cost-effective than equivalent projects in the developed world (Stavins, 1999; UNFCCC, 2007). At the same time, proponents argue, from a social perspective global carbon offset markets allow developing nations to increase rural incomes (Katoomba Group, 2005; Smith & Scherr, 2003)—Niles *et al.* (2002) estimate carbon forestry could generate $16.8 billion for some of the world's poorest nations. Others point out incomes from offset sales are in addition to local benefits from increased firewood supplies, flood control, and other ecosystem services associated with forests (Corbera & Brown, 2010; Montagnini & Nair, 2004; Pagiola, Arcenas, & Platais, 2005).

However, capturing the potential social and environmental benefits of carbon forestry has proven to be an extraordinary challenge (Bumpus & Liverman, 2008). This difficulty may be understood as stemming from at least two sources: (1) the nature of forest ecosystem services (e.g., carbon sequestration), and (2) the nature of forest goods (e.g., firewood and other forest products), both of which involve similar but conceptually distinct market failures.

(a) *Market failures driving deforestation*

First, many ecosystem services provided by forests are public goods and as such, theory predicts, will be underprovided by markets (Myers, 1997; Ostrom, 2003). Carbon sequestration in particular, once provided, is both non-rival and non-excludable in consumption: everyone in the world benefits from forest carbon sequestration, and no one can be denied that benefit. As a result, carbon sequestration and other forest ecosystem services have historically been consumed by the global community and yet paid for by no one (Wunder, 2007). Without compensation for these benefits, individuals and communities in low-income countries have harvested trees without regard for the regional and global implications. In economic terms, therefore, payments for carbon sequestration seek to overcome failures in global markets for forest ecosystem services by internalizing the positive externalities associated with growing trees. Under standard economic assumptions carbon payments should increase rewards for maintaining forests, thereby increasing the market supply of forests to a more efficient level (Sedjo & Sampson, 1997). [2]

At the same time, a second and relatively under-investigated challenge facing forestry-based carbon sequestration in developing countries stems from the nature of forest *products*. Growing forests provide a range of goods in the form of timber, firewood, and other non-timber forestry products (NTFPs). All of these goods have substantial value (Costanza *et al.,* 1997; Smith & Scherr, 2003), however, in the absence of institutions to regulate forest use in many developing nations forest products are often de-facto common pool resources (CPRs). CPRs are goods which can be jointly consumed but in which increasing group size diminishes marginal benefits to all consumers (Isaac & Walker, 1988). When human numbers are small, forests may produce timber and NTFPs faster than individuals can extract them (Daly & Farley, 2004). But when populations are larger forests become rival—by cutting the last tree, one individual robs all others of the opportunity to consume tree products. Empirical research shows that when forests are owned in common individuals tend to overharvest and exhaust them (Agrawal, 2001), especially when they are owned by governments (as opposed to by communities) (Dietz, Ostrom, & Stern, 2003). Economic theory thus predicts that shared property rights over a rival forest resource will lead to overconsumption and degradation, Hardin's "tragedy of the commons" (Hardin, 1968).

Importantly, from a strictly economic perspective, the introduction of carbon payments does not necessarily resolve local CPR dilemmas. Under an open-access regime all individuals have the right and ability to harvest any given tree. As a result, even with large payments to some individuals (e.g., to local elites), poor households might still harvest trees if their share of benefits remains smaller than their opportunity costs (in terms of foregone sustenance or income) (Reynolds, Farley, & Huber, 2010). The implications of such incentive structures are profound: *ceteris paribus*, in order to prevent the harvest of a tree in a CPR system, a carbon forestry project would have to compensate every individual with access to that tree for the opportunity cost of not harvesting. Especially in a system with many users, a payment of that magnitude could dwarf the value of the stored carbon—that is, it would be less costly to sequester carbon elsewhere (Stavins, 1999). It thus appears that internalizing the global benefits of forests through offset payments may be insufficient to ensure permanence of forest carbon sinks. Institutional capacity to overcome failures in local markets for the distribution of forest benefits is also necessary.

(b) *Carbon forestry as a collective action problem*

In this context, forestry-based carbon sequestration projects can be in part understood as efforts to leverage international funding to overcome local collective action dilemmas facing communities living in and near forests. Collective action occurs when multiple resource users self-organize to govern a resource upon which all jointly depend (Ostrom, 1990, 2003, 2005). To overcome CPR dilemmas carbon offset payments could help stimulate collective action in many ways. Adopting a paradigmatic economic approach, projects might require communities to eliminate the CPR, by privatizing forest resources (Ehui & Pender, 2005). If the benefits of participation were sufficiently high for most forest users, such users might collectively act to establish private ownership over a project site (e.g., by leasing land to sponsors, or enforcing previously unenforced property rules) to ensure carbon forestry benefits. If clearly defined property rights over forests and offsets were established, and transaction costs low, a carbon forestry payment could work as predicted by economic theory (Landell-Mills & Porras, 2002).

However, in practice introducing private property rights over a former CPR is likely to be politically infeasible,