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Embedding Carbon Markets: Complicating Commodification of Ecosystem Services in Mexico's Forests

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Payments for ecosystem services (PES) are increasingly employed to address a range of environmental issues, including biodiversity conservation, watershed protection, and climate change mitigation. PES initiatives have gained momentum since the 1990s, and market enthusiasts have promoted them as not only cost effective but generative of social and ecological co-benefits for local communities. Whereas the neoliberalization and commodification of nature has been well explored in geographic and critical scholarship, there is a dearth of theoretically informed, empirically grounded research exploring the dynamics and outcomes of the formation of “markets for nature.” Our study applies theories of commodification and embeddedness to examine these themes in comparative cases of two emergent markets for forest-based carbon offsetting initiatives in Mexico: Scolel Té in Chiapas and the Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO). Although developed over similar time periods and in contiguous states, the two cases vary greatly in the degree to which carbon has been commodified and the markets embedded within the socionatural systems of the sites of production. Through detailed case studies, we demonstrate how interactions of these markets with preexisting social relations, institutions, and social and cultural values—the stuff of embeddedness—are critical for understanding the outcomes associated with markets for ecosystem services. We conclude that greater embeddedness is likely to lead to more positive local outcomes but that the embedding of forest-based carbon markets requires considerable time and extensive networks of nonmarket support and is furthermore dependent on the structure and orientation of finance and the political, institutional, and economic agrarian context of the sites of production. *Key Words:* carbon markets, commodification and neoliberalization of nature, embeddedness, Mexico, payments for ecosystem services.

生态系统服务付费 (PES) 逐渐被用来应对一系列的环境议题, 包括生态多样性保育、流域保护和减轻气候变迁。PES 的倡议自 1990 年代以来获得了动力, 而市场的热衷倡议者, 将之宣传为不仅具有经济效益, 同时能够对在地社区创造社会与生态的共同益处。自然的新自由主义化与商品化, 已受到地理学与批判学术的充分探讨, 但对于“自然的市场”形成的动态与结果, 在理论上充分且深植于经验的研究探讨却相当缺乏。我们的研究应用商品化与镶嵌理论, 在墨西哥以森林为基础的碳补偿倡议的两大新兴市场比较案例中检视上述议题: 恰帕斯州中的 Scolel Té, 以及瓦哈卡州原住民与农民社群的整合者 (ICICO)。尽管在相邻的州和相似的时期中发展, 这两个案例在碳的商品化以及市场镶嵌于生产场域的社会自然系统的程度上相当不同。透过仔细的案例研究, 我们证实这些具有既存社会关系、制度与社会文化价值的市场——镶嵌之物——对于理解生态系统服务市场相关结果而言如何至关重要。我们于结论中主张, 更大幅度的镶嵌, 可能会带来更为正向地在地结果, 但若要让以森林为基础的碳市场具有镶嵌性, 则需要相当的时间与广泛的非市场网络的支持, 并且进一步取决于金融结构与导向, 以及生产场域的政治、制度与经济农业脉络。关键词: 碳市场, 自然的商品化与新自由主义化, 镶嵌, 墨西哥, 生态系统服务付费。

Los pagos por servicios ecosistémicos (PES) se emplean cada vez más para enfrentar una gama de cuestiones ambientales, en la que se incluyen la conservación de la biodiversidad, protección de cuencas y mitigación del cambio climático. Las iniciativas PES han ganado ímpetu desde los años 1990, y los entusiastas de este tipo de mercado las han promocionado no solo como efectivas por costo sino por generar co-beneficios sociales y económicos para las comunidades locales. Si bien la neoliberalización y comodificación de la naturaleza ha sido un tema bien explorado en la erudición geográfica y crítica, hay carencia de investigación bien informada teóricamente y bien asentada empíricamente que explore la dinámica y resultados de la formación del “mercado para la naturaleza”. Nuestro estudio aplica teorías de comodificación e incrustación para examinar estos temas en casos comparativos de dos mercados emergentes con iniciativas de compensación en México, con base en carbono forestal: Scolel Té en Chiapas y el Integrador de Comunidades Indígenas y Campesinas de Oaxaca

(ICICO). Si bien fueron desarrolladas en períodos de tiempo similares y en estados contiguos, los dos casos varían sustancialmente en el grado con que el carbono ha sido modificado y los mercados incrustados dentro de los sistemas socionaturales de los sitios de producción. A través de estudios de caso detallados demostramos cómo las interacciones de estos mercados con las relaciones sociales preexistentes, instituciones y valores sociales y culturales — de lo que consta la incrustación— son críticas para entender los resultados asociados con los mercados para servicios ecosistémicos. Concluimos que un mayor grado de incrustación probablemente conduciría a resultados locales más positivos, pero que la incrustación de mercados del carbono basado en bosques requiere considerable tiempo y amplias redes de apoyo no relacionadas con el mercado y, más todavía, que aquella es dependiente de la estructura y orientación del financiamiento y del contexto político, institucional y agrario económico de los sitios de producción. *Palabras clave:* mercados de carbono, comodificación y neoliberalización de la naturaleza, incrustación, México, pagos por servicios ecosistémicos.

Market and payment-based initiatives intended to address environmental problems from wetlands destruction to climate change have been described as part of a broader trend toward the neoliberalization of nature (McCarthy and Prudham 2004). Markets and payments for ecosystem services (PES) exemplify one such approach and refer to transactions wherein ecosystem services, or management activities thought to produce them, are provided in exchange for payments through state finance, multilateral funds, or market mechanisms. PES initiatives have gained momentum since the 1990s, and market enthusiasts have promoted them as not only cost effective but generative of social and ecological co-benefits for local communities. Empirical research, however, demonstrates the limited success of these schemes, with many falling short on delivering sustainable development and livelihood benefits (Pattanayak, Wunder, and Ferraro 2010). Although numerous scholars have analyzed environmental governance and institutional arrangements (Corbera and Brown 2008), local participation (Hendrickson and Corbera 2015), and project design and implementation (Grieg-Gran, Porras, and Wunder 2005; Milne and Adams 2012) as key factors in local outcomes of PES and carbon markets, there has been little attention paid to the structure and orientation of markets and other forms of finance and their interactions with noneconomic and institutional contexts (for an exception, see Wunder, Engel, and Pagiola 2008).

Whereas PES is often financed through multilateral and state funds, forest-based carbon offsets are one form largely financed through markets. Within carbon markets, greenhouse gas-emitting entities, including industries and individuals, pay others to reduce their emissions through offsets, sold as units of greenhouse gas equivalent to the impact of a ton of carbon dioxide

(CO₂e). Although there are numerous markets for carbon offsets, they primarily fall into two categories: compliance markets, in which emitters are required through regulation to lower their emissions, and voluntary markets, in which emitters choose to purchase offset credits or certificates. One means of producing offsets is through changing forest management practices in ways that sequester and store additional carbon.

In this article, we explore the dynamic processes of forest-based carbon commodification and carbon market embeddedness by examining the interaction between finance mechanisms and the agrarian context of sites of production. The agrarian context, which includes particular configurations of institutional arrangements and governance, and social and cultural values of land, are central for understanding the complex and uneven implications for local communities. We explore related questions in the context of two case studies of forest-based carbon offsetting in Mexico: the Scolel Té project in the state of Chiapas and the Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO). This research builds on and contributes to the scholarship on the commodification of nature and, more specifically, fills a critical gap in the literature and empirical research on the processes of carbon commodification and market embeddedness as they relate to social and ecological co-benefits in places of production.

Agrarian Context and Carbon Markets in Mexico

Mexico is an ideal site to explore the intersection of finance and agrarian contexts, including the confluence of forest governance, cultural values, and local outcomes. There are numerous and long-standing PES initiatives in Mexico, where smallholder producers own the majority of the country's forests and so are necessarily involved in and affected by forest projects.

Neoliberal policies in the late 1980s and the 1990s, including a constitutional reform to allow the privatization of collective agrarian communities, the North American Free Trade Agreement (NAFTA), and a total of thirteen structural adjustment programs, caused significant disruption in rural areas (C. G. Gonzalez 2010). Collectively, these policies devalued and undermined the livelihood strategies and cultural reproduction of rural smallholders by removing trade barriers, price supports, and subsidies for essential crops (e.g., corn, beans, coffee, etc.), which in turn led to substantial price drops and general instability (Otero 1996). The resulting impacts have led to massive outmigrations and left many rural communities vulnerable to the ever-expanding influence of drug cartels (C. G. Gonzalez 2010).

The majority (approximately 60 percent) of Mexico's forests are held collectively by smallholders in common property arrangements known as *núcleos agrarios* (Madrid et al. 2009). This forest tenure structure has led to and supports a robust system of community-conserved areas and sustainable management for timber production, although the extent of these activities varies considerably by region (Bray et al. 2003; Martin et al. 2011). Although it has slowed by 55 percent from the previous decade, the average rate of deforestation from 1990 to 2010 was approximately 0.39 percent annually (Food and Agriculture Organization 2015), with land use change broadly contributing an estimated 3.34 percent of the country's total greenhouse gas emissions (World Resources Institute 2016). The two states that are the sites of our case studies have some of the higher rates of deforestation in Mexico: Chiapas at 1.1 percent and Oaxaca at 0.6 percent annually (Céspedes-Flores and Moreno-Sánchez 2010).

Along with foundational, regional initiatives such as *Scolec Té*, Mexico's federal state has been an early and enthusiastic player in forest-based carbon markets. The National Forestry Commission (CONAFOR) administers a national-level PES program, which included a forest-based carbon offset component from 2004 to 2010 that provided significant financial and technical support to participating rural communities (Shapiro-Garza 2013b). The spread of carbon forestry in Mexico has more recently been driven by Reducing Emissions from Deforestation and forest Degradation (REDD+) discourse and policies, with eleven pilot REDD+ projects underway and more than thirty REDD readiness initiatives (REDD Desk 2016). Five Mexican states, including Chiapas, are also members

of the Governor's Forest and Climate Task Force established to link REDD+ projects to international offset markets (REDD Desk 2016).

The impetus for and impacts of forest-based carbon offsetting in Mexico, and of PES more generally, must therefore be understood in the broader political and historical context of rural communities impacted by neoliberal reforms and with varying levels of experience with the concept and practice of PES (Osborne 2011; Shapiro-Garza 2013a).

Commodification, Embeddedness, and the Fictitious Nature of Carbon

Forest-based carbon offsets are a rich source of engagement for theories of both the commodification of nature and the embedding of markets. As with all PES approaches, carbon offsetting is relatively new, providing a dynamic view of the processes and evolution of market formation, but at the same time is much further advanced in market development compared to other forms of PES. We argue and demonstrate that key processes, in particular alienability, individuation, and abstraction, that render nature legible as commodities are also those associated with reduced carbon market embeddedness.

Forest-based carbon offset markets represent a prime example of the attempt to commodify nature (Kosoy and Cobera 2010; Osborne 2015). The scholarship on the commodification and neoliberalization of nature has received widespread attention from geographers (Castree 2003; Liverman 2004; McCarthy and Prudham 2004; Bakker 2010), particularly with regard to the impacts on marginalized communities and the nonhuman world (Mansfield 2004; Heynen and Robbins 2005). Neoliberalism has been described as a hybrid project based on the myth of the self-regulating market in which everything, including nature, becomes commodified (Peck and Tickell 2002; Larner 2003; McCarthy and Prudham 2004). Scholars of the commodification of carbon have addressed a range of issues associated with neoliberal natures, including the role of the state (McAfee and Shapiro 2010; McElwee 2012; Shapiro-Garza 2013b), materiality and problems of measurement and calculation (Robertson 2006; Lansing 2010), questions of access and land control (Corbera and Brown 2010; Osborne 2011; Lansing 2014), and equity broadly defined in the form of sustainable development and livelihood outcomes (Brown and Corbera 2003; Milne 2012; Osborne 2015). Although

supporters claim that carbon offsetting programs generate a “development dividend” for local communities (Forsyth 2007), carbon forestry has largely failed to deliver promised local livelihood benefits. Case study analyses have grappled with this contradiction (Smith and Scherr 2003; Chhatre and Agrawal 2009; Osborne 2015); however, empirically grounded studies of the processes of carbon commodification and the dynamics and outcomes of their interaction with the nuanced context of the sites of production are lacking.

As conceived by neoliberal policymakers, PES approaches reimagine healthy ecosystems as self-functioning factories, the various outputs of which (i.e., water purification, carbon sequestration, biodiversity conservation, scenic beauty, etc.) can be disaggregated through a process of “bundling of nature into tradable bits of capital” (Smith 2007, 21). It is through this bundling process that, according to this model, ecosystem services are to be converted to commodities: physically, morally, and conceptually separated from their source (alienability, individuation, and abstraction), designated with legal title and ownership (privatization), assigned a monetary value (valuation), and dissociated from the means and places of production to be sold or traded (displacement; Castree 2003). Based on Castree’s (2003) model of commodification, we recognize the “commodity status of a thing not as intrinsic to it, but, rather, assigned” (277), with the salient question therefore being not what is a commodity but what characteristics do things adopt in becoming commodities. In particular, we are interested in the ways in which the types and configurations of finance for forest-based carbon offsets intersect with grounded socionatural systems to either facilitate or complicate the commodification and disembedding of ecosystem services.

The work of Karl Polanyi on the commodification of nature and embeddedness of markets is particularly instructive for unpacking the processes and outcomes of forest-based carbon offset markets. Polanyi was centrally preoccupied with embeddedness, the idea that the economy is not free or self-regulating, as suggested by liberal economic theory, but instead embedded in and subordinate to politics, religion, noneconomic institutions, social relations, and the social and cultural values of a society (Block 2001). Highly critical of the market economy, Polanyi ([1944] 2001) characterized economic systems directed by market prices as dangerous and radically different from previous economies in their dependence on the commodification of what he termed fictitious commodities: land, labor,

and money. He argued that the fictitious commodity of land, an element of nature, has an integral connection to place and therefore holds deep social and cultural value for local communities, the result being attempts at commodification are often resisted (Polanyi [1944] 2001). Polanyi’s use of the concept of embeddedness is known to be somewhat ambiguous and even contradictory, simultaneously suggesting that all economies are embedded but also that market economies are unique (Lacher 1999; Krippner 2002; Gemici 2008; Muellerleile 2013). His point, however, is that economic activity is always enacted through and embedded in institutions, and when institutions in market economies become disembedded from the social and political sphere, society is then treated as simply an “adjunct of the market” (Dale 2010).

The embeddedness of fictitious commodities such as forest-based offsets and other ecosystem services, along with carbon dioxide’s lack of materiality, can erect barriers to complete commodification, making carbon dioxide what Bakker (2003) termed an “uncooperative commodity.” Because these offsets are actively produced when carbon is sequestered in trees, they have an unbreakable and continuous bond to living biomass and can therefore never be fully divorced from the place of production or the people who produce them. As with other ecosystem services, however, forest-based carbon must be physically, morally, and conceptually separated, or disembedded, from its supporting ecological and social context to be sold as a commodity; this is achieved through the processes of alienability, individuation, and abstraction (Castree 2003). These processes render things legible as commodities by extracting them from their supporting contexts and placing boundaries around them so as to isolate them for sale (Castree 2003; Robertson 2006). To sell bio-sequestered carbon on a market, it must therefore be metaphorically “disembedded” from its supporting context through complex, costly, and continuous techniques of measurement, calculation, and monitoring to “abstract” it as a homogenous entity that can be exchanged on the market. These contradictory characteristics of forest-based carbon offsets make them the quintessential fictitious commodity (Kosoy and Corbera 2010; Lansing 2010; Osborne 2015).

Although a number of scholars have evoked Polanyi’s work to broadly describe the dynamics of carbon offsets as fictitious commodities and the role of the state in their regulation (Bumpus and

Liverman 2008; Lohmann 2010; Lederer 2012; Carton 2014), fewer have engaged with Polanyi's work to examine the dynamic formation of forest-based carbon markets. As exceptions, Milne (2012) argued that forest carbon is both embedded and a fictitious commodity, with embeddedness best analyzed through both property relations and power dynamics, whereas Osborne (2015) argued that the contradictory outcomes of carbon forestry, particularly changes in land use, reflect Polanyi's insight about the challenges of commodifying nature due to its inextricable links to social and cultural institutions.

Our study engages with and builds on previous literature on both the commodification and the embedding of socionatural systems. Through two parallel case studies of forest-based carbon offsetting, we explore the ways in which interactions of the structure and orientation of finance with preexisting social relations, institutions, and social and cultural value—the stuff of embeddedness—contribute to particular outcomes. In doing so, we fill a gap in understandings of Polanyi's concept of embeddedness by exploring the specific dynamics through which markets are or are not embedded and commodification can be complicated. We also contribute to the applied literature on PES by examining the conditions under which the embedding of social and cultural values can occur in these and other markets for nature.

Case Studies: Dynamics of the Commodification of Forest Carbon and the Embedding of Carbon Markets

We present here case studies of two forest-based carbon offset initiatives in Mexico: *Scolel Té* in the state of Chiapas and *ICICO* in the state of Oaxaca. Through these cases, we explore the ways in which local agrarian contexts have intersected with the differing structures and orientations of sources of carbon finance to in turn produce varying degrees of carbon commodification and the embedding of carbon markets, the processes through which these intersections occurred and the local outcomes. The two case studies were developed through multiple research projects and long-term engagement by the researchers (2005–present) with the organizations and communities involved (McAfee and Shapiro 2010; Osborne 2011, 2013, 2015; Shapiro-Garza 2013a, 2013b; Sims et al. 2014; Shapiro-Garza and Sandford forthcoming). Through

these cases, we investigate the role of local institutions and governance and of social and cultural values as key factors of embeddedness.

Scolel Té Carbon Forestry Project

Scolel Té is a long-standing carbon forestry project and among the first to emphasize local development benefits in linking small farmers to international carbon markets. Literally translating to “the tree that grows” in the Tzeltal Mayan language, the project enrolls Indigenous and campesino smallholders to produce carbon offsets through agroforestry and forestry systems (Ruiz-De-Oña-Plaza et al. 2011). The project began in 1994 as a feasibility study, was launched as a pilot project in 1996, and began selling carbon credits on the international voluntary carbon market in 1997 (Tipper 2002). Since its inception, the project has grown from eight coffee-growing families in the Chiapas Highlands to more than 1,200 smallholder carbon producers in nine community groups, covering almost 9,000 hectares throughout Chiapas and parts of Oaxaca (see Figure 1; Plan Vivo 2017).

The *Scolel Té* program is coordinated by *Cooperativa AMBIO*, a Chiapas-based nongovernmental organization (NGO) responsible for providing technical support to local producers and carbon sales and administered by the *Fondo Bioclimático*, a trust fund through which credits are held and sold. The *Edinburgh Centre for Carbon Management (ECCM)* previously served as carbon broker before *AMBIO* assumed that role in 2009. The credits are certified through the *Plan Vivo* Foundation standards, a set of sustainability criteria for community-based ecosystem services projects, and are periodically verified through the *Rainforest Alliance SmartWood* program (see Figure 2). Also involved are state agencies, including Mexico's Secretary of the Environment and Natural Resources (*SEMARNAT*), which provides training to carbon producers as well as permissions to harvest and sell timber, and the *National Forestry Commission (CONAFOR)*, which provides seedlings (Osborne 2015). Although smallholders' participation serves as the basis for *Scolel Té*'s reputation as a model of sustainable community development, empirical studies demonstrate limited social and ecological co-benefits (Brown and Corbera 2003; Osborne 2015). This case study suggests that co-benefits have been constrained by the project's focus on carbon commodification and timber management and the associated technical requirements for monitoring and verification in the context of weakened local institutions.

Figure 1. Map of Scolel Té and Integrator of Indigenous and Campesino Communities of Oaxaca sites of engagement as of 2016. ICICO = Integrator of Indigenous and Campesino Communities of Oaxaca.

Agrarian Context

The agrarian context, and the ways in which it intersects with carbon markets, is central to understanding the emergence and outcomes of carbon forestry, particularly with regard to local co-benefits. Chiapas has a large indigenous population that composes 36 percent of the population, the majority of whom hold land rights in the forms of *núcleos agrarios* (Instituto Nacional de Estadística y Geografía 2015). Neoliberal agricultural policies of the late 1980s and early 1990s wreaked havoc on the *campesinos* of Chiapas, catalyzing massive migration and limiting access to land, particularly that used for *milpa*, a swidden system of subsistence production that holds tremendous social and cultural importance (Harvey 1995). The Zapatista Army of National Liberation (EZLN) emerged in resistance to these policies, with clear demands for land, democracy, and autonomy. An important outcome of the EZLN presence in Chiapas was a widespread discourse, particularly in Indigenous communities, that emphasized autonomy from the state and state-aligned community leaders (Harvey

1995; Eisenstadt 2009). In response to the mobilization of EZLN, state violence increased, as did the number of palliative state-led development programs in health, education, and sustainable regional development (Harvey 1995). These development programs, a type of Polanyian double movement, attempted to shift peasant allegiances to the state, what Armando Bartra (2007) called “developmentalist counter-insurgency.” Although reforestation projects were developed in this vein, community forestry was more limited in Chiapas than in Oaxaca due to the creation of the Montes Azules Biosphere Reserve in Chiapas’s Lacandon rainforest and forestry bans in the 1980s and 1990s that restricted commercial logging (Castanos 1994; Hendrickson and Corbera 2015). Therefore, Scolel Té was many carbon producers’ first engagement with market-oriented forest management.

The local impacts of neoliberal agrarian reforms, particularly the phase-out of price supports and subsidies for coffee and corn, contributed in fundamental ways to farmers’ participation in the Scolel Té project. The first participants were shade-grown coffee farmers in the Central Highlands, who were motivated by

Figure 2. The governance and organizational structure of Scolel Té and Integrator of Indigenous and Campesino Communities of Oaxaca, from offset producers to carbon markets. ICICO = Integrator of Indigenous and Campesino Communities of Oaxaca; CAR = Climate Action Reserve; ANSI = American National Standards Institute; ECCM = Edinburgh Centre for Carbon Management; GHG = greenhouse gas.

carbon payments that supplemented falling coffee prices (Harvey 1995). For the primary grain farmers in the low-lying Lacandon rainforest, the main catalyst was the decline in corn and bean prices following NAFTA's phase-out of tariffs and import quotas on grains. In these ways, Scolel Té partially filled the gap created by neoliberal reforms in the agrarian sector by serving as an economic alternative (Osborne 2015).

Finance and the Commodification of Carbon

The first phase of Scolel Té (1994–1996) was dedicated to research and the development of a pilot project with the explicit goal of producing carbon credits and smallholder livelihood benefits. The feasibility study was conducted by El Colegio de la Frontera Sur (ECOSUR) and the University of Edinburgh and financed by the UK Department for International Development (DFID) Forestry Research Programme and Mexico's National Institute of Ecology (Tipper 2002; Brown and Corbera 2003). During the pilot

phase, Scolel Té received significant input from *Pajal YaKac' Tic* (Pajal), a local association of coffee producers. Starting in 1997, the commercialization phase shifted the project's orientation toward international voluntary carbon markets, which required technical experts for measuring and monitoring carbon and international institutions for accessing global markets. The processes of commodification also shaped eligible activities, distribution of payments, and capacity building, all essential elements of local co-benefit production.

As of 2014, AMBIO had sold 467,912 tons of carbon (1,717,237 tCO₂) on the international voluntary market, with the majority of buyers paying prices in the range of US\$12 to \$14/tC (US\$3.27–3.81/tCO₂¹; AMBIO 2014). Major buyers of Scolel Té credits include the International Automobile Federation to offset car race emissions, the rock band Pink Floyd, the carbon company Forest Futures, the World Bank, the International Union for Conservation of Nature, and Mexico's state-owned petroleum company

PEMEX (Tipper 2002; AMBIO 2016); credits are also sold to individuals. While contracts are for a total of twenty-five years, payments are split into five payments over the first eight years, with carbon producers receiving approximately 60 percent of the carbon price, between US\$1.09 and \$3.55/tCO₂ depending on the forest activity (higher payments for forestry and agroforestry, lower for conservation), with most payments provided at US\$2.18/tCO₂ (US\$8.00/tC). This translates into approximately US\$138 per hectare per year for eight years. This figure is much lower than feasibility study estimates of US\$500 to \$1,000 per hectare (de Jong et al. 1995). Although payments are fixed, they reflect the generally low prices on the international voluntary carbon market: The average price has dramatically declined since 2008, from US\$7.34/tCO₂ to US\$3.30/tCO₂ in 2015 (Hamilton et al. 2009; Hamrick and Goldstein 2016).

The low prices paid for carbon and the complexity of rendering carbon legible to the market led Scolel Té managers to emphasize land uses and tree species suitable for timber production over other options. Because the protocols for measuring carbon capture and storage accepted by compliance markets are based on silvicultural biomass assessments, activities associated with timber production have been prioritized: forest plantations, coffee agroforestry systems planted with timber species, live fences, and improved fallow and *taungya*, in which timber trees are interplanted within the *milpa*. While the project also includes some forest conservation, the emphasis on timber production is also intended to supplement low carbon payments with potential revenue from future timber sales. Carbon producers are expected to harvest timber every twenty-five years for four rotations, growing trees on the land for one hundred years based on the Kyoto Protocol's definition and requirement for permanence. The time horizon for a mahogany plantation in the tropical lowlands though, for example, is often longer than twenty-five years, making it a poor economic choice for an individual producer (Osborne 2015).

Interactions: The Process of (Dis)Embedding Carbon Offset Markets

The ways in which Chiapas's agrarian context intersected with the processes of carbon commodification led Scolel Té's managers to focus on technical and economic dimensions of the project and to work primarily with individual producers. These intersections have resulted in the shifting of decision making away

from project participants and undermining of traditional governance structures and practices.

Because of the dictates of international markets and a very limited project development phase, Scolel Té has focused on the techno-economic dimensions of making carbon legible, shifting control and power from participants to more distant intermediary organizations. The production of carbon offsets for sale on international markets is a highly technical process, involving the measurement and monitoring of carbon storage, land surveying and georeferencing, and an understanding of the technicalities of the markets themselves (Lansing 2012). The high level of expertise required after the two-year pilot phase and the pressure to quickly produce offsets for the international market resulted in the local producer association, Pajal, being replaced by the NGO AMBIO and broker ECCM, both of which are at greater distances from communities and their experiences (see Figure 2). Local participation now only involves community extensionists who conduct very basic monitoring activities and smallholders who produce carbon in growing trees. Although carbon producers can decide from a narrow range of carbon activities, they have had little influence on broader project design and implementation.

The eligible carbon activities and tree species planted are also a direct reflection of the techno-economic focus on carbon production. Although the growing of fruit trees was permitted during the pilot phase, this activity became ineligible during carbon commercialization due to the carbon storage and measurement benefits of timber species compared to fruit trees (Genárd et al. 2008). However, while as of 2010 carbon producers have regained permission to plant up to 10 percent of carbon plots with select fruit trees species (Henderson and Corbera 2015), Scolel Té's strong focus on timber species (e.g., pine in the highlands or mahogany and tropical cedar in the lowlands) over subsistence systems of *milpa* has prioritized exchange value over use value of land, thereby reducing both the livelihood security of the participants and the biocultural diversity often found in such systems.

From the beginning, Scolel Té chose to work with and enroll individual producers because of the challenges of working through the often-contested community institutions in Chiapas and of gaining the consensus necessary to implement projects on communal lands (de Jong et al. 1995). This arrangement problematically necessitated that carbon forestry be implemented on participants' designated agricultural

plots within established systems of common property land tenure. The choice to circumvent traditional governance structures also reinforced growing regional discourses that called for autonomy from the state and state-oriented community authorities. This tension has engendered internal conflicts between carbon producers and local authorities, leaving the latter suspicious of the challenges to their authority and to the very basis of communal land tenure (de Jong et al. 1995; Osborne 2011, 2015). In this way, Scolel Té has effectively challenged internal institutions and further undermined traditional governance structures and practices.

Outcomes: (Under)Production of Co-benefits

In discussing the outcomes of Scolel Té, we focus primarily on the dynamics of one participating community: Frontera Corozal, a Mayan Chol community in Chiapas's Lacandon rainforest. This analysis is largely based on interviews with community leaders and Scolel Té participants from 2006 and 2007 (Osborne 2010).

In Frontera Corozal, the emphasis on carbon commodification and timber production has limited the project's expected co-benefits. Due to the challenges of registering timber trees, the main financial benefits have been derived from carbon payments, which have been low, and intermittent wage labor (Osborne 2011). In addition, the emphasis on timber has limited women's participation, occupied labor and land that could have been otherwise employed, and in some cases weakened the ecological health of these systems (Osborne 2011, 2015). As a result of internal conflicts with local authorities, carbon producers might ultimately be unable to harvest and sell timber, severely limiting expected financial benefits.

Carbon production involving forest management is extremely labor intensive and entails nursery preparation, land clearing, tree planting, weeding, and often replanting following tree mortalities (Osborne 2011). Although collective forms of labor are often employed for communal projects, because many carbon forestry projects are implemented on individual plots, work is primarily carried out through family or wage labor. Although wage labor can provide important, if intermittent, local benefits within communities, the occupation of arable land with carbon forestry and extensive labor requirements have in some cases constrained more traditional land uses, such as the production of subsistence and annual cash crops that provide more immediate and consistent benefits (Osborne 2011).

Although during the feasibility stage women expressed interest in planting fruit trees in home gardens, this activity was not advanced into the commercial stage because, as mentioned previously, the silvicultural practices of carbon measurement are based on timber rather than fruit species, and because greater effort is required to measure a few fruit trees over a large area (de Jong et al. 1995). Women's limited land rights concurrently constrained their participation in other project options. In some cases, carbon activities have also affected women's access to fuel wood, as carbon forestry established on plots formerly used for collection meant that some women were forced to walk farther distances to access wood or purchase it on high-priced local markets (de Jong et al. 1995; Brown and Corbera 2003; Osborne 2010).

The emphasis on timber species has also had problematic ecological impacts, exacerbating moth larva infestations in the tropical lowlands (Osborne 2015). Both the forestry literature and Plan Vivo specifications recognize that mahogany (*Swietenia macrophylla*) and tropical cedar (*Cedrela odorata*) planted in semimono-cultural systems attract a moth larva (*Hypsipyla grandela*) that can significantly affect tree growth and reduce the value of timber trees (Wylie and Speight 2012). Carbon producers themselves have observed that project requirements of weeding and clearing undergrowth exacerbate this "pest" problem. Therefore, the dominance of timber species has in some cases reduced biodiversity and increased insect infestations, ultimately limiting timber value and carbon sequestration potential, calling into question the potential of Scolel Té to produce localized ecological and financial benefits.

Despite significant effort, carbon producers in communities such as Frontera Corozal might be unable to harvest and sell their timber. As mentioned previously, the long maturation period for species such as mahogany might be uneconomic for individual producers. In addition, the bypassing of traditional agrarian authorities to work instead with manufactured producer groups on their individual agricultural plots has threatened the viability of the project and financial benefits accrued to carbon producers when local authorities, particularly the *sub-comisariado* elected community leader, refuse timbering permits (de Jong et al. 1995; Osborne 2011, 2015). In Frontera Corozal, the authorities' refusal to provide needed documents and project support even spurred participants to call for land privatization (Osborne 2015).

The commodification process and focus on individual producers of Scolel Té has therefore resulted in

nonlocal decision making, an emphasis on timber (the benefits of which are difficult to realize), and conflicts with traditional governance structures and practices. Given these conditions, the project has produced limited social and ecological co-benefits. Even carbon payments, the primary benefit to producers, have been significantly lower than expected. Yet the lack of viable alternatives continues to draw smallholders to Scolel Té (Osborne 2015).

The Integrator of Indigenous and Campesino Communities of Oaxaca

ICICO is a Mexican civil society association that aggregates forest-based carbon offsets produced by a consortium of twelve indigenous communities in the state of Oaxaca (see Figure 1) that are then sold under the name Indigenous Carbon, Water and Biodiversity (CARBOIN). The majority of these offsets are currently sold on a national voluntary carbon market, but ICICO communities have also recently begun to link to international markets (see Figure 2). Between 2008 and 2016, ICICO enrolled approximately 3,205 ha of land and sequestered 217,730 tons of CO₂, which sold for MX\$19,339,285 (US\$1,436,908),² providing direct and indirect benefits to 19,000 people in participating communities (Shapiro-Garza and Sandford forthcoming).

ICICO provides an important contrast to Scolel Té because of these communities' relative success in embedding carbon markets within traditional governance practices and livelihood strategies aligned with their social and cultural values for land and forests.

Agrarian Context

The agrarian context in Oaxaca has absolutely mediated the processes of carbon commodification and the embedding of markets for forest-based carbon offsets. As with Scolel Té, ICICO communities were willing to engage with these markets because of the dearth of other economic options but, because of strong community-level institutions and governance, were able to do so in ways that partially embedded local social and cultural values.

As in Chiapas, the rural smallholders in the state of Oaxaca, particularly basic grain and coffee producers, were devastated by the neoliberal reforms of the late 1980s and 1990s (Cohen 2010). Migration from rural areas of Oaxaca, primarily of young adults, began to escalate in the late 1980s and rose even more rapidly

in the mid-1990s (Cohen 2010). The reduction of the number of working-age adults, concurrent with a shift toward dependence on the remittances these migrants sent home, led to decreasing demand for agricultural lands (Velázquez et al. 2003).

Oaxaca is known throughout Mexico for having maintained strong community-level, indigenous governance practices and collective action for natural resource management (González Ríos 2011). There are sixteen distinct indigenous groups in the state, which is one of the few in Mexico to legally recognize indigenous customary law and governance practices, and approximately 80 percent of the territory is held communally as legally recognized *núcleos agrarios* (González Ríos 2011). Unlike Chiapas, the functionality of governance at the community level, as well as strong state-level umbrella organizations and NGOs, has led to robust systems of and experience with natural resource management and protection, including community forestry, cooperative coffee, and community protected areas (Bray et al. 2003; González Ríos 2011).

Finance and the Commodification of Carbon

ICICO has had many iterations as an organization. In 2000, six civil society and grassroots community organizations in the state of Oaxaca joined together to form the NGO Environmental Services of Oaxaca (SAO) with the intent of promoting the capacity of its member communities to conserve natural resources and identify and link with sources of ecosystem service-based finance. From 2000 to 2007, SAO and its member communities received significant financial and technical support from international foundations, NGOs, and the Mexican federal state. During this period, member communities participated extensively in the national PES programs, as well as linking briefly with Scolel Té and a bioprospecting initiative with the pharmaceutical company Syngenta (Rosa and Kandel 2002; Shapiro and Sandford forthcoming). Beginning in 2002, SAO received support from CONAFOR and the Ford Foundation to pilot a forest-based carbon offsetting initiative, which in 2004 translated into a five-year, MX\$41,187,790 (US\$3.74 million) contract with CONAFOR's PES carbon program (Bray 2012). Twelve communities were originally selected to participate based on forest type, strength of internal governance, and the compatibility of existing land use and livelihood strategies with carbon forestry (Bray 2012).

The nonmarket funding that the SAO consortium received in the first eight years provided significant exposure to the concepts and practices of PES, as well as the time and support for participatory decision making around how to best engage with these markets and to develop the capacity and infrastructure to do so. The groundwork laid by SAO during this period included training in both carbon markets and forest management, establishing baseline levels of carbon sequestration, participatory development of land use zoning plans (including for carbon forestry), and scoping for potential buyers. Financial and technical support from government, nonprofit, and academic sources has continued to be instrumental even after the SAO communities gained access to carbon markets.

In 2008, SAO partnered with a well-known Mexican environmental NGO, Pronatura, to sell carbon offsets produced by ten SAO communities under the CARBOIN “brand.” Pronatura had created the national Neutralízate (Neutralize Yourself) market through which Mexican companies, individuals, and organizations, including the charitable arm of Televisa, Mexico’s largest television network, nationally based pharmaceutical and baked goods corporations, and the office of the Mexican president, voluntarily offset their emissions. In 2012, SAO’s director, himself from one of the participating Zapotec communities, split to form ICICO with the ten communities participating in the CARBOIN program (see Figure 2).

The very nature of the Neutralízate market allowed ICICO and its member communities to continue to maintain fairly strong control over program design and outcomes. Pronatura promoted these offsets as supporting the threefold goals of climate change mitigation, conservation of “priority ecosystems,” and rural development, particularly in indigenous communities (Pronatura 2016). Because this market is voluntary and largely based on trust, Pronatura has avoided the pressure to impose rigorous but costly and inflexible verification standards and third-party monitoring (Bray 2012; Shapiro-Garza and Sandford forthcoming). In interviews with a subset of offset buyers, most confirmed that their primary motives were to promote their public image or to support a holistic suite of environmental and social goals, stating that they felt Pronatura’s reputation was sufficient “certification” that these mandates would be achieved (Shapiro-Garza and Sandford forthcoming). The partnership with Pronatura has also linked ICICO to other funding

sources, technical support for certifications necessary to access international markets, and help in brokering those deals.

The Neutralízate market was also designed to provide two elements crucial for rural smallholders: transparency and consistency. The price is set at US\$10/tCO₂, with US\$2 covering overhead costs at Pronatura and ICICO and US\$8 going to participants (Pronatura 2016). This is significantly higher than the majority of compliance or voluntary markets, including for Scolel Té, and provides income stability (Shapiro-Garza and Sandford forthcoming). The amount allocated to intermediaries (20 percent) is also small compared to other offset markets (Bray 2012). The Neutralízate market is of limited size, however, unable to accommodate all of ICICO’s offsets. As contracts are renewed annually, it also lacks stability, although the majority of the larger buyers have so far chosen to renew.

From its founding, SAO/ICICO sought to access international carbon markets to sell greater quantities of offsets with longer term contracts but were frustrated by the low prices, complexity and constantly changing standards. In 2014, ICICO took steps to engage, securing ISO 14064 certification, which is widely accepted in international carbon markets, and beginning the Climate Action Reserve (CAR) certification process, which is primarily used to participate in the California voluntary market (see Figure 2). ICICO is currently completing the CAR certification process and is in negotiations to sell the first offsets verified using this protocol, a total of 17,000 CO₂, to the Disney Corporation. The hundred-year contracts through the California market are significantly longer than the annual Neutralízate contracts, but the prices are also likely to be lower: Disney will pay only US\$2.50/ton of CAR-certified CO₂. Using these newly developed certification protocols, ICICO is also working with other communities in Oaxaca and four other states to expand their model of participatory, community-centric, forest-based carbon offset production.

Interactions: The Process of (Dis)Embedding Carbon Offset Markets

This section explores the ways in which the agrarian context of rural Oaxaca interacted with the structure and orientation of finance to complicate commodification and produce the embedding or disembedding of these carbon offset markets. We find

that preexisting institutional strength, both at the community and intermediary level, allowed ICICO to present a strong, unified voice in establishing the terms under which they engaged with carbon forestry. This institutional strength, combined with the initial period of nonmarket funding followed by sales to an offset market that imposed few restrictions, has allowed ICICO and its member communities to collectively embed some of their social and cultural values into the markets with which they interacted.

The governance of ICICO has been participatory from the start and has grown to be more so over time. The founding organizations, Rural Research and Advising A.C. (ERA) and the umbrella cooperative, the State Coordinator of Oaxacan Coffee Producers (CEPCO), had a good deal of solidarity with collaborating communities. When SAO was created in 2000, six organizations, including NGOs and grassroots organizations, composed its governing board. When ICICO formed in 2012, the participation by and accountability to participating communities further increased. Mimicking the governance structure of indigenous communities, ICICO created a general assembly of elected members from each of the participating communities to provide guidance and oversight (see Figure 2). ICICO's mode of operating at the community level has also integrated and reinforced the traditional governance structures and practices of the participating communities. ICICO employs one or more community extensionists in each site to create strong linkages and ensure that local knowledge of social and ecological contexts is represented in project planning and implementation. ICICO also reinforces traditional forms of collective resource management by encouraging the use of *tequio*, through which each household provides labor toward communal projects, for carbon forest management activities.

SAO/ICICO communities were selected based on the compatibility of existing land use patterns and livelihood strategies with carbon forestry: strong local institutions, availability of collective lands not being used for agriculture, and experience with forest management for timber or shade-grown coffee. During the first eight years of nonmarket funding, the community extensionists and other SAO/ICICO personnel worked closely with the *comisariado*, the elected leadership, in each community, in a process of participatory land use zoning and planning. Once the entire communal territory was zoned for selected land uses, including carbon forestry, SAO/ICICO and the *comisariado* collaboratively developed management plans

that were then ratified by the community's democratic assembly. SAO/ICICO also allowed communities to select preferred native tree species and from a broad range of forest management types: afforestation of former agricultural fields, reforestation, management of natural regeneration, improvement of degraded forests, timber production, and shade tree management for coffee agroforestry systems (Shapiro-Garza and Sandford forthcoming). This flexibility in how communities wished to enact carbon forestry helped ensure compatibility with local cultural practices and livelihood strategies. Another important aspect of these management options, and one emphasized by ICICO, is that each had the potential to produce locally important secondary ecosystem goods (i.e., coffee, timber, firewood, etc.) and services (i.e., watershed protection, habitat for wildlife, etc.) as well as carbon offsets (Shapiro-Garza and Sandford forthcoming). SAO/ICICO did impose a standard set of restrictions in carbon forestry zones (i.e., prohibiting hunting, grazing, etc.) and required that the community provide the necessary labor and assists with monitoring activities (Shapiro-Garza and Sandford forthcoming).

SAO/ICICO has also had some freedom to adapt protocols for measuring and monitoring carbon to local environmental and social conditions and needs. CONAFOR's national PES program for carbon sequestration, which SAO joined in 2004, required participants to adopt the Kyoto Protocol's Clean Development Mechanism (CDM) protocol for forest-based offset projects. Although SAO's director served on the federal design committee, this requirement still posed challenges, as the protocol proved costly to implement for small-scale projects and was not readily available in Spanish (Shapiro-Garza 2013b). SAO adapted the CDM protocol to better match local conditions and to simplify it so that community members could participate in data collection and understand how results were generated (Bray 2012). In joining the Neutralízate program in 2008, SAO built on and adapted this existing protocol (Bray 2012). Although the ISO 14064 and CAR certification standards entail stricter, less flexible, and more costly monitoring protocols, ICICO's previous experience with carbon forestry and the fact that in both cases they were the first project certified in Mexico gave them some ability to negotiate with the certifying agencies, the American National Standards Institute (ANSI) and CAR, to adapt both the eligible forest management practices and monitoring systems according to their own values and practices (G.

Gonzalez 2014). ICICO's director described the development of the ISO protocol as "a learning process between ANSI and ICICO" (personal communication, 19 June 2015).

Outcomes: (Under) Production of Co-benefits

Based on the results of extensive semistructured interviews in 2012 with male and female participants in three of the ten ICICO communities, we found that the program is largely perceived by participants as having produced more benefits than costs and that there is a strong sense of ownership over the program and its implementation (Shapiro-Garza and Sandford forthcoming). Except in the case of coffee producers, who participate as individuals, payments from ICICO carbon offset sales are distributed to the traditional authorities of each community, with the democratic *asamblea* approving how the money will be spent. The Neutralízate market requires that approximately 90 percent of funds be reinvested in carbon forestry management activities, leaving little for other communal projects; however, the great majority of participants perceived provision of temporary employment in forest management activities to economically vulnerable community members to be a significant economic benefit, providing a local source of income as an alternative to emigration (Shapiro-Garza and Sandford forthcoming). ICICO estimates that between 2008 and 2015, CARBOIN communities had invested approximately MX\$10,788,000 (US\$829,597) in temporary employment (averaging four months per year) for an average of 135 people per community. Interviewees, both men and women, also frequently mentioned secondary benefits from carbon forestry: timber harvests, firewood, improved coffee production, and local ecosystem services (e.g., cleaner, more abundant water; the return of animal species; improved air quality; etc.; Shapiro-Garza and Sandford forthcoming). ICICO has also linked communities with nonmarket sources of support for community-led and managed enterprises: spring water bottling plants, biodiversity monitoring programs, ecotourism ventures, and the creation or expansion of sustainable timber management operations. Although the great majority of interviewees primarily perceived positive impacts, two also mentioned that ICICO has generally limited access to agricultural lands and the harvest of timber (Shapiro-Garza and Sandford forthcoming).

It is unclear how ICICO's engagement with international carbon markets might alter the production of

co-benefits at the community level. When analyzed in isolation, it appears that participation in these markets is more costly in terms of both funds and labor, more restrictive on forest management and use, and will involve longer term contracts that may limit current and future participants' ability to make decisions over their own forests. In the case of the ICICO communities, however, the long period of developing carbon forestry on their own terms has, to some extent, allowed them to "embed" carbon markets in ways that are largely compatible with their traditional governance systems, their social and cultural values for land and forests, and, ultimately, the reproduction of their socionatural systems.

Discussion

The case studies of Scolel Té and ICICO provide an empirical basis for understanding the dynamics of market embeddedness and commodification of forest-based carbon and of nature more broadly. They demonstrate that key processes of commodification are associated with reduced market embeddedness and that the degree of embeddedness of these markets depends on the interaction of two main factors: (1) the agrarian context, specifically the strength of local institutions and compatibility of carbon forestry with traditional governance structures, existing livelihood strategies, and social and cultural values; and (2) the structure and orientation of the finance that in turn determines the ability of local actors to influence the market.

The agrarian context, through which we analyze embeddedness, is critical for understanding the dynamics and outcomes of these communities' interactions with carbon markets. In both Oaxaca and Chiapas, the structural violence of decades of neoliberal reforms that constrained the economic viability of traditional land uses has provided the impetus for smallholder participation in carbon forestry. The particularities of the two sites, however, are also crucial to understanding the dynamics and outcomes of these two initiatives. The state of Oaxaca is known for the strength of its community-level institutions and the network of civil society organizations that serve them. That ICICO was founded with communities selected for the strength and functionality of their institutions and NGOs with whom they had existing solidarity greatly increased the organization's capacity to later negotiate carbon markets on their own terms. Chiapas

is a state with greater levels of political repression and economic disenfranchisement that have resulted in a weakening of both community-level institutions and civil society, leaving communities less able to negotiate the terms of carbon markets (C. G. Gonzalez 2010).

We also argue that the structure and orientation of finance is equally important for explaining the differing dynamics and outcomes of the two cases: more specifically, the degree to which the sources and intermediaries of finance are focused on carbon as a commodity as well as their concern for and knowledge of the social and cultural values that are the essential elements of embeddedness. In the case of Scolel Té, although Pajal, the local producer group, had meaningful decision-making power during the feasibility stage, it was quickly replaced by the nonlocal NGO, AMBIO. Moreover, although Scolel Té offsets have been sold through the voluntary carbon market, a principal goal of Fondo Bioclimático from the beginning was the production of carbon as a commodity legible to the more demanding and restrictive international compliance markets. In contrast, ICICO's multiple, nonmarket sources of finance, including their primary market, the national Neutralízate program, have been both less focused on commodification and more motivated by the production of co-benefits. ICICO's participatory governance structure has furthermore made it highly attentive to the needs, desires, and values of those communities.

The impacts of the structure and orientation of finance on the degree to which markets are embedded can best be understood through an examination of the various processes required for commodification and the ways in which these were facilitated or complicated through interactions with the agrarian context, the institutions, and the social and cultural values of each case.

As previously discussed, that forest-based carbon offsets must be continuously maintained in the living tissue of trees means that the steps to commodification of alienability, individuation, and abstraction are unusually costly and complicated (Castree 2003; Robertson 2006; Lansing 2010). Although the discourse of Scolel Té and the Plan Vivo standard promises the production of co-benefits, the intense focus on commodifying carbon has supplanted activities aligned with local social and cultural values. For one, the highly technical nature of producing international market-legible offsets in

a short time frame necessitated that outside experts carry out much of program design and oversight, leaving only the labor of carbon production and some technical support to participants. This focus on commodification has also resulted in a stock set of carbon forestry activities that prioritize ease of measurement over co-production of locally beneficial uses and services. In contrast, ICICO's initial, eight-year period of nonmarket funding allowed for a participatory design process to define carbon forest management practices compatible with local values and livelihoods and where and through whose labor those activities would be enacted. It has also allowed ICICO and the communities to develop an understanding of the complexities of carbon markets and the capacity to negotiate, to the extent possible, on their own terms when they have engaged with these markets.

Privatization is the step to commodification that gives exclusive rights of a resource to an individual, group, or institution in the form of legal title (Castree 2003). Although in both cases, participants maintain the rights to the carbon offset, whether these rights were individually or communally held has influenced the degree to which the market has become embedded within local land tenure and governance regimes. With Scolel Té, carbon rights have been primarily allocated to individual farmers, and in many communities this has led to conflicts with the institutions of communal land governance and, at least in Frontera Corozal, calls for land privatization (Osborne 2015). In contrast, with the exception of coffee farmers, carbon rights in ICICO are collectively held, with all management decisions and payments channeled through traditional institutions, reinforcing and "embedding" those governance structures into the fabric of the market. An emphasis on individual rights has also meant that Scolel Té participants have largely located carbon forestry on individual lands, where it has competed with and reduced agricultural production, relied on family and wage labor, and limited access to secondary forest products such as fuelwood. In contrast, ICICO's communities have been able to employ territorial-level zoning of communal lands to select areas least likely to conflict with other productive activities. Furthermore, labor costs have been distributed, either through *tequio*, the traditional system of required labor for communal projects, or through paid labor, often used to provide income to community members in need.

The commodification processes of valuation and displacement have also played an important role in our case studies (Castree 2003). Scolel Té's early and continuous focus on accessing international voluntary and compliance markets has meant that the value assigned to the metaphorically abstracted carbon has only been based on the low and volatile prices assigned by carbon commodity buyers, "displaced" from the context of the site and people of its production. In interactions with markets, ICICO has emphasized the co-production of carbon forestry through land uses compatible with local livelihood strategies and ecosystem services with local value, an approach encapsulated in the branding of their carbon offsets as "Indigenous Carbon, Water and Biodiversity." The production of these co-benefits has been supported and "valued" by both the broker and buyers in the national, voluntary market with which ICICO has primarily interacted. By the time ICICO interacted with international carbon market intermediaries, their previous experience developing locally adapted monitoring and verification protocols meant that they were able to have a strong role in coproducing the rules of engagement.

These cases also suggest that the degree to which a carbon market is embedded mediates the production of local economic, social, and ecological co-benefits. That the payments per ton of CO₂ received by producer communities were significantly higher in the case of ICICO (US\$2.18/tCO₂ on average for Scolel Té compared to US\$8.00/tCO₂ for ICICO) certainly contributed to the differing perceptions of benefits between the two cases, but the governance and structure of the programs were also influential. As mentioned earlier, distribution of payments to individuals within manufactured groups of individual producers in Scolel Té has disrupted traditional governance and imposed burdensome costs. In contrast, ICICO, through careful selection of communities and participatory project design through traditional institutions, has helped develop carbon forestry systems more compatible with local livelihood strategies and land uses enacted primarily on communal lands not immediately needed for subsistence agriculture. These differences have also led to differing perceptions of ecological outcomes, with Scolel Té participants observing that management practices chosen solely for maximizing carbon sequestration and ease of measurement diminished ecosystem health, whereas ICICO participants largely perceived that the project produced locally relevant ecosystem goods and services, from newly returned animal species to cleaner water.

Conclusions

In this article we have explored the dynamics of embeddedness and commodification through an analysis of two case studies of market-based carbon forestry in southern Mexico. In examining these cases, we find that the agrarian context in the sites of production and the structure and orientation of the markets engaged have been the primary determinants of the degree to which carbon could be commodified, fully abstracted from the producers and sites of production versus embedded within local social and cultural values. We also find that, as Polanyi theorized, institutions have proven the primary site of embedding, with the strength of local institutions and their involvement in mediating market processes crucial for determining the degree of embeddedness.

Our study also elucidates the factors necessary for embedding markets for ecosystem services and subsequent outcomes for communities in sites of production. The less embedded market, represented by Scolel Té, with its combination of disempowered local institutions and a market intermediary focused on carbon commodification, has produced active conflicts, high costs in labor and land, and ecological degradation that were not outweighed by the promise of economic gain. In contrast, the factors that have contributed to ICICO participants' higher perception of benefits include preselection of communities with strong local institutions and livelihood strategies and land uses compatible with carbon forestry; initial nonmarket funding for participatory planning and capacity building; higher payment rates and the distribution of funds and decision making through traditional governance institutions; and linking to market intermediaries and buyers who valued co-benefits. Those interested in working toward the production of co-benefits for carbon forestry participants should note the difficulty in locating sites with these initial characteristics and, even then, of the significant time and nonmarket funding required to develop the capacity of these communities to successfully navigate and negotiate with carbon markets. In addition, the higher payments provided through ICICO, critical to the overall success of the project, were only possible because of linkages with markets that valued and prioritized social and environmental co-benefits. Our findings therefore challenge the argument that smallholder-managed forests in the Global South are the cost-effective low-hanging fruit of climate change mitigation and that they will necessarily provide multiple benefits for climate, biodiversity, and local communities (Stern et al. 2006). Establishing

embedded markets with substantial co-benefits is time consuming, costly, and dependent on the agrarian context of the communities involved and the orientation of the markets with whom they link.

Although the larger and longer term political, economic and ethical implications of carbon offsets that exchange fossil fuel-based carbon for biocarbon are outside the scope of this article, these case studies point to more equitable forms of markets for local carbon producers. The contrasting cases of Scolel Té and ICICO therefore provide crucial lessons for understanding the dynamics and possibilities for embedding markets for nature and pragmatic suggestions for addressing what remains one of the grand challenges of our century: global climate change.

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Notes

1. Scolel Té lists offset prices in US\$/ton of carbon (C) versus ICICO, which lists in US\$/ton of carbon dioxide (CO₂). We report in tons CO₂ as it is the norm in carbon markets and apply the standard conversion rate of one ton C = 3.67 tons CO₂.
2. We have converted Mexican pesos (MX\$) to U.S. dollars (US\$) where appropriate and have used the average exchange rate for the time period referenced.

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