

Applied Landscape Ecology, Future Socioeconomics and Policy-Making in the Neotropics

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1. Introduction

The colloquial basis of ecology and reality is that “all things interact,” in one way (magnitude) or another. All living and non-living entities intertwine constantly over time in amazing forms and complex systems. These entities are linked by higher flows of matter and energy to form what we commonly refer to as nature. Species are a fundamental part of the multifaceted ecological world and act as basic entities in ecosystem-building and evolution (Guisan et al., 2006; Hey et al., 2003) as they constantly change the dynamics of ecological patterns and processes.

Anthropogenic activities have often been responsible for prolonged global and ecological alterations (Halper, 2008; Hobbs, 1997; Vitousek et al., 1997). Extreme levels of population growth, industrial and agricultural consumption affect the ecological processes that drive local and global biogeochemical dynamics. The impact of these alterations, however, is still the topic of scientific debate. Biotic systems have great resilience that for humans has been a double-edged sword; it has given rise to the false belief of an unlimited supply of resources, as in neoclassical economics, and led to a disposable mentality for human consumption and high rates of exploitation. The degradation of ecosystem services has led to several environmental problems that the world now faces even after the “no-return” or “tipping point” has inadvertently been reached (Ives & Carpenter, 2007; Ludwig et al., 1997). Until regional, global and time-series dataset patterns were observed, the negative synergic effects from human activities were not clearly understood (Bøjrnstad and Bryan, 2001; Ducklow et al., 2009; Gaston, 2000; Wiens, 1989). Even with current available knowledge, we still face several ecological data gaps for decision-making. However, a multitude of clues to understanding the structure and function of landscapes in the Neotropics are buried in the data. It takes an entrepreneurial and scientific inquiry mindset to find them.

Over the past three decades, the ecological world and our view of it, has undergone accelerated rate of global changes. Little more than a century ago, pristine ecosystems were

still common in Neotropical lands and the favorites of rigorous researchers since Victorian times (Davis, 1996). Now, they are more an ideal that is rarely found in the field, especially in the Neotropics (Hobbs et al., 2006; Vitousek et al., 1997). The ecological science that was based on so-called natural conditions was recently confronted with unnatural contexts and processes: extensive land cover transformations (Fischer & Lindenmayer, 2007), water and nutrient cycles alterations (Smith et al., 1999), and many other disturbances of nature's dynamics have widely been observed in recent years. Conversely, as the disturbed environments are now more common in the world, a new ecology is also arising from the "novel ecosystems" (as defined by Hobbs et al., 2006) formed under such altered conditions. Side-road prairies (Hopwood, 2008), native-exotic mixed forests (Lugo, 2004) and tropical agroforestry and agricultural landscapes (Chazdon et al., 2009) are a few examples of these new communities that surprisingly retain certain ecological services, and even more, these could probably be the best opportunities for maintaining some of the original functions of local ecosystems (Harvey et al., 2008).

Under the mosaic of an altered ecological world, human communities live elsewhere, and decisions about actual and future biotic resources, and ecological services management, are expected. Environmental monitoring and assessment have been recently included in the design of different national and international policies around the world (Ashford & Caldart, 2008; Edwards et al., 2010; Van den Bergh & Grazzi, 2010). Despite how accurate or effective each legal framework could likely be, decisions about environmental issues (conservation areas, biotic exploitation rates, land use and territorial management) are particularly conflictive because they involve interactive processes with components at different spatio-temporal scales and different social actors (Ashford & Caldart, 2008). Laws are usually thought to be general and permanent, but ecological problems are usually very specific and variable depending on the audience.

In a context where landscape ecology could streamline a fast, accurate and integrated assessment of several ecological processes in both time and space. Remote sensing analyses is now a widespread tool in public and private organizations and can be done repeatedly over time and at a range of scales. The synthetic evaluation allowed by landscape analysis is capable of geospatially integrating both environmental and socioeconomic frameworks at the regional scale, but it also identifies hidden political ecologies among people's empowerment of their territories (Restrepo, 2006). The integration of these two points of view is the basis of multi-scale planning and is clearly fundamental for decision makers in both public and private environmental institutions (Dinerstein et al., 1995).

2. Landscape ecology in the Neotropics

The term Neotropics defines a highly diverse and complex biogeographic region that roughly encompasses Latin America and Caribbean countries and their adjoining seas (Udvardy, 1975; Pielou, 1979). This delimitation, unless based on ecological parameters, also fits a territory with common cultural and socioeconomic realities. Several major ecological threats are undoubtedly associated with regional social problematics (Dinerstein et al., 1995). Despite the great attention that some Neotropical ecosystems (i.e. tropical rain forest, tropical montane cloud forest, and páramos) have received in the past decades, landscape

approaches to environmental planning are still scarce in the region. Ninety studies were found in the ISI Web-of-Science database under a search for “landscape” and “Neotropics” (1920-2011). Of them, just 70 were in landscape ecology, the majority related to tropical forest fragmentation and biodiversity conservation. Ninety-two percent of the research published during the last ten years was primarily by scholars at institutions from United States (41%), Mexico (20%), Brazil (18%) and England (11%).

In 1114 the Inca civilization coined the term “*Ispalla pachamama*”; *ispa* means plants, *alla* animals, *mama* mineral and soil attributes and *pachamama* for the cosmologic insight of the spiritual-natural connector to the land. The Inca civilization had integrated knowledge of their landscape that allowed them to terrace and channel water in the Andean mountain landscapes. This integrated landscape knowledge allowed Inca’s civilization to be able to overcome a warming climate over a 400-year period (Chepstow-Lusty, 2009). The word landscape was developed from the Dutch word “*landschap*” which is originally referred to a patch of cultivated ground in a snapshot through time. Humboldt and Darwin in the 19th century understood the interaction of physical attributes and living nature. In 1884, the term “landscape science” was used to describe physical attributes that assembled processes into geomorphology and physiographic prints. German and Russian geographers in the 20th century envisioned this natural science through socio-cultural and psychological features embedded in physical territory. Then, the term landscape ecology was normalized and applied to the first aerial-photograph interpretation; then to studies of interactions between environmental processes and vegetation (Troll, 1939), and subsequently to its contemporary application as a science by using geographic information systems, remote sensing data and the ecological economics of carbon potential for plant sequestration (Fig. 1) as well as payments (values) for ecosystem services.

Hence, landscape ecology research is primarily focused on the degradation processes of ecosystems, as the result of deforestation, degradation through fragmentation, and the prioritization of selected sites for assertively managing local biodiversity (Guadagnin & Maltchik, 2007; Martinez-Morales, 2005). But the level of degradation and interference that human activities have generated in certain ecosystems needs a different focus: the integration of human dimension (i.e., land use, human demography, socioeconomics) and its effect at landscape scale over ecological dynamics. This would chiefly enhance the theory for this new scenario and facilitate necessary mapping for better planning and management about natural capital. Recently, some studies of ecological processes and interactions in agricultural, urban and sub-urban landscapes are providing insights into this approach (Chacon & Harvey, 2006; MacGregor-Fors, 2010; Sanchez-Clavijo et al., 2008; Suarez-Rubio & Thomlinson, 2009).

Nevertheless, beyond old paintings of landscapes and scientific conceptualizations, the ontology of landscape ecology is synthesized in the Dutch school of thought, which might be described as a big-headed horse riding among geography, ecologies, cultures, and the power of wise agriculture to shape a landscape by revealing geospatial patterns and processes over time (Zonneveld, 1979). As a result, the Dutch applied this knowledge to their landscapes and seascapes while reclaiming land from the sea, and established a coherent policy-making through the “polder model” as a reference to the Dutch term for concession politics, water-boards, constructed wetlands, waterways and pump mills.



Fig. 1. Map distribution with some Neotropical plants at the level of order with keystone potentials for sequestering carbon. Source: Inter American Biodiversity Information Network (IABIN) <http://www.iabin.net> of Data Integration and Analysis Gateway (DIAG) , InBio Costa Rica, Global Biodiversity Information Facility (GBIF).

Landscape ecology in the Neotropics is better applied to biodiversity planning in order to categorize ecosystem services aimed at estimating both functional ecological aspects and effective demand for these services. Since nature conservation is not the exclusive domain of either human condition or the Neotropical societal mindset, biodiversity strategic action planning needs to be better understood philosophically. Instead, the wise use and management of biodiversity is widely assimilated in the Neotropics as nature “elongation” by referring to a co-evolutionary process to extend the breadth and length of wildlife species over interacting cultural landscapes. For example, in past years Nearctic guidelines of non-profit organizations and governments have been aimed at streaming revenue to buy land for protected areas in the Neotropics. They believe that the trespassing legal concept prevails in practice as it occurs over their lands. However, if impoverished communities around buffer areas need to secure their livelihoods, they will most likely use legally protected areas for survival in the Neotropics. All in all, the dominant matrix for a Neotropical landscape is transformed into agrofarming mosaics of socio-ecosystems and remnant patches of protected areas (Fig 2).



Fig. 2. Map of protected areas (pink) in the Neotropics. Source: IABIN DIAG and IABIN protected areas network, World Database on Protected Areas.

Applications of landscape ecology are often assembled in spatial units and time series through overlapped tiles. This analytical approach lays out geology, topography, soil structure, biogeography, vegetation, carbon content, ecosystems, water balance, socioeconomic valuations, road networks, and demographics by using GIS technology. This approach represents a better fit for an applied socio-ecological structure and function, especially in a region characterized as mega-biodiverse, but at the same time socioeconomically mega-poor. This means that communities do not fully comprehend the resource potential around their locality.

Consequently, the region is missing a paramount opportunity compared to Nearctic neighbors, lagging behind on the establishment of effective and timely mechanisms of tax exemption among diverse taxpayers and non-profit organizations in order to bridge the rich and poor gap. A region with hundreds of oil, mining, extensive agriculture and power generation companies should mobilize revenue toward biodiversity research, development and innovation in prioritized landscape units for nature elongation based on a) chorological types (defined as groups of ecosystems that are more spatially related between them than with others); and b) minimum ecosystem targets (defined as the area of an ecosystem that has to be conserved to secure the survival of its species) (Wyngaarden & Fandiño-Lozano, 2005). Ultimately, there is often widespread discussion in the region as to whether or not a coupled socioeconomic and ethnospheric map would be best to describe the degree of geospatial control of truly anthropogenic interaction with its territory; similar to a *fuzzy set* classification that is a class with a continuum of grades of membership (Zadeh, 1987). Maps of this type enable either bottom-up or top-down approaches for delivering effective market mechanisms derived from payment for ecosystem services in accordance with social structures and traditional knowledge throughout the Neotropics.

2.1 The socioeconomic ecologies in the Neotropics

Unplanned urban, road infrastructure and agricultural expansion are the main causes of degradation patterns of ecosystem structures and functions (McKinney, 2006; Morton et al., 2006). The decoupling of ecological and social planning is one of the main causes for the failure of conservation and restoration efforts, the loss of ecosystem services, and in some cases, displacement of large (human) communities (Bennett et al., 2005). Integrating the evaluation of ecological resources and services with human population dynamics allows decision-makers to estimate the ecological costs of a social change or vice-versa; the social “expense” of an ecological change (Matthews & Selmann, 2006). Not only physical elements, such as infrastructure or rates of land transformation, are useful and informative when assessing socio-ecological dynamics; It is important to also assess the capacity of local communities to incorporate the basic changes that are needed to achieve an ecological goal into their daily activities coupled with the knowledge of an impact-threshold at their focal ecosystems. In the next section we will explore this relationship in more detail, focusing on the key factors for effective socio-ecological integration for a better intergenerational justice.

2.1.1 Landscape reasoning applied to small scale problems

Complex ecological problems are easily detected at the landscape scale. Degradation tends to have a pattern that is observable at the regional scale through synthesis indicators. In order to detect and prevent a regional ecological problem, local landscapes, particularly boundary (ecotone) landscapes are monitored and analyzed together to understand regional dynamics. Hence, a landscape approach doesn't have an associated scale *per se* (Forman, 1995). Small-scale (local) problems are, by definition, undetectable at the landscape (regional) scale, but from the point of view of local communities the problem may be affecting their whole locality. Using the landscape approach, the mosaic of spatial units inside a locality could be analyzed as dynamic entities with their own interactions, fluxes and compositions, leading to their local landscape properties and certainly to better solutions (Zurlini et al., 2006).

For example, a very common situation that restoration or conservation initiatives have to face in implementation is, (despite the techniques and models used for determining the assigned project area), that a designated territory will always encroach onto someone else's property or land use interests. In the simplest case, if there is only one owner (usually a state or public entity) the task may take some time. But if an initiative is expected to work and the project is approved, there is a good chance that it will be incorporated into a permanently established, legally ensured, and environmentally managed area (e.g., a park, reserve, or nature sanctuary). Unfortunately, this is not the typical circumstance. Usually, the cadastral layer is overlapped on ecosystems, and their boundaries rarely coincide. Ecological problems are elsewhere in the Neotropics, but they are primarily associated with human activities (Morton et al., 2006) and historic land tenure transgressions. For this reason, phases of the processes to restore ecological services or manage an ecosystem, there will be a need for a period of exclusion (time without human presence) that could vary between months and permanency. But even locally, the desired exclusion area can be distributed among several owners with diverse and particular socio-ecological demands. The landscape approach suggests that the socio-ecological conditions of all land owners should be characterized and integrated to develop a consistent land-use management program.

Social variables could be related to an owner's income, economic activities, property area or any relevant combination of factors. In the same way, ecological conditions of each property could be described by specific factors such as diversity, focal ecosystem area, or degradation risk. Therefore, a cross-tabulation of this knowledge could reveal the different socio-ecological categories. Through mapping, this information can enable identification of concrete strategies to establish the relevant ecological and communitarian connection to maintain a restoration or conservation project over the time in a shared space. Complementarily, each local landscape could provide comparison points to assess degradation and potential actions across similar localities in a region.

2.1.2 Adapting Neotropical landscapes through voluntary carbon markets for both native afforestation and reduced emissions from forest ecosystems degradation and deforestation (REDD Plus)

There are widespread anthropogenic agents of deforestation and ecosystems degradation in the Neotropics in terms of magnitude and direction: a) linear large-scale agricultural and livestock expansion patterns; b) the linear clearing from cooperative road-building projects by colonists; c) common land-clearing in the fishbone pattern for farm development, and d) the dendritic spread of logging operations. From these processes and the uneven distribution of efforts at afforestation, the Neotropics contains only 40% of its original forest (Fig. 3). Moreover, heuristic accounting for REDD+ using geospatial technologies and ground-truth methodologies for Neotropical deforestation and forest degradation that should be rendered in terms of: a) time-series cumulative deforestation rates of change in accordance with its agents and drivers; either as linear, exponential, logarithmic, potential, logistical or polynomial functions; b) total leaf area; c) water content and quality of the vegetation; d) fragmentation patterns; e) biodiversity estimations; f) socioeconomic welfare indicators; and g) sound metrics about above- and below-ground carbon pools and stocks.

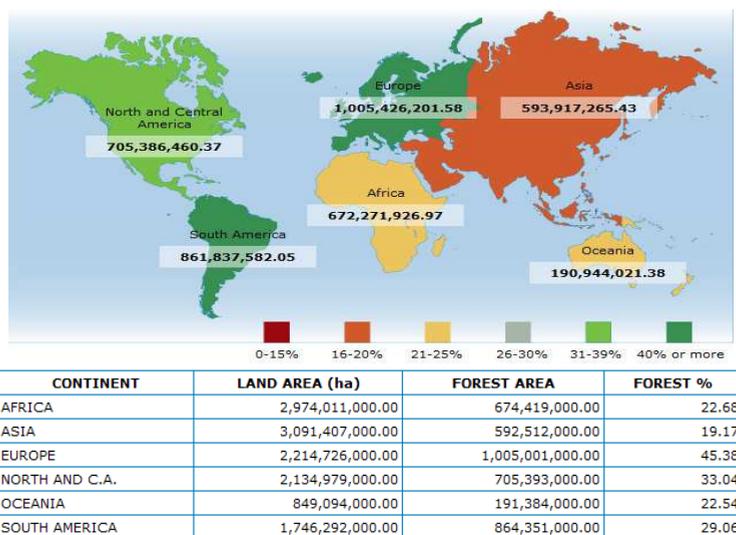
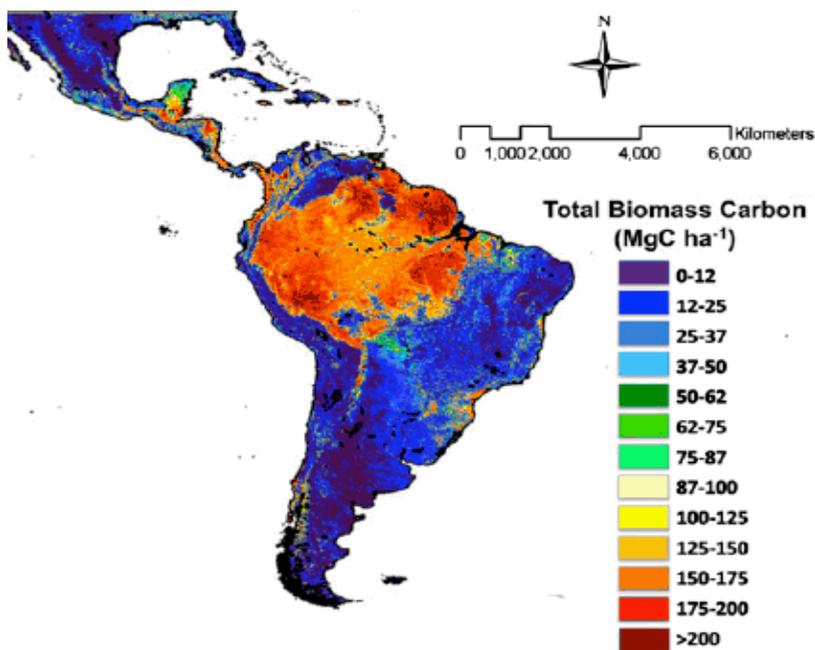


Fig. 3. Global and Neotropical 2011 forest remaining area. Data Source: World Forest Scenario Tool from Global Green Carbon & FAO 2010.

These above-mentioned features are important to determine the health of Neotropical forests, as landscape ecologists have long known that different landscape patterns affect biogeochemical cycles and ecological processes differently. Therefore, these ecological-economics attributes are keystone indicators since the price of voluntary carbon units to be traded into metric tons equivalent (MtCO_2e) are driven by these features within the voluntary carbon markets for REDD+. Thus, the potential effect of turning blue areas of the map into yellow or red would stream revenue to the Neotropics, if transparent mechanisms and demand for carbon certificates are effectively supplied (Fig. 4).



Source: Saatchi S. S. et al., 2011/ PROC. NATL ACAD. SCI. USA.

Fig. 4. Map of total biomass carbon content counting up for the 49% in the Neotropics,

Carbon-offset certificates for emissions reduction, either voluntarily or regulated, are financial tools developed under the trade scheme for reducing greenhouse gas (GHG) emissions by expanding biomass development and making sequestration permanent while phasing out GHG emissions. Transactions take place in the international climate market to ensure proper compensation for climate, communities, biodiversity, and water in order to phase out, avoid, and sequester GHG emissions. This mechanism is based on nature elongation and market strategies to enable better economic incentives for sequestering carbon or avoiding deforestation and ecosystem degradation. Moreover, these markets facilitate the availability of financial resources for implementing ecological actions, diagnosed through ecological informatics software applications over landscapes and cultures dwelling on terrestrial, freshwater and marine ecosystems for footnote blue carbon. These specific actions at a project site, or at national, regional or global scales, should focus on reducing gas emissions by avoiding deforestation.

The carbon-offset certificates are then be standardized in the market for all GHG in MtCO₂e known as voluntary carbon units (VCUs) to be validated through the voluntary carbon standard (VCS) or climate community and biodiversity standard (CCB) and many more as TUV SUD and ISO. Carbon offset certificates are negotiated at a determined price in the voluntary emission reduction (VERs) markets through verified emission reduction purchase agreements. The certificates allow the incorporation of opportunity cost over the damage produced by GHG warming potential in the Neotropics into the world's economy for the first time. The gases can be unnaturally produced by various economic sectors such as energy generation, transportation, agriculture, deforestation, infrastructure construction, ecosystem degradation, and livestock rearing.

Integrating carbon offsets with landscape ecology can improve guidelines for Project Design Documents (PDD) or Project Appraisal Documents (PAD) in order to determine the baseline of carbon stocks accurately and generate verifiable credits. This is what is needed for effective funding in the Neotropics to have baselines and catalyze investment in forest protection. Essential data about the Carbon pools and stocks, additionality or avoidance of emissions, permanence of reduction, and mitigation of leaks demanded by any carbon project to be traded can ensure fair trade compensation for communities near forests or in buffer zones negatively impacted by climate change. Carbon-offset certificates in the Neotropics, therefore, are needed to synergize GHG-reduction with the global economy through applied ecological economics.

These actions can catalyze an adaptive convergence among better climate, community adaptation, biodiversity elongation, and carbon-market conditions. Even if perverse incentives exist, adequate market regulations and communities' self-regulation will ensure that benefits and advantages will be fairly produced and properly allocated based on sound scientific, technological, legal, and financial frameworks. Ultimately, landscape ecologists that apply and deliver these market-based mechanisms efficiently would be maintaining and improve ecosystem structure and function in the Neotropics, one of the main sources of ecosystem services and resources for global socioeconomic systems. No planet, no markets!

2.2 The policy-making ecologies for forests in the Neotropics

The world's economy, biodiversity, and human population are at stake if nothing is done to mitigate climate-change effects. Climate change is a common challenge to all countries and can be solved only through international cooperation. International initiatives include United Nations Framework Convention on Climate Change (UNFCCC) of 1992 (UNFCCC, 1992), the Kyoto Protocol (KP) of 1997, and the agreements for Reducing Emissions from Deforestation and Degradation, plus Conservation, Sustainable Management of Forests, and Enhancement of Forest Carbon Stocks (REDD+) and Land Use, Land Use Change and Forestry (LULUCF). The carbon market created in the Kyoto Protocol has only proven to be a partial solution to the reduction of the GHG/CO₂ emissions which affect the world's climate, environment and the agricultural economy (De la Torre et al., 2009). However, more committed initiatives will be necessary to effectively reduce climate change and the global "free rider problem" (Ostrom, 1990).

Tropical forests play an essential role in the biogeochemical global carbon cycle and must be at the forefront of the discussion to reduce global GHG emissions and to mitigate climate-change effects. Tropical forests include a variety of ecosystems. These forests, while significant for their biodiversity and other exceptional characteristics, store immense amounts of carbon. Studies show that forest ecosystems store greater amounts of carbon than the total amount of carbon in the atmosphere. When forest areas are cleared or degraded, this carbon is released into the atmosphere. Some calculations from the Intergovernmental Panel on Climate Change (IPCC) show that annual GHG emissions from deforestation and degradation of forests account for 20 percent of global emissions, a figure about equal to the emissions of the global transportation sector. The consensus is that in order to achieve significant GHG reductions worldwide, the international community must focus on halting and degradation of tropical forests (O'Sullivan & Saines, 2009).

The 13th conference of the UNFCCC Committee of the Parties (COP) was held in Bali in 2007. Governments agreed to devote two years to the consideration of “policy approaches and positive incentives” for the reduction of emissions from tropical deforestation. These incentives could become part of an agreement implemented after the expiration of the current obligation under the Kyoto Protocol (KP). In 2009, at COP 15 in Copenhagen, Denmark, parties agreed only REDD+ projects were important and should be financed (UNFCCC, 2009). Currently, UNFCCC member states are considering different policy approaches for REDD+. However, the KP maintains a restricted allocation for forest projects such as REDD+ that can eventually produce certified emissions reductions (CERs). The international alternatives are intended to create mechanisms that will create positive incentives to tackle the reduction of GHG by avoiding deforestation and degradation (O'Sullivan & Saines, 2009). That is why some of the UNFCCC, KP and Bio-Carbon Fund goals are to “improve livelihoods, restore ecosystems, adapt to climate change, remove CO₂ from atmosphere, and provide access to carbon market” (Baroudy, 2009).

Experts recommend market-based mechanisms as one of the most promising ways to provide the considerable financing needed for REDD+ (O'Sullivan & Saines, 2009). Practitioners stress the value of forestry and land-use changes for coping with climate change, thereby improving both livelihoods and environment. They also found that forestry and LULUCF projects are among the few opportunities for impoverished rural communities and indigenous peoples to access the carbon market. However, there are tight restrictions on forest projects under the Kyoto Clean Development Mechanism (CDM) and the international environmental system, including European Union Emissions Trading System (EU ETS). These have concerns with REDD+ and LULUCF projects in all developing countries. These concerns range from CO₂ leakage accumulated in forests projects, uncertain land tenure, and the lack of effective governance capable of monitoring and enforcement in forest areas. The main policy problem is that even though tropical forests provide critical environmental benefits such as wildlife habitat, biodiversity, water and carbon sequestration, they also provide exploitable resources, such as timber, fuel, and agriculture. Since the 1980s, several international organizations have adopted agreements in support of environmental and economic interests contingent on the principles of sustainable forest management. Nevertheless, deforestation in tropical countries continues with alarming speed.

Experts agree that non-market based funds must compliment market approaches if REDD+ policy goals are to be achieved (O'Sullivan & Saines, 2009). Another reality is that REDD+ projects must be sufficiently profitable to compete with other crop or timber businesses (Sandker et al., 2010) in order to meet the interests of local farmers and other investors. Developing countries require consistent funding for REDD+ projects so that they can access national and international carbon markets (O'Sullivan & Saines, 2009).

A parallel objective of this chapter is to present to the international policy advisor for the Neotropics an analysis of environmental, legal, and institutional aspects relating to climate change. This is especially important for developing countries with tropical forests, high biodiversity levels, and human communities whose dependency on the natural resource is fundamental to their well-being. The chapter will be useful to carbon project developers, non-governmental organizations (NGOs), communities, and indigenous peoples. The combination of landscape ecology and offset-payments for ecosystem services will help improve efficiency in GHG emissions reduction. It will also be useful for assessing difficulties and providing recommendations for future climate change regulations in Neotropics. The Neotropical governments will need to obtain international technical cooperation, and create space for GHG emissions reduction projects in the international carbon market created by the Kyoto CDM and the Voluntary Carbon Market. To accomplish these goals, developed countries and the International Climate Change System need to be more aware of the Neotropics' fragile position as most of the countries that comprise it are impoverished and possess tropical forestland (De la Torre et al., 2009).

Unfortunately, opening space for CO₂ reduction projects has proven especially difficult following the COP 15 negotiations in Copenhagen. At these negotiations developed countries were expected to take the lead in developing a carbon mechanism to effectively control climate change, and agreed only to fund REDD+ projects (Figueres & Streck, 2009). Consequently, Neotropical countries' national policies should address agricultural and forestland issues to obtain a more comprehensive and effective approach to climate change. This will be especially important to help reduce leakage in LULUCF and REDD+ projects.

While this recommendation may seem obvious, in countries like Colombia, national policies addressing climate change on forest lands are distinct from the agricultural and rural development law reforms. Many Neotropical developing countries feel uncomfortable addressing both issues jointly because they believe it will negatively affect their agricultural production. However, this is far from the truth; agricultural production is being affected first and most significantly with climate change (De la Torre et al., 2009). Thus, an integrated agricultural and forestland policy is fundamental for Neotropical developing countries. In addition, its absence creates confusion and concern among indigenous people, land tenants and other stakeholders, making any international carbon market or national REDD+ or LULUCF effort unproductive.

This study depicts an integrated analysis of the current situation in some Neotropical countries current situation and potential implementations of CO₂ /GHG emissions reduction mechanisms. This highlights the importance of forest projects for the Neotropics and suggests the importance of holistic analyses that show original and current distribution of Neotropical ecosystems as a tool to prioritize biodiversity conservation plans while

mitigating climate change. In the Colombian case this research already exists and should help to establish government policies, to assist project developers and VCM investors in selecting and prioritizing project locations for ecosystem restoration and climate change adaptation (Wyngaarden & Fandiño-Lozano, 2005); the importance of Free Prior and Informed Consent (FPIC) for indigenous peoples and its value for the implementation of REDD+ and LULUCF projects. Moreover, these heuristic studies about carbon property rights of indigenous peoples' reservations and the history of their property rights correlated with the legal framework and tools available in a Neotropical country like Colombia will foster emissions reduction contracts.

Here, we suggest a suite of recommendations for policy strategy, regulations, and mechanisms to channel investment for the effective operation of the carbon trade business in Colombia and other Neotropical countries the project approach, with private sector involvement (Industry, Communities, NGO's & Project Developers) accompanied by results-based contracts such is Colombia's Payment for Environmental Services (PES), as the most effective solution while coordinated command and control regulations are implemented (Richards, et al. 2006 ; Wunder, 2007). This conclusion is based on findings that local efforts initiated by forest communities or those inhabitants that receive benefits from the forest beyond CO₂ emissions reductions have proven successful in Colombia as well as the basis to finance REDD+ initiatives whereas a carbon market is supported by the international and various sectors of the economy.

The need of inclusive forestland, rural development and mining law reforms along with effective use of FPIC for indigenous peoples and other ethnic groups proposes the enforcement of current consumer protection law arguing that while the private sector may present some resistance to GHG emissions reductions, the final consumer also will force environmental responsibility in the business sector. While tax advantages for GHG emissions reduction may seem attractive, Neotropical countries must establish a clear baseline (Passero, 2009) and GHG emissions reduction projects should not be managed and owned solely by the government given the risk that government projects may be targeted by guerrillas, as in the Colombian case. It suggests that at national levels, the government role should be limited to formulating coherent agricultural and forestland policies, contributing advice and partial co-finance for REDD+ and LULUCF projects, aimed at raising awareness and educating about climate change, and facilitating space for private carbon markets to flourish.

2.2.1 International Emissions Trading (IET)

Article 17 of the KP establishes the third mechanism to allow trades or transfers of the emissions rights of assigned amount units (AAU) among Annex I countries. This system has evolved into what is known as international emissions trading (IET). One concern with this type of AAU trading is that it will not be sufficiently green because it is not linked to emissions reduction by either the sellers or buyers. For that reason, a green investment scheme (GrIS) was designed to " earmark AAU revenues for environment-related activities". In this scheme, sellers have the option either to reinvest their proceeds into measures that further reduce their emissions or to support measures with other environmental benefits. Currently, other IETS have been implemented in Australia, the United Kingdom, and Denmark. The IETS and AAU trading became so popular that a Voluntary Carbon Market

(VCM) in emissions reductions has been created and the private sector is becoming the main player (Freestone, 2009; Simonetti & de Witt Wijnen, 2009).

2.2.2 Voluntary Carbon Markets (VCM)

The voluntary GHG emissions reduction market or VCM is a voluntary GHG emissions reduction by one party and the subsequent sale or transfer of these reductions to another party. In exchange for this transfer of reductions, the receiving party provides either financial compensation and obtains the right to claim and use their benefits or to transfer the reductions to another party. Emissions reductions or “offsets” are decreases of GHG emissions by the removal and storage of GHG emissions from the atmosphere (Passero, 2009). Since the GHG emissions voluntary offset began, companies around the world have been investing at an ever-increasing rate in projects that will reduce their footprint at “Carbon footprint” (Hamilton et al, 2008).

There are several VCM strategies, tools and venues such as the Chicago Climate Exchange (CCX), the New York Climate Exchange (NYCX), the Montreal Climate Exchange (MCeX), the Northeastern Climate Exchange (NECX) a manifold of voluntary but legally binding international and U.S.-based cap-and-trade system and “over the counter (OTC) voluntary carbon markets” in which transactions occur on a deal-by-deal basis at a trade level (Bayon, et al., 2006). Some of the sellers in the VCM consist of retailers selling offsets online, project developers or conservation organizations that hope to connect the influence of carbon finance with buyers from the UN Global Compact for example, and potential CDM or JI projects that could neither qualify nor wait for the regulated market. There are also a wide variety of buyers such as international corporations, nonprofit organizations as market catalysts, and individuals. The buyer’s incentive rises from their interest in good publicity, good public relations, philanthropy, and the ability to resell and broker credits at a profit. Combining figures from both VCMs, the United States acquired \$93 million worth of credits in 2006 (Hamilton et al, 2008; Passero, 2009).

In 2007, \$331 million worth of credits were traded and it is expected to increase in the coming years. The VCM’s appeal is its innovation, flexibility, and lower transaction costs that benefit both buyers and suppliers, unlike to the CDM or JI regulatory requirements that create cost and time barriers that exclude project participants from accessing the markets (Hamilton et al, 2008; Passero, 2009). The most popular type of GHG emissions reduction in this market comes from renewable energy, energy efficiency, forestry, sustainability benefits, and methane destruction. One of the concerns relating to projects within the VCM is that there is no standard process for monitoring and certifying these projects to avoid leakage or test the results. Thus, baselines are needed for GHG emissions reduction accounting and requirements for registry standards in projects (Passero, 2009). The VCM’s flexibility is crucial as a laboratory to be scaled out for the creation, evolution and strengthening on emissions-reducing forestry projects throughout The Americas.

Deforestation alone represents 20 to 25 percent of global carbon emissions. Currently, forest project developers and conservation organizations are interested in financing GHG emissions reduction through reforestation and forest protection projects (“avoided deforestation projects”) or REDD+ through the VCM after they discovered that these projects do not fit into the CDM market (Hamilton, 2008). The development of GHG

accounting standards and registries have been essential to quantification and verification of GHG emissions reduction. Registries are advantageous because they centralize accounting data, provide transparent monitoring of reductions, and track transactions in order to avoid the double counting of reductions. Registries also provide legal and policy information that ranges from the crafting of GHG emissions-reduction contracts, known as verified emission reduction purchase agreements (VERPAs), to regulatory measures and government policies. Accounting standards for native forest projects included in the VCM are each country's baselines, "additionality" tests, permanence, verifiability, and leakage control. Baselines and additionality tests work hand-in-hand to assess whether additionality exists in a project and requires the establishment of a baseline to reveal "business as usual" or "without a project scenario". Permanence refers to the duration of GHG reductions and the capacity to address any setback in emissions reductions previously verified as a reduction. Permanence is especially significant in soils, grasslands, or forest projects that entail long-term GHG reductions and back-up storage to fulfill VERs. Verifiability requires independent or third party corroboration of the accuracy, permanence and ownership of the GHG reductions overtime. Leakage avoidance aims to reduce or avoid displacement of GHG emissions caused directly by the GHG reduction offset project (Passero, 2009).

The VCM is contributing greatly to climate-change mitigation. Even under the most demanding reduction targets it is doubtful that all GHG emissions-producing activities will be regulated (Hamilton, 2008). Nonetheless, the VCM has obtained GHG emissions reductions, raised awareness and engaged individuals and businesses in emissions reductions. This has also served as the forum for developing important market infrastructure such as purchase/sale contracts, GHG accounting standards protocols and registries (Passero, 2009). The importance of the VCM in LULUCF and REDD+ to climate change cannot be overemphasized. And finally, since the Kyoto CDM not includes REDD, the VCM is the only option to assist developing tropical countries with forest projects.

2.2.3 The Global Environment Facility (GEF)

The Global Environment Facility (GEF) managing system is a permanent and independent secretariat housed within the World Bank. In 2007, the COP 7 in Marrakech asked the GEF to be the financial mechanism of the UNFCCC to start and operate the Special Climate Change Fund (SCCF), the Least Developed Countries Fund (LDCF), and the Adaptation Fund. The GEF has become instrumental in achieving convention goals as it manages Bank funds addressing global environmental issues. Donor countries supply these funds to finance four basic areas: part of ozone depletion not covered by the Montreal Protocol Multilateral Fund, biological diversity, international waters and climate change. In 2002, two new areas were added: land degradation including desertification and deforestation, and persistent organic pollutants (POPs). The latter is the least known in the Neotropics. There is a lack of ecotoxicological research about POPs or pesticide use over the Colombian rainforest targeted to illicit crops, co-funded by the U.S. Department of the State and Colombia's government.

Nonetheless, GEF funds are considered insufficient to cover environmental challenges a recent study found that the GEF role in mitigating climate change is minor. Even though, it plays a key role in "cofinancing and transforming some markets for energy and mobility in developing countries." In accordance with the UNFCCC mandate, the GEF finances

“incremental costs,” meaning a country contributes the amount it would have supplied to the “least cost” but climate-damaging project and the GEF finances the additional or “incremental cost” of the new climate-friendly technology (Freestone, 2009).

2.2.4 Special Climate Change Fund (SCCF)

The Special Climate Change Fund (SCCF) was established in 2001 to complement other UNFCCC funds that financed projects relating to: adaptation; technology transfer and capacity building; energy, transport, industry, agriculture, forestry, and waste management; and economic diversification (Decision 7/CP.7.) (UNFCCC, 2010).

2.2.5 World bank Climate Investment Fund (CIF)

At the request of G8 donors, in 2008 the World Bank created the Climate Investment Fund (CIF) to invest in developing countries. The funds are distributed as grants, concessional loans, and risk mitigation instruments which are managed through the Multilateral Development Banks (MDB) and the World Bank Group. Two funds are included, the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF). The CTF finances projects or programs oriented to demonstrate, deploy, and transfer low-carbon technologies with a long-term CO₂ savings. The SCF finances a broader scope of projects and programs to assess creative approaches to climate change mitigation (Freestone, 2009).

2.2.6 World bank biocarbon fund

The BioCarbon Fund, part of the World Bank’s Carbon Finance Unit, is a trust fund with public and private financing managed by the World Bank. The fund finances projects intended to absorb or maintain CO₂ in forests, agricultural areas, and other ecosystems. The fund provides financing to developing countries with very few opportunities to participate in the Kyoto CDM as well as to countries with economies in transition through JI. Although still in its evolutionary stages, the BioCarbon Fund is proving how LULUCF projects might generate high quality emissions reduction (ERs), provide benefits for the environment and communities’ livelihoods, and persevere investments for the long term, which will allow these projects to be measured, monitored, and certified. Mid-level emitter countries that sign the KP are expected to access this market, but in practice Kyoto’s CDM is highly restricted for forest projects. Currently, there are only three pilot projects. REDD+ is preparing forest projects in the VCMs in hopes of accessing Kyoto’s CDM or a Post-Kyoto market agreement.

2.2.7 Forest Carbon Partnership Facility (FCPF)

Established in 2008, the Forest Carbon Partnership Facility (FCPF) is a public/private partnership working in conjunction with other programs; the UN-REDD Programme set up by FAO, UNDP and UNEP; and the Forest Investment Program (FIP) (UNFCCC, 2010). REDD+ is divided into three phases: readiness, capacity, and operations. The readiness phase involves diagnosis of the current situation and formulation of a REDD+ strategy and a monitoring system. The capacity reform and investment phase examines the countries’ promotion of REDD+, institutional strength, sustainable forest management, forest governance, and investment outside the forest sector. The mission of the FCPF is to assist tropical and subtropical forest countries in the development of systems, policies, and

strategies for REDD+; design of monitoring systems; establishment of national management arrangements; and inclusion of all key stakeholders. The fund will also award the countries with performance-based payments for REDD+ (Bosquet & Andrasko, 2010). The World Bank is the trustee for the Readiness Fund and the BioCarbon Fund, provides secretarial services and technical support to REDD+ country participants, and conducts due diligence in fiduciary policies and environmental and social safeguards (UNFCCC, 2010). Presently, the FCPF focus is on REDD+ readiness. This is expected that through the assistance of the BioCarbon Fund, the FCPF will provide payments for VERs from REDD+ programs in countries that have achieved progress towards REDD+ readiness.

2.2.8 Forest Investment Program (FIP)

The Forest Investment Program (FIP), established in 2009, provides financing to developing countries for the policy formulation necessary to reach their REDD+ goals, as well as to assure sustainable forest management (FIP, 2010). The FIP is part of the World Bank under the SCCF and the CIF (FIP, 2010). The program focuses on the public sector's formulation of critical forest policy assuring: (a) regulatory and institutional frameworks to support private and public sector investments; (b) private sector investment in sustainable forests and forest landscape management in reforestation, afforestation and conservation through grants, tax relief, and subsidize loans; and (c) finance for forestry activities that include social and environmental benefits. In essence, the FIP promises "to contribute to multiple benefits such as biodiversity conservation, protection of the rights of indigenous peoples and local communities" (CIF, 2010; BIC, 2010).

2.2.9 Wealth Accounting and Valuation of Ecosystem Services (WAVES) program

Payment for ecosystem services (PES) are important for the Neotropics where communities whose livelihoods depends upon their natural capital exist. As a result, a national accounting PES system unveils winners and losers on supply and demand of services when correlated into a rate of changes over ecosystems.

The World Bank through the footnote WAVES program bolster pilot cases about natural capital for public policy delineations addressed to recover and elongate ecosystems services over time. The welfare accounting of natural capital is measured by revenue of utility margin derived from determining effective demand of functional ecological services. Currently, the World Bank is supporting a readiness plan for Colombia and Costa Rica to become the premier vehicles of evidence based impacts to effectively apply and replicate payment for ecosystem services as integral part of public policies in the Neotropics.

2.2.10 Property rights and carbon property in civil law systems: The case for Colombia

This section will explain general property rights protected by Colombia's civil law system and property rights of indigenous peoples and a myriad of ethnic groups. We focus on the application of the law to owners of carbon property rights in Colombia and those who buy and sell environmental services through the appropriate legal contracts. Article 713 of the second book of Colombia's Civil Code relating to property rights defines accession as "a way to acquire property. The owner of one good passes to be the owner of what that good produces or adheres to it. The products of a good are civil or natural."

Article 714 defines natural fruits as those that “come from nature with the help or not of the human industry”. Also, Article 716 states that “the natural fruits of a good belong to its owner” (C. Civ. Col., 1887). Thus, the property owner is required to arrange for carbon storage since, by accession of the natural fruits, the CO₂ created in the biogeochemical cycles adheres to trees and soils through its leaves and roots. The owner is required to arrange for environmental services such as carbon storage. These carbon storage agreements and the environmental services they provide are made with property owners under contractual guidelines such as the payment for environmental services (PES). These agreements are consistent with the civil code and the Colombian legal system.

However, there has been a legal complex gap based on belowground carbon due to the Colombia’s and many other Neotropical mining regulation, that states that all minerals below ground deserves royalties for its state countries. This situation is critical because in this gap, inorganic Carbon may be claimed by local governments, losing project site incentives for trading when a baseline has been surveyed.

2.2.11 Indigenous peoples property rights in Colombia

In 1991, the constitution of Colombia established legal recognition of a multicultural society. This recognition was necessary to ensure the permanence of human rights, as well as property rights. Now indigenous peoples are owners of carbon rights and have the authority to allow carbon projects on their property with approval of the indigenous authorities on their reservations. Article 63 of the constitution establishes that “The goods of public use, the natural parks, the communal land of ethnic groups, the land of indigenous reservations, the archaeological patrimony of the Nation, and other goods determined by the law are unalienable, imprescriptibly, and cannot be attached or seized.” This measure guarantees that indigenous peoples’ property in Colombia cannot be sold or acquired by other people or groups and will not be subject to the statute of limitations. Article 329 and Article 330 numbers 5 and 6 of the constitution also state that indigenous territories are collective property and are governed by their own indigenous council. The council has responsibility to both “5. Oversee the preservation of their natural resources” and “6. Coordinate programs and projects promoted by other communities in their territory” (C. Pol. Col., 1991). These constitutional mandates give indigenous peoples the authority to allow any project on their property, including projects relating to the elongation of natural resources such as A/R, REDD+, and LULUCF. They also have authority to coordinate projects and programs with regional or local institutions and other communities nearby. Thereby, indigenous peoples can exercise their right to give FPIC as well as to take responsibility and ownership of the projects that they decide to approve.

In general, with the exception of some nomad indigenous communities located in the Guaviare-Amazon region (Martinez, 2010), indigenous reservations have two kinds of property: family land and collective land. The collective land is usually forestland that has been typically used sustainably and in ways that do not damage the environment. Indigenous peoples are owners of land that cannot be sold, acquired by prescription, or seized, and this permanence guarantees better participation in carbon storage projects and

contracts such as PES. They can also organize themselves through legal entities and sell their carbon storage outputs and other forest by-products.

2.2.12 International support for A/R, REDD+ and LULUCF projects

REDD+ and LULUCF projects present a more sustainable and environmentally consistent alternative to reducing GHG emissions than other methods for the production of biofuels such as soy biodiesel which also slightly reduce GHG emissions. According to several reports soy production for biofuels and other uses have triggered human rights violations in Argentina, Brazil, and Paraguay. The ecotoxicological use of chemical pesticides on soy plantations in South America is affecting the public health of indigenous communities (Ketabi, 2009). Clear-cutting forests for the production of soy also threatens their subsistence (Wallace, 2007). REDD+ and LULUCF projects present a much better alternative for GHG emissions reduction, watershed policy-making, biodiversity use, integrated water resources management and improvement of communities' livelihoods. If the international system favors and prioritizes funding of forest projects in mid-level emitter developing countries in the tropics, it might be achieved through several of the United Nations Millennium Development Goals (UN, 2010).

2.2.13 Participation on International and national carbon markets

The EU ETS, the major market for carbon credits, prohibits forest-based carbon credits (O'Sullivan & Saines, 2009). This is regrettable because Colombia has more potential for participation in the carbon market with GHG emissions reductions through forest projects. High-level GHG emitters like China deliver more GHG reductions in the power sector and, because of this, have greatly benefited from the Kyoto CDM that sells CERs to the EU ETS. Correcting this inequity at the international level has proven difficult. Mid-level emitter countries must assume a more active role in the post-2012 international negotiations to ensure increased market participation for REDD+ and LULUCF projects among developing countries. As mentioned previously, half of the Colombia's tropical ecosystems, and remnants which include islands, are extremely fragile. Because of the numerous islands in the region, experts recommend that Latin America and the Caribbean (LAC) should be "ahead of the pack" in climate-change reductions since the region currently suffers disproportionately from negative climate-change, intensive mining impacts and this will only be worsened.

To solve some of these issues, LAC countries must use a regional approach. The weather insurance market is currently underdeveloped in LAC and experts recommend incentivizing and establishing regulations for this high-risk market. This approach would allow these countries to engage completely in the insurance business and ultimately in the global carbon market. But first committed and continued international technical assistance for basic research is needed (De la Torre et al., 2009). This research provides critical insight needed by the weather-insurance business and UNFCCC to establish a clear baseline for accounting GHG reductions. It is a duty for Colombia and other Neotropical countries to report in detail GHG-CO₂ emissions inventories to establish the countries' baselines. The baseline is imperative to keep an accounting of reductions of

GHG emissions in the UNFCCC, the Kyoto CDM and VCM. These studies will also help collect useful and consistent information required for forest projects, leakage mitigation, forest management, agriculture, and the sustainability of communities dwelling in the forest buffer areas.

Progress was made at the December 2007 COP 13 in Bali where delegates agreed to “invite parties to further strengthen and support ongoing efforts to reduce emissions from deforestation and forest degradation) on a voluntary basis” (BioCarbon Fund, 2009). This decision opened the path for a more comprehensive international approach toward REDD+, LULUCF, and other forest projects. Later, at the 2009 COP 15 in Copenhagen, industrialized countries agreed to only support REDD+ projects (UNFCCC, 2010). This decision provides a small opening for international environmental cooperation on forest projects in developing countries to reduce CO₂ emissions. The pronouncement also recognizes the need to provide support to REDD+ projects in countries with serious concerns about the impacts of climate change. This decision will attract project developers interested in forest projects in the VCM and the Kyoto CDM.

Support and finance in these areas will complement Colombia’s efforts at the national and local levels to implement REDD+ and LULUCF projects. Consequently, a team formed from members of the private sector and NGOs in Colombia is creating its own exchange-like market to facilitate the flow of carbon credits and to provide the initial baseline financing for Colombian forest projects that can participate in VCMs with VERs. This is necessary because current CDM projects with CERs restrict space for forest projects. For that reason, through the auspices of the GEF, non-profits, the Colombian Ministry of Environment, and the Inter-American Development Bank (IADB) launched their strategy on “Colombia’s underwhelming carbon market presence” in July 2010 (Peters-Stanley, 2010).

2.2.14 National governmental involvement

Some experts recommend that the central government should take ownership of all REDD+ carbon credits (O’Sullivan & Saines, 2009). However, governments’ financial resources are scarce and the potential for increased bureaucracy and corruption in monitoring and accounting is significant. In some countries guerrilla groups will most likely target projects if the government is the exclusive owner or demands royalties. Also as a developing country, Colombia has little ability to enforce regulations and the nationalization of forest areas “creates open access resources where limited-access to common-property resources had previously existed” (Ostrom, 1990). In addition, a local community project approach is the most effective (Robledo & Tobon, 2008). Of course there are main “command and control” regulations necessary to maintain a climate-change policy at national and regional levels. Yet, in the end, forest inhabitants and forest-adjacent communities are the ones to either protect or destroy the forests. Thus, they must be included in project formulation and implementation in order for projects to be successful.

2.2.15 Project site approach

The project approach allows local communities and project developers to obtain direct benefits from REDD+ if their projects are doing well. This private investment is required to

make a significant dent in GHG emissions reduction from REDD+ and LULUCF projects at a global level. Advisory to the private sector investment will require that policymakers generate long-term demand for REDD+ credits (O'Sullivan & Saines, 2009).

LAC/Neotropical countries must advocate for increased participation in the Kyoto and post-Kyoto regulatory carbon market. Unfortunately, given the current international ambience, this is unlikely unless the countries with major GHG emissions craft more committed goals for climate change. Currently, there is no real market to participate in Kyoto's CDM selling CERs in the EU ETS. For now, in some Neotropical countries, groups like Colombia's NGOs, Ministry of Environment, and those working with the IADB, make efforts to strengthen the carbon market. In July 2010 the Mechanism for Voluntary Mitigation of GHG Emissions in Colombia was launched to encourage participation by the private sector with forest projects in the VCM offering VERs.

2.2.16 Payment for environmental services, legal contracts and price drivers

Colombia's limited technical and financial resources require the implementation of new policy mechanisms. The command-and-control approach is important, yet by itself has not been enough to make the private sector and land owners change their forest management practices. However, the PES introduces an important alternative that complements the command-and-control regulations while catalyzing markets. Many Neotropical countries seek to solve some of these environmental issues applying the PES at the national and local levels (PROFOR, 2004; Richards et al., 2006; Wunder, 2007). In Colombia, experts found that currently the PES is used effectively only at the local level in watershed and CO₂ emissions reduction projects (Blanco, 2010). Many forests produce water for residential consumers and irrigation systems, help to maintain fisheries, and supply hydroelectric power generation which are essential to community livelihoods, business development, and ecological economics growth.

The PES has proven an effective contractual tool to provide ecological services because forests affect the quality and quantities of water flow, carbon sequestration, and biodiversity conservation (PROFOR, 2004). Therefore, a hybrid policy approach of practice-based incentives and results-based incentives or PES can help efficiently implement environmental protection and international climate-change mitigation goals. This will allow the government to coordinate with indigenous peoples and other local communities that are directly involved in the fight against problems like diminishing water supplies, CO₂ emissions and biodiversity conservation (Casas & Martinez, 2008). Because current REDD+ payments are insufficient to achieve UNFCCC, Kyoto, and national goals, these projects must be financed continuously from implementation to completion (Sandker et al., 2010). This will be necessary for the remainder of the financial aid to be delivered depending on the results-based payment for the PES. However, the critical point is governmental monitoring of the projects (Blanco, 2010). This is one of the primary reasons that national-level strategies and governmental programs in forests and climate change based on governments' initiatives have not been successful in Colombia (Watershed Markets, 2010). A consistent national and local monitoring system is needed to establish Colombia's baseline and to evaluate the effectiveness of all PES, REDD+ and

LULUCF programs and projects. Therefore, international financial assistance is needed to improve monitoring systems for use by government employees, project developers, NGOs, and independent companies. If all monitoring responsibility is left to the government, the program will fail because of ever-lasting bureaucratic inefficiency and insufficient training of employees. It will also be important to monitor for leakage and additionality. In practice, the legal instrument used to buy and sell carbon-storage services in Colombia is the PES, which is currently used in other kinds of watersheds protection and forest management projects.

There is a national tendency to use PES in watershed management and biodiversity conservation services (Casas & Martinez, 2008). PES "is a voluntary, conditional agreement between at least one 'seller' and one 'buyer' over a well-defined environmental service—or a land use presumed to produce that service" (Wunder, 2007). Because REDD+ projects require considerable amounts of forestland, the "seller" organizes itself as one legal entity, usually a public, private, and civil society partnership, to represent the community and take responsibility for the project. This entity facilitates the trade of products and environmental services such as watershed provisions or carbon storage (Robledo & Tobon, 2008). Several reforestation and conservation projects with private and public parties are being developed under PES (Blanco, 2010). For example, explain what Chaina is micro-basin project around the Iguaque's Sanctuary of Fauna and Flora of Colombia, developed in 2005 through PES, solved a historic socio-economic conflict concerning the distribution of natural resources and enforcement of environmental rules (Casas & Martinez, 2008). PES is supported in Colombia by different laws titled here: (1) Articles 58, 79, 80, and 95 of the Colombian Political Constitution; (2) Ley 99 of 1993, Articles 42, 43, and 45; (3) Ley 165 of 1994 and Ley 216 of 2003; (4) Ley 139 of 1994; and (5) Ley 3172 of 2003, Tax Statute Article 158-2.

3. Conclusion

Climate change represents a serious international challenge especially for developing countries in LAC that are mid-level GHG emitters (De la Torre et al., 2009). Neotropical countries are in a fragile position with sensitive tropical forestland, high overall poverty rates, and impoverished communities. Neotropical landscapes are extremely valuable for their great capacity to store carbon dioxide and necessary for the preservation of the world's biodiversity and indigenous peoples. REDD+ and LULUCF projects appear to be one of the few opportunities for impoverished rural communities and indigenous peoples to access the carbon market and get an income source (Carbon Finance Unit & Forestry Team, 2008). The main policy issue is that forests provide critical environmental benefits such as wildlife habitat, biodiversity, and carbon sequestration, while at the same time they are an exploitable resource for timber, fuel, and agricultural production. Experts conclude that a market-based mechanism for REDD+ and LULUCF is the best solution (O'Sullivan & Saines, 2009).

However, in order to create carbon markets mechanisms, continuity in finance from non-market-based funds will be necessary to meet REDD+ policy goals. At the same time, international technical cooperation will be required to assist LAC countries in different

UNFCCC and KP commitments ranging from baseline reports and climate change policy to GHG emissions and Global Warming Potential reduction projects such as REDD.

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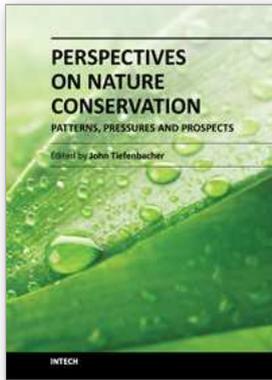
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