Title: Linking Theory and Practice: Disturbance Regimes and the UN-REDD+ Projects

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Linking Theory and Practice

Disturbance Regimes and the UN-REDD+ Projects

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Purpose of the Assignment

My doctoral dissertation will focus on measuring the effectiveness of the UN-REDD+ projects in reducing emissions of carbon, enhancing local communities' capability to initiate and/or continue existing community forestry projects, and conserving biodiversity in the project sites. In other words, it essays to understand how the theoretical frameworks constructed by the United Nations and relevant partners are manifesting themselves in actual projects. Therefore, this paper is an attempt to bring the concepts discussed in the literature on disturbance and disturbance regimes to the development and implementation of the UN-REDD+ project in Brazil, Cambodia, and Indonesia. This is because sustainable management of natural forest resources should be based on an ecological understanding of the processes of disturbances, which are vital to the development of structure and function of forest ecosystems. The paper has two objectives: (1) reviewing literature on disturbance and disturbance regime, and (2) synopsizing three REDD project development documents.

Linking Theory and Practice
Disturbance Regimes and the UN-REDD+ Projects

A substantive review of forest ecology literature suggests that natural disturbance is fundamental to the development of structure and function of forest ecosystems, and therefore sustainable management of natural forest should be incontrovertibly based on an ecological understanding of the processes of natural disturbance (Pickett and White 1985a, Oliver and Larson 1990, Attiwill 1994). For example, Pickett and White (1985b) concluded that not only is disturbance common to many different systems, it also functions at all spatial and temporal scales and levels of organization of ecological and evolutionary interest. These roles, according to Sousa (1984) are clearly interdependent. On top of this, Walters and Holling (1990) polemically stated that there is certainly room for great disparity between the degree of scientifically ecological understanding and socio-political objectives when it comes to the effects of human disturbance on the forest resources.

One of the most applicable outlets where forest management programs based on informed understanding of disturbance regimes on particular landscapes could, if not must, be applied is through the United Nations' mechanism called Reducing Emissions from Deforestation and forest Degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries, hereinafter referred to as REDD+ projects. The REDD+ projects are designed based on two underlying

principles. First, adequate financial compensation should be provided to developing countries in exchange for their efforts to preserve their natural forests, or to participate in sustainable forest management initiatives. And second, the financial compensation should be attractive enough to developing countries that, when given the option to preserve or clear forestland, they opt for conservation (United Nations Economic Commission for Africa 2010).

This paper will therefore proceed by first reviewing the extensive literature on disturbance and disturbance regime. Then, based on in-depth evaluation of three REDD+ project development documents, the paper intends to examine the extent to which the conceptual discussions on disturbance regimes are applied in these mega-sized forest management initiatives. Basically, in the first half, the paper begins by examining the context in which disturbance is defined, the theoretical disagreements on the definition, the agents of disturbance, the difficulty in identifying the characteristics of specific disturbance, and the useful utilization of the concept of disturbance regime. The second half of the paper will subsequently starts with a brief history of how RED has evolved to REDD+ projects and the definitional distinction between deforestation and forest degradation allowed under the projects. It then moves on to evaluate in detail three REDD+ project sites located in Brazil, Cambodia and Indonesia. In this section, the paper summarizes the project development documents of the three projects starting with the location, size, time frame, and the implementing organizations of the projects. It then examines the sources that are identified in each of the project as the leading causes of deforestation and forest degradation, followed by the main activities proposed for each of

the project. Finally, the paper concludes by arguing that although a great deal of focus has been placed on studying the anthropogenic disturbance regimes for each of the REDD+ project site, project developers ought to increase their observation on the natural disturbance regimes of the area to enhance the effectiveness of the project.

Literature Review on Disturbance Regimes

In this section, the paper begins by situating the context in which disturbance and disturbance regimes are defined. It then looks at some of the controversies associated with the definition, followed by the main agents of disturbance. After, the paper discusses the difficulties in attempting to classify types of disturbance processes. It suggests that the concept of disturbance regime should be helpful as a conceptual framework for considering the characteristics and consequences of disturbances.

Not only has disturbance been defined variously, the contexts in which this term is elaborated also differ. For Pickett and White (1985a), disturbance is defined not in a sense that is relative to the normal environment but rather in a more tractable and physical sense. Their definition of disturbance includes environmental fluctuations and destructive events, whether or not these are perceived as normal for a particular system. Therefore, according to Pickett and White (1985a), a disturbance is defined as "any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment". In addition to this definition, Neilson and Wullstein (1983) suggested that there are two general kinds of disturbance: destructive

events and environmental fluctuation. Turner (2010) added the temporal description to this definition by specifying that disturbances occur over relatively short intervals of time; hurricanes or windstorms occur over hours to days, fires burn for hours to months, and volcanoes erupt over periods of days or weeks. Furthermore, by origin disturbances, according to Turner (2010) may be abiotic (for example: hurricanes, tornadoes, or volcanic eruptions), biotic (for example: the spread of a nonnative pest or pathogen), or some combination of the two (for example: fires require abiotic conditions suitable for ignition and burning as well as a source of adequate fuel, which is biotic).

On the contrary, for Sousa (1984) viewing disturbance as irregular events that cause abrupt structural changes in natural communities (Pickett and White 1985a) and move them away from static, near equilibrium conditions (White 1979) provides limited usability based on two observations. First of all, as argued by Connell and Sousa (1983) evidence from long-term censuses suggests that few natural populations or communities persist at or near an equilibrium condition on a local scale. Thus, there is no clear demarcation between assemblages in an equilibrium state and those that are not. Second, the change caused by any force can vary from negligible to extreme, depending on the intensity of the force and the vulnerability of the target organisms. And, how does one objectively decide what degree of change along this continuum constitutes a disturbance (Sousa 1984)? Therefore, according to Sousa (1984), a disturbance should be defined as "a discrete, punctuated killing, displacement, or damaging of one or more individuals or colonies that directly or indirectly creates an opportunity for new individuals or colonies to become established".

In regards to agents of disturbance, Sousa (1984) categorized them into physical and biological processes. Physical processes are the kind most often associated with the term disturbance with examples such as fires, ice storms, floods, drought, high winds, landslides, large waves, and desiccation stress. Three of the most commonly studied local physical agents in natural communities are wind, fire, and water motion (Sousa 1984). The second group, agents of biological disturbance encompass everything from predation or grazing to non-predatory behaviors that inadvertently kill or displace other organisms (Dayton 1971). On the other hand, White (1979) and Pickett and White (1985a) stated that major natural disturbances shall include fire; hurricanes, windstorms and gap dynamics; ice storms, ice push, cryogenesis and freeze damage; landslides, avalanches and other earth movements, including coastal erosion and dune movement; coastal flooding; lava flows; karst processes; droughts, flash floods, rare rainstorms, fluctuating water levels, alluvial processes and salinity changes; biotic disturbances including insect attack, fungal disease, browsing and burrowing animals, invasion by plants (weeds); and disturbance caused by man.

In terms of natural disturbance caused by man, shifting agricultural practices in the tropics have extensively been studied (Attiwill 1994). Shifting cultivation, swidden or slash-and-burn agriculture, is a traditional form of agriculture used by at least 240 million people in the humid tropics. A small area of forest between 0.5 and 2 hectares is felled and the debris is burnt to generate an ash bed. Then, a variety of plants is grown until their productivity declines after two or four years. That area is then abandoned to the encroaching forest, and agriculture shifts to a new forest clearing (Padoch and Vayda 1983). With low-level disturbance, return to the mature primary forest is possible with a

time-scale of about 190 years. However, the greater the input into maintaining the clearing in a forest-free state (bulldozing, applying fertilizers and herbicides, sowing grasses for pasture) the less certain it becomes that forest will re-establish and the time-scale for possible recovery increases to a thousand or more years (Attiwill 1994). Remarkably, the ubiquity of human-caused alterations in natural disturbance regimes significantly complicates evolutionary interpretation of contemporary patterns of morphology, physiology, and life history in relation to physical disturbance (Keeley and Zedler 1978). Only in some communities, such as forests, is accurate reconstruction of pre-settlement regimes of disturbance possible. The same concern applies to human alterations of biotic components of the environment. Cautious consideration of such effects should precede speculation about the evolutionary mechanisms underlying current patterns (Dayton and Tegner 1984).

Other than classifying disturbances as physical and biological processes (Sousa 1984), according to Pickett and White (1985a) early in the development of the field of ecology two sorts of community changes were recognized: autogenesis and allogenesis. In the former, change is driven by the biological properties of the system at hand, while in the latter an outside driving environmental forcing function is present. Factors responsible for change were divided into endogenous - within the community, and exogenous - outside the community. Classically, natural disturbances were treated as exogenous (White 1979). Where the successional state of the community influences the likelihood of disturbance and where the community possesses disturbance-promoting traits, the classification of disturbances as endogenous or exogenous becomes problematic (Christensen 1985). In

addition, the difficulty in characterizing causal factors of natural disturbance as endogenous or exogenous is because they both operate over wide ranges of size, frequency, predictability, season of the year, and magnitude or intensity of impact (Webb et al. 1972, White 1979, Pickett and White 1985a, Hopkins 1990)

Therefore as cited in Kulakowski and Veblin (2006), Pickett and White (1985a) suggested the concept of disturbance regime as a conceptual framework for considering the characteristics and consequences of disturbances, of the coordination of spatial and temporal characteristics of disturbances in a particular landscape. The key potential descriptors of a disturbance regime shall include: spatial distribution; frequency – mean number of events per time period; size of the area disturbed; mean return interval – mean time between events; the inverse of frequency; predictability; rotation period – time required to disturb an area equivalent to the study area once; magnitude or severity; and the synergistic interaction of different kinds of disturbances and their driving factors – such as climate or human ignition sources (Pickett and White 1985a). Variations in these parameters are major determinants of landscape heterogeneity (Kulakowski and Veblen 2006).

Turner (2010) argued that disturbance regimes are rapidly changing, and this will result in acute changes in ecosystems and ecosystem services over the short term and long term. Thus, it is urgent that amidst the many pressing challenges to understand the causes and consequences of changing disturbance regimes and anticipate the future trends in disturbance size, frequency, and severity on various regions (Vecchi et al. 2008, Flannigan et al. 2009), ecologists must engage in the policy process (Turner 2010). One of the crucial

outlets for this policy engagement would be to contribute to the development and implementation of the REDD+ projects, because these projects have the potential to alter disturbance regimes over considerably large areas of forest ecosystem. Consequently, the following section of the paper explores how RED evolved to REDD+ projects and the logic behind the creation of these projects.

REDD stands for Reducing Emissions from Deforestation and forest Degradation. The REDD+ concept, the original appellation "compensated reductions", was first introduced at the ninth Conference Of the Parties (COP) to the United Nations Convention on Climate Change (UNFCCC) by a group of scientists who developed the mechanism as a national approach to reducing deforestation. Later, at COP-11 in Montreal, Costa Rica and Papua New Guinea on behalf of the Coalition of Rainforest Nations submitted an official proposal on RED, Reducing Emissions from Deforestation, which was endorsed by most Parties because of its new focus on a national accounting approaches and the growing awareness of the contribution of deforestation to overall carbon emissions. The concept was further elaborated, expanded to incorporate activities leading to forest degradation, and eventually adopted during COP 13 in Indonesia in 2007 officially in the form of REDD. Following the debates during the 14th COP in Poland in 2008, it was decided that REDD should evolve to REDD+ to encompass all the initiatives that can increase the carbon absorption potential of forests (Environmental Defense and the Instituto de Pesquisa Ambiental da Amazonia 2007, Cortez and Stephen 2009, United Nations Economic Commission for Africa 2010).

The insertion of '+' on the acronym REDD is aimed at broadening its scope to include all operations associated with preservation, restoration and sustainable management of forest ecosystems (United Nations Economic Commission for Africa 2010). The official definition of REDD+ as set by the UNFCCC Decision 2/CP.13-11 is "reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries. Following the clarification of its identity and mission, REDD+ won greater importance and since 2008 has become one of the key mechanisms for tropical forest countries in the negotiations on climate change under the United Nations (United Nations Economic Commission for Africa 2010).

The logic of REDD is that countries that are willing and able to reduce emissions from deforestation should be financially compensated for doing so (Scholz and Schmidt 2008). Some of the main observations and assertions for promoting REDD include (a) deforestation is the second largest source of anthropogenic greenhouse gas emissions after fossil fuel combustion (Rogner and Zhou 2007), (b) REDD is a relatively low cost mitigation option that would lower the economic costs of achieving global emissions reductions and is thus a highly cost-effective way to reduce emissions (Stern 2007), and (c) the carbon mitigation benefits of REDD over the short term exceed the benefits from afforestation and reforestation (Rogner and Zhou 2007). Although deforestation and forest degradation are often combined together as the acronym REDD suggests, they have distinct drivers and result in different forest conditions making the processes of identifying and

abating deforestation and forest degradation very different (Myers Madeira 2008). Hence, it is important to clarify the differences.

The IPCC, Intergovernmental Panel on Climate Change, defined 'deforestation' as the permanent removal of forest cover and withdrawal of land from forest use, whether deliberately or circumstantially. Forest conversion to pasture, cropland, or other managed uses is considered the same as deforestation unless noted otherwise. The UNFCCC and IPCC employ a minimum crown cover criterion of 10 to 30 percent to differentiate between forests and non-forests. If crown cover is reduced below this threshold, deforestation has occurred (Trines and Hohne 2006). Forest 'degradation', in the context of REDD project, is the result of selective logging, grazing within forests, and under-story fires as well as over-cutting for fuelwood and subsistence agriculture (Myers Madeira 2008). Forest degradation causes the gradual thinning of forests and possibly lead to deforestation, as seen in studies from the Brazilian Amazon (Asner and Broadbent 2006). In the vicinity of roads and settlements, forest degradation may be at least as widespread as deforestation (Trines and Hohne 2006).

The Three REDD+ Projects

The following section is the summary of the project development documents, the official and legal documentation for all UN-REDD projects, of the three REDD+ projects in Brazil, Cambodia and Indonesia. Here, the paper outlines the general descriptions of the three projects, the identified drivers leading to deforestation and forest degradation in the

project sites, and the proposed project activities. It is necessary to state that there is no categorical guideline on how project development documents shall be developed, and thus the amount of information included for each of the document varies.

Case study 1: The Juma Sustainable Development Reserve Project: Reducing Greenhouse Gas Emissions from Deforestation in the State of Amazonas, Brazil (Banco do Planeta et al. 2008)

Cattle and agriculture production expansion over the past few years, the decline in forest cover due to various activities, and the lack of available land resulting from intense historic deforestation in the other states of the Brazilian Amazon, such as Acre, Mato Grosso, Pará and Rondônia, have driven an obvious trend of migration towards the central region of the Amazon, primarily in the State of Amazonas. The agriculture and cattle production expansion makes the large expanses of sparsely populated forests of the Amazon even more attractive. The future scenario is clear: if the historic trends of deforestation in the Amazon continue, then millions of hectares in the State of Amazonas will be deforested and replaced with large areas of pasture and agricultural crops. In addition, the region in which the Novo Aripuanã municipality is located is in an area under high risk for deforestation due to construction of large highways.

These deforestation forecasts were strongly considered by the Government of Amazonas when it established the Juma Sustainable Development Reserve in 2006. The main objective of creating the reserve was to protect forests with high conservation value. The reserve seeks to protect species in severe risk of extinction while also preserving the

quality of life of the hundreds of families that live in these areas. The Juma Reserve was created in an area of 589,612 hectares of Amazonian forest located alongside the BR-319 highway and crossed by the AM-174 highway. Its establishment and effective implementation was only possible due to the perspective of the Government of the State of Amazonas' plan to create a financial mechanism for generating a financial compensation from activities reducing emissions from deforestation (RED). The resources raised from the sale of these credits will permit the State Government to implement all of the measures necessary to control and monitor deforestation within the project site, enforce the law, and improve the welfare of local communities.

The Juma Sustainable Development Reserve Project for Reducing Greenhouse Gas Emissions from Deforestation, hereinafter referred to as Juma Reserve RED Project, will be implemented by the Amazonas Sustainable Foundation in partnership with the State Secretariat of the Environment and Sustainable of Amazonas with technical assistance from the Institute for Conservation and Sustainable Development of the Amazonas. The institute will be responsible for the technical coordination of the development process for the Baseline Methodology and Monitoring as well as the Project Design Document. The Juma Reserve RED Project aims to address deforestation and its resulting emission of greenhouse gases in an area of the State of Amazonas, which is under immense land use pressure. Its implementation is part of a wide strategy planned and initiated in 2003 by the current Government of the State of Amazonas to halt deforestation and promote sustainable development in Amazonas, derived from the concept of assigning value to the environmental services provided by its standing forests.

The success of this project depends on activities and measures developed in two major areas: 1) the development and implementation of the Reserve and its Management Plan; and 2) the generation of funds from carbon credits through reducing greenhouse gas emissions from deforestation. First, the creation and implementation of the Juma Sustainable Development Reserve began with several studies in the Project area conducted by different institutions between April and May of 2005 with the goal of diagnosing biological and socio-economic aspects, the ethno-characterization of the landscape and the mapping of natural resources, archeological sites and land tenure surveys. Public consultation meetings followed these studies with local stakeholders and the publication of the Decree of the Creation of the Juma Sustainable Development Reserve in April 2006. Then the development and implementation of the Reserve Management Plan includes identifying demands and implementing all the necessary measures to promote the conservation of natural resource, biodiversity, and sustainable development within the limits of the Reserve. The actions and investments will be based on a Sustainability Matrix, which is a tool developed for community actions to plan the construction of the production chain, in order to verify economic losses and gains. The main results expected from its implementation include: monitoring and law enforcement activities; income generation through sustainable businesses; community development, education and scientific research for local communities; and direct payment to the local communities for environmental services

The second major area, that is the systematic generation of resources resulting from the RED carbon credits, depends on the implementation of actions to curb deforestation and

a program to monitor carbon emissions, as well as the signing of contracts with financial partners and the transfer of resources to a management endowment fund. The creation of this endowment fund establishes a stable long-term mechanism that can guarantee the longstanding application of the necessary resources to supply the maintenance needs of the Reserve. The implementing organizations will provide investors and donors with a guarantee that it will be executed and completed in compliance with all of the relevant legal, governmental and regulatory structures. The project was designed through a transparent process involving participatory workshops and political consultations in order to guarantee the involvement and commitment of all the local stakeholders. The starting date of the Juma RED project is the day the Reserve was created (July 3, 2006) as well as the project crediting period. And the end date for the crediting period will be January 2050 corresponding to the date when the world must half its carbon emissions by half if it is to avoid dangerous climate changes.

Case study 2: Reduced Emissions from Deforestation and forest Degradation in Oddar Meanchey Province, Cambodia: A Community Forestry Initiative for Carbon and Biodiversity Conservation and Poverty Reduction (Forestry Administration of the Royal Government of Cambodia 2009)

The Royal Government of Cambodia and the Forestry Administration, along with Community Forestry International and Terra Global Capital have developed the first Cambodian avoided deforestation project. The project involves 13 Community Forestry Groups, comprised of 58 villages, which protect 67,853 hectares of forest land in the Northwestern province of Oddar Meanchey. The project will be one of the first to use a

new methodology for submission under the Voluntary Carbon Standard combined with the Climate Community and Biodiversity Standards. The project is expected to sequester 7.1 million metric tons of carbon over 30 years, demonstrating how developing countries can generate income from carbon markets and positively impact climate change. The Forestry Administration is the implementing organization, supported by three implementing partners: PACT Cambodia, Children's Development Association, and the associations of local communities. Three technical partners will provide assistance on technical issues: Terra Global Capital, Clinton Climate Initiative, and the Technical Working Group Forest and Environment.

In the absence of this project, it is likely that deforestation in the province will continue at the current rate of 3 percent per annum over the next decade. Additionally, it is likely that deforestation will be caused by the same deforestation drivers and agents as the ones that have been active in the province in the past. Project assessments, interviews and participatory rural appraisals indicate that at least ten drivers of deforestation and six agents of deforestation have been and continue to be active in the Oddar Meanchey Province. Those drivers are: forest clearing for land sales, conversion to cropland, conversion to settlements, fuel-wood gathering, annual forest fires induced to clean the land, hunters inducing forest fires, illegal logging for commercial purpose, timber harvesting for local use, large economic land concessions, and timber concessions. These ten drivers represent the ten most prevalent drivers that have been active in the past. Threats of deforestation that have not yet been active in the past, such as deforestation due to mining, were excluded from this analysis, since no quantitative data is available on their historical dynamics.

Equally, the project will undertake ten different activities to achieve reduced forest degradation and deforestation. The ten activities include: reinforcing the land-tenure status, sustainable forest and land-use plans, forest protection, assisted natural regeneration and enrichment planting, fuel-efficient stoves, mosquito nets, agricultural intensification, water resource development projects, non-timber forest products development activities, and fire prevention. Each of these activities targets one or more of the above identified deforestation drivers. For example, reinforcing legal land-tenure only directly affects migrant encroachment and the concession-type deforestation drivers. It is clear from previous analysis that community's respect and acceptance of the legal status and laws is absolutely essential in the success of the project. Other project activities may be highly inefficient if the communities involved do not have legal rights to the land. To optimize the efficiency of the project activities, these activities are incrementally implemented, with reinforcement of land-tenure status being the first project activity. Because of this implementation, the total benefits accrued from the proposed project activities will increase gradually over time.

The first five years of the project represent the project establishment period. These five years will be allocated for activities such as stabilizing project boundaries; controlling drivers of deforestation and degradation in the project areas; developing community project management institutions; building REDD and afforestation/ reforestation project development and management capacity in the Forestry Administration; regenerating degraded forest lands within the project boundaries; and instituting monitoring and measurement systems for carbon accounting, biodiversity, and livelihood generation. Then, during years 6-30, the project will move into the maintenance period during which the

management will be supported by the project communities, the Forestry Administration, and local non-governmental organizations. Net revenues from carbon payments during this period will be utilized to benefit local communities by enhancing livelihoods and improving the quality of the forest. The project started on January 1, 2008 and will end on December 31, 2038.

Case study 3:Reducing Carbon Emissions from Deforestation in the Ulu Masen Ecosystem, Aceh, Indonesia (The Provincial Government of Nanggroe Aceh Darussalam et al. 2007)

There are currently six logging licenses in the project area, comprising 404,704 hectares. These licenses, though currently inactive due to the conflict and Tsunami, could be reactivated by the Ministry of Forestry with support from local governments. In addition to the concessions already granted, almost 60 percent of the total forest area could be legally logged, whether or not they have been assigned a logging concession. A report by World Wildlife Fund Indonesia noted some of the high threats for conversion in the Aceh are the districts of Aceh Jaya, Aceh Besar, and Aceh Barat, provinces that comprise the majority of the Ulu Masen forests. Therefore, this project will develop and test carbon finance mechanisms to reduce greenhouse gas emissions, contribute to sustainable economic and social development and conserve biodiversity over the next 30 years. The project will use land use planning and reclassification, increased monitoring and law enforcement, reforestation, restoration, and sustainable community logging on 750,000 hectares of forest in the Ulu Masen Ecosystem and peripheral forest blocks located in the Indonesian Province of Nanggroe Aceh Darussalam. Adequate carbon finance is extremely essential for this project to succeed.

Leadership by the Aceh Provincial Government will ensure compliance and integration with the existing governmental and regulatory structures. Fauna and Flora International, its non-governmental organization partners and locally based civil society organizations will facilitate participatory processes for community development, spatial and land use planning, biodiversity conservation, collaborative law enforcement and community-based forest management. Carbon Conservation Ltd, PTY is the lead private company assisting with project design, development, start-up and carbon finance at the request of the Governor's office. The project is closely associated with, and builds off the work of the World Bank Multi-Donor Fund's Aceh Environment and Forest project which called for among other tasks, development of sustainable ecosystem service finance, including carbon credits, to be developed for Aceh. All project proponents are committed to ensuring that benefits are equitably shared among stakeholders, including forest dependent communities and those with customary rights to forest land.

The project will help the province avoid an estimated 85 percent of legal logging by using carbon finance to justify land reclassification and permanently eliminate the legal possibility of land conversion and logging. With carbon finance justification, areas currently zoned for logging will be reclassified as permanent protection forests and community-managed low impact, limited production forest areas. The three major project activities are prevention of legal logging via land re-classification; prevention of illegal logging; and reforestation, agro-forestry, mangrove restoration, fruit and coffee micro-plantations, orchards and sustainable forestry. Thus the most important immediate activity is to revise provincial and district spatial plans, reduce the forest area classified as

conversion forest, and increase the area under a range of formal permanent forest estate categories. The project will also help curb illegal logging through support for enhanced enforcement, community agreements, increased employment and income for local people, recruiting forest wardens, conducting forest monitoring and patrols, and improving synergies through law enforcement and other relevant agencies.

The project will then use carbon finance to assist reforestation and restoration of mangroves, fruit tree gardens, coffee plantations and woodlots. These will be developed based on needs and priorities identified in the spatial planning and community outreach process of the project. Where possible, project proponents will seek to enable activities that restore degraded areas and build long-term sustainable tree incomes and livelihoods in project areas. Project proponents use a timeframe of 30 years for accounting for changes in carbon emissions between the baseline and project scenario. This 30 year project accounting period will be divided into two stages, a pre-REDD credit stage, from 2008 to 2012, where fungible early-action REDD credits may or may not be available, and a second stage after 2012. This first stage will focus on, in addition to project design and implementation, procuring finance from bilateral and multilateral funds, philanthropic sources, and voluntary credits.

Conclusion: Linking Theory and Practice

Overall, based on the three projects examined in this paper, and as for any other existing REDD+ projects, the primary objective of the project is to improve the current forest management practices within the project areas so as to avoid scenarios where

deforestation and forest degradation will negatively affect the local communities, biodiversity, and global increase of greenhouse gases (The Provincial Government of Nanggroe Aceh Darussalam et al. 2007, Banco do Planeta et al. 2008, Forestry Administration of the Royal Government of Cambodia 2009). And according to the literature on forest ecology explored in the beginning of the paper, it is obvious that there is a great need for planners and policy makers to understand the dynamics of both natural and anthropogenic disturbances and to anticipate the consequences of modifying disturbance regimes of a dynamic ecosystem (Sousa 1984, Attiwill 1994, Turner 2010). Consequentially, this concluding section of the paper will attempt to suggest a way to incorporate in the REDD+ projects, a phenomena that has the potential to alter an extremely significant amount of forest ecosystems in the world (Angelson 2008), the theoretical debates in the academia in regards to sustainable forest management practices based on an informed understanding of natural and anthropogenic disturbance regimes of the forest ecosystems.

In terms of the discussion of disturbance regimes in the three case studies, it is evident that while the anthropogenic disturbance regimes (for example: cattle and agricultural production expansion in Brazil; conversion of forest lands for various purposes in Cambodia; and logging concessions in Indonesia) are discussed in extensive details, the discussion of natural disturbance regimes that are recognized as prevalent within the project areas (for example: natural fires, pests, floods, droughts, and extreme weather events) are extremely limited in each of the 300-page-plus project development documents. Natural disturbance regimes however are considered as one of the many threats that the project

developers will address in terms of leakage of the project activities (The Provincial Government of Nanggroe Aceh Darussalam et al. 2007, Banco do Planeta et al. 2008, Forestry Administration of the Royal Government of Cambodia 2009). In the context of REDD, leakage means that preventing forest degradation and deforestation in one place might actually encourage the phenomena somewhere else because the agents might shift their equipment and labor to a nearby patch of unprotected forest, or REDD activities could create market leakage by forcing up the market prices of timber, livestock, and crops, making deforestation somewhere else more profitable (Sohngen and Brown 2004, Chomitz 2006)

In general, there are two types of leakage known as primary or activity-shifting leakage caused by REDD stakeholders and secondary market leakage from third actors in response to price changes in forest products (Aukland et al. 2003). However, according to Wunder (2008), leakage can be channeled through land markets, labor markets, capital markets, technological innovation, output markets, income generation, and ecological conditions. In terms of dealing with natural events, such as storm, drought, pest, or fire, Dutschke and Angelson (2008) stated that traditional forest insurance shall cover the difference between the salvage value of timber and the commercial value of the trees at maturity. Contracts are usually renewed on an annual basis, in order to reflect the actual risk profile. This coverage can be expanded to the carbon fixed in vegetation. This expansion would require insurance companies to participate in the emissions market. For the three REDD+ projects assessed in this paper, 10 percent of the total carbon benefits generated from the project activities will be reserved for occasions when natural events

such as droughts or floods hit the project areas (The Provincial Government of Nanggroe Aceh Darussalam et al. 2007, Banco do Planeta et al. 2008, Forestry Administration of the Royal Government of Cambodia 2009).

Based on the extensive amount of literature on the roles of natural disturbance regimes in shaping the characteristics of dynamic forest ecosystem (Pickett and White 1985a, Attiwill 1994, Frelich 2002), it seems imperative to enquire about the limited attention given to natural disturbance regimes in the development of these REDD+ projects. According to Sousa (1984) and Oliver (1981) though there might be several reasons for this neglect, one of the prime causes is possibly that major disturbances often recur at intervals longer than the duration of an average research project or even than the lifespan of the investigator. Thus, the effects of disturbance cannot always be directly observed, which may lead one to conclude that natural disturbance is inconsequential. Nevertheless, even a very long recurrence interval does not necessarily indicate that the impact of disturbance on the community is insignificant (West et al. 1981, Sousa 1984). In addition, modified disturbance regimes, through the REDD+ proposed project activities, may have acute impacts on property and yield of food and fiber, and injuries or mortality could increase with this neglect of scientific observations of natural disturbance regimes in the project areas.

For that reason, the effects of changing ecological disturbance regimes on ecosystem services and human wellbeing need greater attention (Turner 2010) in the development of REDD+ projects. That is because it is unanimously agreed in the scientific community that both natural and anthropogenic disturbance regimes influence the

development and sustainability of most forests of the world (Sousa 1984, Pickett and White 1985b, Attiwill 1994, Kulakowski and Veblen 2006, Flannigan et al. 2009, Turner 2010). One of the plausible ways to do so would be through the utilization of the conceptual framework of disturbance regime. Several studies have shown that applying the disturbance regime descriptors, such as distribution, frequency, magnitude, and synergism, proved to be a useful way to summarize much information on the natural dynamics and regeneration of forests within particular location. The concept lends itself well to the continued development of a management theory for those forests (Runkle 1985, Frelich 2002, Kulakowski and Veblen 2006). After all, as Angelson (2008) stated the activities proposed under REDD+ projects are developed with the primary intention to sustainably manage existing forest resources.

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