SEE THE CARBON THROUGH THE TREES:

MARKET-BASED CLIMATE CHANGE MITIGATION,

FOREST CARBON OFFSETS

AND THE UNEVEN POWER OF CARBON ACCOUNTING

by

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Abstract

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See the carbon through the trees: Market-based climate mitigation, forest carbon offsets, and the uneven power of carbon accounting

Thesis directed by Professor William R. Travis

This dissertation examines how forests get absorbed into carbon markets, and climate change mitigation schemes broadly. It asks: How is a forest carbon offset made? What are the specific political, technical, institutional, environmental, and policy-based factors that contribute to the creation of a tradable carbon offset credit? The research opens the black box of 'carbon offsets' by asking how, and by whom, such offsets are made. It explores the dichotomy of how a mechanism designed to mitigate climate change works as an administrative tool, verses how, and if, it works to physically address atmospheric carbon concentrations. To answer these questions data was collected in three research phases: 1) Through expert interviews at professional conferences around the world, including the United Nations, the Center for International Forestry Research (CIFOR), the Red Cross, etc.; 2) Via field research at multiple forest carbon projects, including the Farm Cove Community Forest in Maine, and the Alto Mayo Protected Forest in Peru; and 3) Via participant observation in professional carbon accounting training courses through Greenhouse Gas Management Institute. The results of this study indicate that developing and managing forest carbon offsets requires such intense administrative processes that the related conservation is often too far removed to accurately quantify its impacts on atmospheric carbon pollution. Forest carbon offsets do, however, serve a number of needs unique to

individual stakeholders, including facilitating flows of conservation finance, balancing administrative carbon budgets, and re-envisioning financialized forest management amid a collapsing pulp and paper industry in the US.

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Introduction

See the carbon through the trees:

Market-based climate change mitigation, forest carbon offsets,

and the uneven power of carbon accounting

Introduction: Farm Cove Community Forest, Grand Lake Stream, Maine

Driving along Route 1 in Washington County, Maine, it appears that nearly one-third of the real estate is abandoned. Life is hard in Downeast Maine, where the closing of paper mills and an on-going rural-to-urban migration spurred a domino effect on the collapsing local economy. Driving west from the coast, through Princeton, Maine, (population 725) local teenagers gather afterhours outside the public library—an aging doublewide trailer—to pick up the Wi-Fi signal, even in the rain, because there is not anywhere else to go, or anything to do. There's a grocery store, two gas stations, and a modest diner where you can order fried foods—in the summer there's a small weekly farmers market. Across a rusted bridge is Indian Township (population 232), the western part of the Passamaquoddy Indian Reservation where the community gymnasium has been turned into a bingo hall (personal communication, 27 July 2017). The forestry office, an old house, sits abandoned and crumbling. In Indian Township, the road to Grand Lake Stream begins. About 7 miles from Route 1 emerges the tiny village of Grand Lake Stream (year-round population 109), an iconic Maine sporting village, whose claim-to-fame is more Registered Maine Guides per capita than anywhere else in the state. Hunting and fishing in the area are reportedly some of the best in Maine. It is here, in Grand Lake Stream, where the use of forest carbon offset projects took hold in the US, and is now one of the most fruitful tools for expanded conservation and economic development in the state.

In 2012 the Downeast Lakes Land Trust, a small local trust, successfully enrolled nearly 20,000 acres of forested land with the Climate Action Reserve, generating 200,000 compliance-eligible carbon offsets to sell on the state of California's carbon market (Finite Carbon 2012). In addition to generating these carbon credits, the land trust raised several million dollars from selling the credits, which went to protect public access to surrounding forestlands through the creation of a community forest (personal communication, 27 July 2017). Since then, seven more forest carbon project have been developed in Maine, encompassing more than 182,000 acres, with more in the works (Truesdale 2017; personal comunication 9 August 2017). The generated carbon credits served a duel role: 1) To balance a California company's state-mandated carbon budget, and 2) To set the stage for a significant capital campaign that allowed DLLT to raise a total of $20 million for expanded conservation efforts.

Forest carbon offsets[1] are big business, but as opaque components of emerging carbon markets, they are still widely misunderstood. Throughout the US, land trusts and forestland managers are beginning to utilize links to carbon markets like California's AB-32 and the Regional Greenhouse Gas Initiative (RGGI) as a means of conservation finance (personal communicatoins; Kay 2017). With the Grand Lakes Stream project, the land trust is using carbon offsets to expand conservation efforts. This approach is new, and while critical scholarship has examined carbon offsets and the popular REDD+ mechanism for more than a decade (Osborne

[1] A note on terminology. As a reflection of the political and contested nature of forest carbon projects, the names applied to them change often, sometimes multiple times within the same year. They are at times called REDD, REDD+ (to account for additional activities, beyond conservation, like aforestation), carbon sinks, forest carbon offsets, conservation projects, or administrative agreements. REDD is a contested, pseudo-branded development mechanism. Some have argued that for a project to be labeled REDD it must meet a set of standards set forth by the United Nations REDD programme, or by independent verification organizations like Verified Carbon Standard (W. Boyd 2010). Others argue that REDD doesn't yet exist because it is a mechanism funded by one central funding institution, like the World Bank, and that relationship has yet to be established. Still others use the term REDD and 'forest carbon offset' interchangeably. Throughout this work, the term "carbon offsets" is used, as these projects are largely assigned value in the context of carbon markets and many are not tied to the braded REDD+ mechanism.

2011; Adam G. Bumpus and Liverman 2008; Adam G. Bumpus, Liverman, and Lovell 2010; Phelps, Webb, and Agrawal 2010; Chatterjee 2009), the use of forest carbon projects in the US remains understudied. Furthermore, aspects of common REDD+ critiques are often incompatible in the context of US projects—like land tenure disputes (Springate-Baginski and Wollenberg 2010), global north/south development and finance politics (Bracking 2015; Nielsen 2014; Dwyer, Ingalls, and Baird 2016), and indigenous land rights (Osborne 2011). Rather, when studying the forest carbon offsets in Maine, it is necessary to situate the research amid trends in conservation finance, changing forest ownership, and timberland transformation broadly. To understand how forest carbon projects operate in the US, both as mechanisms of conservation, and as a means of addressing atmospheric carbon concentrations, it is necessary to ask how forests become financial instruments represented as equivalent to industrial carbon emissions; this calls for a study of the processes by which forests are monitored, reported and verified for their carbon sequestration abilities, processes known commonly as 'carbon accounting' (Gupta et al. 2012; Lovell and MacKenzie 2011; MacKenzie 2009).

This dissertation uses the Farm Cove Community Forest carbon project in Grand Lake Stream, the half-dozen other Maine projects that have emerged in its wake, as well as research on the Alto Mayo Protected Forest carbon project in Peru, as cases to understand the forest carbon offset mechanism and how it has been picked up and adopted in the US. The transparency through which the Farm Cove project was designed makes it possible to answer the primary research question: **How is a forest carbon offset made? What are the specific political, technical, institutional, environmental, and policy-based factors that contribute to the creation of a tradable carbon offset credit?** This dissertation seeks to open the black box of 'carbon offsets' by asking how, and by whom, forest carbon offsets are made. It asks how a standing forest is valued for its carbon sequestration capabilities, then translated into carbon credits exchangeable on global financial markets. The following chapters looks at the institutions, discourses, technologies, and political economic pathways that contribute to the construction of forest carbon credits, and makes cases for theoretical approaches to understanding and contextualizing carbon forestry. The arguments hypothesize that carbon offsets are a collection of administrative processes that make conservation legible on markets, but do not produce the intended effects on CO_2 concentrations and land use change they are intended to.

This dissertation (particularly chapters 4 and 5) challenges the notion that the tools and technologies used to account for forest carbon are technical and apolitical. The research contributes to an emerging subfield in the critical social sciences that situates carbon as an object of inquiry, and asks how, and by whom, it is made a commodity (Whitington 2016; Günel 2016; Twyman, Smith, and Arnall 2015). Carbon, in this case, engages a crucial dimension of human-atmosphere relationships, and becomes the signifier around which climate mitigation is framed. Carbon has become an "organizing logic and mode of accounting through which space and social practice are being rewritten" (Bridge 2010). Further, carbon has been identified as "the metric of the human," a signifier around which human activities are judged by their contribution, or responsibility, to the tragedy of climate change (Whitington 2016; Paterson and Stripple 2010). Drawing on political ecology and science and technology studies (STS), this research frames forest carbon accounting processes as embedded with uneven networks that influence how standing forests are translated into tradable carbon credits, and ultimately contribute to their market value. In order to understand how forest carbon offsets exist as a mechanism that simultaneously supports conservation, carbon sequestration, and the balancing of administrative carbon budgets, this dissertation seeks to identify the social, political, and technical relationships that contribute to the making of such offsets. It situates carbon monitoring, reporting, and verification (MRV) as uneven points of translation that connect forest conservation to global financial markets. Driven by questions of who conducts the MRV, what is counted, and for whom, this research applies nested scales of analysis to explore processes framed as technical and "outside the domain of politics" (Gupta et al. 2012; Clarke and Fujimura 2014). The results will allow us to connect the emergence in popularity of forest carbon offsets to established discourses on environmental governances, climate change mitigation, and payments for ecosystem services (Lovell and Liverman 2010; Höhler and Ziegler 2010, Robertson). As such, this dissertation calls on the concept of "carbon accountability," recognizing the need for accountability *within* carbon MRV systems as well as accountability *by* those engaged in forest management and offset development by asking 'who counts, how, for whom, and with what consequences?' (Gupta et al. 2012; Höhler and Ziegler 2010).

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"It's not a silver bullet."

In Grand Lake Stream, multiple conditions work together to make a smooth transition from working forest to managed carbon project. The initial project was so successful, the DLLT is now engaged in two additional carbon projects, and have leveraged multiple financial instruments like "New Market Tax Credits," which provide a credit to private entities to incentivize investment in low-income communities (New Markets Tax Credit Coalition" 2018). The neighboring Passamaquoddy tribe has enrolled nearly 100,000 acres in forest carbon credit programs, one of the largest projects to date. But, as one stakeholder said of the forest carbon offset mechanism broadly, "It's not going to work for everybody. It's not a silver bullet" (personal communication 15 August 2017).

This dissertation takes on the complexity of what it means to create a forest carbon offset project, from the perspective of developers, investors, landholders and more. **Chapter 1**: Literature Review, situates the study using literature and discourses from the subfields of political ecology, science and technology studies, and critical development geography. The four subsequent chapters explore theoretical and empirical aspects of carbon markets, offsets and forest carbon development broadly.

Chapter 2 is largely theoretical and applies hallmark questions from the field of Science and Technology Studies (STS) to the commodification of carbon, and envisions a subfield 'STS of carbon.' It first provides a review of STS literature and explores engagements with varying notions of carbon. The chapter than takes on questions about whose science, expertise, and knowledge emerges as dominant, and illustrates the work that can be done with an STS of carbon.

Chapter 3 is the research methods chapter. It outlines the qualitative research methods used in the analysis of how, and by whom, forest carbon offsets are actualized. A combination of semi-structured interviews, document analysis, and participant observation contributed to the development of reproducible hypotheses that contributed to answering the dissertation's primary research questions. The research methods transcend traditional geographical methodologies in two ways. First, the focus of the research is not only on a specific place, but on the intangible, often virtual space in which carbon offsets exists. Second, to answer questions about how knowledge is created and legitimized, participant observation was used in online carbon accounting training courses. The research methods used represents a subtle methodological shift that will become more common as spaces of inquiry become increasingly complex, virtual, mobile, and flexible.

Chapter 4 uses the political ecology and STS of carbon, as defined in other chapters, to understand the political and contested nature of forest carbon accounting. It begins by explaining carbon accounting broadly, the specifics of forest carbon accounting, and why forests are popular spaces for financialized carbon sequestration. It then explains the approach to forest carbon accounting as presented by the Greenhouse Gas Management Institute. The analysis section draws on critical theory to explore how and why certain carbon monitoring, reporting and verification approaches (MRV) emerge as dominant and "expert." The chapter concludes with an argument that carbon accounting are uneven technical and political processes that makes multiples forms of carbon legible on financial markets but do little to physically address atmospheric carbon concentrations.

Chapter 5 looks at a forest carbon offset project in Maine that sells carbon credits to California's cap and trade market, and asks how a mechanism originally designed to address industrial GHG emissions in California has become a major tool for forest conservation and economic development in Maine—essentially how climate policy in one place has driven large scale investment in another. Drawing on theories from political ecology, social theory, and science and technology studies, an argument is made that an offset ultimately represents something different to each stakeholder, often with few overlapping characteristics. It concludes that a carbon offset is a 'tie that binds' multiple, varied and often unrelated interests together under the notion, but not always the action, of addressing climate change.

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Chapter 1: Literature Review

(1) Introduction

As a foundation to the arguments in this dissertation I first define and contextualize the mechanisms and tools used to make forest carbon offsets. Carbon markets, carbon offsets, and intuitions like Timber Investment Management Organizations (TIMOs) are defined here to situate arguments presented in subsequent chapters. This section will help frame the commodification of carbon as a means of both managing the atmosphere, as well as engaging in the neoliberal market-making that's become a keystone of climate change mitigation worldwide. These tools are all part of a broad trend in the US and global economies toward financialized environmental management (Newell and Paterson, Peet et al, Stripple and Buckley, Gunnoe and Gellert 2011, etc). And they inform the broad theories in which the details of this dissertation are set.

A market is defined as any human exchange and the place of exchange. Engaging with a carbon market, however, is unique among commodity exchanges. With carbon markets, so much of the market is virtual, or existing beyond, or among, the physical environment. Not only is the carbon traded mostly clear, odorless and intangible, it is stored or emitted in a range of different forms. It is usually not ever physically traded; what's traded are agreements over carbon equivalencies. Critical geography scholarship helps conceptualize a trade in something that is never really "traded," but rather accounted for, converted to equivalences, and those equivalences are valued and exchanged—all for the express goal of addressing concentrations of atmospheric greenhouse gases.

Latour (1987) wrote that the prime time to "open the black box" of complex scientific and technical knowledge is precisely at the moment when scientists and engineers are busy at work. This dissertation was written at a point when policy-makers and land managers are designing long-term implementation of forest carbon offset plans. This study seeks to identify the embedded networks (Sismondo 2009) that constitute the concept of a "carbon offset credit," and foreground those networks to address common themes in theoretical literature, as well as the emergence of forest carbon offsets as a tool for offsetting carbon emissions and as a conservation funding mechanism. This study engages three bodies of literature: Climate change policy, political ecology, and science and technology studies (STS) of carbon. These three fields contribute to understandings of the complexity of how global governance attends to climate change, deforestation and conservation. Forest carbon offsets provide an ideal case for exploring emerging approaches to governing and managing the atmosphere via administratively and bureaucratically complex market mechanisms.

In its complexity, climate change creates policy puzzles that challenge international governance structures. Limiting carbon emissions and mitigating the impacts of climate change has been framed as an ideological clash between "one atmosphere" and "two hundred or so countries" (Barrett 2005: 286). Often portrayed as a natural or environmental problem, climate change is the acute result of political economic processes. Climate change adaptation and mitigation efforts engage these challenges by connecting global policy-making with state and NGO interests, corporate investment, for-profit firms, physical scientists, and the livelihoods and practices of local communities. The physical impacts and mitigation expenses of climate change are a threat to capital accumulation, creating or increasing costs of insurance, land ownership, and access to resources (Bumpus and Liverman 2010).

Increasingly, the world is turning to market-based mechanisms like carbon markets, the Green Climate Fund, the Clean Development Mechanism (CDM), and REDD+ to offer a "spatial fix" that concurrently facilitates the flow of capital while creating new spaces of Northern and corporate capital accumulation (Harvey 2005; Bumpus and Liverman 2010). In other words, market-based mitigation and adaptation are popular because they include the South in the North's carbon fixes by organizing "climate finance" that allows northern polluters to sponsor sustainable development projects in developing nations as a way to offset their carbon emissions (Buchner et. al. 2011).

Many scholars frame theories on the structure of climate governance in terms of Foucault's govermentality, drawing on Marxist interpretations of capitalism that include the hallmarks of privatization, marketization, and deregulation to understand ways of managing the atmosphere (Death 2014). But political ecologists like Noel Castree and others have criticized this singular interpretation as limiting and shortsighted (Castree 2008). It is useful to position forest carbon development within theoretical discourses on the neoliberalization of nature, which situates nature, in its various forms, as an actor in environmental governance, not simply a backdrop-- because natural processes influence outcomes of market-based environmental policies (Castree 2008). This research engages political ecological debates around the neoliberalization of nature to argue that the geographic spaces created by climate governance are political and contested and therefore require nuanced analysis to understand the power relations, situated knowledges, and non-dominant influences that constitute this form of environmental management in practice. Situating climate change, deforestation and other environmental change as components of complex neoliberal practices illuminates path dependencies, variability and contradictions. Indeed, understanding how and why certain neoliberal environmental policies fail opens spaces to envision new, just, and viable modes of governing the physical environment.

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The following section is divided into explanations of mechanisms, as a way of organizing the literature. There are myriad options to organize a literature review, including specifically dividing the literature into geographic subfields. This format was chosen because it both defines the mechanisms and policies, and situates them amid the literature drawn upon for the dissertation project broadly. It is also an attempt to help the reader connect theories and debates with each specific topic.

(2) Carbon Markets

Eighteenth century philosopher Adam Smith wrote that trading and markets are a natural result of human propensity to "truck, barter and exchange," (Kurz 2016). Beyond spaces of trade or exchange, markets signal things like demand and value. At their most basic, markets exist as a manifestation of how humans perceive and express value, yet modern markets rarely exist without institutional intervention. Rather than signaling value, regulated markets tend to instill value, or assert a value that is not the result of those human propensities Smith wrote about. Regulated markets assert what is valuable (Polanyi 1944; Hodgson 2017). Polanyi argued that an effective market system had to be 'self-adjusting' and free of political interference, even when the state was involved in its creation (Hodgson 2017). This Polanian framework is useful in understanding carbon markets—which are designed as either voluntary or compliance markets, meaning they only exist amid institutional structures that administer the regulation. Polanyi also helps us think about the complexity of carbon markets, which engage critiques of both traditional and non-traditional markets and straddle theories of the role of market intervention.

Greenhouse-gas emissions are considered 'externalities,' a side effect or consequence of an industrial or commercial activity that affects other parties without being reflected in the cost of the goods or services involved. Writes MacKenzie (2009):

> *From the viewpoint of the emitter, they bore no cost, and so did not figure in emitters' economic calculations. The goal of a carbon market is to bring emissions within the frame of economic calculation by giving them a price. In such a market, emissions bear a cost: either a direct cost (because allowances to emit greenhouses gases need to be purchased), or an opportunity cost (because allowances that are not used to cover emissions can be sold, or because credits can be earned if emissions are reduced below 'business as usual'). A carbon market is thus an attempt to change the construction of capitalism's central economic metric: profit and loss, the 'bottom line'.*

Across multiple scales-- from the United Nations (UN) to individual states -- ongoing debates around how to manage and govern climate change focus on the construction of new emissions market mechanisms. Since 2013 new carbon markets have been introduced in places as diverse as California, Kazakhstan, Mexico, Quebec, South Korea, and China, as interest in both 'green' carbon, through REDD+ and forest carbon projects, and 'blue' carbon, associated with marine ecosystems, continues to grow. A 2008 assessment from Ecosystem Marketplace estimated participation in compliance carbon markets, including the European Emission Trading System and others, at more than $66 billion, and participation in voluntary carbon markets at $330 million (Hamilton et al 2008). This growth in carbon market-centered climate mitigation is part of what is often called "the new carbon economy (E. Boyd, Boykoff, and Newell 2011).

Carbon markets were designed to internalize the costs of pollution, and operate by placing a price on carbon to motivate behavior change. They are a classic example of Coase Theorem, which states that, given the condition of articulated property rights, no government intervention is needed to address externalities. Coase Theorem asserts that when markets are allowed to function freely they will achieve efficient allocation of resources (Robbins, Hintz, and Moore 2014). But the model that inspires the carbon market is at odds with how they are used in practice, mainly because they are regulatory markets organized around a commodity that largely exists in agreed-up administrative spaces, and cannot stand on its own without regulatory intervention.

Theoretical conceptualizations of climate and carbon finance, broadly, borrow ideas and tools from traditional financial markets. This begins with the initial development of a credit rating agency, like the now-defunct The Carbon Rating Agency, which oversee the credit-worthiness of carbon brokerage firms, governments, or other institutions, and simplify investment and lending decisions for financiers (Sinclair 2008). Additionally, the carbon market used in its design the financial derivative instruments used to make other regulatory markets ("Barclays Capital Launches Global Carbon Emissions-Trading Index" 2008). (The role of credit rating agencies will factor in to the chapters on carbon verification).

As the popularity of carbon markets grows, so do critiques. "Promoters of carbon markets tend to assume a "natural" roll-out of a market logic, while critics quickly ascribe colonial or nefarious corporate intent," write Descheneau and Paterson (2011). A primary critique of carbon markets is that they simply do not work. They create new social and power relations that embody the price of carbon but they fail at doing what they were designed to do: lower carbon emissions and atmospheric carbon concentrations (P. Bond et al. 2012). A key problem with climate mitigation strategies like carbon markets and offsets is that the actors involved —governments, NGOs and others— "do not challenge the regime of accumulation that produced the climate crisis in the first place" (Robbins 2011: 249). For example, in practice, forest carbon projects do not combat the drivers of deforestation—capital accumulation, increasing population, etc—but rather seeks to solve the problem by mitigating its symptoms.

Goodman and Boyd (2010) describe the "carbon-ification" of all social and political problems, in which the "social life" of carbon is so extensive, and permeates so many aspects of culture, that climate change now dominates nearly all environmental narratives. In that context, carbon becomes representative of the human; it is a metric by which all human activities can be measured and perceived as relevant within the world (Whitington 2016). But privileging a focus on carbon over other environmental and industrial processes (other externalities) influences how humans interact with nature, and the construction of human-environment relationships.

Carbon trading inspires new market relationships, and creates new finance pathways, including what some have identified as neo-colonial relationships between the global North and South (Stephan and Lane 2014; A. G. Bumpus and Liverman 2010). It also raises questions of what the increasing commodification of carbon does to the networks that constitute environmental governance (Beuret 2017). Does an increase in carbon's social-value change the way objects are enrolled in particular networks, while other objects are marginalized? Patterson and Stripple (2010) believe carbon credits are intentionally framed as a "virtuous" commodity, inducing a sort-of governmentality that aims to neutralize resistance by imbedding carbon and carbon markets with moral qualities. Valuing carbon as a primary means of mitigating climate change imbues it with power and increases its focus as an object of governance, all while altering the networks in which it exists. And carbon markets quickly emerged as the most politically viable way to garner wide-spread buy-in to climate mitigation. According to Boyd, et al, "markets offered the most politically acceptable solution as part of a suite of measures to bring down the costs associated with reducing emissions and increase flexibility about where emissions' reductions take place" (Boyd, Boykoff, and Newell 2011).

(3) The critiques of carbon offsets and the role of forests

The incorporation of carbon offsets, or commoditized carbon sinks, raises a number of questions around the role of privatization of land and atmosphere, and the technical possibility of managing the atmospheric commons (Hulme 2009). A common critique of carbon offsets, and other forms of financialization of the environment, is that capitalist-driven conservation does little to curb the factors that lead to environmental degradation in the first place, meaning that market-driven mitigation initiatives engage the climate crisis on a cursory level but do not address the root causes of increased carbon emissions, like consumption, population growth and deforestation (Rutherford 2011; Peet, Robbins, and Watts 2010; P. West 2006; Ferguson 1994). In fact, the market-focused nature of forest carbon offsets, for example, requires, by design, that communities remain dependent on project developers in order to exist as subjects of the development apparatus (Stephan and Lane 2014; Escobar 1996) and engage "appropriately" with conservation measures. This critique is particular to north/south offset projects, especially those where there is settlement within or amid a carbon project, and politics of land use and tenure are vital to distribution of project benefits. It is less relevant in north/north projects like Farm Cove.

Forest carbon offsets are one of the more dominant types of offset, designed to simultaneously address carbon emissions while saving tropical forests. Between 1990 and 2015, an estimated 129 million hectares of forests-- an area nearly the size of South Africa-- was lost to development (FAO 2016). This loss of sequestered forest carbon accounted for an estimated 10 to 20 percent of greenhouse gas emissions during that time (Baccini et al. 2012; Harris et al. 2012; "Land Use, Land-Use Change and Forestry" n.d.). The significance of forest loss as a contributor to atmospheric carbon concentrations and, in turn, human-induced climate change, places forest conservation central to climate change mitigation strategies. Increasingly, forests have been incorporated into carbon markets, both as REDD+ projects and in more loosely defined forest carbon offset schemes. Called "offsets" for their ability to counteract industrial carbon emissions, forest and other conservation activities exist outside cap-and-trade systems, but are included to balance carbon budgets. Key to incorporating forest protection and management into climate mitigation plans is the need to value forests for their carbon sequestration capabilities. For carbon markets to work, multiple forms of carbon must be made commensurate so they can be traded or exchanged (MacKenzie 2009; Lovell and MacKenzie 2011). Carbon accounting-- a broad term for the monitoring, reporting and verification of carbon reduction or sequestration activities-- thus becomes vital to making forests legible within carbon markets.

Forest carbon projects are the most popular type of carbon offset, for three reasons. First, there is simply a lot of standing forest carbon. Boyd has described Brazil as "the Saudi Arabia of live carbon." The United Nations estimates 18 to 20 percent of annual carbon emissions come from deforestation (W. Boyd 2010). Saving or planting trees impacts carbon storage in two ways: preventing emissions from forest degradation *and* creating new spaces for carbon storage. The second reason forests have become popular sites of carbon offseting is an issue of scale. Forest carbon projects scale up easier than, say, investments in renewable energy like building solar or wind farms, or promoting widespread adoption of household-scale renewables. And a third, less obvious reason, is that forests maintain a socially constructed romantic narrative as "wild" and "pristine" places (Robbins 2011; Rutherford 2011). Along the lines of the infamous charismatic mega fauna, this narrative attracts investors drawn to the "social conscience" aspects of offsetting (Stripple and Bulkeley 2013), and who may choose to leverage their investment as a sort of green-washing.

While many scholars are firmly against the incorporation of forests into carbon market schemes, and indeed against market-based mitigation in general (Bond 2012; Lohmann 2008; P. Bond et al. 2012), I take a structural approach in which I frame the case of forest carbon offsets as a critical analysis, and not a challenge to the neoliberal structures that feed market-based climate change mitigation in the first place. There is significant poststructural literature that takes on the very institutional structures and discourses that (re)make market-based approached to environmental management (Wainwright and Mann 2013; Labban 2012; Stripple and Bulkeley 2013; Lohmann 2005) but analysis for this dissertation is situated within the policy-based scholarly conversation on how to best approach carbon offsets.

There are myriad scholarly debates around the use of carbon offsets in climate change mitigation strategies. Anderson, et al (2017) identify two prominent concerns about using offsets for mitigation: "First, the purchase of offsets may resemble the purchase of indulgences (as in the Catholic Church during the Middle Ages), decreasing the incentive for internal emissions reductions from industries, individuals, and entire sectors by outsourcing responsibility to offset providers. Second, offsets may credit emissions reductions that would have occurred even in the absence of the offset program." The most common explanation for including carbon offsets in carbon market schemes is what I call the "added value" clause. By leveraging investments in renewable energy or forests conservation into carbon reduction plans, investors simultaneously lower their carbon footprint (at least administratively) while supporting "socially progressive" causes (Randall 2015). Carbon offsets have been called, "A powerful tool for sustainable development," by proponents. In the case of forest carbon, Boyd (2010) has framed mechanisms like REDD as a last-ditch effort to save tropical forests. Carbon offsets provide the opportunity to 'kill two birds with one stone' by providing means to finance renewable energy, sustainable development, and conservation while balancing carbon budgets. And proponents have argued that, without opportunities to offset carbon emissions, it would be impossible to lower carbon footprints (Stephan and Lane 2015).

Emissions trading have been part of policies to address climate change since the early 21st century, and 'flexible' mechanisms, beginning with the Clean Development Mechanism (CDM), were introduced shortly after (Lane and Newell 2016). Beginning with initiatives from the Coalition of Rainforest Nations, to the Stern Review, to the Bali United Nations Conference of the Parties (COP), forests were seen as tangible carbon storage in which financing could be leveraged to both slow deforestation and increase absorption of atmospheric carbon (Angelsen 2008; Humphreys 2008; Lederer 2011; Hall 2008); REDD+, **R**educing **E**missions from **D**eforestation and forest **D**egradation theoretically served double duty: slowing deforestation while addressing climate change.

In the last decade, carbon sinks, or offsets, have increasingly become part of global carbon budgets and policy approached to climate mitigation— they are also highly contentious. Carbon offsets offer incentives to simultaneously lower carbon emissions while "saving" forests, soils and vegetation, all while supporting conservation funding. But critics say they spur a host of unintended consequence, including disrupting local livelihoods and displacing communities; valuing spaces as carbon sinks over other, more immediately profitable land-uses; and by creating spaces of neo-colonial relationships between the global North and South. Managed carbon sinks have also been equated to placing a Band-Aid on the climate problem, evoking the notion of "putting a price on nature in order to save it" (Liverman 2004).

To understand the contentiousness of carbon commodification, it helps to look to the origins of climate change and the increasing neoliberalization of environmental management (Castree 2006). Climate change is a crisis of capitalism. For more than 150 years humans have extracted fossil fuels from the ground, combusted them for energy, and emitted them into the atmosphere (Lohmann 2006). As Castree (2006) writes, with a turn toward the neoliberalism of environmental management, it makes sense that neoliberal market solutions would be applied to remedy carbon pollution, the product of capitalism.

(3.1) Markets, development and marginalization

Deforestation contributes to an estimated 20 percent of annual carbon emissions (IPCC 2007). REDD and other forest carbon initiatives were introduced as a development mechanism to curb deforestation and mitigate climate change through forest conservation and carbon markets. These relationships work well in theory but flounders upon implementation, when preventing deforestation at the community scale proves challenging (Chatterjee 2009). These projects are designed to support local conservation programs while spurring new capital flows for local communities, but they often perpetuate capital accumulation among investors and their networks. In practice, this means that money invested to conserve forest goes to NGO programs, consultants, and carbon accounting, and little to none directly meets the needs or desires of the communities whose livelihoods are impacted by the carbon offset program.

Degradation and marginalization theory (Robbins, Hintz, and Moore 2014) details the cycle of how overexploitation of natural resources leads to two scenarios for local communities: 1) The need for state response or development intervention and/or 2) The (increased) integration into regional or global markets. Both those scenarios, whether they happen independently or in tandem, lead to increased poverty and, in turn, continued overexploitation of natural resources. Poverty, then, in emerges from the appropriation of natural resources and the marginalization of local communities. Ultimately, conserving trees as carbon sinks leads to a broadening divide between the developed and developing regions, whether its global North/South, or domestic urban/rural. Deconstructing this theory, however, requires a re-framing of forest carbon projects as a political ecological component of a carbon market and not simply as a forest conservation initiative.

But what, specifically, do carbon sinks do to climate policy? For one, they spark enrollment in the neoliberal climate agenda, creating incentives to reframe development as a climate mitigation or adaptation intervention. We see this especially with the Green Climate Fund, a financial entity designed to support urgent development needs in light of the impacts of climate change. As a result, cities and organizations often re-frame longstanding infrastructure needs in the context of climate adaptation in order to attract funding. Further, with climate change policies organized around carbon caps and emissions trading, it would be nearly impossible to gain widespread buy-in without the opportunity to profit, or at least the opportunity to support projects that shed positive light on polluting industries. This is why carbon taxes are largely voted down (or overturned, like in Australia), and why the idea of a carbon cap, without opportunities to trade, would never be adopted. Additionally, Newell and Paterson (2011) see carbon offsets as opportunities to positively "experiment" in carbon markets, providing greater opportunities for risk and profit.

(3.2) The argument against including forest in climate policies

Arguments against the incorporation of carbon offsets, forests in particular, are strong and varied within climate policy circles. Opponents are largely organized around a range of unintended consequences, including privileging sequestered carbon over other land-uses, disrupting local livelihoods, incentivizing monoculture and, in turn, increasing risk, and the conundrum of international development where interventions meet the needs of development organizations over those of host communities. Opponents also raise a number of questions related to the structures and presumed benefits of the projects, like: Who defines environmental benefits or improved quality of life? There is also the issue of technocratic and often convoluted carbon accounting, the backbone of carbon trading where tons of carbon are translated into "commodity form" by processing pieces of information through complex methodologies, which is critiqued as contributing to capital accumulation and flows of finance, while obscuring the complexity of development projects (Bumpus and Liverman 2008).

Most carbon offsets are not designed address the root causes of climate change, but rather mask externalities in webs of complexity. These webs circumvent the need to directly address carbon emissions. Instead, they call on development interventions to approach climate change in two ways: 1) through mitigation of carbon emissions, or 2) through assistance with community adaptation. Within the binary of adaptation and mitigation there are endless spaces for intervention, and clear examples of what Wainwright (2011) calls *development qua capitalism* (development is capitalism and capitalism is development) where development initiatives are centered around capital expansion. The myriad of details required to implement carbon projects often get obscured in the bigger picture of reducing emissions and balancing carbon budgets.

Further, opportunity for Northern polluters to offset carbon emissions via carbon offset projects in developing regions have been cited for their neo-colonial characteristics (Buchner et al. 2011; Stephan and Lane 2014). Some of the strongest detractors have called offsets, "carbon colonialism," arguing that they allow the North to use development as a means to enter local markets and gain control of natural resources (Stripple and Bulkeley 2013; Bachram 2004; Lohmann 2008). "Carbon colonialism" was coined by critics of privatization of atmospheric commons who argue carbon offsets create pathways for capital flows, but do not challenge regimes of accumulation, allow funders to pay to pollute, and don't actually lower carbon emissions (Bumpus and Liverman 2010; Robbins 2006; Bachram 2004). Stephan and Lane (2014) identify neo-colonial imperatives most acutely within carbon forestry projects, which require years of labor-intense management and settlement.

(4) Timber Investment Management Organizations (TIMOs) and Maine's timber history:
"Forestry is a broad field. Finance is integrated into it."

Timber Investment Management Organizations (TIMOs) are financial institutions that play a key role in the inclusion of forests into carbon offset schemes in the United States. TIMOs operate nationally, invest almost exclusively in timberland, and have a heavy concentration of investments in New England's northern forests, as well as in the American South (Gunnoe and Gellert 2011). Mostly constructed as private equity firms, they emerged in the wake of collapsing pulp and paper industries, and quickly invested in land that was once part of paper conglomerates. Industrial ownership of Maine's forests has been largely displaced by various categories of investor ownership. Currently, investors (including banks, university endowments, insurance companies, and mutual and pension funds) own more than 2.6 million acres of Maine's forestland, or approximately 15 percent (Kay 2017). Conservation organizations have also had some success purchasing former paper company lands and now hold a collective 251,000 acres, or approximately one percent, of Maine's forests (Maine Tree Foundation 2015).

This investor ownership began in the 1980s when the US saw the disbanding of vertically integrated pulp and paper corporations, which once held a monopoly on forest land, timber harvesting, and pulp and paper production. Upon the dis-integration of the industry, US timberlands were sold to two types of institutional investors: Timber Investment Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs), through the former, institutional investors have obtained control of more than half the nation's private timberlands (Harris 2007). The majority of forestland in the US is privately held—more than twice as much as is public. And an estimated 20 percent of private forestland is held by TIMOs. In Maine, forests previously held by large, vertically integrated industrial timber corporations were viewed by TIMO management as reliable sources of raw materials to be harvested and sold to sawmills and paper factories. The primary goal of a TIMO is financial: to achieve profitability via diversification of large investment portfolios (Gunnoe and Gellert 2011). "Most conservation TIMOs are structured as private equity firms, with 10–15-year ownership horizons. Once this period has lapsed, the land will be sold to another buyer," writes Kay (2016). This timing structure sets up TIMOs forests as strong contenders for carbon offset schemes. Once a TIMO has aggressively harvested forest products from a parcel of land, other timberland investors are not interested, as it would take 40-50 years to regenerate timber value (personal communication

13 August 2017). Therefore, TIMOs have two potential buyers for their land: Developers or conservation organizations.

Forests are intimately tied to the imaginary of Maine—where they simultaneously symbolize a rich history of logging and come to epitomize wilderness for many people (Judd 1997; Nash 2014). This duality of forests as commodity landscape and wilderness is likely what has attracted significant conservation investors, particularly when leveraged as “added value” amid corporate social responsibility. There are two large conservation TIMOs in the United States, Conservation Forestry and the Lyme Timber Company; the latter holds over 750,000 acres of land in the US and Canada and manages around $1 billion in capital and assets (Lyme Timber 2018); Lyme Timber played a primary role in developing the DLLT forest carbon project and others in Maine, even playing a role as an early offset developer.

Why have investors taken such an interest in owning timberland? One forest carbon offset developer said, “Forestry is a broad field. Finance is integrated into it. You can’t separate the two” (personal communication 14 April 2017). “The conservation investment model works especially well in timber, since it is perceived as a homogenous asset class, which is sold in established markets (lumber, pulp and paper) and can be easily bought and sold in bulk,” writes Kay (2017).

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Chapter 2

Theorizing the commodification of CO2: Toward an STS of Carbon

Abstract:

This chapter applies hallmark questions from the field of Science and Technology Studies (STS) to the commodification of carbon and envisions a subfield STS of carbon. It first provides a review of STS literature and how it engages with varying notions of carbon. The chapter than explores questions about whose science/expertise/knowledge emerges as dominant, and illustrates the work that can be done with an STS of carbon.

(1) Introduction

Carbon has long been commodified: In the form of timber, fossil fuels, gems, soil, etc. But only recently has carbon been commodified as a means of mitigating climate change. With its ability to be conserved, stored, and traded, carbon is leveraged as a key component of climate change mitigation strategies. This shift, sometimes called "the new carbon economy" (Boykoff et al. 2009), is addressed in an emerging subfield within the critical social sciences that situates carbon as an object of inquiry, and asks how, and by whom, carbon is made a commodity. Gavin Bridge (2010) describes carbon as an "organizing logic and mode of accounting through which space and social practice are being rewritten." Carbon engages a crucial dimension of human-atmosphere relationships, and has becomes the signifier around which carbon mitigation is framed. Jerome Whitington (2016) identifies carbon as "the metric of the human," a signifier around which human activities are judged by their contribution, or responsibility, to the tragedy of climate change. By exploring the fungibility of carbon as a lens through which to explore a range of theoretical questions, this chapter contributes to an emerging subfield in the critical social sciences that situates carbon as an object of inquiry, and asks how, and by whom, it is made a commodity (Whitington 2016; Günel 2016; Twyman, Smith, and Arnall 2015). This framing proposes that anthropogenic climate change is designated a problem domain, rather than a set of authoritarian facts (Rabinow 2009), and can be "fixed" with careful management. Theoretical framings of the malleability of carbon can help understand, "How the interpretive social sciences can foster a more complex understanding of humanity's climate predicament," (Jasanoff 2010) and how the role carbon as an actant and object of analysis contributes to the development of science-policy interfaces.

Goodman and Boyd describe the "carbon-ification" of all social and political problems, or the notion that the "social life" of carbon is so extensive, and permeates so many aspects of culture, that climate change now dominates nearly all human-environment narratives. In that vein, Whitington writes that, "Climate change is organized with respect to a single variable, anthropogenic carbon emissions, which can be used as a metric for people's activities all over the world" (2016). Distilling human activities down to their relationship with one element, carbon dioxide, reconfigures understandings of how humans interact with environments, and how those actions are valued socially, financially, politically, and beyond. This distillation, to "carbon as a metric of the human," is key to understanding how climate change is influencing the social sciences across disciplines, and how scholars will adapt to meet this emerging opportunity. The complexity of carbon is appearing more and more in literature, and discourses around the ways in which carbon becomes a focus of scholarship supersedes disciplinary boundaries. In critical social science, broadly, there is a dance around whether carbon might be seen a single variable with an increasingly penetrable influence, or a malleable idea, used intentionally and unintentionally, to shape and define human-environment relationships.

Drawing on science and technology studies, political ecology, and other theoretical sub-fields, this article defines a ‘Science and Technology Studies of Carbon’ to be used as a tool for analyzing material and non-material climate governance structures (ex: material = trees, nonmaterial = trades of ethereal gasses). This chapter is in conversation with an emerging trend in the critical social sciences that explores the commodification carbon in the context of climate change governance and mitigation (Gifford 2016). This subfield follows carbon as it is moves physically and administratively through policies and development practices. In such, this chapter first defines STS, then articulates its engagements with carbon in literature over the past approximately 15 years (Lovell and MacKenzie 2011), and finally makes the case for a subfield of STS in which carbon is the object of analysis-- particularly carbon as it is commodified in the context of climate change mitigation and carbon markets. This chapter applies the history and theory of the STS subfield to new and challenging questions about the commodification of carbon (Bridge 2010; Whitington 2016) and shows how this theory can be used to take on bureaucratic governance structures, the role of expertise, and the messiness of policy production and implementation.

(2) Defining Science and Technology Studies (STS)

Science and Technology Studies (STS) is an interdisciplinary field that seeks to understand the origins, dynamics, and consequences of science and technology. Concerned with the politics of scientific knowledge production, STS is used to question the political neutrality of representations of nature offered by “science.” The field is wide reaching, incorporating medical, technological, legal fields and beyond. At its core, STS scholars attempt to draw connections among the social, political and cultural forces that influence scientific and technological knowledge production and circulation, and vice versa. There is a goal of revealing, uncovering, or disclosing the political interests that reside within objects, theories or policies (Sismondo 2009). The STS used in this chapter maintains a focus on human-environment interactions, particularly within the realm of climate change and ecosystem services; it includes seminal pieces that engage key theoretical takes, like Actor-Network Theory; the influence of multiple subjectivities; the emergence of dominant knowledge claims; and the construction of hybrids. It demonstrates the tension between the field's use of binaries, and evolving understandings of the need to think beyond them. In short, this chapter calls on Jassanoff 's framing of STS to explore the ways science and society are co-produced, arguing that the ways in which we know and represent the world are intertwined with the ways in which we choose to live it (Jasanoff 2004a).

Science and technology studies (STS) play a crucial role in theoretical and practical approaches to understanding carbon as an object and idea that shapes climate change mitigation. STS is, in part, driven by a mission to "un-black box" scientific knowledge (Spiegel-Rosing 1977). It is more complex and theory-based than what Latour calls, "the debunking urge," a drive to expose the hollowness of accepted scientific processes and technologies. STS offers tools to consider the specific social, cultural and political contexts that contribute to scientific knowledge production, with a goal of revealing the complex interests that reside within objects, theories or policies. At its heart, STS seeks to question the embeddedness of science and technology into everyday practices. Using STS to the address the commodification of carbon allow us to look to the complexity of how, and by whom, new networks are created, knowledge is circulated, and who and what gets excluded, and why.

(3) Conceptualizing carbon

Carbon dioxide, CO_2, is a bizarre pollutant. For the most part, it is not toxic. Carbon dioxide is an essential part of respiration for plants and animals. It is a pollutant only at the scale of the planet. Scholars have described carbon as the "new natural resource" of the 21st century (Hepburn 2009). Often intangible and invisible, carbon is a "surreal commodity," its value created by bureaucrats with an invented price that does not reflect supply and demand (Twyman, Smith, and Arnall 2015, Lacalle 2010). With its ability to be conserved, stored (Jindal, Swallow, and Kerr 2008), and traded (Stephan and Lane 2014) carbon is leveraged as a key component of climate change mitigation. But as a pollutant, carbon dioxide is unique. For the most part, it is not toxic, and it is an essential part of respiration for plants and animals. Carbon is only a pollutant at the scale of the planet.

As an object of analysis, carbon engages a crucial dimension of human-atmosphere relationships, and has becomes the signifier around which carbon mitigation is framed—climate policies are designed to address carbon in multiple forms, and at multiple scales, rather than change systems and institutions that maintain dependencies on fossil fuel combustion (Lohmann 2005). This focus on carbon, in some ways, moves the responsibility of climate change away from the individual and onto the molecule. As Bridge (2010) writes, carbon has become an "organizing logic and mode of accounting through which space and social practice are being rewritten."

Multiple forms of carbon have been incorporated into carbon budgets as a means of governing or managing the atmosphere—with an aim to lower concentrations of atmospheric carbon that contribute to human-driven (anthropogenic) climate change. A key component of these schemes is the commensuration of various forms of carbon. Commensuration makes it possible to incorporate multiple states of carbon into market or budget approaches to atmospheric carbon mitigation, rendering them interchangeable and tradable. This idea of "making same," as Mackenzie (2007) calls it, requires the development and incorporation of new technologies to monitor, report and verify carbon stocks. To that end, situating carbon as a primary means of climate mitigation has raised new questions about how humans interact with their environments, and has contributed to the emergence of new social networks that support the valuation and trading of carbon.

(4) The incorporation of political ecology and critical theory

When considering carbon in the context of climate change policy, and climate mitigation broadly, it is useful to look to a trend in STS that incorporates political ecology into the analysis. Political ecology steps in to fill intellectual gaps in STS, to make space for understanding uneven relations and the politics of difference. This combining of sub-disciplines is part of an evolution within STS that is increasingly concerned with the political. There is a divide within the field of STS between: A) the long-standing focus on constructivist approaches that address and challenge traditional perspectives in philosophy, sociology, and history of science; and B) Scholarship motivated by activism or reform that attends to policy, governance, and funding issues, as well as publicly relevant science and technology; it seeks to reform science and technology in the name of equality, welfare, and environment (Sismondo 2009). Increasingly, however, constructivist STS is concerned with theoretical analysis of science and technology in explicitly political contexts (Wouters, P. et al. 2008). The incorporation of political ecology is part of this bridge, bringing with it critiques of the uneven power relations and social constructions that contribute to the production of scientific knowledge and the making of claims of expertise. Wouters et al. (2008) sees this as, "not just insight guided by critical theory but insight into the very ideas of "theory," "the social," and what it means to be "critical." Political ecology, in its quest to understand uneven power relationships, often focuses on the influence in institutions, markets, or other accumulations of capital to understand non-proximate drivers of environmental change. Broadly, STS pushes against this, and frames change as the result of complex networks of human and non-human actors and ideas.

Bumpus and Liverman (2011) use both STS and political ecology in their analysis of carbon offsets, using them in tandem to approach multiple aspects of the same intellectual question. They evoke the now-popular term "carbon colonialism" to analyze carbon offsets as a tool to link the global North and South through a complex set of institutions, discourses and technologies (A. G. Bumpus and Liverman 2010). In such, they rely on STS to contextualize how carbon credits are accounted, evoking MacKenzie's (2009) notion of the need to "make same" multiple forms of carbon. But there are limits. To engage with critiques of uneven development, and the global North leveraging carbon offsets as a new means of claiming control of resources in the South, scholars turn to political ecology, and link it with STS to explore the deeply political and contested nature of carbon management. Essentially, the two sub-disciplines work together to question the uneven relations that contribute to technical environmental management.

Part of the identity of STS is the assignment of equal agency to all actants in a network, asserting that each stakeholder or non-human actant plays an equal role in a scientific outcome. But the use of equal agency has limits, especially as scholars like Mol and Law seek to incorporate the politics of difference into questions of human adaptation of technology (Mol and

Law 1994; Law and Mol 2001). Popular STS tools like Actor Network Theory (ANT) are not equipped to address vital components of social science like race, class, or gender (Callon 1986; Callon and Latour 1981; Law 1999). The incompatibility of the politics of difference within STS, however, has been addressed in an number of ways, including incorporating Haraway's (1988) notion of "situated knowledges," and Jasanoff's (2004b) attention to non-dominant voices, and the interdependency of local and global perspectives. A growing sub-field of feminist STS employs social theory to consider hybridity, cyborgs, and distinctions between humans and machines, designers and users (Haraway 2013). All of these changes are incorporated into a more flexible STS, which sets the stage for the STS of carbon.

As it evolves, however, STS is increasing its scope of analysis and moving away from materiality and fixed points of inquiry, as seen in early ANT, and toward understanding the complexity of technoscientific constructions (Sismoto 2010). This is where this hybrid of STS and political ecology is useful for studying modern climate management. Incorporating aspects of political ecology to STS adds a depth of nuance that includes critiques of social constructions of nature, the role of discourses in expert knowledge production, and how political economic structures influence environmental management.

(5) STS tools and what they can do for the multiple subjectivities of carbon

Popular STS tools are useful in articulating an STS of carbon, like Actor-Network Theory (ANT) and the concept of "boundary objects," defines by Star and Griesemer (1989) as objects or ideas that allow for collaboration without consensus, and offer a meeting place for policy and agendas to move forward. Actor-Network Theory (ANT) is a materialist theory, an approach to understanding object construction through what Forsyth calls "relational materiality" (Forsyth

2004). In STS, techno-scientific networks are situated as chains of sites or actors, characterized or organized by a set of parameters, practices and actors. Each actor's identity is affected by, and affects, the network (Escobar 1998). "Intervention in the network is done by means of models (e.g., of ecosystems, conservation strategies); theories (e.g., of development, restoration); objects (from plants and genes to various technologies); actors (prospectors, taxonomists, planners, experts); strategies (resource management, intellectual property rights); etc," writes Escobar (1998). This can be distilled to the idea that scientific processes are the result of interactions among specific human and non-human actants, and that those specific actants create a result that is unique to their interactions.

ANT reduces the social to material (Latour 1987). It emerged from the seminal STS belief that objects exist only as they relate to other objects (Goldman, Nadasdy, and Turner 2011). A network is a series of actors or elements (actants) with well-defined relations between them (Mol and Law 1994). The actor-network grows from the association of human and non-human things into a configuration that makes things happen (Robbins 2011). Actants in the network become representations of social relationships and actions; they are given their capacity to act, or not, only via their position within the network, as they relate to each other. Such networks are not fixed, but fluid and diasporic. Law believes naming ANT gave the false sense of its set definition and use, when really the theory must remain fluid and malleable to attend to the fluidity of ideas and objects to which it's applied. Law has written that while identifying ANT as a theory implies its definition is fixed and "rendered definite," it is really the opposite.

What makes ANT work as a theoretical approach is also what limits it. Pure ANT's assignment of equal agency to all actants in a network challenges the idea that change is not hegemonic, and does not come from one central location or via one, large-scale global actor.

Transformation and enrollment can occur at a range of scales (Robbins 2011). Critics have said ANT follows dominant paths, and does not ask things are enrolled, translated, or came to be.

(6) Carbon in the STS literature

An entire subfield of critical social science literature has sprung up in response to the commodofication of carbon (Lövbrand 2011, 2007; Lovell and MacKenzie 2011; Lohmann 2005), with a particular focus on accounting, monitoring, reporting and verification practices (MRV). Authors point out that, "accounting makes economic items visible, and whether and how it does so is consequential" (Lovell and Mackenzie 2011). They stress the importance of understanding decision-making processes before they become blackboxed, embedded and routine. This new field draws heavily on science and technology studies (STS) to explore the role of standardization within emerging practices of carbon accounting and carbon markets, the primary sites for constituting carbon as a socio-technical object (Stephan and Lane 2014). STS offers a way to consider the production of scientific knowledges and technologies within their specific social, cultural and political context. It helps reveal the political interests that reside within certain objects, theories or policies. Addressing carbon commodification in the context of STS is driven by questions of how institutional assemblages claim the ability to quantify and trade an ethereal, gaseous atmospheric chemistry. Scholars ask: What is actually being traded when, in a regulatory carbon market there is no actual exchange of physical tons of carbon; only the *idea* of carbon is traded-- in agreed upon aggregations of "tons"? While some existing critiques of environmental markets have paid close attention to the work required to make those markets function (Dempsey and Robertson 2012; Robertson 2004; Adam G. Bumpus and

Liverman 2008), too often carbon trading assumed to be a transparent process of neoliberal commodification. Authors are turning to STS to interrogate this assumption.

Lovell (2014) uses ANT to ask how scientists working on forest carbon measurement have contributed to framing international policy debates. She concludes with a nod to the importance of materiality in broad policy discourses, noting that ANT is useful in remembering that climate policy is built from material "stuff" like forests and atmosphere. But she is also critical that ANTs focus on materiality underplays the role of uneven power relations in processes of change, and argues for using ANT in tandem with Foucault's govermentality to best examine relationships between discourse and practice. In short, she uses STS to think about the commodification of carbon, but finds the sub-field limiting, so suppliments with critical theory that allows for incorporation of the role of uneven relations.

In a critical take on carbon and carbon markets, Lohmann (2005) writes that carbon credits, like any market agent or good, are always boundary objects, drawing different ways of knowing together (Boundary objects are often in contestation with the notion of the immutable mobile-- as explained in the chapter "Ties that Bind"-- which goes out into the world, bringing with it "fixed" uses) Despite complex processes of commensuration or, what Lohmann calls 'resynthesization,' carbon always maintains characteristics relating to other contexts; for example, trees may become market agents as carbon sinks, but they still maintain their characteristics as contributors to biodiverse landscapes, sources of livelihoods for local communities, homes for birds and animals, etc. (Lohmann 2005).

(7) What work can an STS of carbon do?

A hallmark of STS is to ask "how, and by whom" scientific knowledge and practices came to be. These questions are vital to conceptualizing the role of carbon, and its multiple subjectivities, in climate policy-making. An STS of carbon creates spaces to explore how carbon, in multiple subjectivities, contributes to the development of science-policy interfaces. It helps answer such questions as: How is carbon constructed as an object that drives climate mitigation? What tools are used to monitor, report and verify carbon? Who decides what specifically is measured? How do those technologies sometimes contradict one another? An STS of carbon can help consider how future uncertainty can be quantified and used to construct markets around carbon emissions and offsets.

Lövbrand (2007) writes that carbon accounting technologies and practices influence wider discourses of climate change and environmental management. She sees technocratic knowledge creation and policy development as a two-way relationship. Expert knowledge must be usable and applicable to policy development. Applying the notion of co-production, where human and non-human actants work together to determine outcomes, it makes sense that policy would be influenced by measurement tools and vice versa. Looking to the example of climate change and IPCC policy, Peet, Robbins, and Watts (2010) write that the production and legitimacy attributed to certain knowledges is fundamental to how debates on policy are playing out. Using the example of forest carbon projects, Gupta et al (2012) call for increased local participation in carbon accounting processes. They argue that the incorporation of local knowledges can strengthen understandings of the forests that feed technical knowledge. In the same vain, Escobar (1998), in studying social movements organizing around contested conservation initiatives, emphasized the importance of asking, "Whose knowledge, whose nature?"

Carbon accounting maintains great power. It has the ability to privilege one form of carbon while silencing or deemphasizes others— ex: sequestered carbon is more valued on markets that atmospheric carbon. This raises concerns over what gets lost via the process of commensuration, and speaks to how the commodification of carbon broadly reconfigures ways of knowing and relating to nature. Knowing more about how people understand, value, and know carbon allows policies to be better informed and practices more effectively targeted at engaging local populations meaningfully in carbon-related projects. By acknowledging the multiple meanings of carbon, we can question, as Jasanoff (2004) asks: "What constitutes legitimate knowledge, who is entitled to speak for nature, and how much deference science should command in relation to other modes of knowing."

The science of carbon accounting and management has been accused of being too far removed from the physical science of carbon sequestration-- proximately, and empirically (there is a disconnect between the ways scientists have found carbon sequestration to work, and what approaches work for carbon development projects) (Stripple and Bulkeley 2013; Paterson and Stripple 2010; Stephan and Lane 2014). But STS tells us that scientific knowledge production is a political venture. Clarke and Fujimura (2014) write that, "scientific work is sustained or enabled by the accessibility, cost, and pacing of specific tools," which is part of larger debates around the political economy of scientific production. STS situates the laboratory, or spaces of scientific experimentation and production, as constructed by the sum of its parts. But the parts are in flux, with human and non-human actants moving in and out. "Science," then, becomes a product of the moment in which it was created. Science is "situated," (D. Haraway 1988), questioning traditional conceptions of objectivity. This notion appears in the context of carbon sinks as evolving and changing definitions of what is acceptable and what is included in appropriate carbon portfolios.

In studying REDD+ initiatives in Latin America, Rojas writes, "as projects that operate beyond Nature and Culture in the sense that they are carried out by experts who see themselves as inhabiting worlds of 'suffering' wherein old environmental orderings collapse" (2016:19). Rojas' notion of "suffering," what he contextualizes as "an emerging type of climate politics whose problems are *not* derived from striving to preserve the world as it is or to improve it as it should be," helps feed the idea of humans having "differentiated relationships" with carbon. Carbon development projects often serve as mechanisms to produce "virtuous" commodities, either through the credits themselves or linked environmental certifications, which are gaining in popularity. Very often, there is an element of virtue bestowed upon project funders and beneficiaries engaged in carbon projects. The offset credits attached to REDD+ projects imbue investments with a sense of virtue—a form of corporate "green washing" that both adds value to the credits and inspires funders to invest more. This notion of virtue is especially attractive since many REDD+ projects are tied to voluntary markets that simply sell credits back to the investors in cyclical, bureaucratic schemes that allow investors to tout steps toward carbon neutrality. But in privileging carbon sequestration over other forest uses, forest carbon schemes provide virtue for some, and "suffering" for others.

(8) Conclusions

The future of managing carbon is ripe with uncertainty. With carbon market volatility, and the seeming non-start of dozens of markets around the world, it is unclear how carbon commodification will evolve—and how science and policy will evolve with it. The uncertainty of the future of markets has left investors reluctant to engage in markets and lawmakers reluctant to intervene in market structures (Engel et al. 2015). The reliance on offsets, especially in voluntary markets, has created capital flows maintained more for their role as funding mechanisms for sustainable development and conservation than as a means to lower carbon emissions. This raises questions about both the future of carbon markets and the usefulness of other means of pricing carbon. ,

Gavin Bridge (2010) claims that carbon is unique because it is severely reductive, situating global environmental change in terms of a single variable and translating complex social relations onto a simplistic concern with a molecule. Yet, despite attempts to technically, administratively and bureaucratically reduce carbon to a single variable in order to manage it, critical social science has shown this task to be impossible. This revelation creates a space of opportunity for anthropologists, geographers and other social sciences to engage in public conversations regarding climate change politics. Our work shows that attempts to "make same" multiple forms of carbon, an element that has so strongly become a metric of the human, by which past and future actions are judged, is problematic. Such commensuration overlooks or obscures complex social and power relationships, with implications for social justice, humanitarian relationships, sustainability, and even the future of neoliberal environmental management. If carbon continues to go rogue, if it remains unwieldy, or if, as Günel writes, it stays "hard to grasp," (2016) then carbon itself poses a challenge to the integrity of the market-based mechanisms designed to harness it. Ultimately, this means that as social scientists concerned with carbon and climate change who seek to understand carbon's role in human/environment futures, we must explore multiple ontologies, new realities and evoke, as Whitington writes, “speculative experimentation” (2016).

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Chapter 3

Studying the mobility of forest carbon:

Qualitative research methods, with a focus on the intangible

Abstract

This chapter outlines the qualitative research methods used in the analysis of how, and by whom, forest carbon offsets are actualized. A combination of semi-structured interviews, document analysis, and participant observation contributed to the development of reproducible hypotheses that helped answer the dissertation's primary research questions. The research methods transcend traditional geographical methodologies in two ways. First, the focus of the research is not only on a specific place, but on the intangible, often virtual space in which carbon offsets exists. Second, to answer questions about how knowledge is created and legitimized, participant observation was used in online carbon accounting training courses. The research methods used represents a subtle methodological shift that will become more common as spaces of inquiry become increasingly complex, virtual, mobile, and flexible.

(1) Introduction

The primary research question for this dissertation is: "How is a carbon offset made?" To answer this, the focus of the research is on the intangible, often virtual space in which a carbon offset exists. This means the research area isn't one specific place, but rather within multiple, often contested spaces that contribute to the making of an offset. Therefore, **the research methods used in this dissertation are unique in that they challenge traditional human geography research methods and represent a methodological shift that will become increasingly common as spaces of inquiry become more complicated, virtual, mobile, and flexible.**

The methods used in this project are carefully chosen as part of a comprehensive research design that takes into consideration research questions, existing literature, theoretical debates, field sites, and multiple methodological approaches. Research design "involves the intersection of philosophy, strategies of inquiry, and specific methods" (Creswell 2013, 5). The goal of tis research design is to choose the best methods to call on the researcher's strengths and develop a comprehensive answer to the research questions. And ultimately, contribute to broad theoretical debates on climate change mitigation and the financialization of nature.

For this dissertation, in-person field work was conducted in multiple locations: Maine, Peru, and United Nations climate negotiations. In those places I met with experts, project developers, state and NGO representatives, and people living in or near forestlands. I also spent time hiking through forests, experiencing the physical spaces that represent offset industrial carbon emissions, and taking note of policies that sought to quantify forests via both avoided deforestation and improved forest management. Additional semi-structured interviews were conducted both in-person and on the phone, with subjects all over the world. Data was also collected via participant observation in online training courses. Within each of these phases, data collection was divided into several steps, which will be explained below.

The in-person field work allowed for first-hand exposure complexities of forest conservation, particularly when multiple uses for forest were addressed in tandem and challenged by often-conflicting multi-scale policies. Virtual fieldwork—or participant observation within virtual education spaces—offered insights into how knowledge is aggregated, organized and shared. It contributed data to analysis on how expertise emerges amid new and changing science and policy.

The following chapter details the research design and approach for the dissertation, and provides an overview on how data was analyzed and used to draw conclusions within subsequent chapters. It also makes its own point that the shifting complexity of development and political economy challenges traditional research approaches and requires innovative new research design to answer questions of modern conservation and environmental management.

(2) Research Questions

The major research question (MRQ) for this dissertation asked: **How is a forest carbon offset made? What are the specific political, technical, institutional, environmental, and policy-based factors that contribute to the creation of a tradable carbon offset credit?**

In answering the MRQ, the following sub questions were drawn upon. In the planning phase, these questions were accompanied by "expected findings" shaped through preliminary theoretical research and observations. Expected findings served as hypotheses that could be proved or disproved via analysis in subsequent chapters. The four sub-questions and expected findings were:

Q1: What are the tools used to account for and verify carbon offsets, and how do they translate a conservation project into tradable credits?

Expected findings: A number of tools are used to determine carbon emissions or sequestration, including a combination of on-the-ground surveys, forest management plans, remote sensing, GIS, accounting equations, drones and other technologies (Zimring and Rathje 2012; Lovell and MacKenzie 2011). These tools are meant to translate one representation of carbon into the other, making multiple forms of carbon commensurate, supporting a process of "making things same" (MacKenzie 2009).

Q2: What social processes are overlooked, or add-value, to the construction of forest carbon offset credits?

Expected findings: Offsets often receive "added-value" from projects that serve community needs, like education on biodiversity, but that don't directly attend to the physical sequestration of carbon. This study identifies carbon offset schemes as "immutable mobiles," objects that move between social networks, bringing with them "fixed" uses, but that often get taken up in different, or unintended ways that suit the differing needs of stakeholders (Mol and Law 1994).

Q3: How and why did certain carbon verification standards emerge over others?

Expected findings: Early stakeholders designed both MRV techniques and the standards by which they were judged. Today there are a number of competing verification standards, and land managers or carbon brokers often choose the standards that best meet the needs of individual conservation projects, complement existing forest management plans, and/or are most respected in the markets on which they plan to sell offset credits (Gupta et al. 2012).

Q4: Why have conservations managers tied their work to carbon offset credits?

Expected findings: Part of a trend toward the neoliberalization of conservation and environmental management (McCarthy and Prudham 2004), land managers turn to carbon offsets as new funding streams to support existing conservation projects or foster more ambitious protection endeavors.

(3) Background Research & Expert Interviews

The first phase of research design involved seeking out "experts" or "key informants" to determine: 1) The evolution and current state of carbon markets (both voluntary and compliance); 2) The complexity of incorporating forests into climate change mitigation plans; and 3) The role of carbon offset brokers, timber investment management organizations (TIMOs), and other technocrats and "middlemen" who develop carbon offset agreements. This phase, which totaled 77 semi-structured expert interviews, and dozens of other informal interviews, covered approximately five years of immersive research and supported a broad understanding of the state-of-play of carbon markets, carbon offsets, forest conservation and more. It also provided knowledge of who was working and leading in these fields, which helped me make an informal social-scape of who to interview and what to ask them. Finally, I could understand key debates (theoretical and empirical) within these fields and how and by whom they were engaged. The names of all informants have been removed and all identifying information has been omitted from interview quotes to respect informant confidentiality. All research was conducted under IRB approval (17-0148).

Additional observations were made at United Nations annual climate negotiations (COPs15-21) and related side events in Warsaw, Poland; Lima, Peru; and Paris, France, and at professional conferences, and via social networks of experts. Interviews took place in person or via telephone and Skype. In preliminary research I visited a number of forest carbon offset projects, spending four months in the Alto Mayo Protected Forest in San Martin, Peru studying the construction and management of a voluntary offset project sponsored by Walt Disney Corp and administered by Conservation International.

Through approximately one-hour long semi-structured interviews (in-person, over the phone, and via skype) I asked questions about key informants' experiences, opinions, and contributions to the emergence and management of carbon and offset markets. The initial line of interview topics was derived from the research questions and hypotheses. Interviews were used to identify topics, refine more specific questions related to the case-based research, and inform critical analysis of the specific technical processes of carbon accounting explained via the two short courses.

Expert interviews are used to articulate the specific processes detailing how, and by whom, a forest is calculated into tons of carbon, and verified as "certified" carbon credits. They helped to reveal 1) how an offset is technically made; 2) spaces for critique of the tools and technologies used for environmental governance; 3) how highly political processes are framed as "technical," and overlooked by critiques of offset market mechanisms. This framing of research is a hallmark of science and technology studies, and often used in research that engages both political ecology and STS.

Data collected during Phase I was transcribed from audio recordings and field notes onto Microsoft Word documents, and coded for key themes. While there were a number of codes planned during research design (see Figure 1), I ultimately coded for just a few words/ideas. The dominant coding themes included: "Additionality, standards, professional, expertise, best practices, and MRV (monitoring, reporting and verification)." These codes allowed me to isolate comments or discourses look for an overall arc in each of these themes.

Research Questions	Emergent themes (Codes)
Q1: Tools for carbon accounting and verification	Technical expertise; accounting; education; additionally; improved forest management; forest certifications; finance; deforestation; linkage; commensuration; technology; remote sensing; standards, baselines
Q2: Social processes included/excluded from carbon credit valuation	Accountability in both conservation and monitoring, reporting and verification (MRV); forest conservation as a means of managing carbon sinks; tools for the job; added-value; education and outreach; community involvement; payments for ecosystem services (PES); compliance market; voluntary market; benefits; virtue or charismatic carbon
Q3: Evolution of MRV standards	Accounting; Verified Carbon Standard; accounting standards, additionally; improved forest management; expertise
Q4: Connecting conservation to carbon credits	Conservation finance; conservation easements; land use management; funding streams; timber investment management organizations (TIMOs); investment; land trusts; conservation as economic development

Figure 1: Sample set of the recurring themes from data analysis, grouped by research question addressed.

This work followed an approach I designed, inspired by Saldana's use of inductive and deductive coding and recursive abstraction (Saldaña 2015). Each code was identified for its positive, negative, neutral or aspirational. For example, interview and participant observation notes were coded to reflect direct and indirect references to concepts like "additionality." Words and phrases that referenced actions like "proving" or "documenting" improved forest management were coded as "additionality" and identified as positive; this coded data contributed to conclusions situating the role of additionality as key to legitimizing an offset project.

Preliminary analysis of this data contributed to the research in two ways: 1) The major themes which emerged at this stage provided a thematic base to which the outcomes of the case study were compared, and 2) Major thematic elements which arose during this phase were distilled into relevant and focused questions that addressed analysis of data collection from subsequent research phases. A graphic I made to follow the method application is below (Figure 2)

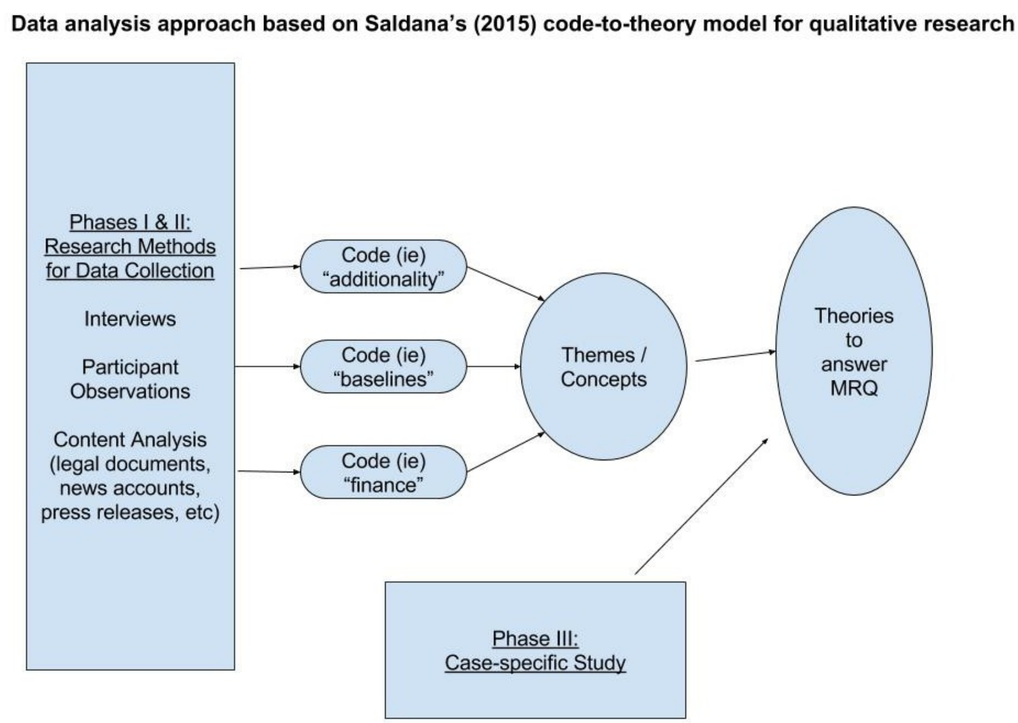


Figure 2: Chart of data analysis plan, based on Saldana's (2015) code-to-theory model of qualitative analysis. This method is used to translate qualitative data into scientific theories that can be applied to answer the major research question (MRQ). Codes are examples; for more details, see Table 2 on Page 7. Source: Lauren Gifford (2016).

(4) Field Sites & Methodology

The case study approach has been selected for its ability to test and build theory, and to identify causal linkages while taking account of real-life complexity (Rowley 2002). Case-study research consisted of semi-structured interviews, participant observation and content analysis. Like the expert interviews, case-based semi-structured interviews were conducted with an initial set of actors and snowball sampling was usedto expand the subject pool, with a total of 34 interviews, providing a "richness of data" for a question set of this size (Morse 2000). Participant observation was conducted at UN climate negotiations and other professional meetings and conferences, land trust meetings and landowner visits (Spradley 1980); and content analysis consisted of carbon accounting records, California Air Resource Board documents, local news articles and other secondary data (Creswell 2013). Figure 2 shows each major field site, the methods used there, and the types of data collected.

Field Sites	Methods & Data Acquired
Farm Cove Community Forest, Maine, USA	Interviews, participant observation, photographs, experience within the space, snowball sampling for interview identification
Alto Mayo Protected Forest, San Martin, Peru	Interviews, participant observation, photographs, experience within the space, snowball sampling for interview identification
Greenhouse Gas Management Institute online courses	Participant observation, identify working terminology, access expert interviewees
Professional Meetings: United Nations COPs, CIFOR's Global Landscapes Forum, Colorado Ecosystem Partnership, Red Cross Development Days, etc.	Learn how carbon markets are operationalized, identify and conduct expert interviews, access applied research and data, stay up to date on professional debates

Figure 3: Major field sites, methods employed and data collected.

(4.1) Site 1: Farm Cove Community Forest, Grand Lake Stream, Maine

Primary fieldwork was conducted in Grand Lake Stream, Maine at the Farm Cove Community Forest, a conservation project that served as the primary case study for this research. The Farm Cove Forest Carbon Project is the second forest carbon project in the United States, and the first outside of California, to sell to the state's carbon market (see Figure 1). It is also one of the most established forest carbon projects in North America. The Farm Cove Forest Carbon project is part of a compliance carbon market in which the credits from sequestered carbon are sold as offsets into California's cap-and-trade market, AB-32. Since 2010, when the Downeast Lakes Land Trust registered a conservation easement on 19,000 acres of forest with the Climate Action Reserve, the project has generated nearly $2 million in carbon credits approved through the

California Air Resources Board (CAB). By the summer of 2016, that number had increased to more than 40,000. The offsets, or “additionality,” comes from an “improved forest management plan,” which is different from common REDD+ projects, which ascribe value to avoided deforestation (Bäckstrand and Lövbrand 2006). The improved forest management plans allow forest carbon projects to be established in spaces with little to no threat to deforestation.

Image 1: Downeast Lakes Community Forest, a second forest carbon project by the Downeast Lakes Land Trust. Photo: Gifford 2017

The Downeast Lakes Land Trust, in collaboration with the New England Forestry Foundation, recently acquired a second conservation easement on an adjacent 21,870-acre parcel nearby, which will also be financed through carbon credit sales, though on voluntary markets. The project is brokered and administered by Finite Carbon, a Pennsylvania-based firm that brokers forest carbon projects around the world. While the agreements that finalize these projects are shrouded behind confidentiality agreements, the Farm Cove project netted approximately $10/ton for carbon, slightly above the offset average per ton.

Grand Lake Stream is a small town (year-round population: 109 in 2010) with a long history of hunting and fishing, and an economy based on guiding out of state visitors. For decades, the surrounding forests were managed first by the pulp and paper industry and then, in starting in the 1980s, by timberland investment management organizations (TIMOs). After aggressive harvesting among TIMOs meant land didn't sustain value for the pulp and paper industry (personal communication July 2016), and created opportunities for conservation organizations, led by the Downeast Lakes Land Trust, to purchase land for conservation (Kay 2017).

The Farm Cove research involved a range of stakeholders, including current and former employees from Maine-based land trusts; local communities, including the Passamaquoddy Tribe; carbon broker Finite Carbon; carbon market and offset experts; employees of the state of California Air Resource Board; and others (Kay 2017). Stakeholders were identified using an initial list of sources tied to the organizations listed above. Snowball sampling was used to identify others.

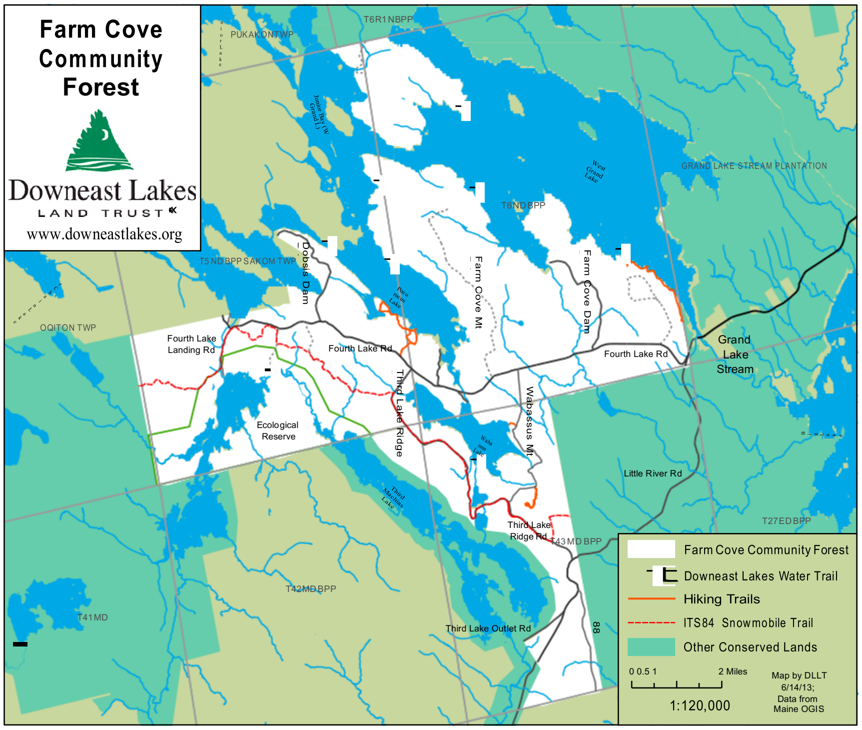


Figure 4: Farm Cove Community Forest, including the forest carbon offset project in white, and surrounding conservation easements that included additional forest carbon projects. Source: Downeast Lakes Land Trust (2016).

(4.2) Site 2: Alto Mayo Protected Forest, San Martin, Peru

Additional, more preliminary fieldwork was conducted in the Peruvian Amazon at the Alto Mayo Protected Forest in San Martin, Peru. Data collected through this work served as a comparison study of REDD+ forest carbon conservation projects, and helped illuminate aspects of the Farm Cove project that were unique when contextualized among more traditional, international, north/south forest carbon initiatives.

Image 2: Alto Mayo Protected Forest, San Martin, Peru. November 2014. Photo: Gifford

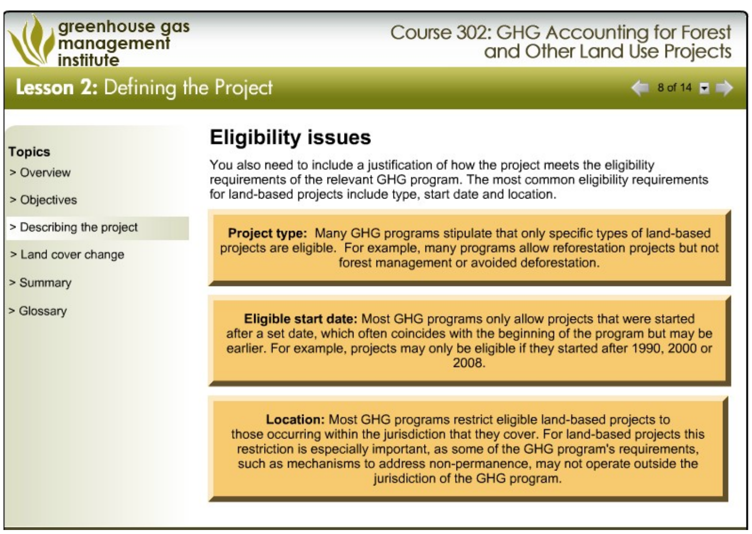
The Alto Mayo Protected Forest conservation project is funded by The Walt Disney Corporation and managed by global NGO Conservation International (CI) and its local partner ECOAN, a Peruvian NGO focused on conserving rare bird habitats. The Alto Mayo is one of the more established forest carbon projects to date, completing two carbon accounting cycles and retiring hundreds of carbon credits sold on voluntary markets—nearly 90 percent of which were sold back to Disney. Though called a REDD project in various CI materials, some managers are shying away from the moniker, and choose to identify the Alto Mayo project as “an administrative contract,” or, “a forest carbon project.” This shift came from deeper clarification on the definition of REDD, as well as the mounting negative connotation of the term, especially among activist groups. The “administrative contract” identification is beneficial to CI as well, as the group has leveraged the success of the Alto Mayo forest carbon project to expand public/private conservation and development initiatives in the region. The interconnectedness of the Alto Mayo project with other development raises questions about the motivation and complexity behind forest carbon, specifically when dozens of jobs and additional development projects hinge on the success of avoided deforestation. This raises a number of questions: Is there motivation to choose MRV methods that continually demonstrate avoided deforestation, even when the claims are dubious? How does that motivation influence how the project is managed? And what does the value of a carbon credit mean if it's immediately sold back to its developer?

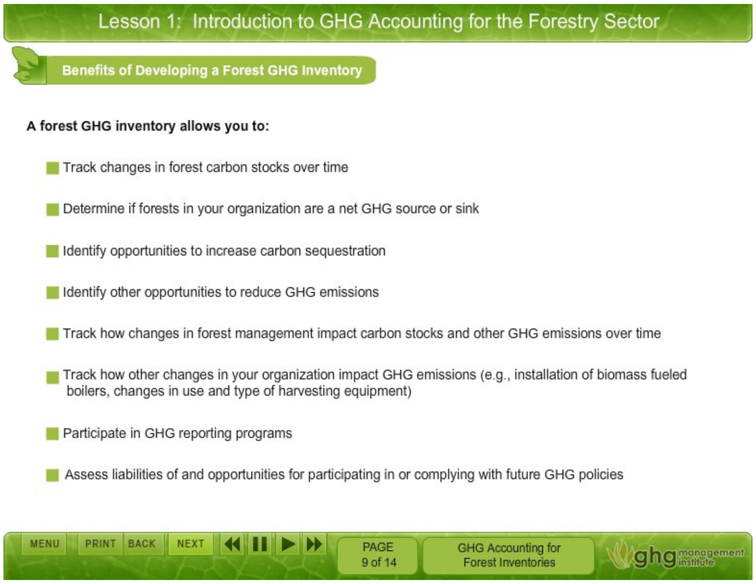
Located in the remote San Martin region in northern Peru, on the western edge of the Amazon and just east of the Andes, the Alto Mayo Protected Forest is home to small-scale coffee, rice, and cattle producers, some of whom are indigenous Awajun and others are Andean migrants who came to lower altitudes for farming and economic opportunities. The Alto Mayo Protected Forest was identified more than 20 years ago by the Peruvian government as an important regional watershed, but lack of funding limited government-led conservation efforts. In 2007, the Walt Disney Corporation spent $3.5 million to sponsor a multi-year forest carbon project, with the expectation of revenue returns upon the sale of the carbon credits. By engaging in a forest carbon offset scheme, the conservation project received a much-needed capital infusion to fund the addition of 25 park rangers, local education initiatives, and support for NGO-led regional public/private partnerships. The conservation project seeks to limit rampant deforestation via increased policing of the state forest (home to more than a dozen farming settlements), educating local communities on the importance of forests as a carbon sink, and providing growers with high-yield coffee seedlings so they can produce more coffee on less land. The Alto Mayo is unique among forest carbon projects in that it is organized in partnership with the state government to support an existing, struggling state conservation project (Chatterjee 2009; Evans, Murphy, and Jong 2014).

(4.3) Site 3: Greenhouse Gas Management Institute

Phase II involved participant observation in two short courses offered through the Greenhouse Gas Institute. Between January and June 2017 I completed two online courses through the Greenhouse Gas Management Institute, the dominant institution for defining and training in carbon accounting standards and practices. This line of research was inspired by Lave (2012), who used participant observation in online stream restoration short courses to develop an analytical framework to assess the politics and political economy of the production of science and scientific expertise used in stream restoration and environmental management.

The first course was 'Basics of Project-Level GHG Accounting,' which served as a prerequisite for the second course, 'Accounting for Forest and Other Land Use Projects.' Completion of both courses took approximately 60 hours, as I stopped the online format frequently to take notes and screen shots of tables, graphs, or specifically worded phrasing. These screenshots, of which I collected 37, were tagged and catalogued, and used to support other data collection and theoretical arguments throughout the research project.





Figures 5a and 5b: Screenshots from Greenhouse Gas Management Institute online courses “Accounting for Forest and Other Land Use Projects” (2017).

Participant observation was used to “notice things that otherwise escape attention” (Zahle 2012; Clifford, French, and Valentine 2010). For this phase, participant observation is used to: 1) Establish a working knowledge of carbon accounting processes as presented in technical trainings, by experts, and to participants working in technical fields, and 2) Identify specific language and discourses used by the professionals and field technicians to address carbon accounting, and (3) to confirm or deny the presence of particular themes and issues related to the research questions and hypotheses. During observation, the researcher acts as a “passive participant” (Spradley 1980), utilizing field-notes, bio sketches of instructors and other participants, and/or screen shots to construct a commentary on forest carbon accounting methods, discourse, and patterned minutiae (Saldaña 2015). Notes were taken in duel notebooks, with unanswered questions (theoretical and empirical) in one notebook, and observations and codes in the other (Kawulich 2005). Codes were used to connect the notes with the screenshots to both drive theory creation and order data for later retrieval.

It is vital to STS research to ask why certain tools are chosen for a job, and why others are excluded (Clarke and Fujimura 2014). This phase of research addressed highly political processes often framed as “technical,” and largely overlooked by critiques of offset market mechanisms. At the conclusion of this phase, the researcher was able to: 1) Identify the areas of added-value, such as community education, that contribute to the valuation of carbon credits but not physical carbon sequestration, and 2) determine what social relationships and processes are excluded from offset construction. This line of research helped determine what activities “escape” the technical processes of accounting and verification. For example, many of the co-benefits that developers and stakeholders says draw them to engage in these projects, are not connected to how an offsets is designed or valued. While an offset project is designed closely with a forest inventory (Figure 5b), co-benefits like public access to forestlands, increased fundraising opportunities, and support for local gaming-centered livelihoods, all exist outside the technical project design, but contribute to how a project is designed and implemented.

4.4 Site 4: United Nations Climate Negotiations (COPs 15-21) & other professional meetings

Attendance at the United Nations climate negotiations and other professional meetings primarily served Phase I of the research, offering access to experts for interviews and literature and lectures for background research. By becoming a regular participant in these meetings I integrated myself in the world of global climate policy, carbon markets and forest management. These experiences and knowledge gained contribute to the backbone of this dissertation, establishing the foundation for the research questions and subsequent scholarly arguments.

Image 3: Outside UN COP20 Lima Peru, December 2014. Photo: Gifford

This research phase also drew on participant observation, using the same techniques described above. It also served as a forum to obtain extensive background information and make connections for expert interviews. As part of this research, I attended COP 19 in Warsaw, Poland, COP 20 in Lima, Peru; COP21 in Paris, France; as well as the Red Cross Development Days in Lima; and events and conferences around the world organized by the Center for International Forestry Research, the United States Department of Agriculture; Climate Justice Now!, Conservation International, the International Emissions Trading Association, Colorado Ecosystem Services Partnership, and many more. I also used these meetings to establish connections and set up meetings—in person and over the phone or skype—to further establish deep understandings of the world in which I was conducting research.

(5) Analysis

This section serves a dual purpose: 1) To explain my actual data analysis techniques, and 2) To offer some analysis of what can be gleaned through these research methods when they are combined within dissertation research.

Interviews and notes from participant observation were transcribed in the same way as described in Phase I and II. The material from each case were coded separately, employing open coding methods in the first few rounds of coding, and then a process of focused coding (Hesse-Biber and Leavy 2008). Once the constitutive themes and experiences were established, they were be compared with the data gathered during Phases I and II (Stake 2005), using a process of axial coding (Saldana 2015). The results of axial coding were compared with the research sub-questions and hypotheses, with the end goal of generating answers to the major research question (MRQ). This approach is modeled after Saldana's "code-to-theory model" (2015) (see Figure 2), in which codes and theory identification are employed to translate qualitative data into theory. Theme identification will help create a discourse analysis that will uncover "regulatory frameworks within which groups of statements are produced, circulated, and communicated" (Waitt 2005), and to reveal the support maintaining those regulatory frameworks.

Detailed field notes were transcribed and observational data catalogued. As with the coding methods in other research Phases, I followed Saldaña's (2015) theory of coding first for categories, and then theories. Using axial coding methods, the themes from Phase II were compared with the codes and major themes that emerged in the transcripts of the "key informant" interviews in Phase I (ibid). These broad answers and themes were contextualized via the Farm Cove forest as a case study, which provided geographically and historically grounded means of contextualizing how the case-based research both conforms to and challenges the data gathered thus far (Yin 2013).

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Chapter 4

‘You can’t value what you can’t measure:’

A critical look at forest carbon accounting

Abstract:

This chapter uses the political ecology and STS of carbon, as defined in other chapters, to understand the technical, political and contested nature of forest carbon accounting. It begins by explaining carbon accounting broadly, the specifics of forest carbon accounting, and why forests are popular spaces for financialized carbon sequestration. It then explains the approach to forest carbon accounting as presented by the Greenhouse Gas Management Institute. The analysis section draws on critical theory to explore how and why certain carbon monitoring, reporting and verification approaches (MRV) emerge as dominant and "expert." The chapter concludes with an argument that carbon accounting is an uneven technical and political process that makes multiples forms of carbon legible on financial markets but does little to physically address atmospheric carbon concentrations. It also addresses research that suggests Unnecessarily strict carbon accounting criteria may dismiss the suite of reasons developers participate in forest carbon offsets projects.

(1) Introduction

At the American Association of Anthropology conference in Denver in 2015, Jerome Whitington enthusiastically told a panel audience, "It is possible to buy and sell atmospheric carbon!" And while that fact may seem unremarkable, he said, it was worthwhile of intellectual unpacking. "How is it," he asked, "that an institutional and informational assemblage can claim the ability to quantify and trade in an ethereal, gaseous atmospheric chemistry? What is actually being traded?" Whitington went on to say that carbon has come to function as a metric of the human, providing a common, partially standardized measure of human activities and their relevance to the planetary atmosphere. Whitington's conference presentation highlights the growing interest in how, and by whom, carbon is quantified, standardized, and commodified. This chapter explores the field of professional carbon accounting and its use of quantification and standardization to make representations of carbon tradable and exchangeable. Ultimately it questions the standards by which carbon is monitored, reported and verified, and frames them as political and contested processes that do little to address physical climate change. Empirical research draws on the technical field of forest carbon accounting for carbon offset markets.

The field of carbon accounting is responsible for translating forest conservation and tree growth into tradable entities used to balance carbon budgets—with the going rate of sequestered carbon hovering between $7-$12 per ton (Hamrick 2017). Carbon accountants play a crucial role in governing the 'new carbon economy,' a web of interconnected carbon markets (E. Boyd, Boykoff, and Newell 2011). Accountants are in many ways the primary managers of carbon, dictating how multiple forms of carbon are translated into standardized units (Lovell and MacKenzie 2011). Part of this shift toward the commodification of carbon storage as a means of addressing climate change, is the push toward development of carbon offsets. Called "offsets" for their ability to counteract industrial carbon emissions, forest and other conservation activities exist outside cap-and-trade systems, and are included to balance carbon administrative budgets. Offset projects are quantified, calculated, and translated into credits and traded on carbon markets as representations of avoided greenhouse gas (GHG) emissions. But there are challenges in turning complex, biodiverse forests into simple numerations. By any nature, measurement of forest growth and carbon storage is subjective, flexible and often significantly over, or under, estimated (Searle and Chen 2017). And the concepts used to determine measurement, like "baselines" and "additionality," are deeply subjective. Michael Gillenwater, head of the Greenhouse Gas Management Institute and one of the foremost experts on carbon accounting, concedes that the vagueness of these terms is widespread and problematic. "No wonder people are skeptical about offsets. If you look at the climate community's own words on the subject, we don't appear to have a handle on a concept we have championed as integral to the policies we have created. Language on additionality and baselines is vague, inconsistent, or both. No two authors seem to define these concepts in the same way without falling back on some platitude like 'business as usual'." (Gillenwater 2012) In another article he called for the elaboration of "more precise and theoretically well-grounded definitions for these terms" as they are "desperately needed to enable real-world offset programs to improve their credibility and effectiveness" (Gillenwater 2012). Furthermore, critical scholarship on these topics is lacking too. By and large, carbon accounting research has focused on the procedural and technical contributions made within the profession, and not on the critical implications of ordering and classifying carbon via these practices (Andrew and Cortese 2013).

This study draws on a mixed methods approach, with data collected via participant observation in the carbon accounting classes through the Greenhouse Gas Management Institute and through extensive fieldwork detailed in chapter 1. Analysis calls on Clarke and Fujimura (2014) to ask how and why specific accounting and commodification tools have emerged over others, and demonstrate that processes that are often situated as technical or apolitical are often just the opposite. Empirical data is used to 'open the black box' of carbon accounting and show that processes deemed technical or "outside the domain of politics "are, in fact, deeply political (Gupta et al. 2012; Clarke and Fujimura 2014).

(2) Carbon accounting and the questions is raises

Key to the functionality of carbon markets is intensive monitoring, reporting and verification practices (MRV). These practices were designed in tandem with the markets they support and, like the markets, are works in progress. The Greenhouse Gas Management Institute, an institution tasked with articulating carbon accounting and management practices, offers online courses to train carbon professionals. These courses are designed to train professionals how to aggregate the data necessary to determine how much carbon is stored in a project area, anticipate emissions, and project how much carbon is avoided via enhanced conservation efforts. Each course is designed to articulate "best practices" in carbon accounting, but in doing so makes clear that the standards by which carbon is quantified are somewhat arbitrary and continually evolving. Therefore, determining the amount of avoided carbon emissions connected to, say, a forest conservation project, is variable, flexible and political.

Central to incorporating forest protection and management into climate mitigation plans is the need to value forests for their carbon sequestration capabilities. For carbon markets to work, multiple forms of carbon must be made commensurate so they can be traded or exchanged (MacKenzie 2009; Lovell and MacKenzie 2011). Commensuration poses challenges. According to Lane and Newell (2016):

> "The materiality of the different forms of 'carbon' that are said to be commensurated and commodified through credits and offsets… are less

> cooperative than they appear… even with strong state intervention.” They continue: “More broadly, a series of abstractions are required to construct both ‘carbon’ and the markets upon which to trade it in what Larry Lohmann refers to as the ‘endless algebra of carbon markets’. For Lohmann, the measurement, accountancy practices, and techniques involved in this endless algebra of commensuration are not being undertaken simply by an international financial cadre of ‘carbon cowboys’ or hucksters (Lohmann 2009), or what the financial press likes to refer to as the ‘shenanigans’ of a few bad apples. Instead, their (necessary) failure to adequately price a truculent environment is hardwired into their institutional functioning.”

Part of this shift toward the commodification of carbon storage as a means of addressing climate change is the push toward development of carbon offsets. Called “offsets” for their ability to counteract industrial carbon emissions, forest and other conservation activities exist outside cap-and-trade systems, and are included to balance carbon administrative budgets. Offset projects are quantified, calculated, and translated into credits and traded on carbon markets as representations of avoided greenhouse gas (GHG) emissions. The purpose of a carbon offset program “is to "capture" certain public benefits, such as GHG emission reductions (or removal enhancements), in a way that is more cost-effective than would be possible using other policy mechanisms,” writes Gillenwater (2012). In part, offset programs achieve increased cost-effectiveness by using a market-based mechanism that incentivizes private actors to search for, and locate, low cost opportunities outside the realm of policymakers (Gillenwater 2012).

(3) "You can't value what you can't measure," or making same to make value

Carbon accounting is often seen as purely technical and "outside the domain of politics" (Gupta et al. 2012). Carbon accounting processes are based on technical and scientific understandings of how and where carbon is stored and emitted; that knowledge is then translated into accounting formulas that account for representations of carbon, often using a combination of on-the-ground surveys, remote sensing, GIS, drones, and other technologies (Zimring and Rathje 2012; Lovell and MacKenzie 2011). Identifying a carbon sink as a valued entity, tradable on a market, makes it legible to wider audiences. It makes a tree a valued carbon sink, or translates manure from animal production into a carbon capture project. Carbon accounting processes produce one way of knowing carbon-- as a quantified commodity-- but different accounting methods produce varying results, a reality that sparked the growth of multiple professional verification and certification standards, like the Gold Standard and Verified Carbon Standard (Gupta et al. 2012). Indeed, project developers often choose an accounting protocol that meets their needs, rather than altering a project to meet protocol guidelines. According to a source: "If you are implementing a specific project and looking for a protocol, then go to one of the GHG offset programs directly, and choose one that best suits your needs" (participant observation communication, fall 2017).

The privileging of one way of knowing carbon silences or de-emphasizes non-dominant or alternative perspectives, situating commodified carbon as the hegemonic way of knowing and relating to carbon, and reinforces market relationships as the most important subjectivity of carbon. In the case of carbon offsets, carbon accounting is the de-politicized point of translation that veils the social and power networks that constitute conservation and sustainable development projects, market dependencies, value-making schemes, and neo-colonial relationships—rendering forests or clean energy project technical spaces of “natural capital” and carbon commodity generation.

Market exchange of carbon becomes possible only through the bracketing of spaces for calculation and transaction (Lohmann 2005; Callon 1986). “Exchange requires simplified, uncontroversial owners, products and modes of ownership, and accounting requires knowing both who is accountable and how and what to count and not to count,” writes Lohmann (2005). By design, markets tend to overlook externalities—indirect effects of production or consumption, or pollution broadly. Market exchange would not work if people were made to account for every cost (Mitchell 2002). Carbon markets, then, only work when then externality of climate change (atmospheric CO2 pollution) is internalized as a ton of carbon (Lohmann 2005). Carbon accounting and MRV, then, is the technical process of internalizing externalities. Management of carbon becomes the realm of experts who decide how climate science (or climate change tropes) are able to be traded on markets (Bumpus and Liverman 2011, Lovell and MacKenzie 2011). In addition to making multiple forms of carbon commensurate, accounting serves to “make same” multiple ways of knowing carbon (MacKenzie 2009).

Amid the context explained above, climate change, and the need for mitigation, has been “rendered technical” by creating spaces for environmental management-by-technical intervention (Li 2007). Carbon accounting is the latest development in this turn, using technical interventions to place a market value on industrial emissions, standing forests, and sustainable development initiatives. All these practices work together to create and place value on the new commodity of sequestered carbon, because “You can’t value what you can’t measure,” (Lovell 2014), Not only does accounting place a value on carbon, it also provides inroads to access carbon markets, creating spaces for new participants to join in trading.

(4) The making of expertise

It is important to ask how authority is gained through the promotion of certain practices over others. Often the first to take ownership of a practice, or to define it, becomes the dominant or expert voice (Lave 2012; Lovell and MacKenzie 2011). Naming, or defining, offers the opportunity to take ownership, assert a dominant knowledge claim, or define "best practices." It allows the dominant voice to lay claim to knowledge, expertise, and legitimacy (Lave 2015). To that end, it is necessary to acknowledge the role of political-economic pathways in shaping expertise. The first person or group to make the rules in a new field can stake a claim to ownership of the expertise. Indeed, Wainwright asserts that naming, in and of itself, is a colonial act (Wainwright 2011). And while this chapter is not taking on colonialism, **it is highlighting the importance of asking who was the first, or most successful, at articulating the standards by which carbon is measured and valued? And how expert or scientific knowledge becomes embedded, contributes to framings of scientific controversy, and ultimately shapes policy.** The following sections explore this question by showing how forest carbon offsets were designed, including the initial use of REDD+ and then a shift to forest carbon offsets more loosely interpreted.

Lave's (2012) look at a debate within the stream restoration community over the dominant approach to restoration is a good introduction to thinking about carbon MRVs and commensuration. While this specific example does not deal with carbon, it lays the groundwork for questioning how dominant knowledge claims are shaped and reproduced. As Lave writes, the contested Rosgen method for stream restoration overlooked scientifically proven methods, project-specific nuance, and widespread ecological concerns—yet it is the primary standard used by governments and contractors. She questioned how Rosgen, a person with little scientific experience, became the foremost expert on stream restoration, and found that his success came from, "producing the systems of perception, training, and certification of capital on which the restoration and policy markets depend." Lave describes a process similar to other critical takes on the making of dominant knowledge claims (Lovell and MacKenzie 2011), that expert knowledge is often created in the realm of opportunity, and not a reflection of the specific needs or concerns of the systems to which it is applied.

In the context of carbon sinks, there is power in holding authority over how carbon is defined and managed. In the case of managing forests as carbon offsets, forests must be situated as "outside" the managed, in order to be deemed "manageable" and enrolled in carbon storage schemes—this is where the notion of improved forest management comes in. This requires forests to be framed as "wild and untamed" so they can be controlled and brought to order by systematic institutional management (Lovell 2014). Those determinations are often made by technocratic authorities and standards organizations, like The Greenhouse Gas Management Institute or Verified Carbon Standard. Carbon credits are valued, or can receive "added value" through activities deemed appropriate or additional by these standards organizations, and those organizations are constantly in competition for the peak of legitimacy, causing land managers to spend excessive time and money on securing the appropriate and "most respected" standardization. Regarding choosing specific standards to apply to an offset project, Gellenwater write on the GHGMI message board, "Which one (project developers choose) will depend on what markets you are looking to engage with and who has a protocol matching your project idea" (participant observation communication, fall 2017)

(5) The making of an offset

Step 1: The introduction of REDD

The idea for forest carbon offsets was first introduced as REDD at the Bali COP in 2007 (**R**educing **E**missions from **D**eforestation and forest **D**egradation). REDD+ is a mechanism implemented through the United Nations Framework Convention on Climate Change (UNFCCC), in which developed country polluters or investors (corporations, nongovernmental organizations, and individuals) compensate developing countries for forest emissions reductions, including through market mechanisms (Phelps, Webb, and Agrawal 2010). (The + was added later to represent other forest activities like reforestation that could also contribute to carbon sequestration.) When interest in REDD+ began to gain traction, an early critic warned: “The scheme could have a deleterious impact on the carbon market through massive hot air creation (fake emission reductions), and ultimately on the current international climate change regime...” (Karsenty 2008). Indeed, a decade later, this opinion is still widely held.

A more current criticism of REDD+ is that we talk a lot about it, but in reality it has never really gained traction. There are only a few dozen active REDD+ projects across the globe. Essentially, academics and activists spend a inordinate amount of time analyzing the idea of REDD+ compared to the mechanisms actual impact. Increasingly, however, forest carbon projects modeled after REDD+, but not branded as such, are being implemented in north/north context. This turn in use is politically and socially less contentious, as such projects largely engage political economic shifts in the forest management industry, and are implemented on long-time working timberlands. (for more info, see TIMO section in the introduction) (Kay 2017; Gunnoe and Gellert 2011).

Buyers of forest carbon credits are drawn to the intangible benefits that come with the look of “saving forests” or investing in sustainable development. This speaks to the virtue intrinsic in participating in offsetting schemes, as well as the benefits to an organizations’ corporate social responsibility. If an organization is aiming for a triple bottom line (social, environmental and financial benefits), buying offset credits from a forest conservation project is a good addition to its carbon portfolio. Forests offer what Wang and Corson (2015) and others call “charismatic carbon.” Forest conservation makes for good advertising, and looks good to shareholders and consumers. “Charismatic carbon” usually refers to development interventions, like low-carbon cookstoves, that bring offset buyers more “brand value,” and provide project developers higher prices for credits generated from development projects (Wang and Corson 2015). Forest carbon projects are often leveraged for their advertising ability, and several of the field site used in this research have been used in investor advertising campaigns (Conservation International 2012).

Step 2: The carbon cycle and its role in policy-making

The design of forest carbon projects hinges on the flow of the carbon cycle, capitalizing on natural carbon fluctuations from the ground to the atmosphere to plant life, and back into the soil. When first introduced as REDD+, the mechanism was designed to financialize those fluctuations by monetizing trees’ ability to absorb and sequester carbon. Indeed, forest carbon offsets were initially designed to prevent deforestation in equatorial tropical forests (see Figure 1- live carbon map & Figure 2, carbon cycle), places with extremely dense above-ground biomass, like Brazil, Indonesia, and the Democratic Republic of Congo.

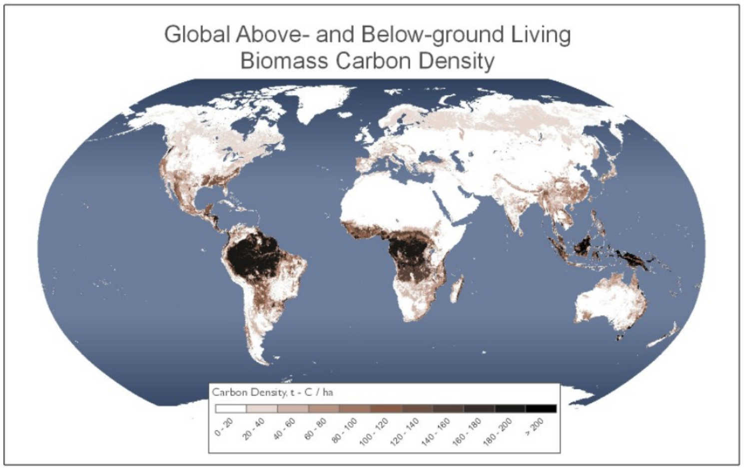

Figure 1: Map showing living biomass density in 2000. Credit: IPCC

For forest carbon to be managed and incorporated into carbon markets it must be measured in a way that is flexible and easy to express in financial terms. Aboveground biomass, then, is translated into representations of tons of carbon. To do so, carbon accounting operationalizes the natural flows of carbon within the carbon cycle, by technically and administratively accounting for carbon along each state of the cycle. The following image from UCAR is commonly used to understand how the accounting profession approaches the carbon cycle and finds ways to track and value it.

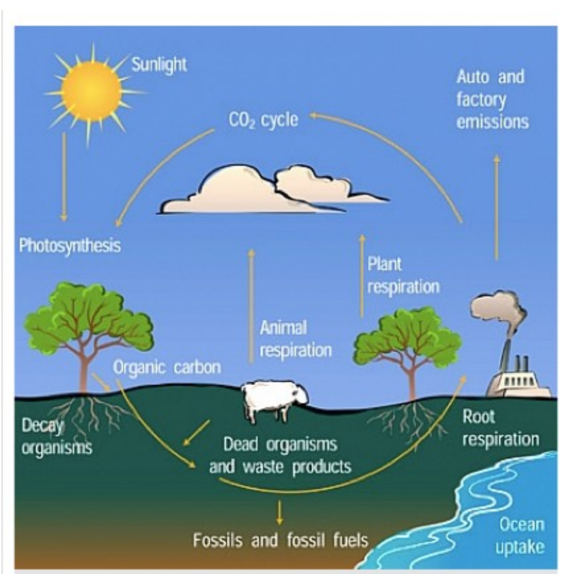

Figure 2: A simple diagram of parts of the carbon cycle, emphasizing the terrestrial (land-based) parts of the cycle. Credit: UCAR

Step 3: Forest inventories & project development

The first step in project development is conducting a forest inventory, which assesses tree counts, sizes, and other biodiversity. Forest inventories are used to understand how forests grow and develop, and access: 1) species makeup for land management plans, 2) amounts of principal products, like timber, 3) and carbon sequestration potential (P. W. West 2009). Project developers call on professional foresters to conduct forest inventories, which are renewed at various intervals, from one to seven years, depending on project stipulations. Forest measurement, or "mensuration" as it is called in forestry, involves a series of complex, and at times contested, processes. Inventories are conducted in multiple ways, from physically walking a parcel of land, to using remote sensing technologies, and are part of the field of land use and land cover change modeling (Parker et al. 2004). A sample of individual trees are measured and accessed for diameter at breast height, total height, live crown ratio (branches and leaves), and age (Bechtold and Patterson 2005), and projects are made for a full inventory based on plot data. Trees are counted via several characteristics, including number, species, quantity of wood products they could provide, and weight. Weight is the primary measurement used to access a forests carbon carrying capacity, because one-third of a tree's weight is carbon. Because of increased interest in carbon sequestration for mitigating climate change, "measurement of the amount of carbon that trees and forests around the world can store has assumed great importance over recent years," writes West (2009).

Forest inventories are integral to developing an offset project, but it is not an exact science. As West writes, because there are so many varying approaches to inventorying, "it is impossible to be completely comprehensive in any text on the practice of plant measurement"

(2009). Even professional foresters work with some level of estimation, or account for arbitrary thresholds of tree growth. “Due to the intensive cost of sampling all trees within these plots, an arbitrary size threshold is typically imposed,” write Searle and Chen, “which leads to only larger trees being sampled. However… the sampling of only large trees may produce biased estimates of biomass dynamics (growth, ingrowth, and mortality)” (2017). West supports this problem of bias in measurement, which can lead to ambiguity of forest assessment. He writes, “When measuring anything, the accuracy required of the measurement, the possibility of bias in it and its precision must all be considered” (2009).

It is important to note that within professional carbon accounting training, including in the Greenhouse Gas Management Institute course, “Accounting for Forest Inventories,” there is little to no coverage of inventory assessment. Carbon accountants operate with the presupposition that a reliable inventory has already been conducted.

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Forest carbon project developers must produce intensive administrative documentation of each projects steps for monitoring, reporting and verification (MRV), essentially documenting their methods and “best practices.” But the definitions for this aspect of the project are vague. In the Project Level Carbon Accounting Course” participants are instructed to “Select or establish criteria, procedures or methodologies for quantifying GHG reductions or removals” (participant observation June 2016). This means the documentation to verify emissions reductions can be flexible and subjective—essentially define your methods, and use previous projects as examples to support why you are using those MRV techniques. These individually designed MRV procedures, then, defines what data by which a forest is deemed an additional carbon sink and, in turn, a representation of carbon credits. The following sections of this chapter offer analysis of those processes. The terms below are regularly used within carbon accounting schemes. They are explored here as a means of understanding the contested nature of terminology, and to demonstrate how their complexity can be used to represent carbon reductions even when physical reductions or sequestration remains elusive.

(6) Commensuration & Standardization: Problems with "making same"

MacKenzie's critical take on commensuration, or "making things the same," asks how different gases are made commensurable, and how accountants have struggled to find a standard treatment of 'emission rights' (MacKenzie 2009). This work distilled carbon accounting to: "how the destruction of one gas in one place is made commensurate with emissions of a different gas in a different place," (2009). Indeed, when using the term "carbon accounting" professional carbon accountants are referring to not just carbon dioxide, but six different greenhouse gases: Carbon dioxide, methane, nitrousoxide, hydroflourocarbons, perflourocarbons, and sulfur hexafluoride. "Carbon" thus becomes a signifier for each of these gases, and each ton of "carbon" refers to one of the six gases' equivalents to one ton of carbon dioxide (See Figure 1 for detail). These equivalencies are framed as "Global Warming Potentials" or GWP, essentially how that gas measures relative to carbon dioxide.

Lesson 3: Introduction to Key Concepts and Accounting Processes

Terminology

Global Warming Potentials

- Global Warming Potentials (GWP) are used to compare the greenhouse gases.
- Each gas is given a GWP measure relative to that of carbon dioxide.

Table 1 – Common greenhouse gases, their human sources, and 100 year global warming potential (GWP). Table adapted from EPA, 2007.

Greenhouse Gas	Human Sources	GWP (100 yrs)
Carbon Dioxide	Fossil-fuel combustion, land-use conversion, Cement Production	1
Methane	Fossil-fuel production and combustion, agriculture, waste decomposition	21
Nitrous Oxide	Fertilizer, Industrial processes, Fossil fuel combustion	310
Hydroflourocarbons	Refrigerants	140 -11,700
Perflourocarbons	Aluminum smelting, semiconductor manufacturing	6,500 - 9,200
Sulfur Hexaflouride	Dielectric fluid used in electrical equipment	23,900

Figure 3 is a screenshot from the GHG Management Institutes course on Project Level Greenhouse Gas accounting. It's a take of six common greenhouse gasses, their human sources, and their equivalencies to CO2.

Commensuration is a technological explanation for what is commonly understood as standardization. In fact, carbon accounting processes rely heavily on the International Standards Organization (ISO) for designing and framing their practices (GHGMI 2017). Standardization, according to Simon, is vital integral to carbon offset development. He writes: "Carbon-financed projects must contain a high level of technological standardization to generate certifiable and cost-effective emissions measurements. Standardization generates simple and reliable accounting procedures while also producing cost efficiencies derived from supply side economies of scale" (Simon 2014).

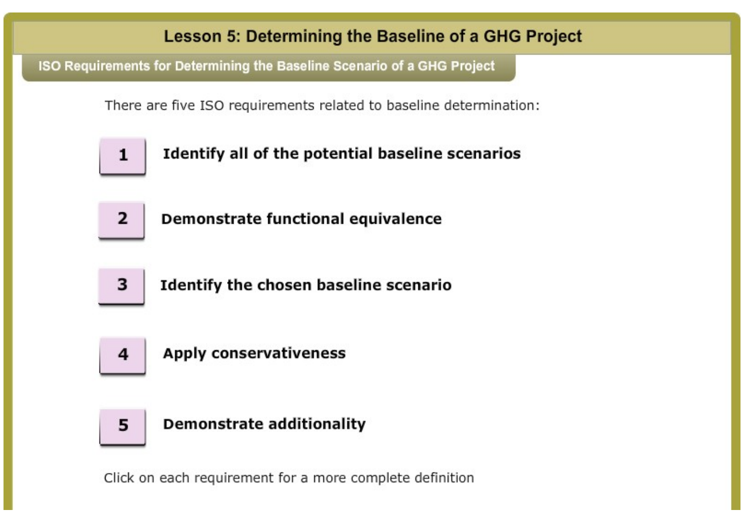
But critiques of commensuration argue that carbon in various forms is never truly made same (MacKenzie 2009). What is "made same" are representations of carbon, and the accounting processes are administrative steps that shape such representations. And when policy takes on commensuration, it tends not to address nuanced understanding of scale. At what scale are multiple forms of carbon made commensurate? At the molecule? At the scale of carbon's physical impacts? At the tree? Atmosphere? Much ambiguity remains. According to a source, “The GHG (greenhouse gas) Protocol documents claim to be standards, and they have some characteristics of standards, in that they do indicate some things are strict requirements, but for the most part they are guidance documents that are not auditable, because no objective person could judge whether they were met” (personal communication February 1 2018). In short, when carbon project developers boast of “carbon reductions” or “retired carbon credits” they are referencing activities that address at least one of six GWP gasses, but the lack of transparency means that the specific amounts and relationships among those gases is not included in reporting details.

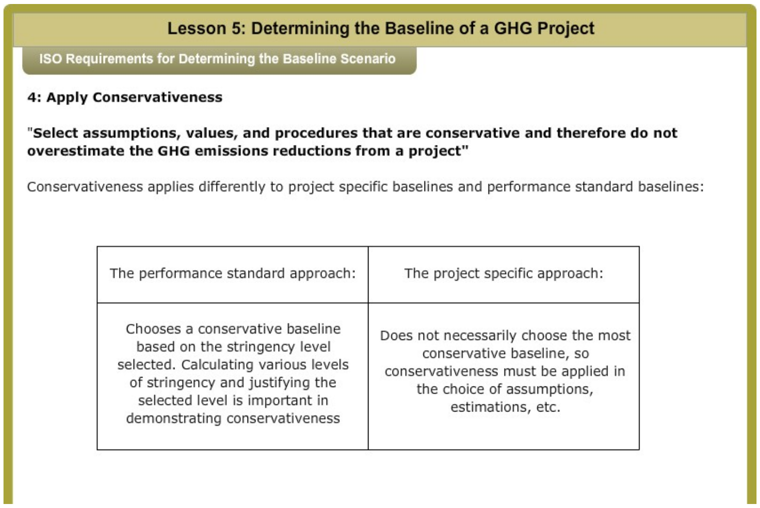
(7) Baselines: The point of change

To determine a change in carbon sequestration, offset project administrators must first define a baseline scenario, outlining what would happen to a forest if there were no carbon project intervention. This baseline is the point from which all changes in carbon storage are accounted and deemed “additional.” Or, in its most technical, the baseline is described as: “A prediction of the quantified amount of an input to, or output from, an activity resulting from the expected future behavior of the actors proposing, and affected by, the proposed activity in the absence of one or more policy interventions, holding all other factors constant (ceteris paribus). The conditions of a baseline are described in a baseline scenario” (Gillenwater 2012).

Baselines can be explained as X tons of carbon sequestered in a business-as-usual scenario, or X tons of sequestered carbon. With an infusion of climate finance funding, a project is able to sequester X+n tons of carbon. n = new and additional carbon sequestration, and n is what a project will get carbon credits for. Determining baselines is challenging, and choosing them for forests is even more so as “it is difficult to determine accurately the amounts and sequestration of carbon in forests because of problems that include weather variations and monitoring" among other fluctuations and impermanence (Adam G. Bumpus and Liverman 2008).

A problem with the integrity of forest carbon project in the US, however, is that they are derived via "improved forest management" in which forest management is improved, and carbon sequestration increased, via the influx of climate finance. But, these projects often exist in spaces that are part of a legacy of forestlands management that first supported the vertically integrated pulp and paper industry and, starting in the mid-1980s, when pulp and paper began to dis-integrate, the land was bought up by Timber Investment Management Organizations (TIMOs)—financial entities and short term holders who aggressively harvest timber and apply multiple layers of financialized forest management to an area, then sell it either to developers or conservation organizations. So, when a conservation organization takes over former TIMO land they are, by design, employing improved forest management techniques that will produce additional carbon sequestration over a baseline from when the land was more aggressively managed. Essentially, the argument for n carbon credits is weak and questionable.





Figures 4 and 5 are screenshots from the GHG Management Institutes course on Project Level Greenhouse Gas Accounting explaining how a baseline is determined.

(8) Additionality: The crux of the offset

Carbon credits represent carbon sequestration beyond baseline projections, meaning beyond the amount of carbon sequestered absent of a carbon project. They are the factor in carbon accounting on which much of the validity of the offset project hinges. According to the Greenhouse Gas Management Institute, “You can’t say you have offset some harm unless you can show that you ‘caused’ some equivalent extra good to occur elsewhere. Additionality is about this causal question” (GHGMI 2017). Additionality is where development or conservation projects—backed by climate finance capital—out-perform their pre-determined baseline, or how it would have evolved without the injection of climate finance funding. It is not only an essential quality criterion for offset credits, it is fundamental to the very definition of an offset.

But, as Purdon and other have written, additionality is political and contested, and political economy plays a role in how additionality is calculated and wielded as a tool for low-carbon development (Purdon 2015). It is also intentionally vague. One source said: “The way that the GHG Protocol addresses additionality is to discuss what the issue, but then it offers no requirements for how it is to be addressed in a project" (participant observation communication, fall 2017).

The need to prove additionality also causes problems for project developers. Indeed, critics argue that when rigid additionality is the primary focus of a forest carbon project, it comes at the expense of the multiple co-benefits that often incentivize project engagement. Anderson et al (2016), write that "Unnecessarily strict additionality criteria may too strongly dismiss the suite of reasons for participating in forest offsets and project co-benefits." Essentially, this is an assertion that when additionality is the primary qualification for certifying carbon credits, it poses a risk to other benefits (co-benefits) of such projects, like increased conservation funding, job creation, support for biodiversity, additional bundled financial incentives like endangered species credits or hunting rights. In other words, organizations engage in these projects for a multitude of reasons and the privileging of "additional" carbon sequestration can make them less attractive to landholders who are more interested in other aspects. Indeed, one source said, "I don't think anyone involved in this project would say climate change is their primary motivation" (personal communication 11 April 2017). Another said his organization was "not driven by some great fire in the belly to reduce carbon emissions" (personal communication, 14 July 2017). But this causes a problem for the very integrity of carbon offsets: Additionality is the crux of the mechanism, but is increasingly seen as a problem to conservation managers who leverage offset funding (climate finance) to support conservation.

Many land managers use carbon projects specifically as a new funding stream, and care little about the climate change mitigation aspects. Indeed, the motivations for a landholder to engage in a forest carbon project often come more from the potential co-benefits then from contributing to additionality in carbon sequestration. I have a slew of quote from subjects that essentially say that the co-benefits are the real incentive, not the opportunity to mitigate climate change. And there are loopholes in project design which allow for this.

When REDD and forest carbon offsetting were introduced officially in 2007, they included a specific clause that forests must be proven at risk for deforestation, to prove additional (additionality in those cases comes from avoided deforestation). But carbon credits in North America are derived not from avoided deforestation, but through "improved forest management" (IFM). Improved forest management does not mean forest preservation, it means conservation. More than half (64%) of improved forest management projects in the US are actively logged (Anderson, Field, and Mach 2017). Active logging can be used to assess additionality in improved forest management projects. If a forest is logged at or prior to a project's implementation, joining a forest offset program would be more likely to induce "altered practices" that lead to increased carbon sequestration (Anderson, Field, and Mach 2017). Forests not under logging can more easily be entered into offset programs, with fewer changes to forest management plans.

Furthermore, additionality and the setting of baselines are used to constrain the supply of credits in a market. In an environmental commodity market, a mechanism is needed to create a scarcity, since the underlying commodity is typically a public good. In the case of offset programs, scarcity is created by separating the activities eligible to receive credits from those that are not, and then only issuing credits for demonstrated performance improvements to the former group (Gillenwater 2012).

(9) Uncertainty & Insurance

Many scholars have critique carbon offsets as neoliberal opportunities to "pay to pollute" (Adam G. Bumpus and Liverman 2008; Patrick Bond 2012; Lohmann 2008). Within forest carbon offsets, these critiques, particularly the neoliberal aspects of them, are useful in understanding how project developers deal with risk and impermanence. There seems to be a disconnect between managing forests as carbon sinks, and directly addressing the reduction of atmospheric carbon. For example, risks to the forest are accessed generally (pests, fire, etc,) and a range of strategies are applied, from forest management decisions at the stand level, to set-aside risk pools of additional land that represent offset risk across trading platforms (Galic and Jackson 2009). A payment is made into a risk pool at the equivalent of aproximately 10 percent of the financial investment into the offset credits (personal communication 7 April 2017). This buffer pool holds some portion of a project's credits in reserve to draw from in the event of an unexpected disturbance (Diaz 2010). And there are even private insurance options, which allow developers to pay for insurance with cash, and not hold a portion of their credits in escrow until they are retired in 20-30 years.

The problem, however, from at atmospheric carbon standpoint, is that insurance pools are financial instruments that provide indemnity for the financial investment, but not the atmosphere. If there is a fire or pest infestation and forest cover is lost, the carbon is released into the atmosphere, yet the carbon offset purchaser still receives credit for their purchase and can use that credit to administratively balance their carbon budget. This arrangement begs the questions: Are forest carbon offsets that are financially insured an example of maladaptation? What does that mean for the integrity of the salable carbon credits?

A key to forest inventory assessment is cataloguing potential threats to forest loss—from development to weather to insect infestation. But while ecologists and conservation professionals maintain concern for these threats, by design they are less of an issue to carbon project developers, thanks to insurance— which makes risk less threatening for those who can afford it. In the case of compliance carbon markets, insurance is mandatory. For most projects, and for every forest carbon project tied to the California market, developers pay into a compulsory insurance pool that covers loss of carbon should the trees be lost to a weather incident, insect infestation, or other natural hazard. But they key is that this design—this insurance policy--provides indemnity for the financial investment, for the capital investment, but not the physical trees, or the sequestered carbon. So while there is protection for the project, protection for the atmosphere remains elusive.

Beyond the uncertainty of offset permanence is the uncertainty of the offset mechanism. The future of managing carbon sinks is ripe with uncertainty. With carbon market volatility, and the seeming non-start of dozens of markets around the world, it is unclear how carbon commodification will evolve—and how science and policy will evolve with it. The uncertainty of the future of markets has left investors reluctant to engage in markets and lawmakers reluctant to intervene in market structures (Dempsey and Suarez 2016). The reliance on offsets, especially in voluntary markets, has created capital flows maintained more for their role as funding mechanisms for sustainable development and conservation than as a means to lower carbon emissions. In fact, engagement with offset projects is often motivated less by an interest in mitigating climate change, and more by the revenue streams made possible by managing carbon sinks (Lovell 2014; Whitington 2016). This raises questions about both the future of carbon markets and the usefulness of other means of pricing carbon, like a carbon tax, which too would require complex and bureaucratically intense accounting and verification standards to make carbon legible and valued.

Furthermore, banks and other institutions are not yet familiar with these mechanisms, and are reluctant to engage with them. In the case of the Farm Cove Community Forest, the DLLT needed to borrow money for a few weeks as it finished the last part of its California Air Resource Board (ARB) review, but the banks they approached refused to take the lending risk because they did not understand the guarantee from the ARB that the money would be available and repaid soon. This widespread lack of understanding is what one stakeholder called, "a great infirmary" in the carbon accounting process (personal communication 13 August 2017).

(10) Conclusions

Carbon offsets are the product of intense quantification, and the result of multiple, often competing interests finding common ground. The integrity of a carbon offset hinges on its strength as an administratively verified development project. Its legitimacy comes from intensive paperwork that verifies the project meets each of the standards explained above, and contextualizes it amid (somewhat) similar projects that developers have shown stack up with similar "best practices." Essentially, the legitimacy and "value" of an offset comes from the work of project developers to make a conservation project legible within the language of other existing projects. A carbon project's validity only exists within the context of other projects; and draws its value from the value of those other projects. Project developers must frame each project and describe the functions and context in which it occurs—what type of land use occurred previously and how that had changed. This includes, as part of the intense MRV processes, project developers conduct complex impact assessments, including determining past land cover change that can contribute to determining baselines and proof of improved forest management (which leads to additionality). This aspect of the work can involve the use of written archival records, satellite imagery, aerial photography, waling the property, wood product assessments and more. But there are no clear guidelines for what the assessment must include, an how that data is obtained, so there remains a vagueness in how, and by whom, a project is reported and verified. To that end, accounting for and verifying offsets involves so many layers of bureaucracy that the original goal of the mechanism gets lost in translation. Ultimately, the complexity of making an offset obscures its influence and makes it is difficult to determine if the offset addresses-- and mitigates-- atmospheric carbon concentrations.

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Chapter 5

Ties that bind:

Forest carbon, conservation funding,

and climate change mitigation in northeastern Maine

Abstract

This article looks at a forest carbon offset project in Maine that sell carbon credits to California's cap and trade market, and asks how a mechanism originally designed to address industrial GHG emissions in California has become a major tool for forest conservation and economic development in Maine—essentially how climate policy in one place has driven large scale investment in another. Drawing on theories from political ecology, social theory, and science and technology studies, it suggests that an offset ultimately represents, and is used for, something different to each stakeholder, often with few overlapping characteristics. It concludes that a carbon offset is a 'tie that binds' multiple, varied and often unrelated interests together under the notion, but not always the action, of addressing climate change.

(1) Preface

Forest carbon projects, an umbrella that includes the contentious REDD+ mechanism, are increasingly being implemented in the United States, employed to simultaneously support conservation, carbon sequestration, and the balancing of administrative carbon budgets. Part of a trend toward the neoliberalization of conservation and environmental management, land managers turn to carbon offsets as new funding streams to support existing conservation projects or foster more ambitious protection endeavors. This chapter examines the use of forest carbon offsets schemes as a means of conservation finance, and considers the complexity of linking forest conservation to financialized carbon storage. By framing carbon offsets as collections of administrative processes that make conservation legible on markets, but that don't often address the problems of atmospheric carbon concentrations and land use change they are intended to, this paper critically looks at the political and contested nature of constructing a mobile and tradable 'carbon offset.' It argues that flows of capital from polluters to conservation organizations become 'ties that bind' mutually exclusive goals (from regulatory compliance to forest conservation). It highlights the role of carbon brokerage firms, 'middlemen' who bureaucratically make legible a unified carbon infrastructure. The paper uses as an illustrative case the Farm Cove Community Forest carbon project in Grand Lake Stream, Maine. The Farm Cove project, one of the first regulatory forest carbon initiatives in the US, is tied to California's cap and trade program, AB-32, through which it acquired several million dollars to launch an ambitious conservation project—which continues to expand and has sparked interest in carbon forestry throughout New England.

(2) Introduction

The Farm Cove Forest Carbon project in Grand Lake Stream, Maine is only the second market-tied forest carbon offset project developed in the United States, and the first outside of California. The Farm Cove project is part of a compliance carbon market in which the credits from sequestered carbon are sold as offsets into California's cap-and-trade market. In 2013 Maine's Downeast Lakes Land Trust (DLLT) received $4 million from a California company to support conservation of 22,000 acres, representing nearly 600,000 metric tons of sequestered carbon. The investment generated 200,000 compliance-eligible carbon offsets to sell on the state of California's carbon market and related offset credits approved through the California Air Resources Board (CAB) (Finite Carbon 2012). The sequestered carbon in the Farm Cove forest served a duel role: 1) To balance a California company's state-mandated carbon budget, and 2) To set the stage for a significant capital campaign that allowed the land trust to raise a total of $20 million for expanded conservation efforts. (The identity of the credit's buyer is shrouded in a confidentiality agreement, but it is know that there is only one industrial buyer for all of the credits.) The investment also provided seed funding, and investor interest, to attract millions of dollars for expanded conservation efforts and to begin additional carbon offset projects. As of 2017 DLLT was involved in four forest carbon projects—three on the compliance market and one smaller, less carbon dense area, as part of a voluntary carbon market (personal communication 17 July 2017; Maine Forest Alliance). The Farm Cove project represents a harbinger of the ways in which these mechanisms are employed in the United States — in fact, since its inception, Maine is now home to nine major forest carbon project, with more in development. One of those nine is an almost 100,000 acre project on Passamaquoddy forest land in the western part of the state (personal communication 11 April 2017, 17 July 2017; Maine Forest Alliance).

The Farm Cove is notable because it represents a shift in how the offset mechanism is used. As forest carbon projects begin to appear in the global north, they are pick up and adopted very differently than that have traditionally been used in the global south, where they've been developed for the past 10 years. In the US they are used less as a means of climate change mitigation *or* as forest protection, but rather they are employed as a new forest 'use' among bundled financial mechanisms aggregated by land managers (Kay 2017). They are also used to attract additional conservation funding, as they often represent seed-funding for ambitious conservation projects. This shift poses a challenge for social scientists to re-visit common critiques of forest carbon offsets and articulate how these mechanisms behave differently in new contexts.

This chapter begins with a simple question: **How has a mechanism originally designed to address industrial GHG emissions in California become a major tool for forest conservation and economic development in Maine—essentially how has climate policy in one place driven large scale investment in another?** When leveraged as a means of conservation finance, it is important to examine the complexity of linking forest conservation to financialized carbon storage. This chapter questions the shift of a mechanism often criticized for its neocolonial implications of north/south capital flows, to one re-imagined by US landholders, reconfigured to administratively meet their needs, often without real change in forest management practices. Essentially, many of these forest carbon projects employ a series of contractors to monitor, verify, and certify conservation practices, and to bureaucratically make forests legible on financial markets; these processes identify spaces where conservation management contributes to "additional" carbon storage, and often this does not require a change in forest management practices.

To understand how the forest carbon offset mechanism works, research draws on participant observation at industry meetings and conferences, as well as semi-structured interviews with representatives of conservation private equity firms and timber investment management organizations (TIMOs), land trusts and other environmental NGOs, state and federal agencies, offset and mitigation firms, and private philanthropic foundations. Interviews were primarily conducted in person, some were conducted over the phone or via Skype. Interview data are supplemented with secondary literature, including industry studies, policy reports, impact investing blogs, news articles, and investor-oriented literature and pamphlets from conservation finance firms.

(3) Forest carbon offsets in Maine

Forest carbon projects are gaining popularity in the US, and in particular Maine, where there is a critical mass of privately held land and landholders accustomed to financialized timberland management, conservation easements, and shifting market forces that drive land use practices (Forests for Maine's Future). Private ownership of Maine's forestland is deep seated: 94 percent of forested land in the state is privately owned (Hagan, Irland, and Whitman 2005). The coexistence of a strong outdoor culture (i.e. hunting, fishing, hiking, boating) and a legacy of private ownership has been made possible by long-standing common access regimes, some of which were normalized by the long history of the vertically integrated forest products industry, whereas others are codified by state law (Kay 2017).

Forest carbon offset projects, in which conservation and forest management support carbon sequestration, produce carbon credits for both voluntary and compliance carbon markets like California's cap and trade program, AB-32. Part of an umbrella of development that include the contentious REDD+ mechanism, forest carbon projects are employed to simultaneously support conservation, carbon sequestration, and the balancing of administrative carbon budgets. They were originally designed to serve the duel goals of slowing tropical deforestation in places like Brazil, Indonesia and central Africa, while sequestering carbon to offset pollution from industrial polluters in the global north. But increasingly-- part of a trend toward the neoliberalization of conservation and environmental management (McCarthy and Prudham 2004; Ouma, Johnson, and Bigger 2018) -- land managers are turning to carbon offsets as new funding streams to support existing conservation projects or foster new, larger-scale endeavors.

While forest carbon projects were designed to address deforestation in areas where forests were threatened with development, illegal logging, and large land grabs, they are increasingly used by conservation NGOs, land trusts, and large landholders already engaging in conservation practices. In the United States they have been employed in forested areas that, at times, provide dubious claims of "additionality," the central tenant that, to be deemed successful, and produce carbon credits, a forest carbon project must produce additional carbon storage over traditional forest management practices.

(4) Conservation finance

Conservation finance is an emerging field that draws capital to conservation and environmental management. It is part of the increasingly popular Impact Finance movement and seeks to close gaps between conservation needs and investor interests (Clark 2012). Many international environmental NGOs and financial institutions have been promoting the conservation finance agenda; yet, at a global scale, conservation finance has not been widely successful. Geographers have shown many international initiatives to have more discursive power than actual market power (Dempsey and Suarez 2016; Kay 2018). But this is not the case in the US where there is an increasing trend of boutique private equity firms investing in conservation and generating returns. In the US, there is an active and growing cohort acquiring land for investors, primarily across two types of working landscapes: forests and ranchlands (Kay 2018) According to Kay (2018): "Unlike philanthropic capital, which expects no returns, North American conservation finance firms are able to deliver competitive returns on investment, with some US-based private equity firms generating returns of as much as 15 percent annually." Finite Carbon, the firm that developed the Farm Cove forest carbon project, is one such organization, and they call on carbon offsets to help achieve those high returns. (For contrast, a typical mutual fund draws returns of 3-5 percent annually).

Financial institutions generate returns via conservation finance by leveraging a suite of financialized environmental rights, certifications, offsets, etc. Endangered species credits, hunting rights, various payments for ecosystems services (PES), offsets and other financial tools are bundled together to simultaneously extrapolate the greatest value (Personal communication 11 April 2017). To that end, carbon offset projects in Maine are just one layer of many in which forests and conservation land are valued and treated as financial investments.

(5) Forest carbon offsets as conservation finance

The Downeast Lakes Land Trust (DLLT) views forest carbon offsets as a conservation tool. Addressing climate change is secondary, at least, to more proximate interests for project developers and stakeholders. One project manager told me his interest offsets had more to do with attracting funds for forest conservation than mitigating climate change. He said: "We're not driven by some great fire in the belly to reduce carbon emissions" (Personal communication 11 April 1027). Furthermore, many stakeholders with local interests in the Farm Cove Community Forest hold personal and financial interests in maintaining forest access via the Farm Cove Community Forest—lodge owners, hunting or fishing guides, owners of seasonal real estate, etc. Maintaining access to the forest, and keeping it from private development, was important to the Grand Lake Stream community broadly.

Forest carbon offsets are successfully expanding in the US because they meet multiple, concurrent needs for a range of stakeholders. Therefore, **the flows of capital from polluters to conservation organizations have become ties that bind mutually exclusive goals.** For polluters within regulatory markets, or participants in voluntary carbon markets, the goal is the balancing of an administrative carbon budget. For conservation organizations and others with an interest in regional conservation land, the goal is increased conservation funding, often providing millions of dollars in seed money to support fundraising efforts. As with the Farm Cove Project, the carbon credit income helped attract state and private matching funds for a $20 million capital campaign.

(6) Discussion

Forest carbon offsets are essentially collections of administrative processes that bind multiple, individual interests. Those processes make conservation legible on markets, but do not always address the problems of atmospheric carbon concentrations and land use change they are designed to. Therein lies the conundrum. To explore this contradiction of an offset serving many purposes, but perhaps not to the one it was designed to address, it helps to call on a concept from critical development geography, found in Ferguson's *Anti-Politics Machine* (1990) and Li's *Will to Improve* (2007). The theory poses: *Development often fails at what it sets out to do, but in that failure achieves something else*. Drawing on that, we can then ask: Forest carbon offsets often fail at what they are designed to do— which is mitigate atmospheric carbon concentrations—but they succeed at something (or somethings) else. What is that?

By drawing on two theoretical framings that often are not used in tandem, we can explore the notion of a mechanism that meets multiple, sometime contradictory needs, and what it accomplishes in doing so. This idea is explored theoretically first through a critique of additionality, the requirement that project-related emission reductions must be “additional” to the counterfactual situation where the project did not exist (Purdon 2015). Next, drawing on Science and Technology Studies (STS), the notion of an “immutable mobile” is used to frame an offset as “an entity that can travel from one point to the other without suffering from distortion, loss, or corruption” (Cooren et al. 2007; Latour 1987). An immutable mobile, according to Latour, is a discourse or instrument that is transported from one point to the other while maintaining the integrity of its crucial aspects (Cooren et al. 2007).

(7) Additionality – where the asset hides

To address the first part of that framing—that forest carbon offsets fail at what they set out to do— it is beneficial to use a critique of additionality. *Additionality* is the central tenant that, in order to be deemed successful, and produce carbon credits, a forest carbon project must produce additional carbon storage over traditional, business-as-usual forest management practices (Bäckstrand and Lövbrand 2006; Purdon 2015). The problem with this mechanism, particularly in the United States, is largely related to the need for additionality, or the requirements that such projects contribute to additional carbon sequestration beyond traditional land management absent of such agreements. Additionality in the Farm Cove, and other Maine forest carbon projects, comes from what is called “improved forest management,” where financial investments support forest management practices that improve overall forest density and health. This type of forest carbon offset is different from common REDD+ projects, which ascribe value to avoided deforestation (Bäckstrand and Lövbrand 2006). Improved forest management plans allow forest carbon projects to be established in spaces with little to no threat to deforestation. For example, while forest carbon projects were originally designed to address deforestation in areas where forests were threatened with development, illegal logging, and large land grabs, but they are increasingly adopted by conservation NGOs, land trusts, and large landholders already engaging in strong forest management and conservation practices. Furthermore, forest carbon projects are often critiqued for overwhelmingly meeting the interests of the global north—or in this case private equity firms-- and overlooking local knowledges and participatory practices (Nielsen 2014)

The problem, however, is that these projects are largely being mobilized by conservation organizations that are bundling them with an array of financialized land practices like conservation easements, endangered species credits, hunting rights, etc (Forests, Kay 2016). Essentially, they are being employed by savvy land managers who, in many cases, already have ambitions forest management practices in place. More ambitious, even, then the requirements for additionality. In the case of the Farm Cove project, the land trust that oversees the project didn't need to make significant changes to their land management to secure verified carbon credits. They were already managing the forest using highly sustainable practices. When asked what the DLLT was doing to meet the requirements of the carbon credit protocol, a project developer said, "nothing new," because as an established land trust they already had a comprehensive forest management plan that was more rigorous than those required by California's Air Resource Board (personal communication, March 20, 2016).

The key reasons these forests do not require changes to their forest management plans is because they are tied to a long history of finacialized forest management in New England and the surrounding area. Most of the carbon offset projects in the northeast US exist in spaces that are part of a legacy of forestlands management that, for decades, supported the vertically integrated pulp and paper industry. Then, starting in the mid-1980s, when pulp and paper began to de-integrate, forestland was bought up by Timber Investment Management Organizations (TIMOs)—financial entities and short term holders who aggressively harvest timber and apply multiple layers of financialized forest management to an area, then sell it. Once the land has been heavily logged TIMOs place land on the market, and they attract two types of buyers: developers or conservation organizations. So when a conservation organization takes over former TIMO land they are already employing improved forest management techniques that will produce additional carbon sequestration over a baseline from when the land was more aggressively managed. Because any land management that seeks to sustain or grow a heavily harvested area is, by design, "improved forest management."

(8) (Im)mutable mobiles

To address the second part of the framing, *that while forest carbon offset projects fail at what they were designed to do, they succeed at something else*, it is helpful to look to the Science and Technology Studies (STS) concept of the *immutable mobile* (Latour 1986, Law and Mol 2001), an object, or idea, "holding itself together in a particular web of relations," that goes out into the world, bringing with it 'fixed' uses. But the immutable mobile is known for being picked up or adopted very differently than it was intended— existing in a fluid state, edited, and subtly reconfigured. Indeed, it becomes *mutable.*

The idea of the immutable—and ultimately mutable-- mobile is used to illustrate the evolving use and implementation of forest carbon offsets. As the most recent growth in carbon forestry is now in the United States, involving working timberlands, it challenges the integrity and design of the mechanism, which was designed to address tropical deforestation. But it also shows how the mechanism has been picked up, edited, and adapted by communities who saw opportunities to use it differently and in ways that meet local needs.

When interviewing stakeholders with the Farm Cove project, this research design included numerous questions, each worded differently, to inquire about the role of additionality: How it was demonstrated and calculated, because it is the foundation of what makes a forest carbon offset project different from a straight conservation project. The original hypothesis was that additionality is the space where the legitimacy of forest carbon projects is hinged. Yet that turns out not to be the case. One respondent admitted that additional carbon storage was not why his organization was involved. They were not particularly interested in climate change mitigation, carbon sequestration, or preventing deforestation from development. Rather, conservation finance was his motive. He said: “Shaky as it may be from, from top to bottom, there is no harm in having money come to conservation” (personal communication, August 12 2016).

We can think of the latest iterations of the forest carbon offset mechanism as existing in a fluid state, with fixed uses that have been edited, subtly reconfigured and, for the beneficiaries of this conservation finance, there was no harm in the mutability of the mechanism, and no harm in the fact that it was employed in ways separate from its intended design.

(9) Challenges (Where doesn’t this argument work?)

The problem with using analytical concepts to think through social and environmental phenomena is that they are, by design, limiting. Those limits work to explain nuanced relationships, but they prove challenging when trying to reproduce arguments to analyze ambiguous development mechanisms, like carbon offsets. The mutable mobile, for example, is limited in its explanation as an idea or concept held together by a web of relationships (Mol and Law 1994). Using this as an analytic never explains what characteristics define, or hold together, a specifics network. Furthermore, the notion of the immutable mobile can prove challenging to this analysis because it is not as flexible as its name suggests. However, we can fill some intellectual gaps with the concept of 'obligatory passage points,' defined as "situations or conditions that must occur in order in order for involved parties to achieve their desired interests" (Simon 2014). Obligatory passage points have a "funneling effect, forcing all actors (households, governments, finance sector, etc.) to converge" around a particular problem or issue (Simon 2014). Framing an offset as something that serves multiple purposes via one *common condition* foregrounds the role of sequestered carbon, and suggests that maintaining carbon sinks—whether for climate mitigation or conservation—is the interest point around which offsets are organized. The perspective shifts the conceptualization away from offsets as a mutually beneficial, yet isolated tool, to a mechanism that draws interests in and together.

(10) Conclusions

Returning to *The Anti-Politics Machine*, Ferguson explores discourses of development, asking how the language and practices used by development practitioners influence the ways in which development is delivered. In such, he found that development projects that failed on their own terms were often redefined as "successes" on which new projects were modeled. Essentially, technically failed projects became tools to strengthen bureaucratic power and expand the development industry (Ferguson 1994). This is an interesting analysis to apply to forest carbon development. Whether defining offset projects in the context of immutable mobiles or obligatory passage points, the integrity of proving additionality remains questionable. Still, carbon forestry is growing rapidly in the United States. This challenges the notion of what a "successful" offset project looks like, and questions whether success in its various definitions is even a goal for stakeholders at all. Ultimately, a forest carbon offset project meets multiple, unique needs for each stakeholder, even when its contributions to atmospheric carbon concentrations remain elusive, or opaque.

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Conclusions

(1) Where is the climate change?

It is egregious what is missing amid the pages of analysis within this dissertation: Climate change. Climate change, global warming, atmospheric concentrations of CO2: the phenomenon around which the markets and mechanisms explored here are designed. Carbon markets and offsets exists specifically to address climate change, to mitigate it, to lessen the negative impacts increasingly faced across the planet. But it does not show up much in this research. Why?

A primary conclusion of this research is that developing and managing forest carbon offsets requires so much administrative work that they are too far removed from their intended goal to impact atmospheric carbon pollution. And that conclusion likely would not draw much surprise among forest carbon developers and conservation teams. In fact, addressing climate change is often low on the list of reasons that attract participants, after conservation finance, investment returns, and expanded spaces of conservation. One forest offset developer shared: "I don't think anyone involved in this project would say climate change is their primary motivation" (personal communication 11 April 2017). Another said his team was "not driven by some great fire in the belly to reduce carbon emissions" (personal communication, 14 July 2017). To that end, climate change simply is not a primary motivator for carbon offset participation. As Anderson et al. (2017) wrote, the requirements to meet carbon offsetting standards often deter involvement in carbon projects. To that end, the illusiveness of climate change within this research exposes a design flaw in offsets, and in Clean Development Mechanisms (CDM) broadly.

(2) The future of forest carbon offsets

A common question within this work is: “Do forest carbon offsets work?” And the answer comes down to another question: “Work for whom?” The results of this research show that it is unlikely forest offsets make an impact in reducing atmospheric carbon, or at least are too administratively convoluted to ever really know. Addressing the first assertion, even conservative estimates project continued increases in atmospheric carbon (“Projections of Future Changes in Climate - AR4 WGI Summary for Policymakers” 2007). According to the US Environmental Protection Agency (EPA), “Greenhouse gas concentrations in the atmosphere will continue to increase unless the billions of tons of our annual emissions decrease substantially” (US EPA 2016). Climate change is getting worse, and offsets are not making an impact. To address the second point: this research found that offsets require intensive bureaucracy and many stages of management that distance conservation activities too far from carbon sequestration to accurately access if they have made an impact.

Carbon offsets do work, however, for a number of stakeholders, particularly as they act as a means of conservation finance. Conservation finance is gaining popularity in the US because it draws capital to conservation organizations, NGOs, project developers like Finite Carbon, consultants, lawyers, foresters and others. And as long as infusions of capital support project developers, it is likely the forest carbon offset mechanism will continue to spread. While international REDD+ projects flounder in the readiness phase, and raise questions about the viability of the mechanism, forest carbon projects in the US are thriving.

Furthermore, common criticisms of REDD+ and carbon offsets in the developing world do not translate to the global North, where offset projects are framed as conservation funding to open or maintain public access to forestlands. This is likely because the land was already, essentially, enclosed. For decades forests in Maine and other areas were privately held timberlands, as opposed to contested spaces were REDD+ projects are applied in the global South. There is no contestation over settlement on the US lands, and tenue is well articulated. Many of the challenges that face forest carbon project abroad are non-issues in the US, opening spaces for continued growth and expansion of the forest carbon offset mechanism.

(3) Further research

This dissertation sets the stage for important research question that explore a number of interesting areas of scholarship. Continued research drawing off the conclusions of this dissertation could move in several directions. Potential projects are explained below (ie: If I had a post-doc I could…):

- Design a study that draws on critical 'payments for ecosystem services' (PES) literature to critique accounting of forest carbon projects.

- Apply similar research questions to the multiple Passamaquoddy forest carbon projects, also in Maine. These projects, which include over 100,000 acres tied to the California Air Resources Board, combine the complexity of forest investments with the interests of the Bureau of Indian Affairs, who oversee all Native American land management. Passamaquoddy offset development also interestingly incorporates discourses of indigenous land rights, social justice, and colonialism commonly found in forest carbon project in the global South. One Native America forester who was engaged in carbon forestry told me: "Can our tribe handle a 100 year 'compliance period?' Of course.

Everything we do is planning for seven generations ahead. 100 years is easy" (personal communication 15 August 2017).

- Examination of the role of insurance and indemnity in forest carbon projects, and ask how the allowance for insurance within a project challenges its stated goal of reducing atmospheric carbon concentrations. Essentially, interrogate the notion that insuring carbon forestry is protecting the financial investment, but not the atmosphere.

- Contrast forest carbon projects with carbon farming and grazing practices, which are much more visual and quantifiable. This study could apply a political economic lens to ask which techniques sequester more carbon and which ones are more financially viable for project developers.

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