The Hidden Frontier of Forest Degradation

A Review of the Science, Policy and Practice of Reducing Degradation Emissions

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Executive Summary

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One of the critical sources of global greenhouse gas emissions can be addressed through conservation of the highest biodiversity ecosystem on earth, tropical forests, by channeling funds to developing countries at a cost-savings for developed countries. We have an historic opportunity to accomplish this four-dimensional win by building an effective structure of incentives and standards to reduce emissions from deforestation and forest degradation (REDD) as part of both international negotiations for a post-2012 climate treaty and national policy development. We review here why it is essential to include the second "D" in REDD, forest degradation (e.g. logging, fire, fuelwood harvest), in order to construct an effective REDD mechanism, and how it can be done.

Forest degradation represents at least 20 percent of forest carbon emissions and acts as a catalyst of deforestation. Despite the growing recognition of the importance of reducing degradation, there is still some skepticism about its inclusion in policy, especially within U.S. domestic legislation. This skepticism stems from a general lack of understanding about the magnitude and importance of degradation as a source of emissions, and about the availability of credible accounting methods and effective strategies to reduce degradation.

We have concluded from a review of both published literature and practitioner experience that:

1. We must include major forms of degradation in a REDD mechanism because of the magnitude of these emissions;
2. We can include major forms of degradation in a REDD mechanism thanks to the availability of both (a) reliable accounting methods and (b) effective, sustainable strategies;
3. Credible methodologies exist and are emerging to verify emissions reductions from avoided degradation; and
4. Solutions to many of the challenges of credibly reducing emissions from forest degradation (i.e. baselines, monitoring, verification, and sustainable strategies) have been demonstrated by existing initiatives.

We summarize our conclusions on each of these four points as follows:

1. Forest degradation produces large direct forest carbon emissions, and catalyzes additional emissions from deforestation.

We find that degradation emissions represent at least 20 percent of total tropical forest emissions, based on values ranging from 20 percent to over 50 percent found in a variety of regional studies across the three major tropical forest regions, and in a global logging emissions study. Our estimate is more than twice that of global studies referenced by the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). We suspect this difference is due to the limitations of existing global remote sensing studies and United Nations Food and Agriculture Organization information that form the basis of the IPCC estimates.

None of these estimates account for the catalytic effect of degradation. In many systems degradation such as logging increases the likelihood of additional emissions from degradation (e.g. fire) and subsequent deforestation, and highlights the importance of addressing degradation.

While reliable data exists for major sources of degradation in some parts of the world, there is a great need for improved estimates of global emissions from forest degradation. This can be achieved by scaling up the implementation of recent advances in remote sensing imagery analysis, expanding field measurements, and improving the consistency of accounting methods, as discussed below.

2a. Credible and affordable methods for measuring major forms of forest degradation exist.

New methods for detecting major forms of degradation (selective logging and partial canopy fires) using free satellite imagery allow for credible measurement and monitoring of forest degradation. However, affordable remotely-sensed monitoring that can differentiate between improved logging practices, as opposed to conventional logging, remains elusive. Existing forest certification systems, (e.g. Forest Stewardship Council—FSC) employing ground-based auditing of specific logging practices, offer a solution to this missing piece. We recommend customizing existing forest certification systems so that they verify practices designed to reduce emissions, balanced with social and ecological co-benefits.

2b. Effective strategies for reducing emissions from forest degradation exist.

A variety of strategies exist to address each of the three major drivers of forest degradation: logging, fire, and fuelwood collection. For logging, we review aspects of "Improved Forest Management" (IFM) and focus on how IFM is operationalized through certification by the Forest Stewardship Council (FSC). FSC includes IFM practices that reduce emissions by (1) reducing area logged, (2) reducing emissions per unit volume harvested, and (3) reducing the probability of subsequent forest conversion. There are other elements of IFM practices associated with FSC that can offset these emissions reductions; however, under most conditions the net impact of FSC certification is likely to reduce emissions. Larger and more consistent emissions reductions from FSC certification can be achieved by (i) more explicit requirements for specific logging practices, and (ii) identification of a set of regionally appropriate emissions-reducing practices that can be audited as part of certification.

Fire management strategies can be implemented in both fire-sensitive and fire-dependent systems to reduce the risk of unexpected fire emissions that can undermine the permanence of forest carbon emissions reductions. Fire management practices in fire-dependent systems (such as seasonally dry forests) are fundamentally different from fire management practices in fire-sensitive systems (such as rainforests). Emissions reductions resulting from fire management practices are often difficult to quantify; however, in some fire-dependent systems where fire behavior is highly predictable, management practices can be linked to quantifiable emissions reductions.

Integrated Fire Management offers a comprehensive framework for planning fire management strategies to reduce CO_2 emissions and reduce the risk of non-permanence. National-scale REDD programs should consider fire management as an integral part of REDD initiatives, given the magnitude of emissions in both fire-dependant and fire-sensitive systems, and the range of co-benefits associated with good fire management practices.

Fuelwood harvest emissions can be addressed with efficient cook stove programs that reduce fuelwood demand, and/or through a variety of strategies that increase fuelwood supply including woodlot development, agroforestry, and community-based forest management.

3. Credible methodologies exist and are emerging to verify emissions reductions from avoided degradation.

Currently, standards and methodologies to verify reduced emissions from forest degradation are at an early stage of development, with the exception of fuelwood strategies covered under the Clean Development Mechanism (CDM). Lessons from forest certification can be used to complement existing and emerging carbon standards and methodologies. While not created to address carbon emissions, FSC certification is a well developed forest management standard designed to minimize ecological impacts resulting from timber harvest, while recognizing the ecological context of different tropical forest systems and achieving standards of social justice. We recommend the development of explicit links between existing forest management standards (e.g. FSC) and carbon standards (e.g. Voluntary Carbon Standard). As part of this process, research is needed to evaluate regionally specific forest practices that achieve quantified carbon benefits and are balanced with ecological and social concerns.

4. Existing conservation projects have demonstrated the viability of reducing emissions by avoiding forest degradation associated with timber extraction, fire, and fuelwood collection.

Accounting for avoided emissions from degradation can be essential to the viability of climate initiatives such as the Noel Kempff Mercado Climate Action Project in Bolivia, the Garcia River Forest Project in the United States, and the West Arnhem Land Fire Abatement project in Australia. Accounting for avoided emissions from degradation can be essential to the viability of climate initiatives such as the Noel Kempff Mercado Climate Action Project in Bolivia, the Garcia River Forest Project in the United States, the West Arnhem Land Fire Abatement project in Australia, and the Cambodian Efficient Cook Stove Project.

The Noel Kempff Mercado Climate Action Project has demonstrated methods to (i) account for the avoided emissions from stopping logging, (ii) address leakage and permanence issues, and (iii) verify tradable emissions reductions. The Garcia River Forest Project is demonstrating that emissions reductions through Improved Forest Management (IFM) efforts, which maintain sustainable timber production, are viable even in a context of relatively good "business as usual" baseline practices and the occurrence of unplanned fires. The West Arnhem Land Fire Abatement project has demonstrated both (i) accounting methods for quantifying the emission reductions resulting from fire management practices in a fire-dependent savanna system, and (ii) the viability of a strategy that engages indigenous groups in traditional fire management activities to reduce fire emissions. The Cambodian Efficient Cook Stove Project has demonstrated that emissions reductions from efficient cook stoves can be real, measurable, and verifiable with existing standards and methodologies, while improving local job opportunities.

CHAPTER ONE

Introduction

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We are in the midst of a critical period of negotiations to develop a framework for crediting reduced emissions from deforestation and forest degradation (REDD) as part of a post-2012 international climate change agreement. Negotiations for a new climate treaty are expected to reach a crescendo over the coming year as we advance from the December 2009 fifteenth Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC-COP 15) towards COP 16 in Mexico.

The issue of deforestation commands the center of attention in negotiations over mitigation policies intended to reduce the approximately 15 percent of annual carbon dioxide emissions produced from converting or degrading forests (van der Werf et. al., 2009; Canadell et. al., 2007). While emissions from forest degradation, the "second D in REDD," are more difficult to measure, the inclusion of forest degradation in a REDD framework is critical for robust and credible REDD accounting, as well as effective implementation of REDD programs.

We have concluded from a review of the literature and practitioner experience with REDD pilot projects that:

1. We must include major forms of degradation in a REDD mechanism in order to credibly measure and effectively reduce forest carbon emissions because (a) emissions from forest degradation are a major component of total forest carbon emissions, and (b) degradation often acts as a catalyst for deforestation.

2. We can include major forms of degradation in a REDD mechanism thanks to both (a) credible and affordable methods for measuring major forms of forest degradation, and (b) effective strategies for sustainably reducing emissions from forest degradation, with additional benefits for reducing deforestation.

3. Credible methodologies exist and are emerging to verify emissions reductions from avoided degradation, while ensuring ecological and social co-benefits. These can be advanced by linking carbon standards with existing forest certification systems.

4. Solutions to many of the challenges of credibly reducing emissions from forest degradation (ie. baselines, monitoring, verification, sustainable strategies) have been demonstrated by existing conservation projects addressing emissions from logging, fire, and fuelwood harvest.

In the following chapters we examine the basis for these four statements. In order to do this we organize each chapter around the following questions:

Chapter 2: *What is the magnitude of emissions from forest degradation?* We review literature on global and regional estimates of forest degradation, and the causal links between various types of degradation and deforestation.

Chapter 3: *What are the best available methods to credibly and affordably account for avoided emissions from degradation, and what gaps remain?* We review the advantages and limitations of existing and emerging methods, and the context in which different methods are appropriate.

Chapter 4: *What strategies are currently available to address degradation on the ground?* We review challenges, discuss solutions, and consider the context in which a given strategy has been demonstrated to be effective.

Chapter 5: *Can lessons from forest certification be used in the development of carbon standards and methodologies for reducing emissions from forest degradation?* We focus on the case of logging, where standards and associated methodologies are further along, but where gaps remain.

Chapter 6: *What cases exist where strategies to reduce degradation have been effectively implemented, and the carbon benefits have been credibly measured?* We present four case studies where degradation is being included in initiatives that avoid forest carbon emissions and/or enhance sequestration. We touch on the issues discussed in other chapters in the context of each case study.

We conclude in Chapter 7 with a synthesis of the critical messages from chapters 2-6 for policymakers heading to the December 2009 COP-15, and beyond.

box one » **what is "degradation?"**

The definition of forest degradation is perhaps the most basic of the policy challenges that must be resolved to include degradation in a REDD mechanism.

The United Nations Framework Convention on Climate Change (UNFCCC) does not have an officially adopted definition of degradation. The UNFCCC and the Intergovernmental Panel on Climate Change (IPCC) differentiate between forest and non-forests based on percent crown cover. Deforestation has occurred if crown cover is reduced below a minimum threshold varying from 10 percent to 30 percent (each national government selects a threshold value within this range). Forest degradation, on the other hand, occurs when emissions from forests are generated without reducing forest cover below 10-30 percent. In general terms then, "degradation" refers to the loss of forest carbon stocks in forests that remain forests. Accordingly, in a nation with a 10 percent crown cover threshold, as much as 90 percent of the forest could be cleared without being identified as deforestation.

The 2003 *IPCC Special Report on Definitions and Methodological Options to Inventory Emissions from Direct Human Induced Degradation of Forests and Devegetation of Other Vegetation Types* offers a more comprehensive definition of forest degradation which reads, "direct human-induced long-term loss (persisting for X years or more) of at least Y percent of forest carbon stocks [and forest values] since time T and not qualifying as deforestation or an elected activity under Article 3.4 of the Kyoto Protocol."[1]

This definition is a move in the right direction, but by excluding activities included under Article 3.4 of the Kyoto Protocol, forest management would not count as a degrading activity. Forest management clearly results in significant reductions in carbon stocks within a forest. Therefore, we would propose the following definition: forest degradation is:

A direct, human-induced reduction in the forest carbon stocks from the natural carbon carrying capacity[2] of natural forest ecosystems which persists for a specified performance period and does not qualify as deforestation.

This carbon-based definition should not be confused with references to degradation in the context of biodiversity or timber value, which are often but not always correlated with carbon degradation.

In maintaining consistency with the Kyoto Protocol, we stress the importance of limiting definitions of forest degradation to anthropogenic activities, such as logging, fire, and fuelwood harvest. The emphasis on carbon stocks provides a real means to measure degradation. Natural carbon stock fluctuations (such as natural fire and hurricane damage) are not designated as degradation in our definition and would be encompassed within the natural carbon carrying capacity. Time-averaged natural carbon carrying capacities vary with landscape, and provide the best indicator of the appropriate baseline state from which to gauge degradation. The use of a different indicator than carbon carrying capacity risks reducing incentives to maintain forests in their natural state and could result in diminished opportunity for credited emissions reductions. In specifying performance periods as the time frame, we exclude temporary changes in carbon stocks, while at the same time provide a realistic means to operationalize the definition. By excluding areas that would be considered "deforested" by current definitions, we avoid double counting issues.

[1] An elected activity under Article 3.4 refers to anthropogenic greenhouse gas emissions by sources and removals by sinks that are reported under the Convention. In Decision 16/CMP.1 (2005), these elected activities were specified as: ***revegetation, forest management, cropland management and grazing land management.***

[2] We define "natural carbon carrying capacity (CCC)" here as the mass of carbon expected to be stored in a forest ecosystem under prevailing environmental conditions and natural disturbance regimes, averaged over large enough spatial and temporal scales to capture the range of natural disturbance, but excluding anthropogenic disturbance; Also see Gupta, R.K. & Rao, D.L.N. (1994) Potential of wastelands for sequestering carbon by reforestation. Current Science, **66**, 378–380.

CHAPTER TWO

Magnitude of Emissions from Degradation

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SUMMARY FOR POLICY & PRACTICE

» Degradation emissions represent at least 20 percent of total tropical forest emissions. This estimate is based on a review of regional estimates from all three major tropical forest zones (Amazonia, Congo basin, Southeast Asia) which find that degradation emissions represent from 20 to 57 percent of total emissions from deforestation and degradation.

» Degradation emissions appear to represent (i) the majority of emissions from tropical forests in Africa, and (ii) a magnitude similar to deforestation in tropical Asia.

» Global estimates referenced by the IPCC Assessment Report 4 appear to underestimate emissions from degradation due to technical limitations of global estimates to date. Work is needed to (i) improve the consistency of methods used to estimate degradation emissions, and (ii) improve the accuracy of global estimates.

» Degradation often increases the likelihood of deforestation. Thus, including emissions from degradation in a REDD mechanism is important not only to address direct emissions resulting from degradation, but also to link incentives for mitigation towards the first steps in a chain of events leading to deforestation.

Estimates of the amount of global emissions from tropical forest degradation vary by almost an order of magnitude. Studies referenced by the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (Nabuurs et al., 2007) estimate that forest degradation emissions represent 4.4 percent (Achard et al., 2004) to seven to nine percent (Houghton, 2003; DeFries et al., 2002) of total tropical forest carbon emissions. In contrast, a recent study attributes about 35 percent of tropical forest emissions to legal selective logging alone (0.51 Gt C/yr), in just the 20 percent of tropical forests identified as "production estate" by the International Tropical Timber Organization (Putz et al., 2008).

Degradation from Logging

Logging is the only type of forest degradation with global tropical emissions estimates (Putz et al. 2008, Houghton 2003). Tropical Asia was identified by Putz et al. (2008) as the largest source of logging emissions. New methods to detect selective logging activities (Asner et. al. 2005), and partial canopy fire (Souza et. al. 2005), have revolutionized the detection of degradation emissions (Curran et al., 2006); however these methods have not yet been applied globally. Asner et al. (2005) determined that emissions from selective logging in major portions of the Brazilian Amazon add up to 0.08 GtC to the atmosphere each year, increasing the estimated gross annual anthropogenic flux of carbon from Amazonian forests by 25 percent over carbon losses from deforestation (Figure 1). It was also found that annual logging activities cover an area similar in size to the area deforested each year. These new analytical methods have thus revealed that selective logging represents about 20 percent of emissions from degradation and deforestation in the Amazon region[3].

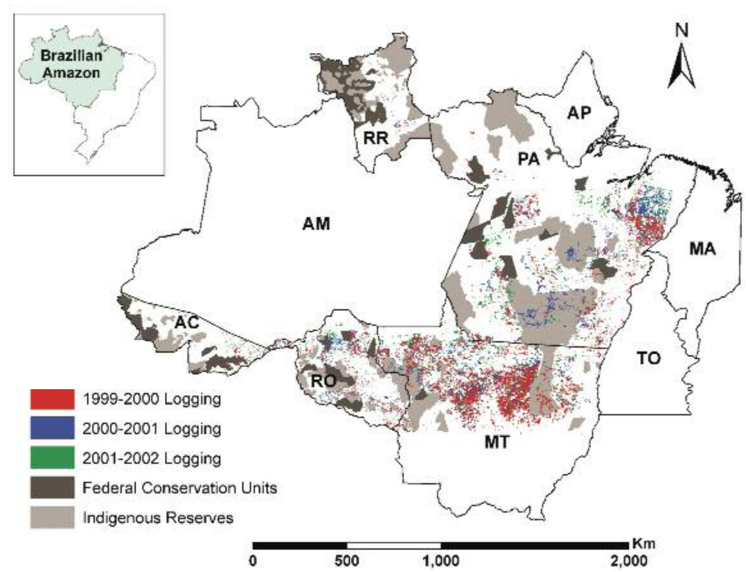

FIGURE 1. Spatial distribution of selective logging in five timber-production states of the Brazilian Amazon for the year intervals 1999 (red), 2000-2001 (blue), and 2001-2002 (green). The states of Amazonas (AM), Amapa (AP), Tocantins (TO), Maranhao (MA), and the southern non-forested part of Mato Grosso were not included in the analysis. Light grey areas show the extent of indigenous reserves; dark grey areas delineate federal conservation lands as of 1999. RR, Roraima; PA, Pará; MT, Mato Grosso; RO, Rondônia; AC, Acre. This figure is reproduced, with permission of the authors, from Asner et. al. 2005.

Degradation from Fuelwood Harvest

It is clear that fire and fuelwood harvest, though not yet measured globally, represent two other major sources of degradation emissions. Fuelwood harvesting accounts for 40 percent of global removal of wood from forests according to the FAO (2006); however, it is not yet clear how to translate this activity to actual greenhouse gas emissions caused by fuelwood harvesting. An analysis by Gaston et al. (1998) concluded

[3] We arrive at this "about 20 percent" figure simply by adding the Asner et. al. (2005) estimate of selective logging emissions to deforestation emissions. It appears that Asner et. al.(2005) have accounted for the average annual area logged that is subsequently deforested in generating their 0.08 GtC value (they find that 19% of the total area logged was subsequently deforested three years later).

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that emissions from forest degradation, due mostly to harvesting wood for direct use as fuel or conversion to charcoal, constituted 57 percent of forest emissions in Africa. Several other studies concluded that degradation accounts for 25-42 percent of forest emissions in tropical Asia (Houghton and Hackler, 1999; Flint and Richards, 1994; Iverson et al., 1994), and that most of wood harvest in Asia is for fuel (Houghton and Hackler, 1999).

The IPCC's Fourth Assessment Report notes that some of the emissions from Land Use Changes (LUC) are the result of "traditional biomass use." However, the assessment departs from its usual rigor by assuming that 90 percent of the traditional biomass harvest is "from sustainable[4] biomass production" referencing analysis by the International Energy Agency (IEA), 2006.

The remaining 10 percent of global harvest is "non-renewable" by default. Based on this assumption, the IEA estimates that global fuelwood use contributes approximately two percent of total global emissions (International Energy Agency, 2006, section III.6). This is roughly equivalent to the emissions from the transport sector in the European Union (World Resources Institute, 2008).

Degradation from Fire

Global emissions from wildfires are also very large; however, it is not yet possible to differentiate fire emissions associated with forest degradation as opposed to deforestation. One regional study that did make the distinction found that understory fire generated carbon emissions ranging from less than 1 percent to about 80 percent of emissions from deforestation in Brazilian Amazonia, depending upon El Niño cycles (Alencar et al., 2006).

Wide-Ranging Estimates

Why is it that these regional studies from all the major tropical forest regions find that degradation emissions constitute 20-57 percent of forest emissions, while the IPCC referenced studies attribute less than 10 percent to degradation?

One reason is that sources of emissions that have not been quantified at the global level with acceptable levels of certainty are generally ignored in global estimates due to the scientific principle of conservativeness. For example, the estimates based on global remote sensing analysis (Achard et al., 2004; DeFries et al., 2002) do not use methods that are sensitive enough to detect cryptic selective logging, fuelwood harvest, and understory fire that are the primary sources of emissions in the regional studies mentioned above.

Another reason is that different methods are used to calculate degradation emissions, such that numbers cannot simply be added up from different regional studies, or different forms of degradation, to arrive at a global value. At least three important methodological issues appear to influence the range of estimates we have reviewed:

1. Time-specific vs. Committed emissions: Some studies include only emissions from degradation (e.g. Houghton, 2003) that occur over a specified time period after a given degradation activity. Other studies include all "committed

[4] The term "sustainable" is defined here as "meeting the needs of the present without compromising the ability of future generations to meet their own needs."

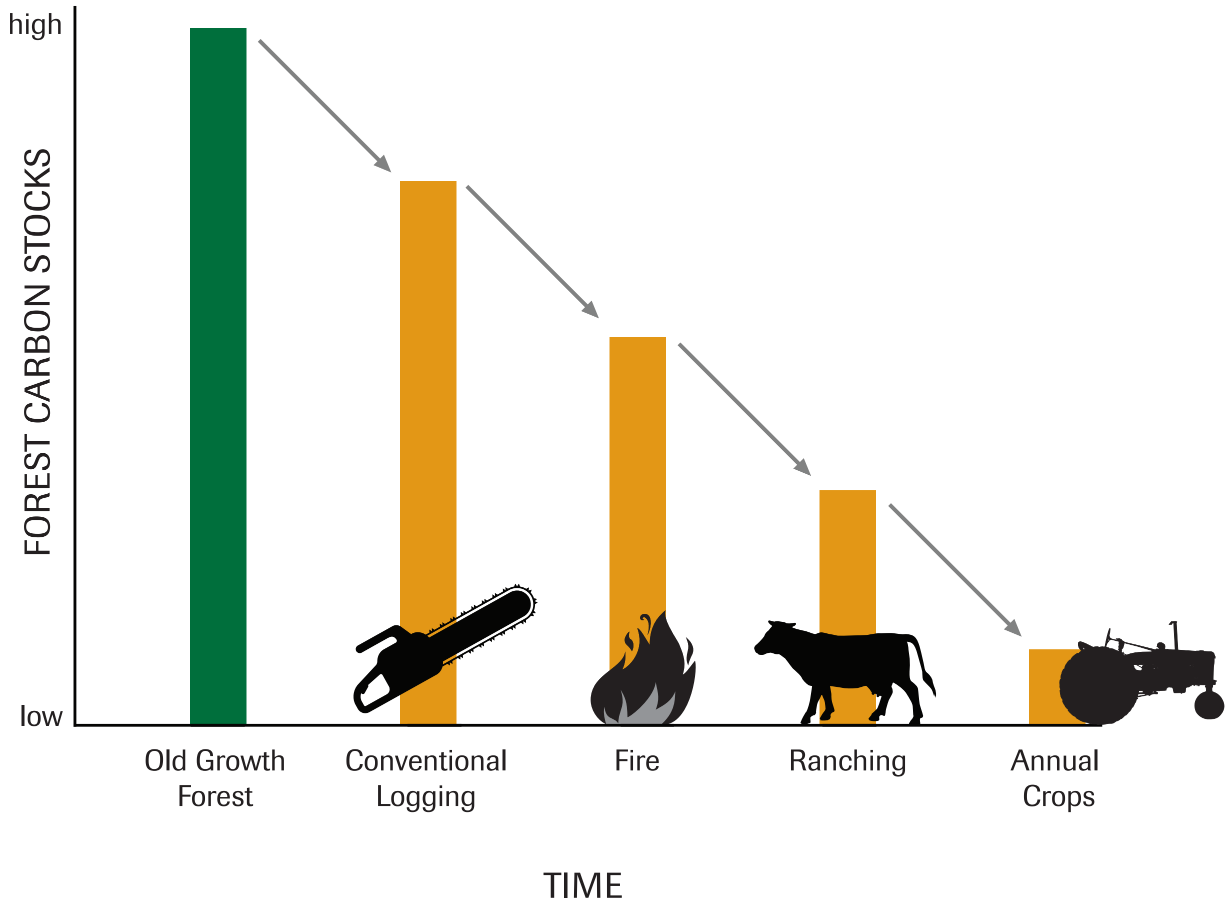

FIGURE 2. Stylized example of interactions between degradation processes leading to conversion. The order and nature of these transitions depends upon location. For example, in Indonesia, the "ranching" phase may instead be palm oil, or another tree crop.

emissions," that is all the emissions that are certain to occur eventually as a result of a given degradation activity (Putz et al., 2008). For example, the majority of emissions from selective logging activities generally come from dead trees left in the forest that rot or burn years after the actual logging event.

2. Forest re-growth: Some studies account for "net" emissions from logging by subtracting the expected increase in tree growth and sequestration rates after logging events from the emissions (Houghton 2003). Others do not make this "growth offset" subtraction (Putz et al., 2008).

3. Lumping Degradation with Deforestation: Some deforestation estimates include some degradation emissions because they assume that forests being cleared are not degraded, even though forests are often degraded before they are converted. This problem results in underestimates of degradation emissions and complicates full accounting of emissions from deforestation and degradation. The critical issue is to avoid double counting of emissions when adding estimates of deforestation and forest degradation.

The problem of lumping emissions from degradation with those from deforestation may be greatest where degradation acts as a catalyst for deforestation. It is these situations where it is particularly important to identify emissions from degradation so that REDD incentives can be directed to the first step in the chain reaction of land use change.

Despite these challenges, from our review of (i) regional studies from all the major tropical forest zones finding that forest degradation emissions from logging, fire, and fuelwood collection represent 20-57 percent of forest emissions, (ii) a pan-tropical study on emissions from legal logging (Putz et. al. 2008), and (iii) the limitations of global remote sensing analyses in detecting degradation, we infer that emissions from tropical forest degradation represent at least 20 percent of total tropical forest emissions, the low end of the regional studies. While more research is needed to identify a single value for the magnitude of degradation emissions, we are suggesting that the studies referenced by the IPCC (Nabuurs et al., 2007), reporting that degradation emissions represent less than 10 percent of forest emissions, are making a conservative underestimate.

Degradation as a Catalyst

Some forms of degradation may be responsible for additional emissions through a causal chain of events. For example, a common causal chain begins with logging, which (i) increases the likelihood of fire by leaving dead wood which is dried by sun exposure, (ii) increases the exposure of remaining trees to blow-down, and (iii) creates roads offering access to ranchers and farmers. Thus, while conventional logging is only directly responsible for emitting a portion of the total forest carbon stocks, it may increase the likelihood of additional emissions from other forms of degradation (e.g. fire, storms) and conversion (e.g. pasture, agriculture) (Figure 2). The extent to which a degradation event actually *causes* subsequent degradation and deforestation in a given location is complicated by both the role of other drivers, and the elasticity of demand for forest products and/or cleared land. For this reason, it is usually safer to derive the magnitude of emissions from degradation only from the emissions directly associated with degradation activities (as done in the above section). Nevertheless, it is valuable to consider the extent to which degradation acts as a catalyst in a larger forest transition process, and thus may offer opportunities for transforming those forest transition processes. We review here studies that consider these forest transition relationships.

Selective logging was found to damage up to 50 percent of the leaf canopy (Uhl & Vieira, 1989) and increase forest susceptibility to fire (Uhl & Kauffman, 1990; Holdsworth & Uhl, 1997). Fire then increases susceptibility to further burning in a positive feedback by killing trees, opening the canopy and increasing solar penetration to the forest floor, and increasing the cover of grasses that typically succeed fire and further increase the likelihood of fire (Nepstad et al., 1995; Nepstad et al., 1999; Nepstad et al., 2001; Cochrane & Schulze, 1999; Cochrane et al., 1999; Alencar et al., 2004; Blate 2005).

Selective logging also can catalyze fire use and deforestation by creating road access to unoccupied and protected lands (Veríssimo et al., 1995). Roads have been identified as a strong predictor of frontier expansion and accompanying deforestation and degradation in a variety of tropical forest regions. More than two-thirds of Amazon deforestation has taken place within 50km of major paved highways (Nepstad et al., 2001). Harris et al. (2008) identified various indicators of accessibility, including roads, as the leading predictors of deforestation spatial patterns in East Kalimantan, Indonesia. As paved roads expand into untouched forests, there is a higher likelihood of degradation because it gives access to logging communities and other resource exploitation. Logging creates additional labyrinths of forest roads that then allow further access deeper into forests (Laurance, 1999). This improved access may trigger emergent human pressures, including gold mining, massive immigration, illegal hunting, illegal logging, and land squatting and/or slash and burn agriculture.

Deforestation can also catalyze degradation. Tree mortality and forest flammability are higher along forest edges (Balch et al., 2008; Blate 2005; Laurance et al., 1997; Alencar et al., 2004), a phenomenon called "edge effects." As a result, the methods used to clear forests for crops and/ or cattle ranching often have unintended destructive effects to adjacent forests. Sometimes, when farmers use fire to clear fields or manage their land, the fires escape beyond their intended boundaries (Ganz & Moore, 2002; Ganz 2001). These unwanted fires may also give local communities or commercial operators access rights to the timber as part of salvage operations.

CHAPTER THREE

Carbon Accounting Methods for Degradation

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SUMMARY FOR POLICY & PRACTICE

» New methods for detecting major forms of degradation (selective logging and partial canopy fires) using free satellite imagery allow for affordable and credible measurement and monitoring of emissions from forest degradation.

» Carbon accounting programs should be designed to accommodate some distinct degradation accounting and verification recommendations associated with (i) mapping and monitoring degradation activities using remote sensing, (ii) plot measurements, (iii) modeling business as usual degradation processes, (iv) assessment of leakage and permanence, and (v) forest certification.

» Affordable remotely-sensed monitoring of the reduced emissions from improved forest management, as opposed to conventional logging, remains a challenge. Existing forest certification systems (e.g. Forest Stewardship Council (FSC)) employing ground-based auditing of specific logging practices offer a solution to this problem. We recommend integrating existing forest certification systems with carbon standards and associated methodologies. We also recommend further research to develop affordable remote sensing methods that offer the resolution necessary to detect reduced emissions from improved forest management.

» No approved voluntary forest carbon methodology is yet available to verify reduced emissions associated with reduced impact logging outside of the U.S., although some have been submitted for approval under the Voluntary Carbon Standard (VCS). We encourage the development and approval of such methodologies.

Forest carbon accounting for REDD projects seeking verified carbon credits on the voluntary market generally involves the following steps, each of which includes a series of distinct analyses or administrative processes, as listed in Figure 3:

1. *Scoping:* The location, strategies, and standards need to be determined at the beginning to establish that which will be accounted for, even though there may be adjustments after initial accounting information becomes available.
2. *Baseline*: The baseline, or reference emission level (REL), provides the expected business-as-usual (bau) level of emissions that is referenced for calculating emissions reductions resulting from REDD interventions.
3. *Additionality:* This is estimated as the difference between the baseline and the expected lower level of emissions after REDD interventions.
4. *Buffers & Discounts:* Adjustments are made to additionality based on estimates of leakage (re-location of carbon-emitting impacts elsewhere) and the size of set-aside buffers (insurance against unexpected events that damage forests after emissions reductions are verified).
5. *Monitoring, Reporting, and Validation (MRV-ante):* A project design document (PDD), reporting on steps 1-4 and the plan for monitoring outcomes, is developed as the basis for validation and registration of expected emissions reductions.
6. *Monitoring Reporting and Verification (MRV-post):* After interventions are made to reduce emissions, the actual emissions are monitored and reported. An independent third party must verify emissions reductions before they are certified and issued.

These accounting steps are used to generate Verified Emissions Reductions (VERs) that can be sold on the voluntary market, or retired. Generating REDD emissions reductions as part of an anticipated post-2012 climate treaty framework will likely involve similar steps. Though the accounting methods have yet to be determined, they will be influenced by both the larger scale at which compliance grade offsets will likely be generated, and the financial mechanism involved.

While many of these steps are essentially the same for deforestation as for degradation, there can be important differences resulting from distinct challenges of measuring and monitoring degradation. On the other hand, some aspects of accounting for degradation may be easier, as in the case of leakage and permanence.

Since a comprehensive discussion of forest carbon accounting methods already exists (GOFC-GOLD, 2009) we only highlight here some of the distinctive aspects of forest degradation carbon accounting: (i) measuring and monitoring change in the area of forest degraded (an element of steps 2 and 6), (ii) projecting business-as-usual degradation (step 2), (iii) methods for estimating emissions factors (step 2), (iv) analysis of leakage and permanence (step 4), and (v) monitoring and verification (step 6).

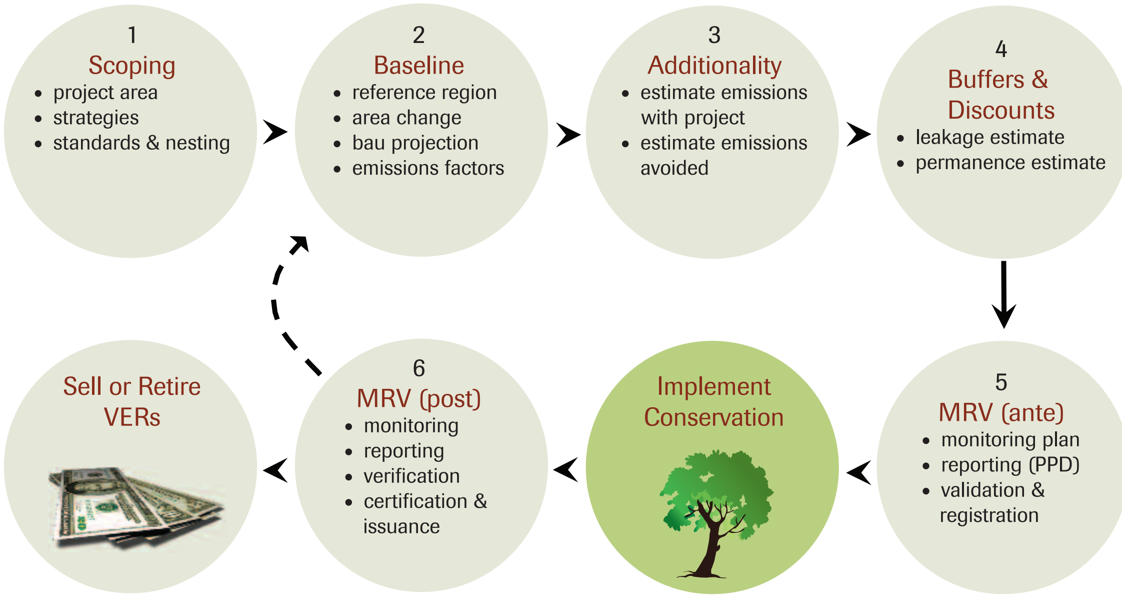

Figure 3. Six steps of REDD forest carbon accounting. See description of these steps in the text for explanation of terms and acronyms.

Baseline

AREA CHANGE—MEASURING CHANGES IN LAND COVER

The advent of remote sensing technology and analysis methods over the past few decades has dramatically reduced the cost of measuring the change in the area of forest that is converted or subject to major forms of forest degradation. It has also allowed measurements of deforestation and degradation area to be made consistently at national and global scales. Forest degradation has posed a greater remote-sensing measurement challenge (and thus, cost effectiveness challenge) simply because the impacts to the forest canopy from partial disturbance are by definition less dramatic and harder to detect than removal of the forest canopy. Selective logging, where only some of the trees in a forest are harvested, is the most common form of logging in tropical forests and was previously considered invisible to Landsat and other standard forest monitoring satellites (Laurence and Fearnside, 1999). Nevertheless, sophisticated methods of satellite imagery analysis have been developed by Asner et al. (2005) (Figure 1) and Souza et al. (2005a) that allow detection of selective logging using free Landsat data (Figure 4). These methods have revolutionized the feasibility of affordably measuring and monitoring major forms of degradation (Curran et al., 2006). The Carnegie Landsat Analysis System (CLAS) (Asner et al., 2005) has been automated to require minimal geospatial analytical expertise, and is expected to become freely available to non-profit organizations for use in an initial set of neotropical countries. The Souza et al. (2005a) method is able to detect both selective logging and associated forest degrading fire. However, there are limitations to these advances, including:

- Imagery must be analyzed at relatively frequent intervals since regeneration of the forest canopy may make degradation difficult to detect a year or two after an impact (despite longer term impacts on carbon stocks). This phenomenon is demonstrated in Figure 4.
- Cost-effective remote sensing methods to detect other forms of degradation, such as small-scale fuelwood collection, have not yet been developed.

Even more sophisticated remote sensing technologies are being developed, as well as methodologies for remote measurement of forest biomass (e.g. using LIDAR), and remote monitoring of individual tree canopy impacts (e.g. with IKONOS) (GOFC-GOLD, 2009, Souza et al., 2005b). The advance of these methods suggest that the remaining technical limitations to high accuracy degradation accounting may be resolved soon. While these advanced technologies are currently too expensive for most non-Annex I national-scale accounting systems, costs are declining rapidly.

"BUSINESS AS USUAL" PROJECTION OF AREA CHANGE

In order to establish a baseline, various methods can be used to estimate a "business as usual" rate of transition from one vegetation cover type to another (e.g. intact forest to non-forest) based on historical rates. The simplest approach assumes that the mean historic rate will be the future rate. At the other end of the spectrum, the most complex approaches involve data on various drivers of forest transition and characteristics of landscape vulnerability, entered into sophisticated computer models that project transitions as spatially explicit future landscapes (e.g. see Harris et al., 2008). The latest computer

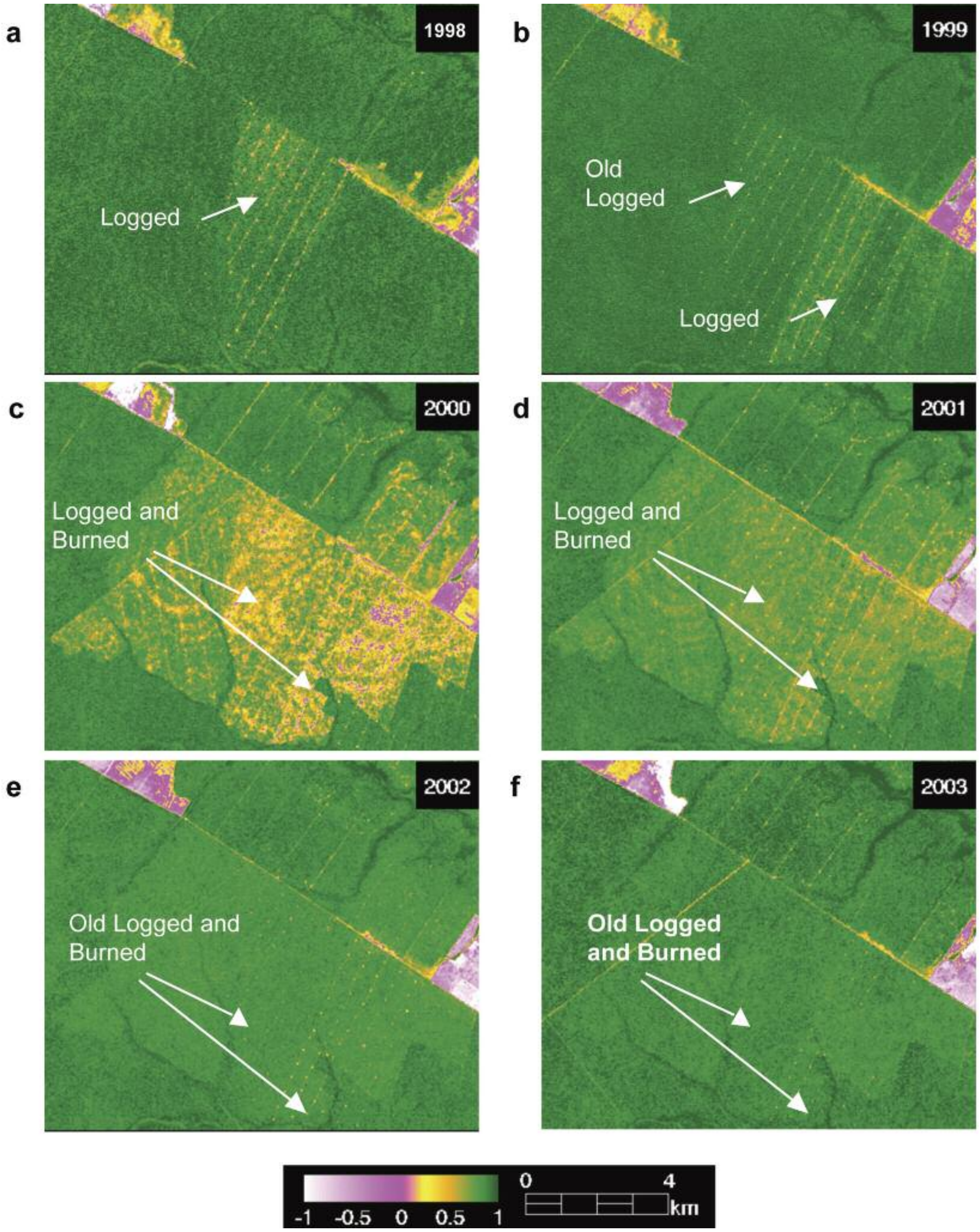

Figure 4. Time-series of Landsat images enhanced to detect degradation from logging and fire using NDFI (Normalized Differencing Fraction Index) in Sinop, Mato Grosso, Brazil. The NDFI degradation signal (yellow to orange colors) change within one to two years. Dark green colors are forests undamaged by selective logging and/or burning (NDFI values >0.75). Orange to yellow colors indicate a range of forest canopy damage (0 > NDFI < 0.75). Areas in white have negative NDFI values (<50% of GV) and represent bare soil. This figure is reproduced from the original, with permission from the authors, in Souza et. al. (2005a).

models (e.g. Land Change Model, SimAmazonia) allow multiple transitions to be modeled, such that both degradation and deforestation transitions can be modeled at once. However, while various examples of modeling deforestation have been tested and compared (Brown et al., 2007), less precedent exists for reliably modeling spatially explicit patterns of forest degradation resulting from logging, fire, and fuelwood harvest. A notable exception is modeling in the Brazilian Amazon region (Nepstad et. al. 1999; Nepstad et. al. 2008) that is now incorporating degradation by logging and fire into the SimAmazonia model. More research is needed on development and comparison of methods for such spatially explicit degradation modeling across a variety of regions. Until this is available, it may be prudent to use non-spatially explicit analyses to project expected business-as-usual degradation emissions in areas outside of the Brazilian Amazon region.[5]

EMISSIONS FACTORS

The amount of carbon emitted for each unit area of forest converted or degraded is called an "emission factor." Emission factors can be determined either by (i) calculating the difference between terrestrial carbon stocks before and after the change (Stock-Difference method), or (ii) by directly measuring the carbon pools that are emitted (Gain-Loss method), as described in the *Sourcebook of Methods and Procedures for Monitoring, Measuring and Reporting* (GOFC-GOLD 2009). In the case of logging emissions, the "Stock-Difference" method can be difficult to use because the natural spatial variability of carbon stocks within intact forests may be higher than the emissions per unit area from logging. In these situations, the Gain-Loss method can be used to generate more cost effective emissions factors with acceptable accuracy. To do this, field measurements are taken during or soon after logging activity so that direct measurements can be made of the biomass of harvested trees (including roots, branches, and leaves), roundwood (logs transported offsite), and collateral damage to surrounding forest from harvesting operations. These time-sensitive field plot measurements can be scaled up by associating emissions per gap in the canopy caused by tree harvest, and mapping the occurrence of canopy gaps using very high resolution aerial imagery (Brown et al., 2000; Stanley 2009).

Buffers and Discounts

While most aspects of forest degradation carbon accounting are more challenging than for deforestation, under some circumstances accounting for buffers and discounts may be easier. Accounting for buffers or deductions associated with leakage and permanence is conceptually the same for degradation as for deforestation. However, leakage and permanence analyses may be either complicated by the complexity of degradation processes, and/or simplified by the absence of leakage and permanence concerns for some degradation strategies. For example, leakage should not occur when emissions are reduced per unit volume of timber harvested. Emissions reductions can be made per unit volume of timber harvested by reducing collateral damage of logging operations and increasing the efficiency of harvesting and processing (see next chapter, IFM strategy). Leakage would not need to be assessed if emissions reductions are achieved without reducing the volume and quality of timber brought to market. Also, improved forest timber harvest and management practices often reduce the risk of subsequent emissions from fire, tree blow-down, or illegal logging (Hughell and Butterfield, 2008; Putz et al., 2008). Similarly, fire management practices that avoid annual emissions while also reducing the risk of unexpected fire (e.g. Holdsworth & Uhl, 1997) may have no leakage and require no permanence buffer.

On the other hand, when leakage and permanence issues cannot be ignored, sophisticated analysis may be necessary. For example, Sohngen and Brown (2004) found that estimating leakage from stopping commercial timber harvest in Bolivia (see Noel Kempff case study, chapter 6) is sensitive to both market demand elasticity and wood decomposition rates.

Monitoring and Verification

The new methods for detecting selective logging with Landsat imagery, described in the baseline section above, offer affordable monitoring of legal and illegal logging, and associated fire. However, these methods may not have the resolution to differentiate between conventional logging and improved logging practices; thus these methods may not be able to be used for remote monitoring of improved forest management practices that generate emissions reductions per unit area logged. Forest certification systems involving on-the-ground auditing, such as the Forest Stewardship Council (FSC), could be employed to verify that a specific set of improved logging practices have been implemented, such that lower emissions associated with those practices can be applied to specific areas being logged. Higher resolution technologies may soon offer options for remote monitoring of improved logging practices, either in combination with forest certification or as an alternative; however, studies are necessary to further develop these methods.

[5] This point was based on conversation with Dr. Sandra Brown of Winrock International.

CHAPTER FOUR

Strategies for Reducing Degradation Emissions

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We discuss here some of the important strategies that exist for reducing emissions from the three major causes of forest degradation described in chapter 3: logging, fire, and fuelwood collection.

Forest sector governance and community-based forest management are umbrella issues that are relevant to all forest management strategies. While a comprehensive review of forest governance and community-based forest management is beyond the scope of this chapter, we consider some of the key factors in Boxes Two and Three.

Improved Forest Management with Forest Certification

SUMMARY FOR POLICY & PRACTICE

» The combination of three elements often associated with Forest Stewardship Council (FSC) certification: (1) reduced area logged, (2) reduced emissions within logged areas, and (3) reduced probability of subsequent forest conversion, suggests that FSC certification offers an opportunity to generate significant reduced forest carbon emissions.

» There is clear opportunity for additionality in expanding forest certification, given that 99 percent of production forests in the tropics are not FSC certified, and more broadly defined "improved forest management" is only practiced in five percent of tropical production forests.

» Additional research to specifically compare emissions from FSC-certified concessions vs. conventionally logged concessions, and analyze additional emissions-reduction practices, will be necessary to quantify the potential emissions reductions generated by FSC and other practices.approval of such methodologies.

Natural forest management, carried out in accordance with rigorous certification standards, typically exceeds the legal requirements for social and environmental performance in all tropical countries and almost all developed countries. Forest certification offers pre-existing systems for measuring, monitoring, reporting, and verifying reduced forest degradation as associated with logging and some other forest products.

Major existing forest certification systems are not explicitly designed to reduce carbon emissions; however they are designed around goals of maintenance or enhancement of high conservation values, sustainable harvest levels, appropriate silvicultural practices, and ecological integrity that are often (although not always) associated with reduced carbon emissions. However, despite significant recent market share growth, certified wood products only make up about 10 percent of global forest products markets, and just a fraction comes from tropical forest countries. Less than one percent of total tropical forest area is under certified forest management (Siry et al., 2005).

CLIMATE BENEFITS AS A RESULT OF FSC CERTIFICATION

Although there are numerous certification systems in existence, the Forest Stewardship Council (FSC) is addressed here given that it is the leading forest certification standard of international scope with the widest engagement of economic, social and environmental stakeholders worldwide. Since its founding assembly in 1993, the FSC has advanced performance and system-based criteria and indicators to assess the quality of forest management globally.

The climate benefits of FSC certification have only begun to be measured and monitored. Existing studies on the impacts of certification and practices associated with certification indicate that they result in climate benefits. In this section, we highlight the natural forest management practices recognized by certification and review existing studies demonstrating (or suggesting) the existence of forest carbon benefits associated with those practices.

Within regionally specific criteria and indicators, the FSC raises the threshold for performance with respect to harvesting impacts and intensity levels, identification and implementation of conservation areas, and resolution of land tenure and other social tensions linked to forest management outcomes. Across this range of issues addressed by FSC criteria and indicators, we differentiate between two categories of forest carbon benefits:

- *Direct climate benefit activities* from forest certification*:* Activities undertaken within the forest management unit, by the forest manager, with a resulting change on factors mostly or entirely under the control of the manager. These activities, such as reduced impact logging practices or increased area of protected forest, often generate more predictable and direct, near-term carbon benefits. The primary types of these activities are:
  1. Reduction of impacts from harvesting.
  2. Increased forest area that is protected and restored.
  3. Reduction in the harvest level (volume).

- *Indirect climate benefit activities* from forest certification: Activities engaged in by the forest manager, which can lead to a behavior change amongst potential drivers of degradation, or can encourage preventative or protective measures that may conserve more forest. These activities, such as res-

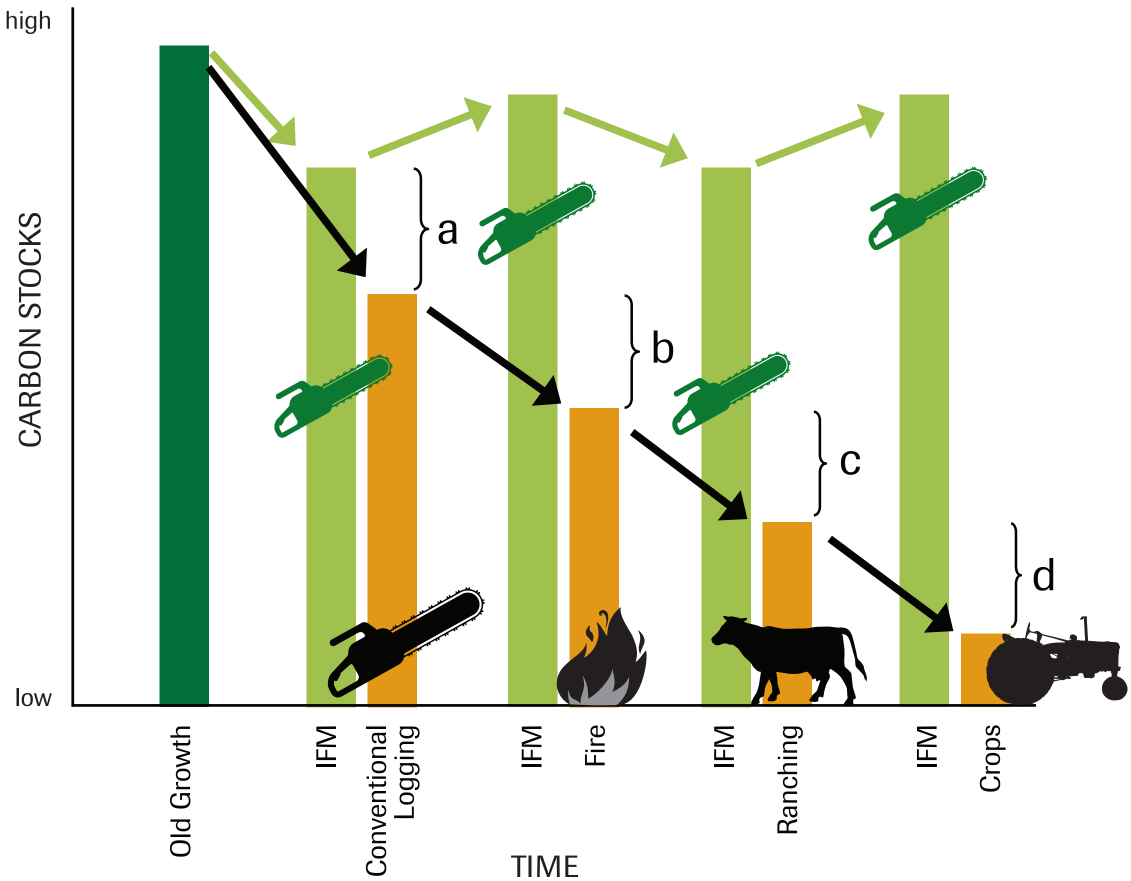

Figure 5. Carbon benefits of forest certification usually consider the immediate emissions avoided, depicted above as term "a," due to reduced impact logging practices, and protection of sensitive areas (e.g. riparian zones, High Conservation Value Forest zones). Additional carbon benefit can occur, due to reduced probability of fire and conversion, depicted by terms "b", "c", and "d", for reasons described in the text.

olution of social conflicts, may have less predictable climate outcomes; however, they could have the potential to generate large carbon benefits over the long term. The primary types of these activities are:

1. Land tenure resolution.
2. Measures to prevent unauthorized activities and fire.
3. Long-term commitment to management of land as forest.
4. Greater market access and product prices, resulting in higher incentive to maintain forest as forest.

A conceptual diagram of the direct and indirect carbon benefits associated with forest certification is shown in Figure 5. In the next section, we discuss each of these direct and indirect activities, review studies on potential carbon benefits where available, and reference examples from case studies.

DIRECT CARBON BENEFITS FROM CERTIFIED FOREST MANAGEMENT

1. ***Reduction of impacts from harvesting:*** Certified forest practices in the tropics have followed Reduced Impact Logging (RIL) as the operational harvesting method rather than conventional logging practices. RIL is an established set of timber harvesting practices designed to reduce the typical collateral damage resulting from timber extraction, in terms of (i) non-target trees damaged per unit volume roundwood extracted and (ii) soil erosion and related hydrologic impacts. RIL practices also may reduce the volume of timber extracted per unit area as discussed below. RIL practices specified within certification include the following:

- Additional training and incentive systems for logging and skidding (log removal) teams.
- Technical training on map production and interpretation.
- Cutting block layout and tree-marking prior to opening roads.
- Reduced skid trail/road density.
- Directional felling (cutting trees so that they fall away from standing trees to avoid damaging them).
- Cable winching of felled trees (extracting logs via cables attached to a tractor).
- Utilization of standards and procedures to optimize wood use by limiting felling damage and log waste (improved efficiency).

- Special procedures for logging steep areas that are prone to erosion problems.
- Procedures for road or skid trail construction, maintenance, and closure.
- Minimization of impacts on watercourses.
- Post-harvest evaluation.

For example, between 2000 and 2006 all certification assessments by Rainforest Alliance in Indonesia required that forest operations adopt RIL practices as a condition of compliance. These operations followed practices to achieve less site degradation, such as soil disturbance from skid trails, less damage to residual trees, and reduced waste from improved felling.

Since the early 1990s, it has been suggested that payments for additional carbon sequestration or emissions reductions could provide incentive to practice RIL, based on studies identifying a potential to enhance carbon storage in comparison with conventional logging. Studies in both the neotropics (Central & South America) and old-world tropics (Africa, Asia) indicate that RIL methods directly decrease carbon emissions by about 30 percent to 50 percent per unit of wood extracted (Healey et al., 2000, Bertault 1997, Durst and Enters, 2001; Pereira et al., 2002; Keller et al., 2004) based on metrics like residual tree damage and area logged. The direct measurement of carbon benefits from RIL have been less well studied. A study in Sabah, Malaysia by Pinard and Putz (1997), found that RIL resulted in 43 percent lower committed emissions as compared to conventional logging. Higher carbon storage resulted from reduced total volume of trees removed, reduced damage to the residual stand, and how well the forest responded to the canopy openings created (Pinard and Putz, 1996). These are the same variables that certified forests are expected to manage and monitor.

Putz et al., (2008) estimate that the potential emissions reductions through reduced impact logging in tropical forests represent at least 10 percent of possible reductions from avoiding tropical deforestation. This estimate does not include the additional emissions potentially avoided by other practices associated with FSC certification discussed above. An advantage of the carbon benefits from reduced impact logging is little or no leakage, since the emissions reductions are largely achieved without reducing the volume of timber extracted, and thus do not have a high risk of shifting production to other locations.

Most studies report negative (Durst & Enters, 2001; Holmes et al., 2002), or low ($3-$4 per ton) (Putz & Pinard, 1993) cost of potential carbon offsets from RIL, with one notable exception ($40 per ton) (Healey, Prince, & Tay, 2000). At least part of this range of estimates can be attributed to inherent differences in logging constraints among regions. For example, where substantial portions of marketable timber occur on steep slopes or wet ground, there are bigger opportunity costs to RIL (Putz et al., 2000). Nevertheless, the very limited occurrence of RIL in tropical forests (Siry et al., 2005) suggests that in reality these potential cost savings are not enough to overcome the barriers to adopting RIL (e.g. initial capital investments, availability of training, and business culture of logging operations).

2. ***Increased forest area that is protected and restored:*** Certified forests also retain more biomass through greater provision of conservation zones with higher forest protection status (see FSC Principles 6.2, 6.4, and 9)[6] , such as special management buffer zones along rivers and streams (P6.5), areas of protected High Conservation Value Forests (HCVF), and areas for forest restoration (P6.3; P10.5). Maintaining and enhancing HCVFs is mandated through FSC Principle 9.

A study of the impacts of FSC certification analyzed 129 out of 234 operations certified in 21 countries by the Rainforest Alliance as of October 2003. The most common positive environmental changes produced through certification related to conservation management. For example, of the certified forests studied, 63 percent showed improved riparian and aquatic management, while 62 percent had improved treatment of sensitive sites and HCVFs (Newsom and Hewitt 2005). More recently, in a review of 118 FSC-certified forests within its SmartWood Program, the Rainforest Alliance found that on average, certified operations designated 22,000 hectares, or 22 percent of their total area, as HCVFs. The total HCVF land in these forests from 2007 to 2008 was 2.5 million hectares (Newsom, 2009). This area is approximately the size of the state of Vermont and equates to carbon sequestration above what would have been expected had these forests been logged.

3. ***Reduction in harvest level (volume):*** FSC-certified tropical forests often, but not always, harvest lower mean volumes of roundwood (logs transported offsite) per unit area as compared with conventionally logged forests. This is primarily due to the FSC requirement that the volume of timber extracted during a given cycle, and the frequency of cutting cycles, represents a yield that can be sustained over time.

In the tropics, harvesting at levels that represent a sustainable yield is the exception rather than the rule. Without effective management planning and control, opportunistic harvesting leads to logging on accelerated, intensive time-frames that are more aggressive than can be sustained. Such repeated timber extraction on short intervals causes forest degradation, akin to mining of a non-renewable resource (Applegate, 2001).

[6] FSC has developed a set of Principles and Criteria for forest management that are applicable to all FSC-certified forests throughout the world. There are 10 principles and 57 criteria that address legal issues, indigenous rights, labor rights, multiple benefits and environmental impacts surrounding forest management. The Principles and Criteria were last updated in 2000. We reference (in parentheses) specific Principles and Criteria where relevant in the main text, and we will use "P" to denote an FSC Principle.

A common non-certified scenario is for re-entry logging on 10- to 15-year cycles, rather than adherence to longer-term harvest cycles, which causes a decline in living biomass, lack of seed source for regeneration of timber species (often representing species that attain large size) and a decline in carbon storage through conventional commercial logging (Applegate, 2001).

In contrast with these conventional practices in the tropics, FSC-certified forests are required to practice sustainable harvest over the long term, and assess sustainable harvest by systematic inventories and growth monitoring (P5.6). This sustainable harvest often translates to lower volume removals at less frequent cycles (i.e., 30- to 60-year) with longer-term planning horizons as compared with conventional logging. In some cases greater volumes are extracted per unit area at the scale of harvest blocks (although rarely at the scale of logging concessions) in order to increase light levels for regeneration of marketable species. Certified forests typically retain biological legacies in terms of large, mature trees retained for seed dispersal or wildlife habitat.

The extent of volume reduction at the concession level, and harvesting intensity at the harvest block scale, varies by region depending upon the status of conventional practice, market drivers, local capacity for logging, the natural density of marketable timber, and regeneration dynamics of marketable species, among other variables. One study at Deramakot Forest Reserve in Sabah, Malaysia, showed the possibility of higher carbon stock after FSC certification than was present under historic non-certified logging (Kitayama 2008). The mean carbon in above-ground vegetation was estimated to be 156 tC/ha ± 18 tC/ha in Deramakot where Reduced Impact Logging is practiced (a reduced annual allowable cut of <20,000m3/yr), and it was 123 tC/ha ± 11 tC/ha in a neighboring conventionally logged forest (Kitayama 2008).

INDIRECT CARBON BENEFITS FROM FOREST CERTIFICATION

Substantially more carbon benefits from FSC certification would likely be identified if indirect benefits that reduce the probability of additional forest degradation and/or conversion are considered (Gerwing, 2002; Pinard and Putz, 1997; Holdsworth & Uhl, 1997).

Logging in tropical forests often acts as a catalyst for subsequent forest conversion, as discussed in chapter 2 above. Various practices involved with FSC offer indirect carbon benefits by decoupling the link between logging and further degradation or conversion.

1. ***Tenure resolution.*** Managers of certified forests strive to address social conflicts that often may lead to degradation, such as tenure disputes and land claims. Certified forest managers are required to use mechanisms to resolve disputes among forest stakeholders (FSC P2.3; P3.1; P3.2; P3.3;). Certified concessions are expected to follow processes that include working with neighboring concessions, local communities, and government officials, to complete the delineation of concession boundaries. As this may be a source of dispute, certification authorities would expect managers and local communities to delineate traditional and customary lands (areas with special use rights) in a participatory manner. In the FSC certification audit report, the Sumalindo concession (SLJ2) was found to have minimized the conflict between Indonesian laws and regulations and FSC Principles 2 & 3 by actively consulting local communities in definition of traditional "adat" lands (Rainforest Alliance, 2006).

2. ***Measures to prevent unauthorized activities and fire.*** Certified forests are required to implement and monitor management systems and training programs (P 7.1, 7.3, 8.1, 8.2) which reduce the impacts from unauthorized encroachment and extraction, illegal logging, or from wildfire and pest/disease outbreak (P 1.5, 7.1). In addition to these measures, reduced impact logging associated with certification reduces the probability of fire by decreasing the quantity of lying dead wood that can fuel fires and reducing openings in the canopy cover that result in drying of this fuel (Gerwing, 2002; Holdsworth & Uhl, 1997).

FSC-certified community managed logging concessions in the multiple use zone of the Maya Biosphere Reserve have 20 times lower rates of deforestation than strictly protected core protected areas. These FSC-certified logging concessions also had lower rates of fire than elsewhere in the Peten province of Guatemala (Hughell and Butterfield 2008). Analysis of the management plans for these community forest concessions shows that harvesting lightly impacts about 70 percent of the area, with an average removal of only 1.5 trees per hectare. The remaining area (about 30 percent) is under strict conservation, with monitoring and fire prevention offering better safeguards from emissions than in surrounding protected areas.

3. ***Long-term commitment to management of land as forest*:** FSC requirements result in a longer-term commitment to forest management including:

a. restrictions barring certified managers from converting natural forests to plantations,
b. requirements to maintain sustainable (longer) rotation cycles (as discussed above) that subsequently generate sustained timber income over the long term,
c. better market access and product prices,
d. improved tenure, encouraging long-term planning and investment.

4. ***Greater market access and product prices, resulting in higher incentive to maintain forest as forest.*** The last three issues (b, c, and d) create higher incentives to manage and maintain forest as forest over the long term. The primary incentives to achieve certification—market access and better prices—also increase the likelihood that long-term timber management is a successful

business venture, and competitive with land use options that require land conversion. Where high-value timber has FSC certification, price premiums have been obtained. For example, in the province of Berau, Indonesia, concession owners report that prices for FSC-certified timber are double that of prices for non-certified timber, due to access to European markets which are increasingly selective. A comparison of bid prices offered for FSC-certified timber by FSC chain-of-custody certified buyers and non-certified buyers showed that the Pennsylvania Bureau of Forestry received an extra $7.7 million between 2001 and 2006 due to its FSC-certified status (Rainforest Alliance, In Press).

box two » **forest sector governance**

High rates of deforestation and forest degradation throughout the tropics and in specific temperate regions can be directly linked to inadequacies or outright failures in the governance of forests. Governance in this instance refers to the performance of public agencies in developing and implementing operational policies within a defined legal framework in pursuit of national goals for forest management. The quality of forest governance is shaped by a variety of inter-related factors. The most significant of these factors, and associated attributes of success, are as follows:

Administrative Capacity: Government agencies charged with developing and implementing forest policy often lack the human, technical, and financial resources required for effective management. Decentralization of responsibility to lower levels of government has, in many cases, increased the capacity gap between public agencies and the private sector or quasi-government firms they are charged with regulating. *Public agencies need enhanced technical and managerial capacities as well as the internal structures to vet and implement decisions, to access and manage information and to insulate themselves from political interference.*

Institutional Relationships: In some cases, competition exists at the national and/or sub-national level between agencies claiming jurisdiction or executive authority over forest resources. In other instances, the decisions of other ministries may have a cross-sectoral impact on forests. Decentralization processes have increased the number of agencies with a direct or indirect role in forest management. *Greater clarity around decision-making, oversight, approval and enforcement processes between and within different levels of government is required.*

Legal and Policy Regime: As legal instruments pertaining to the management of forests have evolved over the years they have often become confusing and/or contradictory. The opaque nature of the legal and policy environment in many countries presents challenges for land managers seeking regulatory compliance while encouraging corruption. *The combination of legal instruments needs to clearly articulate required processes for accessing forest resources, planning for the use of those resources and managing, harvesting and marketing those resources. Penalties for non-compliance need to create an adequate deterrent to circumvention of the law.*

Land Tenure Status: While national and/or sub-national levels of government may claim authority over forest resources, in some places these statements have long been challenged by indigenous and other communities based on traditional rights. The lack of formal recognition of these rights in some forest nations perpetuates uncertainty and conflicts in the forest which can, in turn, accelerate deforestation and forest degradation rates. *Efforts to codify and honor the roles, rights and responsibilities of communities vis-à-vis government agencies and commercial enterprises can create positive outcomes for the forest, stabilize and secure livelihoods and produce a national consensus on goals for forestland management.*

The attributes of a nation's forest governance regime are complex and intertwined. As such, governments are often unwilling or unable to address core, or even peripheral, forest management issues, as political and financial realities favor adherence to the status quo. Including REDD in an international carbon emissions framework has the potential to fundamentally improve forest sector governance by changing incentive structures and improving transparency. These changes are absolutely essential if we are to collectively reduce deforestation and forest degradation rates at a meaningful scale.

Fire Management

SUMMARY FOR POLICY & PRACTICE

» Integrated Fire Management offers a comprehensive framework for planning fire management strategies to reduce emissions and reduce the risk of non-permanence.

» National-scale Reducing Emissions from Deforestation and Degradation (REDD) programs should consider fire management as an integral part of REDD initiatives, given the magnitude of emissions in both fire-dependant and fire-sensitive systems, the availability of a comprehensive framework of Integrated Fire Management and the range of co-benefits at stake.

» REDD initiatives that incorporate fire management approaches should recognize the distinctions between fire-sensitive and fire-dependent ecosystems.

» In fire-sensitive systems, it is often difficult to assess the additionality of fire management. A stronger precedent exists for assessing additionality of fire management in fire-dependent systems. In those systems where methods are not yet available for quantifying fire management additionality, fire management can be pursued as a strategy for reducing the risk of non-permanence of REDD offsets.

A Reducing Emissions from Deforestation and Degradation (REDD) mechanism will need to recognize that some forest ecosystems have evolved positively in response to frequent fires from natural and human causes while others are negatively affected. There are two types of fire ecosystems for REDD practitioners and policymakers to consider: (i) those systems that are negatively affected by fire, also known as fire-sensitive systems, and (ii) those that cannot persist for long without the right kind of fire, known as fire-dependant systems. Previous work by the Global Fire Assessment (Figure 6) indicates that fire-dependent ecoregions cover 53 percent of global terrestrial area; fire-sensitive ecoregions cover 22 percent; and fire-independent ecoregions cover 15 percent (Shlisky et al. 2007).

Fire-sensitive ecosystems developed in the absence of fire and can be destroyed when fire becomes too frequent, too intense, or too widespread. These ecosystems warrant a REDD strategy that protects the resource from fire, and allows for carbon stocks to continue to grow in the absence of fire.

In contrast, the maintenance of carbon stocks and ecosystem integrity in fire-dependant ecosystems involves maintenance of an ecologically appropriate fire regime which may involve intentionally setting controlled fires and planning for and managing wildfires. An ecologically appropriate fire regime is one that maintains the role that fire normally plays in an ecosystem of a given landscape to maintain desired structure, function, products and services.

Integrated Fire Management[7] is a comprehensive framework for managing fire, and emissions from fire, in both fire-sensitive ecosystems and fire-dependent ecosystems.

This framework involves a series of steps including (i) assessment and analysis of context, (ii) definition of fire management goals and desired ecosystem condition, (iii) assessment of laws, policy and institutional framework, (iv) fire prevention and education, (v) fire preparedness and response, (vi) ecosystem restoration, recovery and maintenance, (vii) adaptive management, research and information transfer and (viii) promotion of secure land tenure and community based solutions. Land tenure issues are as critical to successful fire management as they are to other land management issues (such as the timber management issues discussed above). Landholders tend to avoid the use of fire as a land management tool and invest more in the prevention of accidental fire, subsequently accumulating fire-sensitive species on their properties (Nepstad et al., 2001).

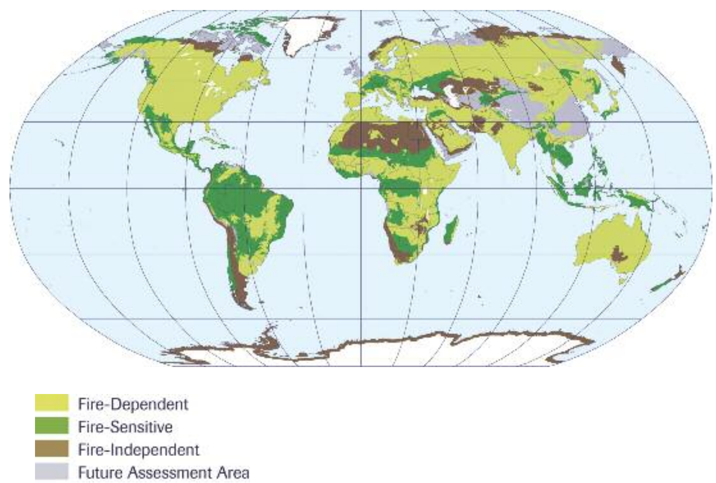

Figure 6. Global Distribution of Fire Regime Types. This figure is reproduced, with the permission of the authors, from Shlisky et al. (2007).

FIRE-SENSITIVE ECOSYSTEMS

Recent reports of fire emissions in fire-sensitive tropical forest systems are alarming and highlight the importance of fire management strategies to protect investments in REDD (Schultz et al. 2008; Yokelson et al., 2008; Van Der Werf et al., 2003). During the 1997-1998 El Nino-Southern Oscillation (ENSO) event,[8] severe drought caused normally moist woody debris to dry out in forests of Indonesia. The fires that resulted elevated

[7] We use this term as it is defined by The Nature Conservancy and the Food and Agriculture Organization's Voluntary Fire Management Guidelines (2006).

[8] El Niño is a major warming of the equatorial waters in the Pacific Ocean. El Niño events usually occur every 3 to 7 years, and are characterized by shifts in "normal" weather patterns.

Indonesia to one of the largest carbon emitters in the world (Asian Development Bank [ADB], 1999; Schweithelm, 1999; Barber & Schweithelm, 2000). During the same 1998 El Nino episode that Indonesia experienced, the Brazilian Amazon experienced understory fires that affected an area of forest twice the size of annually deforested areas (Alencar et al., 2006). This ENSO episode killed trees with an amount of carbon (0.049-0.329 Pg) equivalent to that released each year through deforestation (0.2 Pg C/year) in the Brazilian Amazon (Alencar et al., 2006). Some climatologists believe that these anomalies will become more frequent as long as greenhouse gases continue to accumulate in the atmosphere (Trenberth & Hoar, 1997; Timmermann et al., 1999; Hansen et al., 2006). Forest understory fires are likely to play an even more important role in the future of fire within fire-sensitive ecosystems as more degraded forests interact with more extreme climate events (Balch et al., 2008).

The crux of the fire problem in fire-sensitive ecosystems is not so much the introduction of fire into these ecosystems but the frequency with which they are burned. Historical records and charcoal in soil profiles show that tropical forest fires, even in the wetter forests, are not unprecedented. Fire can be considered endemic in some areas, but occur in topical rainforests with intervals of hundreds if not thousands of years. Wetter forests burn less frequently but are more vulnerable to fire than drier forests because they have thinner protective layers of bark and suffer much higher mortality rates from fires. Periodic disturbances by fire in these ecosystems may also be important in favoring the reproduction and abundance of some important tropical timber species and maintaining biodiversity (Otterstrom and Schwarts 2006; Snook 1993).

Successful fire management strategies within an Integrated Fire Management framework engage the local stakeholders who are causing forest-degrading fires in fire-sensitive systems. Local communities are logical partners in fire suppression and management because they are at once the first line of attack and the most affected by unwanted fires (Ganz et al., 2007; Moore et al., 2002; Ganz et al., 2001). Such communities should be given incentives to provide logistical support for preventing escaped agricultural fires and putting out unwanted fires in a timely manner. Successful strategies establish plans and procedures linking local and regional fire fighting support for large fire suppression as a function of expected size, duration, and complexity. Mobilization of local communities is further enhanced by providing training in early detection, initial attack, and decentralized communications. As with fire suppression and management, local communities are logical partners for rehabilitating degraded landscapes and reducing fire susceptibility before conversion to agricultural or degraded non-forested lands.

FIRE-DEPENDENT ECOSYSTEMS

As with fire-sensitive systems, Integrated Fire Management offers a comprehensive framework for reducing emissions from fire in fire dependent ecosystems. The distinction for fire-dependent systems is that fire itself is used as a tool in fire management (Myers, 2006; FAO, 2006). It is well established that the complete exclusion of fires in fire-dependent systems often leads to increased scale and intensity of wildfires and their emissions (Myers, 2006; Liu, 2004; Piñol et al., 2005; Pollet & Omi, 2002; Agee & Skinner, 2005; Baeza et al., 2002; Grady & Hart, 2006; Perry, 1994; Stocks, 1991).

Fires set in the right place and at the right time can actually reduce carbon emissions over large landscapes (PSW, 2009; Nechodom et al., 2008; Narayan, 2007; Ganz et al., 2007) especially in savannas and in other forested systems where livelihoods have promoted a culture of anthropogenic fire (Myers, 2006). There are many forest and savanna/grassland ecosystems which have evolved positively in response to frequent fires from both natural and human causes, maintaining high biodiversity and a changing steady-state for low intensity disturbance regimes from fire. In the absence of fire, the ecosystem either changes to something else and species and habitats are lost, or, fuels build up, which increases the probability of intense wildfires that cause long-term damage to people and ecosystems. There are many places around the world where fire exclusion has created these dangerous conditions, including the Western United States, Australia, Africa and the Mediterranean.

Planned or wanted fires are sometimes referred to as "prescribed" or "controlled burnings" (Johnson, 1992). Typically the opportunities for reduced emissions through prescribed burning in non-Annex I countries (those that do not have binding emission reduction targets for the first period, 2008-2012, of the Kyoto Protocol) will be in fire-dependent savannas or woodlands where local communities have traditional knowledge of the uses of fire as well as incentives to burn early in the growing season. Ideally, these are places where such prescribed burning is also beneficial to biodiversity.

There is a potential to leverage millions or even billions of dollars from the emerging global carbon abatement offsets market to both improve fire management practices for the benefit of people and nature and prevent large-scale carbon emissions from wildfire. In one particular example from Northern Australia, ConocoPhillips is paying indigenous people from West Arnhem $850,000 per year for 17 years to light low-intensity fires early in the growing season, as they had traditionally done for millennia, resulting in fewer high-intensity late-season wildfires and subsequently reduced carbon emissions, estimated at 145,000 tCO_2e annually (see case study chapter 6).

Thus far, the majority of carbon abatement offsets in fire-dependant systems are voluntarily set up by Annex I countries (the countries, most of them industrialized, that have emission caps under the UNFCCC) where the capacity for accurate monitoring of emissions from fire is strong. Effective monitoring of fire emissions requires rigorous studies on seasonality, severity, fine scale satellite imagery of fire perimeters, fine scale mapping of above-ground vegetation, landscape level assessments of fuel types and accumulation rates and corresponding combustion rates under various intensity levels. Substantial improvements in measurement and monitoring of greenhouse gas emissions from fire will be necessary in most non-Annex I countries before fire management strategies to reduce forest degradation can generate compliance-grade emissions reductions offsets. Before rigorous measurement and monitoring of forest-degrading fire is achieved, fire management will be an important strategy for reducing risk of impermanence to REDD emissions offsets generated from other strategies.

FINANCIAL BENEFITS OF IMPLEMENTING FIRE STRATEGIES

High-intensity wildfires often lead to a loss of benefits for ecosystems and people, including, but not limited to, those associated with greenhouse gas emissions. The owners of large properties in Mato Grosso, Brazil report that undesired fires contribute at least $11,000 per year (per landholding) in lost cattle forage and fencing. Additional losses from fire include timber, wildlife, buildings, and livestock (Nepstad et al., 2001).

The value of such losses has been estimated by using either the replacement costs or the value of the market resources burned (Merlo & Croitoru, 2005) and may include lost income-generating capacity, lost recreation opportunities, airport closures, and degradation of ecosystem services such as clean water (ADB, 1999; Dunn, 2005). In the forest concessions of East Kalimantan, Indonesia, the loss of 23 million cubic meters of harvestable timber due to the 1997-1998 fires was estimated to be worth approximately US$2 billion dollars (Hinrichs, 2000). Economic costs were estimated at more than US$9.3 billion from the same fires (ADB, 1999; Barber & Schweithelm, 2000). Accounting for ecosystem goods and services is rarely comprehensive, but will be necessary if we are to understand the true costs of unwanted fire events and the impacts of long-term site degradation (Ganz, 2005). The quantification of greenhouse gas emissions is an important first step in such accounting, so that the appropriate incentives can be directed toward fire management.

Fuelwood Management

SUMMARY FOR POLICY & PRACTICE

» Fuelwood strategies that integrate agroforestry, community-based forest management, and/or improved forest management, where implemented properly with cultural sensitivities, offer promising opportunities for quantifiable emissions reductions.

» To address supply-side strategies like woodlot development that can provide an alternative to fuelwood gathering in intact forests, the devolution of forest management to local communities has proven to be effective, provided that communities are sufficiently empowered with strong institutional arrangements and sufficient resources to achieve sustainable outcomes.

Several strategies exist to alleviate the degradation of forests caused by fuelwood collection. As previously mentioned, the lack of reliable estimates on the extent of areas experiencing intensive fuelwood extraction in different habitat types is a serious constraint in projecting the extent to which fuelwood strategies could counter carbon emission from degradation. Nevertheless, it is clear that fuelwood collection is a major driver of forest degradation, particularly in Africa and Southeast Asia (Gaston et al. 2008, Houghton and Hackler 1999). Fuelwood strategies relevant to REDD may be classified under a variety of management approaches and improved cooking regimes, including:

1. Cook stoves—reducing the demand for charcoal and fuel wood through the introduction of efficient stoves, with associated benefits in energy efficiency and household air quality.

2. Community forestry—increasing the supply of fuelwood and decreasing the risk of forest fire by improving forest management and agroforestry, with associated benefits in agricultural productivity and forest products.

3. Reforestation and afforestation—rehabilitating degraded landscapes to sequester carbon while providing fuelwood and other forest products.

4. Wind-breaks and wind-rows—increasing fuelwood production at the margins of agricultural fields while increasing agricultural productivity and reducing the probability that agricultural fires escape into adjacent forests.

REDUCING FUELWOOD DEMAND WITH COOK STOVES

There has been growing interest in the use of improved efficiency cook stoves as a strategy to reduce greenhouse gas emissions. Academic studies have quantified the differences in emissions between traditional and improved stoves in both lab (Bertschi et al., 2003; Brocard et al., 1996; Pennise et al., 2001; Smith et al., 2000) and field settings (Johnson et al., 2008; Roden et al., 2006). However, estimates of emission reductions from household stoves are complicated by the difficulty of identifying the primary cause of emissions. It's not as easy as just comparing emissions from conventional fuelwood use with lower emissions from improved stoves, because some or all of fuelwood may be counted as part of emissions from other degradation or conversion activities (e.g. logging, clearing for pasture). Thus, net emission reductions usually depend on forest management as well as emissions from stoves.

Despite the challenges in linking household wood use with land cover changes, some carbon markets are accepting carbon offsets generated from substituting traditional stoves with improved ones. The Clean Development Mechanism (CDM) of the Kyoto Protocol has recently accepted two methodologies that cater to this type of project, after a long period in which improved stoves were not considered suited to CDM, because fuelwood itself was considered to be sustainable (i.e. that which was extracted was replaced via growth). Significant forest degradation and associated emissions due to fuelwood harvest in some areas, however, made the potential for emissions reductions from improved cook stove efficiency apparent. Despite this change, very few cooks stove projects have yet entered the CDM pipeline (Fenhann, 2008). In addition to that which was submitted to the CDM, a voluntary offset methodology has recently been accepted by the CDM Gold Standard, an organization that certifies carbon offset projects that maximize social and environmental co-benefits (ClimateCare, 2008). The fossil fuel sector has the potential to yield emission reductions with substantial co-benefits and revenue generated from the sale of offsets could assist with scale-up of improved efficiency cook stove projects, which often struggle to achieve widespread adoption.

In the case study chapter, we describe a cook stove program in Cambodia that reduces pressures from fuelwood collection. The Food and Agriculture Organizations' Rural Wood Energy Development Program (RWDP) has also evaluated the effectiveness of promoting highly energy efficient stoves to rural fuelwood users in Thailand, Laos, India, and China. In Laos, the Participatory Development and Training Center has been introducing highly efficient stoves at a rate of 15,000 per year. According to FAO, these stoves reduce fuel consumption by about 30 percent and are a valuable market commodity. Under these conditions, improved efficiency cook stoves can pay for themselves. Many of the users also appreciate the time saved for fuelwood collection which can be redirected to small-scale enterprise development. The carbon dioxide equivalent for these fuelwood savings in Laos are large enough to offset a five MW fossil fuel power plant (Rural Wood Energy Development Program 1999).

It is not clear whether the CDM or a future REDD mechanism would be the appropriate home for reduced degradation from improved efficiency cook stove projects. In theory, once an appropriate methodology was approved, this type of project would be eligible under UNFCCC Clean Development Mechanism: category Type II—Energy Efficiency Improvement Projects. Alternatively, given the direct and measurable benefits for reduced forest carbon emissions, this type of project could be housed under a future REDD mechanism.

INCREASING FUELWOOD SUPPLY

For many parts of the world, the obvious strategy to fuelwood scarcity is to plant trees, whether at the margins of agricultural systems (e.g. wind-rows, wind-breaks), integrated with agriculture (i.e. agroforestry systems), or as restoration of contiguous forests. In some cases this strategy coincides with the needs of communities that are dependent on wood for energy, such as Jatropha development in India, but that is not always the case. Planting and maintaining trees can be a time-consuming, labor-intensive process for local communities. People are unlikely to plant trees for fuelwood if alternative sources exist, such as crop residues. Similarly, if land can be put to more lucrative uses like cash crops, planting trees for firewood may be seen as 'burning money.' Tree planting as a response to wood scarcity is, in any case, complicated by local property institutions. In some places, property rights in trees and their products are separable from rights in the land on which the trees grow (Fortmann and Bruce, 1988). Planting trees may represent a claim of land ownership, and result in disputes. For example, in the Palestinian Authority and Israel, tree plantings are a primary driver in land-use conflicts. In addition, in many post-colonial societies there is a long history of land appropriations and forced evictions predicated on real or perceived environmental crises (Leach and Mearns, 1996). Thus, strategies for increasing wood supply through tree planting may be viewed with suspicion (Skutsch, 1983).

If a tree-planting strategy is introduced as a means of easing the pressure that demand for fuelwood puts on forests, it may be advocated through state-run, community, or farm/household-level forestry or agroforestry systems. Many state forestry institutions have a history of antagonistic relations with local communities (Castro and Nielsen, 2001; Skutsch, 2000). Nevertheless, some governments have successfully established woodlots or managed forests specifically for community wood production (FAO, 2003). However, establishing tree plantations is expensive, particularly when state bureaucracies are involved, and highly centralized state-run forests are not usually an economically feasible way to mitigate fuelwood scarcity.

On the other hand, if state-owned forests are already established (for example, in reserves established for timber production), the state can ease wood scarcity by allowing local communities access to dead wood, fallen trees, and pruned branches or by devolving a section of the forest to community control.

In contrast to state forestry approaches, Community Forest Management (CFM) and agroforestry systems are either partially or wholly vested in the community. Improved Forest Management (IFM) practices are designed to enhance the long-term value of forests to communities. Many variations of these community forests exist in different regions and ecological systems. The managed trees may be a section of natural forest, a plantation, a wind-row, wind-break or a woodlot. Land may be held in common, or it may lie on state-owned land with management responsibilities vested in the community. Fuelwood provision is one of many possible dimensions of CFM and IFM, but energy is rarely the sole purpose of establishing community control (except for the case of some biofuel crops). Some CFM arrangements limit communities to non-commercial/non-timber uses (e.g. rights to graze livestock, fish, hunt and extract a variety of forest products like food, medicine, leaves and thatch). Other community forestry systems vest commercial management rights in communities including the right to sell timber concessions or harvest timber commercially themselves, as in Mexico, Laos, and Vietnam (Bray et al., 2003; Sunderlin, 2006).

Wood scarcity can also be mitigated by tree planting at the household level. Smallholders throughout the developing world maintain wide varieties of trees on their own land (Chambers and Leach, 1989). The majority do so without outside assistance, though outside intervention can help to provide seeds or seedlings and technical advice. As with CFM, trees on farms are rarely used only as sources of fuelwood. Agroforestry systems, which integrate trees with cultivation and livestock systems, are particularly effective for maintaining trees on the homestead (Montagnini, 2006). Estimates of agroforestry alone are difficult to come by; however, the estimated carbon gain is projected at 0.72 Mg C per hectare per year with potential for sequestering 26 Tg C per year by 2010 and 586 Tg C per year by 2040 (Montagnini and Nair 2004; Watson et al. 2000).

In Guatemala, the conversion of degraded land to woodlots and permanent agriculture through agroforestry systems increased fuelwood supply and met most of the local fuelwood needs (Bryant et al., 1997). In this case, a CARE project established tree nurseries run by local farmers which later became self sufficient. It also increased fuelwood availability and agricultural productivity by providing trees. The agroforestry systems have persisted during years of political strife and uncertainty primarily because they involve local people as the primary stakeholders. The local farmers then adopted the project's techniques in areas beyond its boundaries by setting up their own tree nurseries, potentially increasing the amount of carbon sequestered (positive leakage) and providing a steady and sustainable supply of fuelwood. In this case, the methods of increasing fuelwood availability and agricultural productivity were widely reproducible, and the project sponsor had the mobility to work at the country level, ensuring that project benefits could be scaled up where appropriate (WRI, 1997).

box three » **community-based forest management**

Community-owned and managed forests comprise significant portions of a wide variety of forest ecosystems, constituting 11 percent of global forest cover (White and Martin, 2002). The worldwide amount of forest land under Community Forest Management (CFM) doubled between 1985 and 2000 (White and Martin, 2002) and is expected to continue increasing due to global attention to rural land tenure rights. By 2015, the percentage of forest land under CFM is expected to increase to 1.36 billion hectares or 22 percent of the world's forests (ITTO, 2007). In developing countries alone, 22 percent of the forest area is already under CFM (White and Martin 2002), nearly three times the area under private or corporate management. Due to the large and increasing footprint of CFM, strategies to avert degradation will require engagement with the people who live in these forests and the communities that own and manage them.

Limited existing data suggest that CFM outcomes — even in the absence of an existing REDD mechanism that supports CFM-based actions — are highly compatible with averting degradation. In Nepal, CFM is associated with improved forest condition and biodiversity value, along with increased production of firewood, timber, fodder and non-timber forest products; degradation has been reversed and carbon continues to accumulate in forests under CFM (Karky and Skutsch, 2009). In 20 case studies from around the world the International Tropical Timber Organization (ITTO) documented that CFM was associated with numerous outcomes that help avert forest degradation, frequently including improved fire reporting and control, suppression of agricultural clearing, and reduction of illegal logging (ITTO, 2007). Murdiyarso and Skutsch (2006) report on a variety of CFM projects around Africa and Asia, documenting increases in carbon sequestration as a result of CFM from one to five MgC per hectare per year.

Intentional actions to avert degradation via CFM are likely to be cost effective under some circumstances. Two studies looked at the potential for CFM to deliver carbon sequestration through improved forest management. Karky and Skutsch (2009) found in the Himalaya region of Nepal that if traditional forest uses (such as fuelwood collection, fodder, limited timber extraction and extraction of non-timber forest products) are allowed to continue, then CFM in Nepal can deliver carbon sequestration at an opportunity cost of $2.0 to $13.6 per MgC. If all extractive uses are banned, the values rise to an opportunity cost of $32.8 to $63.9 per MgC. In Mexico, De Jong and his co-authors (2000) reported that improved community forest management could deliver substantial sequestration benefits at carbon prices of $15 per MgC.

Achieving avoided emissions from degradation via CFM requires intensive investment in capacity building in multiple communities (De Jong et al., 2000). Training in basic business management, marketing, forestry, fire management and a variety of other disciplines may be necessary. Equipment needs for monitoring and patrolling must be met. Regional and global mechanisms may be needed to support CFM and provide market access for forest-based products from small enterprises scattered through remote geographies. Much of this same level of engagement with communities is likely needed in order to reduce degradation, even in the absence of a CFM focus, with REDD activities (Poffenberger and Smith-Hanssen, 2009).

During the development of the Kyoto treaty there were repeated calls for the Clean Development Mechanism to support CFM as an eligible activity to produce carbon offsets (De Jong et al., 2000; Klooster and Masera, 2000). Today, the evidence supporting inclusion of CFM under a REDD mechanism is stronger and the increase in area of the world's forests under CFM makes finding a strategy for its inclusion even more important.

CHAPTER FIVE

Integrating Certification Systems with Carbon Standards

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SUMMARY FOR POLICY & PRACTICE

» Better alignment of carbon verification and forest management certification will enhance the acceptability and leverage of Improved Forest Management (IFM) as part of a REDD framework.

» We recommend the development and integration of carbon verification standards (e.g. VCS) with forest management certification (e.g. FSC) in order to address carbon accounting issues associated with IFM while safeguarding other values and benefits of forests. By doing this we can capture the strengths, history, and advanced development of a forest management certification system such as FSC with the specialized expertise of carbon standards.

» Work is needed to evaluate carbon-beneficial forest practices at a regional level, such that those practices can be integrated into IFM and carbon verification standards.

Despite the immense potential benefits attainable from implementation of Reducing Emissions from Deforestation and Forest Degradation (REDD), concerns remain about both the credibility and accountability of carbon claims, and the threats of poorly-designed REDD mechanisms to social justice and environmental values. Third-party certification systems can provide an essential component of credibility for emissions-reduction claims from carbon projects, as well as performance in meeting the needs of stakeholder groups. Standards for carbon accounting currently exist and are constantly improving, presenting rigorous guidelines for claiming carbon offsets. Simultaneously, forest management standards exist to ensure protection of social and environmental values. Use of these complementary sets of standards in a REDD framework—especially when dealing with degradation and the role of timber extraction—is a path to credibility, transparency, value recognition, and, ultimately, acceptance.

CERTIFICATION: OVERCOMING TECHNICAL CHALLENGES TO REDD

The technical difficulties of credible carbon accounting are well known. Carbon sequestration estimates can vary widely depending on factors such as baseline definition and the selection of which carbon pools can be included (e.g. soil-based carbon and harvested wood products). From a social perspective, concerns regarding poorly designed REDD projects include: (i) tenure security, (ii) participation of indigenous groups and local communities, and (iii) the equitable distribution of benefits. From the environmental perspective concerns include: (i) expansion of commercial timber extraction to areas previously protected from logging, and (ii) increased focus on carbon management instead of other ecosystem service values such as native biodiversity. The success of a post-2012 REDD mechanism depends upon robust and effective methods that resolve both carbon accounting issues (i.e. additionality, leakage, permanence, verification) and management issues (i.e. safeguarding environmental and social co-benefits).

Given the focus on sustainability and verifying improved management practices, relevant certification[9] programs and associated standards can address many of these challenges and facilitate the implementation of promising REDD strategies. The complexity of forest degradation presents the greatest challenges to carbon accounting and verification, and by association, verification of co-benefits. Therefore, carbon accounting systems and certification systems for activities related to forests (forest management, fuelwood management, and fire management) are especially relevant to the "degradation" component of REDD.[10] Since certification programs and the activities they address also impact deforestation,[11] albeit more indirectly, we refer to REDD in its entirety throughout this chapter.

Governments and institutions can use existing certification systems as tools for building credible REDD programs. Relevant certification systems can provide a means of overcoming several political and technical barriers to successful REDD mechanisms, including:

1. Safeguards for co-benefits: Comprehensive certification systems help safeguard the non-carbon environmental and social values associated with forests (e.g. old growth forest structure, indigenous rights, biodiversity).

2. Verification: Certification systems provide an auditing platform to link on-the-ground forest practices and carbon verification.

3. Economies of scale: Certification systems and the associated infrastructure can enable the rapid scaling up of practices associated with REDD strategies, so that global offset credits can be efficiently and effectively linked to practices on the ground.

[9] We use the term "certification" to mean the process through which an organization grants recognition to an individual, organization, process, service, or product that meets certain established criteria (http://wiki.answers.com/Q/What_is_the_definition_of_certification). Likewise, certification programs or systems are the entire certification entity, including governance structures, accreditation and auditing functions and the standards, or requirements, themselves.

[10] See discussion of degradation as a catalyst in chapter 2.

[11] SmartWood Maya Biosphere study

4. Knowledge dissemination: Standards provide information and set the stage for training, enabling land or concession owners to implement changes and manage risks.

5. Organizational benefits: Certification systems can provide sound structures for decision making and conflict resolution.

Certification systems associated with each of the degradation prevention strategies identified—improved forest management (IFM), fire management, and fuelwood management—vary widely in their stages of development and application. While recently a Voluntary Carbon Standard (VCS) endorsed methodology has been developed to estimate forest degradation caused by fuelwood extraction,[12] in general, systems for forest management are exceptionally well-developed compared to systems and methodologies for other REDD strategies and can provide a model for other strategies to follow. As such, forest management certification systems will largely be the focus of this discussion.[13]

As certification systems and standards are developed to resolve challenges for REDD, and in particular degradation, the limitations and challenges faced by existing systems offer valuable lessons. The overall challenge of expanding forest certification hinges on accessibility for landowners and managers. Accessibility of certification is determined by costs of pursuing certification, capacity (or lack thereof) to implement standards, and the existence (or lack thereof) of well-developed markets and incentives. Implementation of rigorous certification systems requires relatively sophisticated management systems and can be expected to increase the cost of management and the resulting timber products. It would presumably also add costs to any carbon credits generated. On the other hand, the rigor of certification systems will ultimately provide a solid foundation on which to build carbon credits. If carbon and IFM incentives are aligned, potential revenues for landowners will increase and the process of verification and auditing will be streamlined, minimizing associated costs to landowners.

The Intersection of Carbon Accounting and Forest Management

Improved forest management (IFM),[14] as one strategy to address forest degradation, has not yet become an accepted and creditable means to combat carbon emissions under a regulatory framework due to two significant obstacles: 1) the lack of credible, consistent, and replicable approaches linking carbon with forest management techniques (i.e. IFM carbon methodologies), and 2) the perceived and real threats of carbon-centered management to other forest values and services. Since forest management has relatively mature certification programs and voluntary standards already in place, it provides an example of how a strategy might overcome political barriers through the use of standards and certification.

The solutions to these two obstacles lie in the development and integration of standards that address both carbon accounting and safeguards for other values and benefits. Currently, carbon standards capture the issues related to deforestation reasonably well, but are not yet well-developed to address all major sources of degradation due to both (i) complexities surrounding additionality, leakage, and permanence, and (ii) only recent availability of affordable methods for mapping selective logging and understory fire with remote sensing. Some voluntary standards (e.g. VCS, Climate Action Reserve—CAR) address degradation through IFM and show more promise for broad acceptance by environmental and social organizations, but methodologies are still under development. Forest management standards that protect social and environmental values exceptionally well (e.g. Forest Stewardship Council—FSC) do not currently explicitly address carbon values, but can be used concurrently with carbon verification standards to establish a complete package.

Where forest management and carbon management intersect, there are also complex and region-specific issues that need to be resolved. Forest certification has evolved to deal with regional complexities in forest management, with the FSC being a leading example. In addressing the issues of responsible forest management world-wide, the FSC developed a standards structure that both frames issues at a global level (Principles and Criteria) and facilitates more specific regional or national-level standards (Indicators) that fit within the overall framework.

[12] Avoided Deforestation Partners, REDD Methodological Module: Estimation of Baseline Emissions from Forest Degradation Caused by Extraction of Wood for Fuel.
[13] It must also be recognized that existing certification programs and standards within forest management (and the other strategies) vary and may not function uniformly.
[14] See "Improved forest management with forest certification" chapter for more detailed discussion of IFM, and associated elements including reduced impact logging (RIL) and High Conservation Value Forests (HCVF).

Likewise, there is a need for nuanced region-specific standards to credibly facilitate IFM as a carbon strategy. Existing voluntary standards such as VCS are still developing and do not yet have the sophistication to address regional variations in approaches to carbon-beneficial forest practices. At the same time, while many FSC-required and encouraged practices benefit carbon, there are some conflicts. Not all responsible forest practices have carbon benefits (e.g., to regenerate some shade intolerant species, such as mahogany, larger opening sizes are needed, which may have negative implications for carbon).

ALIGNING STANDARDS FOR IMPROVED FOREST MANAGEMENT AND CARBON VERIFICATION

For IFM to become a workable and high-leverage strategy to combat degradation and deforestation in a REDD context, the worlds of carbon verification and forest management certification standards need to be better aligned. Options that are being explored include the following:

1. Existing IFM systems could develop carbon-specific standards. An example of this would be for FSC to develop a new 11th Principle around carbon storage/sequestration, which would become a *mandatory* part of the system and require annual carbon audits of certificate holders. This action would require FSC national, or in some cases, regional initiatives to develop regionally specific indicators to operationalize an 11th Principle. In this scenario, the forest certification system would essentially create the carbon standard for IFM.

2. A second scenario similar to the first would be that a forest certification system offers a *voluntary* carbon add-on to the typical forest management audit and certification, for those wishing to access carbon markets through IFM activities.

3. Partnerships/direct linkages could emerge between carbon and forest management systems. A carbon verification system (e.g., VCS) and a forest certification system (e.g., FSC) could join forces, leading to integration at various levels relating to IFM, all the way from governance to standards to auditing.

4. Accreditation processes for forest carbon and forest management auditors could be combined and streamlined. Accreditation bodies such as ANSI, ISO, or ASI could develop systems that would allow and encourage auditing firms to become accredited for forest management and carbon at the same time.

5. An international system of independent regional "Carbon Best Management Practices" for forest management could be developed and referenced by carbon verification systems (where IFM is part of the project design) as well as by IFM systems.

The most likely scenario at present is a combination of numbers three and four. In most cases, there is a strong correlation between protection of the environmental and social values that most certification programs were designed around, as well as carbon benefits. Forest certification programs such as FSC require most, if not all, components of IFM. Additionally, several independent certification bodies[15] (auditors) are already accredited to audit both carbon and forest management. The explicit link between an independent IFM carbon methodology and a forest management standard is not a difficult step and can be facilitated through mutual recognition and elimination of redundancies by the certification organizations. Examples of potential redundancies include (i) ensuring legality, (ii) carrying out periodic forest inventories, (iii) verifying financial capacity to enable long-term planning, (iv) maintaining documentation, and (v) monitoring.

Theoretically, the connection is simple—overlay a carbon accounting standard (e.g. VCS) with a forest management standard (e.g. FSC) to address other environmental and social values and eliminate any mutually agreed-upon redundancies for efficiency. The difficulties of this step are in development of a robust and accessible carbon accounting standard. One forest management standard, FSC, has initiated steps to improve alignment with credible carbon accounting standards; at the same time, FSC-accredited certifiers have tested integrated audits for both forest management and carbon verification in the field. These are all important steps towards aligning and integrating carbon accounting and forest management certification.

[15] Certification bodies are those entities that have been accredited to audit and certify operators to a given standard or a legal reference and financial feasibility baseline is used. A given project then needs to model carbon stored and sequestered over time. Only when a project reaches a stocking level above the common practice baseline can credits be allocated.

CHAPTER SIX

Case Studies: Lessons Learned—Reducing Forest Degradation

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We review here case studies to provide location-specific and strategy-specific examples of the major themes of the paper. Since strategies to both avoid logging and reduce logging impacts are receiving a great deal of interest, we include two case studies on logging: a "stop logging" strategy being implemented in Bolivia and an "improved forest management" (IFM) strategy being implemented in California. We include a third case study on indigenous community-based fire management as a strategy to reduce carbon emissions in Australia. Finally, we describe an improved efficiency cook stove program in Cambodia that reduces fuelwood collection. In each case, we describe the major themes of this paper: (1) drivers and magnitude of degradation emissions, (2) accounting methods, (3) strategic approach, and (4) political & institutional challenges, standards and solutions. Since these case studies are projects (not national-scale), the last issue revolves largely around standards at the project scale.

Halting Emissions from Logging at Noel Kempff, Bolivia

SUMMARY FOR POLICY & PRACTICE

» Emissions avoided by stopping commercial logging generated the majority of REDD credits from the Noel Kempff Mercado Climate Action Project, the first third party verified REDD project.

» Leakage from avoided commercial logging was successfully tracked at a local scale (activity leakage) and modeled at a national scale (market leakage), resulting in a 16 percent deduction to credits avoiding degradation generated to cancel out the effects of leakage.

» A well-designed community development plan was crucial to REDD to: a) assure local communities and indigenous groups benefit from project activities and b) address the drivers of deforestation and degradation.

» Robust standards recently developed for REDD, particularly the Voluntary Carbon Standard, incorporate lessons learned from the pioneering efforts of Noel Kempff. These new standards, which didn't exist when Noel Kempff was started, allow project developers to design REDD activities in ways that generate high quality verified emissions reductions by accounting for the challenges posed by measuring/monitoring, baselines, leakage and permanence.

PROJECT SUMMARY

The Noel Kempff Mercado Climate Action Project ("Noel Kempff") was one of the world's first large-scale projects to implement Reducing Emissions from Deforestation and Degradation (REDD) in practice. Noel Kempff is addressing the drivers of both D's in REDD: deforestation from conversion to agriculture and degradation from logging activities in timber concessions. In late 1996, The Nature Conservancy and Bolivian conservation organization Fundación Amigos de la Naturaleza (FAN) worked together with the Government of Bolivia and timber concession holders to terminate logging rights in an area in the northeast of the Department of Santa Cruz and incorporate the land into an existing national park. In addition, to address the threat of deforestation from agricultural expansion, project developers worked with local communities on a robust community development plan, which included the facilitation of their application for land tenure and alternative employment opportunities. In 2005, Noel Kempff became the first REDD project to be verified by a third party, using rigorous standards based upon those developed for the Kyoto Protocol's Clean Development Mechanism. With achievement of this milestone, the project serves as a powerful example of how well-designed REDD projects can result in real, scientifically measurable, and verifiable emissions reductions.

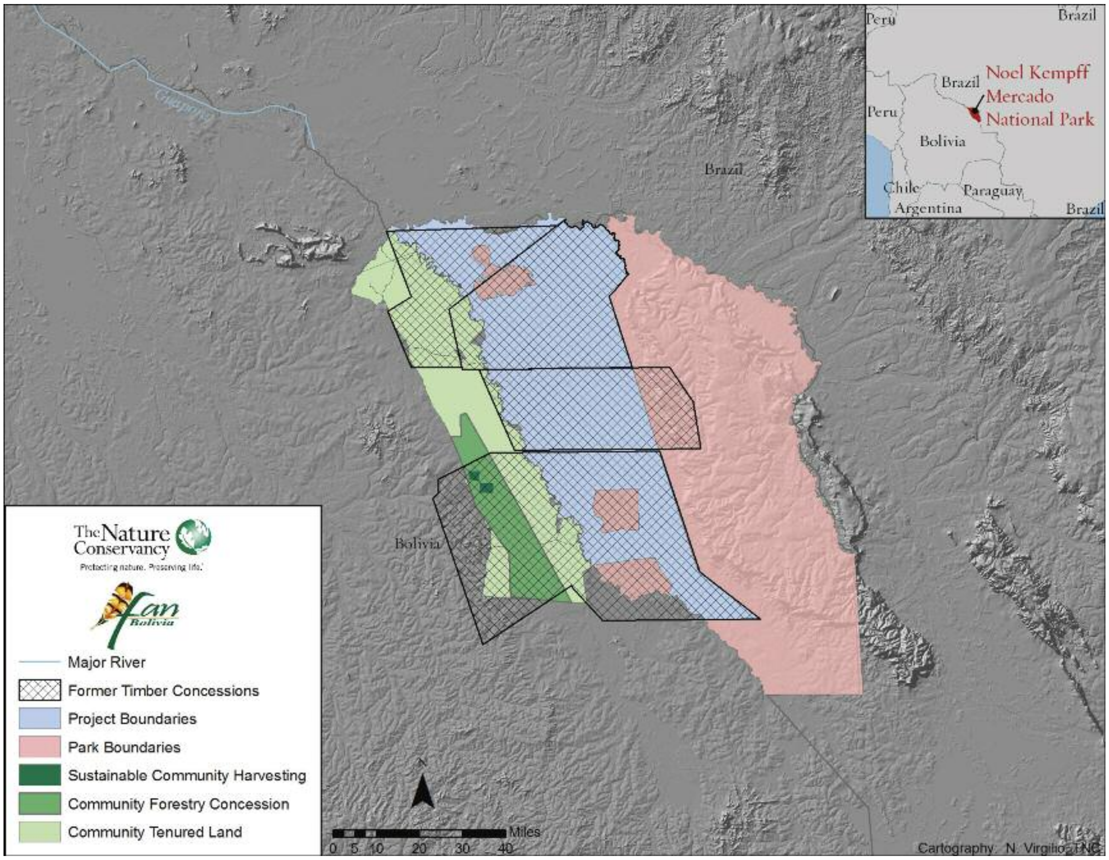
DRIVERS AND MAGNITUDE OF DEGRADATION EMISSIONS

The main driver of deforestation in the area was expansion of subsistence farming activities by seven local communities situated adjacent to the project boundaries. These communities also depended on the forest for hunting, fishing, fuelwood and botanicals. The main driver of degradation in the area was commercial logging operations in four timber concessions adjacent to (and in one case overlapping) the original national park boundaries. A sawmill on one of the concessions provided employment for about 20 local community members.

The project is estimated to avoid the emission of 5,838,813 metric tons of carbon dioxide equivalent (tCO_2e) over its 30-year lifetime. Of this total, about three-quarters of the carbon benefits, or close to 4,500,000 tCO_{2e}, are estimated to come from the avoided degradation component of the project. Thus far, a total of 1,034,107 tCO_2e have been verified to have been avoided from 1997 to 2005 (371,650 tCO_2e from avoided deforestation and 791,433 tCO_2e from avoided degradation). This equates to 763 hectares (ha) saved from deforestation and 468,474 square meters of timber left standing.

STRATEGIC APPROACH

In order to avoid future deforestation from agricultural expansion, project developers worked with the seven local communities on a 10-year community development plan. The plan included five main strategies to ensure that negative impacts



Noel Kempff Mercado National Park, Bolivia. Cartography: N. Virgilio.

on communities were avoided or mitigated and the project succeeded in avoiding deforestation: 1) organizational empowerment, 2) land tenure and community property rights, 3) education, capacity training and land use planning, 4) healthcare, and 5) alternative employment opportunities. More specifically, project developers worked with community leaders to access the correct government officials and complete the paperwork for recognition as an official indigenous organization with legal standing. The communities' application for land tenure was eventually granted, resulting in the official designation of 360,565 ha as indigenous lands. Project developers worked with community members to create a sustainable land use plan for the indigenous lands, including a sustainable forestry plan for a small subset of the area. Sustainable timber operations within these tenured lands, as well as investments in biotrade and ecotourism, were part of an alternative income strategy.

To avoid emissions from degradation caused by commercial timber harvesting adjacent to the existing national park, project developers negotiated with and compensated concession holders to cease their operations and surrender harvesting equipment, while working with the Government of Bolivia to incorporate these lands into the existing national park. Via a presidential Supreme Decree, former logging concessions just adjacent to the original protected area were cancelled and consolidated with the park itself, more than doubling the previous size to its current 1,582,322 hectares. The expansion incorporated ecosystems and species not represented in the original park perimeter and improved the park's protection by establishing natural boundaries.

ACCOUNTING METHODS

Carbon stocks in the project area were calculated with field data collected from 625 on-site permanent plots, and wall-to-wall Landsat satellite imagery. A baseline scenario for the avoided deforestation project component was created using Landsat satellite data from 1986-1996 to calculate historical deforestation rates and a spatially explicit land use change model[16] to simulate the extent and location of anticipated deforestation over 30 years. The avoided deforestation baseline will be re-evaluated every five years to maintain accuracy by comparing it with a reference area adjacent to the Park that is serving as a "control" for the baseline, and is also monitored using Landsat data and field inventory.

A separate baseline scenario for the avoided degradation project component was created based on expected emissions from logging. Rotation length and annual cutting block area

[16] GEOMOD implemented in the GIS software IDRISI Kilimanjaro. As per Noel Kempff PDD, 2006: http://conserveonline.org/workspaces/climate.change/ClimateActionProjects/NoelKempff/NKPDD/PDDZip

were determined from local land management plans and information from the Superintendent of Forestry. To estimate the amount of damaged and dead biomass produced from logging operations and to quantify the effects of logging on rates of carbon accumulation of the residual stand, scientists took measurements in 102 permanent paired plots established within the same forest type in an adjacent forest concession and monitored growth over time (FAN Bolivia, 2006). It was determined that for every metric ton of carbon extracted in logs, 2.35 tons of carbon in wood were damaged, thus representing committed emissions due to logging (as opposed to instantaneous emissions, since wood takes time to rot). Differences in growth rate between logged and unlogged areas were not found to be statistically significant. Results from this and the original field inventory, as well as various supply, demand and cost parameters, were inputs for an advanced statistical model of the Bolivian timber market that was used to determine both the without-project expected degradation baseline and anticipated leakage from project activities (Sohngen & Brown, 2004). The potential pathway of future harvests in Bolivia, both in the project area and within the entire country, was simulated based on the assumption that Bolivia is a small open economy that does not affect global timber prices. Economic variables for the timber market model are being monitored annually to every five years, depending on the particular parameter.

The largest short-term risk for avoided deforestation activity-shifting leakage existed from the communities living along the border of the extended park area. As such, these communities were the focus of leakage prevention activities associated with the project design, including educational campaigns, workshops in sustainable agriculture, application for land tenure and development of a management plan for ancestral lands (as described under "Strategic Approach"). The project is using a geographically based method to detect activity-shifting leakage from this component, which employs a 15 km buffer around the borders of the Noel Kempff project area (monitored via satellite data) to capture any activity shifts. None have been detected thus far. Market leakage from this component was anticipated to be negligible since activities were at the subsistence level.

In order to monitor potential activity-shifting leakage from the avoided degradation component of the project, it was necessary to follow the activities of the concessionaires after they relinquished their holdings. The Agreement to Prevent the Displacement of Noel Kempff Environmental Benefits, signed in 1997 by the former concessionaires, prevented them from initiating new logging activities for a period of five years, and allowed FAN to track their activities and expenditures outside the project area. Harvesting equipment was also retired as part of the project, to avoid it being sold and used elsewhere. No activity-shifting leakage has been detected from this component thus far.

Since timber harvesting was on the commercial scale, it was determined that there *would* be market leakage associated with this project component. Using the same model employed for the degradation baseline, market leakage from the closure of four timber concessions on the property was calculated and verified to be 127,516 tCO_{2e} over the period 1997 to 2005. This amount was subtracted from the verified carbon benefits, and represents a 16 percent deduction to each ton of emission reductions from avoided logging.

Remote sensing technology has been used to complement field work in monitoring the performance of project activities. Landsat satellite imagery taken between 1997 and 2005 shows that deforestation and degradation within Noel Kempff has been effectively limited. Fires within Noel Kempff are being monitored using MODIS satellite imagery (Rapid Response System Fire Response products). A total of 115 fires were detected between 2001 and 2004, occurring mostly in savanna areas. Subsequently, estimates of biomass carbon stocks were discounted by five percent to cover expected carbon losses from fire.

Permanence of carbon benefits generated by the Noel Kempff Mercado Climate Action Project is safeguarded by legal, financial and institutional means. The project area has been incorporated into a national park, as legally designated by the Government of Bolivia. Through the project, an endowment has been established to fund the protection and management of the expanded Noel Kempff Mercado National Park in perpetuity; including rangers, equipment, and infrastructure to protect the park. After the project ends, the endowment fund must be used for the benefit of the Noel Kempff Mercado National Park according to an endowment fund agreement. Risk of fire was considered in the calculation of project carbon benefits as a five percent discount, as described above. No permanence buffer was established for Noel Kempff, since this concept was not standard when the project was developed.

The estimate of lifetime carbon benefits has been recalculated several times since the project began, resulting in considerable reductions from initial estimates and increases in accuracy. These changes, driven primarily by adjustments to the baselines, reflect the pioneering nature of the project, which broke ground on methodologies for estimating baselines.

As a result of methodological advances, anticipated lifetime carbon benefits were ratcheted down from the initial approximation of 53,190,151 tCO2e calculated in 1996, to the current estimate of 5,838,813 tCO2e calculated in 2005. The large decrease in the lifetime carbon benefit estimate is due primarily to a shift in reliance on interviews, secondary data sources, and reference documents from other parts of the world, to site-specific studies, local field measurements and advanced statistical models, which are more robust and accurate.

POLITICAL AND INSTITUTIONAL CHALLENGES, STANDARDS AND SOLUTIONS

Noel Kempff demonstrated "state-of-the-art" technical methods for credibly measuring and monitoring avoided emissions from forest degradation resulting from logging; however, it was expensive to accomplish this level of accounting rigor at the project scale. Of the total project costs, 12.4 percent came from emission reductions and leakage measurement costs. Substantial economies of scale can be achieved by implementing accounting at larger scales (i.e. national or state-level), providing accounting data for multiple projects.

Because Noel Kempff was initiated before standards addressing REDD (e.g. Voluntary Carbon Standard (VCS) and Climate Action Reserve (CAR)) were created, project developers created their own methodology, based upon those outlined for Afforestation/Reforestation in the Kyoto Protocol's Clean Development Mechanism (CDM). The methodologies, contained in a comprehensive project design document, was reviewed, validated, and verified in 2005 by the accredited third party Société Générale de Surveillance, a Designated Operational Entity to the CDM.

Solutions to some political and institutional challenges faced by the project remain to be demonstrated. As of this writing, key milestones in the community development action program have not been reached. The program called for the Government of Bolivia to establish the necessary legal instruments to commercialize the Government's share of the carbon credits and to assign carbon credit revenue according to the earmarks (which include community development) set out in the Comprehensive Agreement between project partners and the Government of Bolivia. The Government of Bolivia has yet to complete this process. The Noel Kempff experience brings to light the need for strong local government capacity to establish the necessary legal, financial, and institutional means to manage carbon revenue and benefit sharing.

Reducing Emissions with Improved Forest Management at Garcia River, California

SUMMARY FOR POLICY & PRACTICE

» Improved forest management can result in measurable carbon benefits while restoring land to its historical ecological composition, improving water quality, and facilitating old-growth forest conditions.

» An unplanned fire disturbance did not threaten the environmental integrity of the real and verified carbon credits generated by the Garcia River Forest Project because appropriate safeguards are in place. These include effective monitoring and conservative accounting methods.

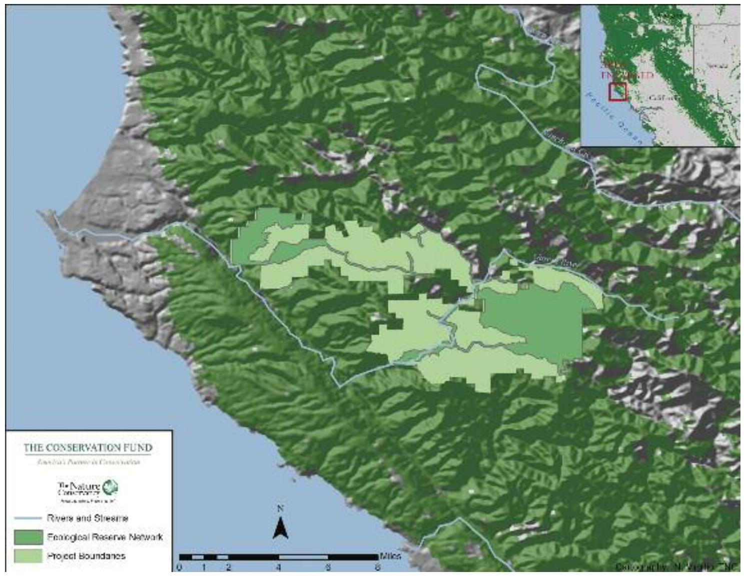
» Inventory methodologies exist that achieve a high degree of certainty in estimating emissions reductions and/or increased sequestration associated with improved forest management. The inventory system used in the Garcia River Forest Project allows measurement and monitoring of carbon stocks associated with the various forest types over time, with an overall carbon sampling error of less than five percent with 90 percent confidence.

» Other standards, such as Climate, Community and Biodiversity (CCB), Sustainable Forestry Initiative (SFI) and Forest Stewardship Council (FSC), have been demonstrated to complement carbon standards by assuring community and biodiversity co-benefits.

PROJECT SUMMARY

The Garcia River Forest Project ('Garcia River') was implemented in 2004 by The Conservation Fund (TCF) in partnership with The Nature Conservancy (TNC), the California State Coastal Conservancy and the Wildlife Conservation Board. The Garcia River Forest is comprised of almost 9,712 hectares previously harvested redwood/Douglas-fir forest in coastal California, one of the most carbon-rich ecosystems on the planet. The forest carbon opportunity aligned perfectly with the partner's intended management—cut fewer, smaller trees than before to allow bigger trees to grow more quickly, resulting in a variety of environmental and economic benefits, including increased carbon storage on the land. TCF has begun the process of improving the stock of high carbon native redwood and Douglas-fir trees by removing tanoak trees, as well as smaller, unhealthy Douglas-fir and redwoods which were competing for sunlight and resources. A conservation easement was purchased by TNC over the entire property which required a sustainable forest management plan emphasizing uneven-aged selection harvests. Also in accordance with the conservation easement, 35 percent of the forest was placed in a protected area to be managed for the enhancement of old-growth forest.[17] Management of the property has been determined by independent auditors to be in conformance with the Forest Stewardship Council (FSC) and Sustainable Forestry Initiative (SFI) standards and has been recognized for the emphasis on watershed restoration and timber stand improvement silvicul-

[17] The Garcia River Forest Integrated Resource Management Plan can be viewed at www.conservationfund.org/sites/default/files/The Conservation Fund Garcia River Forest Integrated Resource Management Plan.pdf.



Garcia River Forest Project, California, USA. Cartography: N. Virgilio.

ture. These changes have resulted in both carbon stock enhancement and emission reductions, and are expected to result in other ecological benefits such as improved water quality and a return to a more natural forest composition. The project has been verified in accordance with California Climate Action Registry (CCAR) Forest Project Protocol version 2.1. Its carbon benefits accrued between 2004 and 2008 have been verified by an accredited third party, for a total of 525,370 tCO_2e.

DRIVERS AND MAGNITUDE OF DEGRADATION EMISSIONS

Due to rising land prices and strenuous regulation, forest owners in the Pacific Northwest are increasingly pressured to convert their properties into other land uses, such as residential subdivisions and vineyards. In response to these threats, TCF purchased almost 10,000 ha of forest in 2004, using a combination of TCF funds and contributions from TNC, The California Coastal Conservancy, the Packard Foundation, and The Wildlife Conservation Board. Previously, the land had been heavily harvested and was in a highly degraded state upon purchase.

Using the standards for carbon accounting established by CCAR v2.1, it is estimated that the project will result in over 2,223,373 metric tons of carbon stored on the property after 100 years, more than twice the baseline carbon storage, while providing essential habitat for species such as the northern spotted owl and anadromous fish.

STRATEGIC APPROACH AND ACCOUNTING METHODS

A random sampling of 1,051 permanent inventory plots have been established and measured within the project area since 2004 (including above and belowground living biomass, standing dead biomass, and lying dead biomass carbon pools); new plots are added annually to address recent disturbances such as harvests and fire. When combined with an additional 540 older plots, the inventory system allows TCF to measure and monitor carbon stocks associated with the various forest types over time, with an overall carbon sampling error of less than 5 percent with 90 percent confidence (SGS and SCS, 2007). Through aerial photos taken in 2004, 21 forest stand types (classified by dominant species, size, and canopy closure) were identified and outlined within the Garcia River project area and confirmed with surveys on the ground. Field data was extrapolated to cover the entire forest based on identified stand types.

Guidance for determining the project baseline was provided in the CCAR v2.1 standard, which is based on the maximum amount of timber harvest permitted under the California State Forest Practice Rules. Specifically, under the baseline management scenario, all forested stands outside of required no-cut riparian zones (forest lining rivers and streams) and those that harbored endangered species would eventually be harvested. Harvests would follow an even-aged management plan, where tree stands were clearcut as they became 60 years or older, followed by single tree selection harvest every 10 to 20 years as stands re-gained commercial maturity post-clearcut. This management plan would have resulted in 1,062,449 metric tons of carbon stored on the property after 100 years.

The with-project scenario will result in more carbon stored on the land than in the baseline scenario by switching to uneven-aged management with selection harvest. This means smaller trees, such as tanoak and low-quality redwood/Douglas-fir, will be harvested more frequently to make room for larger trees to grow more quickly, keeping a variety of age classes across the property. The harvest rate will be less than the growth rate for the first 80 years of the project, allowing surplus volume to accumulate and add to the growing stock. Thirty-five percent of the project area was placed in a no-cut protected zone (with harvest only allowed for the specific purpose of returning the forest to old-growth stage). No-cut riparian buffers along rivers are larger than they would be in the baseline scenario. After 100 years, this management plan is predicted to result in 2,223,373 metric tons of carbon stored on the property, more than twice the baseline carbon storage. While this management scenario will result in carbon benefits, it will at the same time restore the land to its historical ecological composition, improve water quality by reducing sedimentation, and work towards old-growth forest conditions in the ecological reserve network.

The main activity- shifting leakage risk for the Garcia River Forest Project, as per CCAR v2.1 rules, would be if TCF (the owner of the land) increased harvest levels on their other properties to offset reductions on this one. To eliminate this future risk, TCF pledged not to engage in activity shifting leakage, although at the time, TCF did not own other forest property in California. As of today, TCF does own two other parcels and has received CCAR verification under improved forest management for both. When they register these other projects, they will expand their analysis of activity shifting leakage, but given the lack of management history for TCF on all three properties, there is no activity shifting leakage expected (as verified by SGS in 2007). This is due to the fact that they will be expanding timber harvest over time pursuant to specific management plans and CCAR submission. Market leakage is not specifically required by CCAR v2.1 standards.

With regard to permanence, California Climate Action Registry's Forest Project Protocol (CCAR v2.1) requires project developers to account in their annual reporting for any unplanned event (fire, pests, storms, etc) that results in a loss of carbon stocks. Any such event that results in the loss of at least 20% of carbon stocks triggers a requirement to conduct field sampling within three years of the event to determine the full extent of the loss. California Climate Action Registry's Forest Project Protocol (CCAR v2.1) also requires that a permanent easement be placed on project lands to act as a legal guarantee that project lands remain dedicated as a forest land use in perpetuity. In accordance with these requirements, a permanent easement on the property was purchased by The Nature Conservancy, as described above.

The Garcia River Forest is being monitored annually, with the entire forest physically sampled over the course of each 12-year period, to identify changes in carbon stocks as a result of natural disturbances and the improved forest management practices. This information will be compared to the baseline management scenario to calculate project carbon benefits. As required by CCAR v2.1, any significant disturbances in the project area must be reported and sampling conducted within three years. On June 20, 2008, a lightning storm caused 127 wildfires in Mendocino County, including one fire on Garcia River Forest property. Ongoing monitoring and containment action by TCF's forestry staff and local partners ensured that the fires were detected and controlled quickly and ultimately resulted in fewer carbon losses than might have otherwise occurred. In total, 243 hectares were burned and mortality of overstory trees was estimated at 15-25 percent. In late 2008, TCF's forestry staff re-measured the burned area as part of the annual inventory update and documented a slight increase in carbon stocks, primarily due to the increased sample size and the initial growth projections being conservative. Carbon benefits accrued between 2004 and 2008 have been verified by an accredited third party, for a total of 525,370 tCO_2e (143,283 tC).

POLITICAL AND INSTITUTIONAL CHALLENGES, STANDARDS AND SOLUTIONS

Although the focus of this paper has been non-Annex I countries, the Garcia River Forest project still provides overarching lessons on how strong institutions combined with robust scientific methodology can result in real and measurable emissions reductions from improved forest management (IFM).

CCAR v2.1 uses established legal frameworks to set the baseline for project activities (i.e. the maximum harvest level allowed under the California Forest Practice Rules). It is likely that most non- Annex I countries will not have such established regulatory systems in place that represent actual business-as-usual practices, just as clear management histories for working forests might not be available. However, baselines can be estimated using field surveys and measurements, as was shown in the Noel Kempff example, providing a reference level for estimation of carbon benefits. As institutions become more developed in non-Annex I countries participating in REDD mechanisms, it is possible that baseline estimation can move toward an easier and more cost effective legal framework baseline.

California, the site of the Garcia River Forest project, has some of the strictest environmental regulations and standards in the United States. While accounting will be more challenging in the non-Annex I context, given that land management in many non-Annex I countries is not strictly regulated, the opportunity for additionality will often be higher, offering greater carbon payment opportunities than was available for this case study.

The Garcia River Forest project also demonstrates how biodiversity benefits can be achieved through an IFM strategy focused on carbon sequestration. CCAR does not require specific or conservation-based management prescriptions in its mandatory easements; however, project developers held the project to a higher environmental standard, taking into account biodiversity preservation and allowing for a premium on the sale of carbon credits produced.

Reducing Emissions with Fire Management in West Arnhem, Australia

SUMMARY FOR POLICY & PRACTICE

» In some countries, such as Australia, uncontrolled late dry season wildfires contribute a significant amount to annual GHG emissions, creating an opportunity for measurable reductions through strategic fire management. Parallels can be drawn to situations in many other forested systems where a history of improper fire management has resulted in increased carbon emissions.

» Policies which engage indigenous groups in traditional fire management activities on their ancestral lands are a promising means to aid in their economic development, while measurably reducing fire emissions. Clarification of issues surrounding indigenous land tenure should be addressed to assure positive livelihood co-benefits from fire management strategies.

» Accounting methods for emissions reductions from savanna fire management strategies, using remote sensing and on-the-ground monitoring, have become highly refined, and are now integrated into Australia's National Greenhouse Gas Inventory. These methods provide valuable lessons for fire management in forests.

» Given the large role that wildfires play in annual emissions from some countries, including fire management projects in a global carbon market ˜could provide a convenient and cost-effective means for emissions reduction.

PROJECT SUMMARY

In Australia's Northern Territory, savanna fires are the major single source of GHG emissions, accounting for 36 percent of territory emissions and two percent of total national emissions from all sectors in 2006 (Garnaut Climate Change Review, 2008). The West Arnhem Land Fire Abatement (WALFA) project, implemented in Australia's Northern Territory to help abate these emissions, represents a landmark partnership between Australian Aboriginal Traditional Owners and Indigenous Ranger Groups, Darwin Liquefied Natural Gas (DLNG—a subsidiary of ConocoPhillips), the Northern Territory Government and the Northern Land Council. Through this collaboration, Indigenous Fire Rangers are being paid $1 million per year for 17 years to conduct traditional strategic fire management across 2.8 million ha of Western Arnhem. The project has reduced an average of 140,000 tCO_2e annually from 2005 to 2007 (a 38 percent reduction in GHG emissions over three years relative to the 10-year project baseline). These activities were initiated to offset a portion of the GHG emissions from DLNG, equating to a cost of approximately $15 per tCO_2e (Whitehead, Purdon, Russell-Smith, Cooke, & Sutton, 2008). At the time of this comprehensive review, there is not a fire emissions carbon abatement program in tropical forests or fire-sensitive systems documented in the literature. Although the WALFA example illustrates improved fire management in a savanna ecosystem, parallels can be drawn to situations in forested systems where a history of improper fire management has resulted in increased carbon emissions.

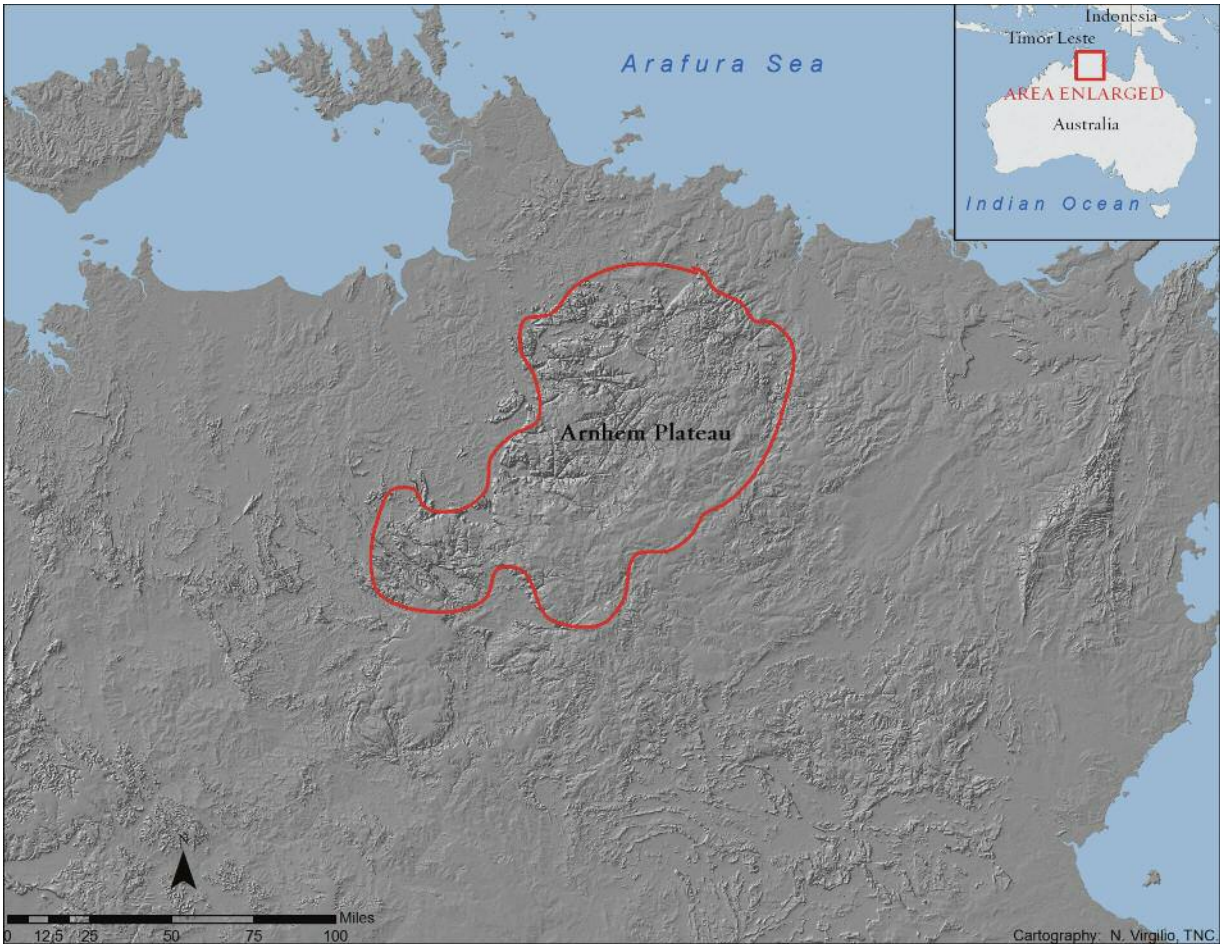
DRIVERS AND MAGNITUDE OF DEGRADATION EMISSIONS

Changes in settlement patterns across Northern Australia, beginning with the appearance of European settlers several decades ago, have had major implications for fire regimes in the area. For generations, indigenous groups had lived on the West Arnhem Plateau. Part of their traditional way of life included lighting small early season fires to clear living spaces, protect resources and sacred places, facilitate hunting, and communicate. An important effect of these traditional fires was the reduction of fuel loads, creation of fire breaks and appearance of a heterogeneous, patchy landscape. Over the past century, Aboriginal Peoples have abandoned the area to take advantage of new resources offered by cattle stations, mining and buffalo camps off the plateau. In the absence of these traditional fire management activities, fires originating from accidental ignition or escape from more settled areas in the surrounding lowlands are evolving into late dry season wildfires that generate much larger emissions of CO_2.

Recent analysis of satellite imagery shows that, an average of 37 million ha (19 percent of the 190 million ha of tropical savanna) burned annually from 1997-2004, mostly in the late dry season (Myer, 2004). It has been estimated that such savanna wildfires in northern Australia release up to 218 million tCO^2e each year (Australian Greenhouse Office, 2006). Field studies and remote-sensing data have shown that early dry season fires are lower intensity, do not usually spread to the tree canopy, and emit less CO_2e than the late dry season fires (Russell-Smith, Edwards, Cook, Brocklehurst, & Schatz, 2004). Studies have also shown that a return to traditional indigenous burning practices can lead to a reduction in the area burnt annually, leading to a further reduction in emissions (Whitehead, et al., 2008).

STRATEGIC APPROACH

In an effort to offset emissions from their new plant, DLNG negotiated with the Northern Territory Government to pay indigenous peoples in West Arnhem to light fires early in the growing season, as they had traditionally done for millennia. These relatively small blazes (positioned across a huge landscape) are creating fire breaks that reduce the number, size and large scale of emissions from wildfires later in the year, when conditions are hotter and drier. The goal is to shift the overall long-term pattern of fire away from one dominated by less frequent, intense fires to one with more frequent, low-



The Arnhem Plateau, site of the WALFA project. Cartography: N. Virgilio.

intensity fires that result in lower average GHG emissions per year. Additionally, the project is providing jobs and income for indigenous fire rangers (30 to date), encouraging their return to the previously abandoned landscape and reviving an ancient culture, while protecting a rich assemblage of flora and fauna.

ACCOUNTING METHODS

Researchers were contracted to carry out carbon accounting activities measuring GHG reductions associated with the project. This led to the creation of a methodology to calculate emissions from fire, which incorporates terms for fire seasonality and severity, Landsat satellite imagery of fire scars, improved mapping of vegetation and assessment of fuel accumulation and type (Russell-Smith & Whitehead, 2008a). Sophisticated remote-sensing map technologies were developed and combined with efficient ground monitoring to inventory vegetation types on the plateau and their emission characteristics when they were burned by fires of varying intensity. In 2004 these efforts resulted in acceptance of the new GHG emission accounting methodology by Australia's National Greenhouse Gas Inventory (Meyer, 2004). The WALFA GHG accounting framework is being applied to other fire-prone landscapes as well. In fact, building on the experience of WALFA, other projects are envisioned under the Commonwealth Government's *Indigenous Economic Development Strategy*, a policy commitment to assist indigenous peoples to engage with and develop carbon market opportunities. North Australia Indigenous Land & Sea Management Alliance partners are in the process of developing four new landscape-scale emissions abatement projects in the north Kimberley, central Arnhem Land, Gulf region, and western Cape York (Whitehead, et al., 2008).

Results from the WALFA carbon study indicated that on average 40 percent of the West Arnhem Plateau is burnt each year by fire: 32 percent by late season, intense wildfire and the remaining 8 percent by cooler early fires. The goal of the project was to shift the amount of the plateau that was burned by wildfires each year so that only 20-25 percent burned in late season fires, resulting in emissions reductions equivalent to at least 100,000 tons of CO_2 per year (Whitehead, et al., 2008).

Indigenous fire rangers are using traditional methods, coupled with modern technology, to manage wildfires in Western Arnhem. Helicopters and aircraft help them install fire breaks along tracks, rivers and creeks quickly, over large areas, and close-to-real-time satellite data on the location of fires can be accessed over websites. The impact of the project in reducing wildfires can be seen in satellite images of fire-scars from the last few years.

It is possible that despite the best efforts of fire managers, a large wildfire may burn a very large percentage of the WALFA Project area at some point in the future. Such fires would only have minor impacts on the overall GHG emissions, provided that they were infrequent, because unlike southern forests, the fire-prone northern savannas do not accumulate large amounts of fuel in the form of litter. As in the humid tropics, litter is rapidly decomposed by organisms including bacteria, fungi and termites, and the available fuel for burning tends to level out after two to three years. So if an area of savanna is left unburned for five years or even 10 years, most of the grass and leaf litter produced in this period will have been decomposed, leaving only a small proportion available as fuel for fire (Savanna Explorer, 2009).

POLITICAL AND INSTITUTIONAL CHALLENGES, STANDARDS AND SOLUTIONS

Currently, fire management projects, as related to the degradation component of REDD, are not recognized by national or international climate change frameworks as a means to abate CO_2 emissions. However, given the large role that wildfires play in annual emissions from countries like Australia, including fire management projects in a global carbon market could provide a convenient and cost-effective means for emissions reduction. Like forest carbon strategies that are currently being proposed, fire management has the potential for a triple bottom line: emissions reductions, community benefits, and biodiversity benefits. The WALFA project, serving as a model for other landscape-scale projects in Australia, demonstrates that fire management strategies can indeed reduce emissions from fire below a historical baseline at a reasonable cost, while creating ancillary benefits for indigenous groups and regional biodiversity. However, there are considerations that must be addressed before such a strategy would be viable on a global, or even national scale.

Specifically, local tenure issues must be considered with respect to liability for impermanence. In the Australia example, indigenous land owners could be considered liable for emissions from fires occurring on their land, whether or not the fires originated elsewhere by accidental ignition. These indigenous landowners would be unable to pass on the cost of liability (in contrast to the industry sector), and their inability to meet liability could potentially further marginalize this group. Regional partnerships covering both indigenous and non-indigenous stakeholders could reduce economic risk to indigenous communities, as well as achieve the desired social and cultural outcomes. In 1997, the Australian Labor Party committed to the development of an indigenous emissions trading program as part of an overall indigenous economic development strategy. The goals of this program are to establish a legal framework for the creation of carbon credits through indigenous-controlled, altered fire regimes, providing $10 million for capacity building and research (Russell-Smith & Whitehead, 2008b).

The Commonwealth has indicated it is unlikely that emission reductions from savanna burning would ever be included in Australia's overall Carbon Pollution Reduction Scheme (CPRS) along with other agricultural emissions. Nonetheless, several options have been proposed for complementary strategies that encourage the development of large-scale fire management while providing economic incentives to reduce emissions and support indigenous economic development. The most viable seem to be those strategies that do not include savanna burning within the CPRS, but allow emission reduction credits produced from these activities to be traded with covered sectors (Russell-Smith & Whitehead, 2008b).

To date, we are aware of no standards which include fire management and associated methodologies within their creditable mitigation activities, highlighting a need for further work in this area.

Reducing Fuelwood Demand in Cambodia with Efficient Stoves

SUMMARY FOR POLICY & PRACTICE

» In countries such as Cambodia, unsustainable demand for fuelwood and charcoal represent a significant degradation driver, which can be addressed in part by improved efficiency in the creation of energy from this fuel source.

» The project has created 265 additional jobs and stove users have saved a total of $2.5 million on charcoal purchases between 2003 and 2006 (GERES, 2007). Emission reductions between 2003 and 2007 totaled 179,518 tCO_2e and have been verified by a third party to the Voluntary Carbon Standard (VCS), demonstrating that emissions reductions from fuelwood projects can be real, measurable and verifiable.

» Methodologies for such projects are being developed to conform to already established regulatory and voluntary standards such as the Clean Development Mechanism (CDM) and Voluntary Carbon Standard (VCS).

» Further research is needed to explicitly link the emission reductions to reduced degradation in forests, as well as to determine the best place for such a strategy to be housed (energy efficiency vs. REDD frameworks).

PROJECT SUMMARY

The Cambodian Efficient Cook Stove Project is part of the larger Cambodian Firewood Saving Project (CFSP), implemented to address the rapid loss of forests in Cambodia due to unsustainable fuelwood harvest, logging, and agricultural expansion. This strategy uses the introduction of efficient stoves to reduce demand for charcoal and thereby reduce fuelwood consumption and carbon emissions. French NGO Groupe Energies Renouvelables Environnement et Solidarités (GERES) and partners facilitated the production and distribution of improved-efficiency charcoal cook stoves in nine Cambodian states and provinces. As of 2006, 14 manufacturers had produced and sold more than 130,000 of the improved-efficiency stoves. Ancillary social benefits of improved-efficiency cook stove use have included: improved indoor air quality, improved access to energy and reduced time and money spent (mainly by women) on gathering and purchasing fuelwood (GERES, 2006). The project has created 265 additional jobs and stove users have saved a total of $2.5 million on charcoal purchases between 2003 and 2006 (GERES, 2007). Emission reductions between 2003 and 2007 totaled 179,518 tCO_2e and have been verified by a third party to the Voluntary Carbon Standard (VCS), demonstrating that emissions reductions from fuelwood projects can be real, measurable and verifiable.

DRIVERS AND MAGNITUDE OF DEGRADATION EMISSIONS

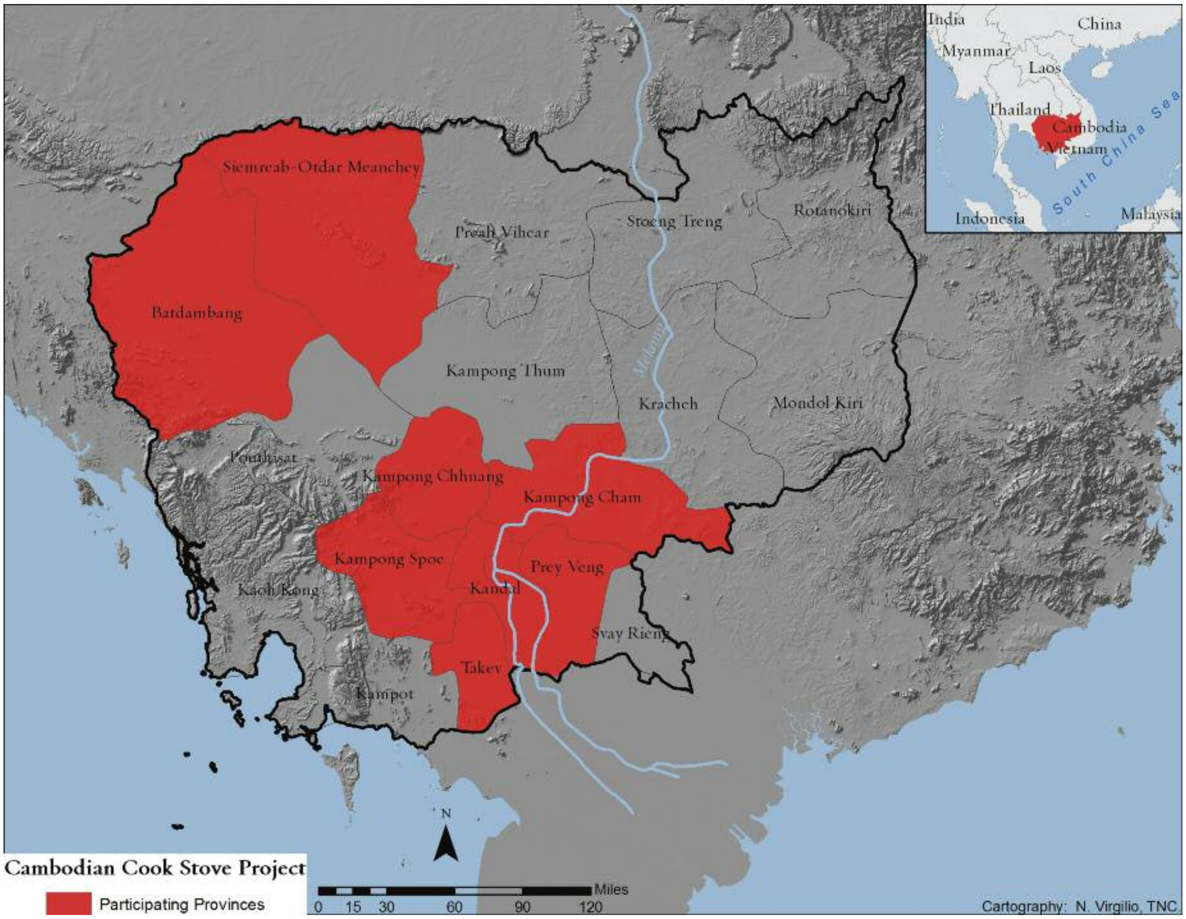
As per US Food and Agriculture Organziation (UN FAO) data, deforestation in Cambodia has led to a decrease in forest cover from 73 percent of total area of the country in the 1970's to 58 percent in 1996 (GERES, 2006), with an average loss of 197,000 ha per year between 1995 and 2005 (World Bank, 2004). With a total demand of 4.5 million tons per year (Van Mansvelt, 2001) 95.3 percent of the Cambodian population depends on daily use of fuelwood for cooking (National Institute of Statistics, 2005). Most of this wood is illegally collected from unmanaged forests. The demand for fuelwood is unsustainable and expected to increase to five million tons per year in 2009, leading to further decreases in forest cover (Van Mansvelt, 2001).

STRATEGIC APPROACH

The cook stove supported by GERES for distribution in Cambodia, uses 21.76 percent less charcoal than traditional stoves to generate the same cooking utility, and thus decreases the pressure on local forests for fuelwood production. Stove manufacturers, who had previously been producing traditional stoves, were trained to make the new stove. Production between the 14 manufacturers has increased to 7,000 stoves per month and demand is such that all stoves are sold to end users within one month of production. The improved-efficiency stove is double the price of the traditional stove; however, the extra cost is recouped by users within two months of purchase by reduced charcoal consumption. Thus, a subsidy program to encourage stove purchase was not needed, but instead, an educational program was implemented in the nine provinces to inform potential users of the benefits of improved-efficiency stoves.

ACCOUNTING METHODS

The project employs a methodology called "Improved Efficiency in Use of Non- Renewable Biomass," issued by the Climate Care Trust and based on modifications of the original methodology proposed by the Joanneum Institute, to create and calculate carbon benefits (Joanneum Institue, 2005). Although the methodology was based on the CDM, it is not currently approved under the CDM. Thus the project is generating credits for the voluntary market through the Voluntary Carbon Standard. To ensure that calculations are conservative, the methodology focuses solely on CO_2; hence does not include avoided methane emissions or reduced transport emissions associated with charcoal. Parameters used in the baseline calculation include number of stoves per family, fuel savings, wood-to-charcoal conversion, stove lifespan, biomass burning factors, number of stoves produced and number of stoves sold. Fuel savings were calculated first in a lab using a "water boiling test" and then replicated with a field study of 20 families in representative circumstances, resulting in the calculated fuel savings of 21.76 percent. In order to determine the lifespan of the stoves, heavy users (mainly restaurants)



Cambodian Improved Efficiency Cook Stove Project. Cartography: N. Virgilio.

were studied and the number of use-hours was recorded, converting the results into lifetime years.

Improved-efficiency stove producers, intermediaries and retailers are trained in data collection and are required to maintain logs of stove production and sales. Monthly visits are made by project personnel to a sample of the group and data is recorded for monitoring purposes. Representative samples of improved stoves from producers are tested in a lab every four months for efficiency and production quality (GERES, 2006). Using the abovementioned data provided by retailers, a sample of people who acquired improved stoves are chosen annually and project personnel visit their homes to survey use, lifespan, replacement, satisfaction, as well as to re-emphasize the benefits of the improved technology.

The methodology has included a 15 percent leakage discount to carbon credits generated from the project to account for possible displacement of traditional stoves. This was deemed to be conservative and in line with CDM methodologies that also apply the same 15 percent discount factor where the leakage is hard to assess.

POLITICAL AND INSTITUTIONAL CHALLENGES, STANDARDS AND SOLUTIONS

The use of improved cook stove technology is one of various strategies for the reduction of degradation by fuelwood harvest and can be used in combination with other strategies to obtain maximum carbon benefits. Other strategies for emission reductions from the fuelwood sector include the creation of energy plantations, community forest management, and improved forest management. Each of these approaches, if well designed, can result in social benefits as well as emission reductions. Further research is needed to implicitly link the emission reductions to reduced degradation in forests, as well as to determine the best place for such a strategy to be housed (energy efficiency vs. REDD frameworks).

CHAPTER SEVEN

Synthesis of Conclusions for Policy

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When REDD was first introduced into the United Nations climate change negotiations it stood for "Reducing Emissions from Deforestation in Developing Countries." The original focus was on deforestation and did not include degradation. However, as the concept gained traction and more information emerged, it became clearer that forest degradation was also a critical element to include in the mechanism. Degradation was given equal weight with deforestation within the Bali Action Plan, the roadmap for negotiations between COP-13 and COP-15. Current negotiation text on REDD contemplates policy approaches and positive incentives for avoiding both deforestation and degradation equally.

Despite the growing recognition of the importance of reducing forest degradation, there is still some skepticism about its inclusion in policy, especially within U.S. domestic legislation. This skepticism stems from a general lack of understanding about the magnitude and importance of degradation as a source of emissions and about the strategies available to reduce degradation. Additionally, doubts still exist about the credibility of accounting for emissions reductions from reduced degradation and some are concerned that measuring and monitoring degradation could be cost-prohibitive. Finally, a lack of a clear definition of degradation is seen as an obstacle to its inclusion in policy. One important result of these challenges is that, thus far, degradation has been included in draft U.S. legislation only as an option for the Environmental Protection Agency (EPA) to consider for inclusion, rather than as a fully eligible activity for crediting. In this chapter, we will examine each of these issues and provide recommendations for policymakers about solutions.

Strategies to Reduce Degradation

Discussions of strategies to reduce degradation have not received widespread attention and therefore confusion exists about how degradation can be reduced and how incentivizing these strategies may impact land use and access.

This paper has summarized many effective strategies for reducing emissions from forest degradation, including:

- Reduced impact logging (RIL), which involves techniques, such as directional felling and cutting of vines from trees before they are felled, to minimize the damage to surrounding forest. Several studies reveal that RIL methods may directly decrease carbon emissions per unit of wood extracted by 30 to 50 percent.

- Forest certification incorporates RIL and can produce additional carbon benefits due to social and environmental provisions, including reduction of harvests to sustainable levels, retention of more biomass, requirements to resolve tenure disputes and use rights, and improved enforcement of laws through increased training and monitoring.

- Integrated Fire Management can be used to reduce carbon emissions in fire-dependent ecosystems by maintaining natural fire regimes (thereby preventing catastrophic fires) and in fire-sensitive ecosystems by preventing understory fires.

- Fuelwood management, which alleviates the degrading pressures of fuelwood collection through a variety of land management and improved cooking strategies. These strategies include employing agroforestry systems, planting trees that can provide a new source of fuelwood, planting windbreaks that both improve agricultural productivity and provide a source of fuelwood, and replacing wood-burning stoves with models that burn other fuels or are more efficient.

Measuring and Monitoring Reduced Degradation

There is a general lack of knowledge about the state of technology and methodologies for measuring and monitoring degradation that leads to a widespread view that credible methods do not exist to measure and monitor degradation and that there is not sufficient data to create baselines for degradation. Because of this misperception, some have advocated excluding degradation from the mechanism so as not to undermine its credibility.

As described in this paper, the main sources of emissions from degradation can now be effectively monitored. Recent scientific advances now allow for efficient, cost-effective, and reliable remote detection of logging and fire across large areas. While older techniques were unable to detect logging and fire activity within forests, these new methods allow countries to reliably and affordably map the extent of these activities. Two methods, in particular, utilize sophisticated analysis of free and publicly available Landsat data to detect impacts of logging and fire.

The Carnegie Landsat Analysis System (CLAS) offers a fully automated and standardized method for evaluating the "fingerprint" of satellite images to determine logging sites across large areas of forest. This system has been used successfully in Brazil to identify areas that have been selectively logged. The system has now been automated (CLASLite) allowing for the method to be applied in different countries with a minimum of specialized geospatial expertise. The Souza et al. (2005a) method takes an additional step to identify forest degradation not only from logging but also from understory fire. This method is currently being tested over large areas in Brazil.

Complemented by traditional field methods for determining carbon stocks (e.g., soil sampling and tree measurements), these new approaches can reduce the time, expense and uncertainty associated with measuring and monitoring degradation.

Very sophisticated, yet more costly, methods have also been developed to overcome challenges associated with cloud cover and the need to ground-truth satellite imagery with labor-intensive field observations. Light Detection and Ranging (LIDAR) methods combined with software developments are able to measure tree canopy structure (e.g., crown diameter, height) to estimate biomass with many fewer ground measurements and are being piloted across the country of Panama. Radar-based approaches have been developed to reliably penetrate areas with cloud cover and also take canopy structure measurements. While these techniques are still prohibitively expensive for most users, prices are dropping rapidly.

The Importance of Including Degradation in a REDD Mechanism

Chapter 2 of this paper reviews estimates of the magnitude of emissions from forest degradation. Studies referenced by the IPCC are generally used to describe the importance of degradation emissions in policy arenas. These estimates range from 4.4-9 percent of total tropical forest emissions. While these numbers are significant, they have been easy to dismiss as less important than the emissions that come from deforestation. However, more recent estimates that take advantage of advanced technologies for detecting emissions from activities that were previously undetectable now show that degradation is likely a much more significant source of emissions. This paper argues that the magnitude of emissions from forest degradation represents at least 20 percent of total emissions from the forest sector. Failing to include degradation in REDD frameworks could thus leave considerable amounts of forest-based emissions unaccounted for. Additionally, forest degradation is a greater source of emissions than deforestation for many countries. Including incentives for reducing degradation is important for bringing those countries into an agreement.

Addressing degradation is not only critical because it represents a substantial source of emissions, it is critical to ensuring the credibility of the accounting framework. Under current definitions of forest, deforestation does not occur until roughly 90 percent of the crown cover is removed. If Tier 1 accounting methods are used (in which look-up tables are used to estimate the carbon density of forests), then actors could remove 89 percent of the crown cover of their forests without having to account for the resulting emissions. However, if degradation was included in the mechanism, those emissions would be accounted for. If degradation is not included, stringent accounting rules that require regular site measurements of carbon density would be necessary to ensure that all emissions are captured.

Finally, degradation is often an important precursor to deforestation. Figure 2 in chapter 2 illustrates a common process of incremental degradation that eventually leads to the complete conversion of land to other uses. By explicitly dealing with degradation, a REDD mechanism could halt this progression and preserve forests largely intact, before they have suffered the degrading impacts from logging, fire, ranching, and agriculture. Including degradation in REDD not only prevents emissions, it is also critically important for preserving biodiversity.

Some of the strategies described above, particularly reduced impact logging and forest certification, have been controversial within the REDD debate, partly because some groups would like to stop logging of primary forests completely and immediately. While this is a noble goal and the aim of a REDD mechanism should be to stop conversion and degradation of primary forests to the greatest extent possible, demand for timber products continues to grow. Developing countries continue to need sources of income and many tropical forest countries will not be able to put all of their remaining primary forests under protection. In many countries, tens of thousands of hectares of primary forests are currently slated for traditional industrial-scale logging. In the absence of very large incentives, those forests will be logged.

By reducing baseline emissions through verified Improved Forest Management (IFM) practices in places where the legal harvesting of timber has already been granted to stakeholders, forests can be sustainably managed to provide timber revenue while reducing many of the impacts associated with traditional logging. In addition, as sustainable logging operations are able to generate jobs for local community members and tax revenues for local government, the social and economic value of forestland is increased. Including the sustainable management of natural production forests in the overall REDD framework reinforces the central message — forests must have an economic value if we are to reduce the rates of deforestation and forest degradation.

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