Rethinking Forest Resource Use Contracts in Latin America

Jared J. Hardner and Richard Rice*

Environment Division Working Paper

Inter-American Development Bank
Washington, DC

*Jared J. Hardner, an associate at Industrial Economics, Inc., Cambridge, Massachusetts, holds a Master's degree in Forest Science and Natural Resource Economics from Yale University's School of Forestry and Environmental Studies, and has extensive experience as a natural resource economist working in Latin America. Richard E. Rice, Director of the Natural Resource Economics Program at Conservation International, holds a Ph.D. in Natural Resource Economics from the University of Michigan's School of Natural Resources and the Environment. Dr. Rice is presently involved in a variety of projects in Latin America and Asia.

The authors wish to thank the following persons for comments on this document: Kari Keipi; Marc Dourojeanni; Gilbert Nolet; Jeff Vaughan; Raul Tuazon; Steve Stone; and Nigel Sizer. Others who assisted in research, editing, and production of this document include Toben Galvin, Amy Rosenfeld, Ali Jalili, Shaye Hokinson, and John Williams.

Table of Contents

List of Tables

List of Boxes

Abstract

This study challenges the current design of forest resource use contracts in Latin America. Radical rethinking of forest resource contracts is imperative, due to the constraints that now face the successful achievement of forest policy objectives of economic development and conservation of forest resources. The constraints identified in this study include:

- Financial incentives that favor selective logging rather than management in tropical forests;
- Lack of a technical basis for silviculture in neo-tropical forests;
- Governments that lack the administrative capacity and political will to impose management; and
- Cultural and social norms that fail to recognize local users of forest resources.

Forestry is generally looked upon as an important activity in rural development. If conducted in a "sustainable" manner, it is widely embraced as a means to maintain forest cover and thereby provide various environmental services such as biodiversity conservation, watershed protection, carbon sequestration, soil conservation, and habitat preservation. Given the constraints outlined in this study, it seems unlikely that the dual objectives of economic development and conservation will be achieved via current models for forest resource use contracts.

Examples of the current constraints and future opportunities for improving forest resource contract practices are illustrated in five case studies:

Peru: Current proposals for the privatization of public forests present some innovative approaches to resolving the current administrative and regulatory problems faced by the forest sector.

Bolivia: The *Bosque Chimanes* case study illustrates that extensive forest management can be both efficient and of relatively low impact without regulatory oversight. Past efforts to mandate "sustainable" management through regulatory force have failed in Chimanes due to financial, silvicultural, and administrative constraints.

Colombia: An industry/community collaborative effort at intensive forest management provides an example of resolving the issues of multiple-use and local user rights that plague many forest resource use contracts in Latin America.

Brazil: The creation and development of extractive reserves offers insight into the viability of non-timber forest products as economic alternatives to timber production.

Chile: In an effort to reduce the burden on State agencies and improve forest management, the government is experimenting with the transfer of forest concessions to private enterprises for eco-tourism development.

To rethink the current models for forest resource use contracts requires a clear definition of objectives. Current definitions of “sustainable forestry” are inadequate for measuring success.

Once clear objectives are defined, realistic means to achieve them must be designed. The following are suggested as means to achieve these economic and conservation objectives:

- Replace command-and-control regulations with periodic performance audits;
- Replace complex revenue systems with an area tax;
- Promote adaptive management techniques that allow for new input;
- Require conservation set-asides within the contracted forest area; and
- Integrate local users into commercial forest resource-use contracts.

This study is intended to serve as a turning point in forest concession policy and provide useful guidelines for policy analysts, non-governmental organizations, and multilateral lending institutions interested in facilitating this process. A comprehensive rethinking of forest resource contracts will greatly benefit all those relying on the economic development and conservation of forests in Latin America.

Forest Resource Use Contracts in Latin America

This chapter introduces the fundamental concepts of forest resource use contracts for public forests, defines such contracts and reviews their legal basis. Forest use contracts have two principal objectives: economic development and the conservation of forest resources. Designing forest use contracts to achieve those objectives is the subject of subsequent chapters.

Description of Contracts in Government Lands

In general, a forest utilization contract gives a non-public entity the right to harvest and/or manage given resources under general conditions related to maintaining the health and productive potential of the forest. It also defines the payment for using those resources. The Food and Agriculture Organization of the United Nations (FAO 1977) defines a forest utilization contract for woods as follows:

> *...formal permission of the government or a public agency, which entitles an individual, a private company or a public or semi-public corporation, under clearly defined conditions, to the exclusive rights to explore the forest potential, to harvest wood, and/or to manage a specified area of public forest land. Such a contract combines public ownership of land with private or semi-private utilization of the raw material thereon. This kind of arrangement may lead to a partial or complete integration of the production process of forestry and the industrial utilization of wood without affecting the ownership of the land.*

This definition could be broadened to include non-timber forest resource uses as well. Under these terms, the grantor of the utilization contract is responsible for enforcing forest policies. These can include regulating any management requirements, legally protecting the contractee from encroachment on the granted forest land and/or from poaching the resources under contract, and, in some cases, installing and maintaining the necessary infrastructure (such as public roads) used to transport the products extracted from the forest.

Forest utilization contracts are based on the legal status of the property. In much of Latin America, forested land is the property of the government and is generally composed of two types of legal property: the forest itself and the land on which it grows. In those countries where the forest does not have a separate legal identity from the land, extracted forest resources may be defined separately. The property regime, therefore, affects directly the type and scope of a utilization contract for forest resources.

The property rights for land and natural resources comprise a legal property relation that is enforceable by the state. Such rights define the specific set of uses for the land and its resources to which the property holder is entitled. In much of Latin America, the government holds the formal property rights over forest resources, although local populations often exercise customary property rights over those same resources. In such cases, any contractual use of shared forest resources must consider how the rights of customary users may be affected by contracts between the government and other private entities.

Forest utilization contracts differ in their length in time, the size of forest area to be exploited, and the required forest management practices. Generally speaking, the larger an area under contract, the longer the contract period and the greater the management requirements. The terms and conditions of contracts in Latin America vary greatly from one situation to another (see Appendix A).

A contract may be between the government and a private firm, a community, a corporation of private entities, or other groups. There are several elements to be considered in a forest use contract.

- The contract may cover a variety of natural resources, each with its own management utilization and characteristics.
- The objectives of the state may vary according to social, environmental, economic, geographical or other factors.
- The profits from the resource utilization may be shared between the government and the contractee through the use of one or more revenue systems.
- A government may choose to privatize public forest resources to reduce its administrative burden or to increase the efficiency of resource allocation and use.

Forest Revenue Systems

Forest revenue systems are designed to capture the funds generated by the use of public forest resources. These funds are then redistributed through public agencies and may be used for forest regulation and management. The following list of taxes and fees includes the most commonly used ones in the forestry sector of many developing countries.

License fees: this fee is determined administratively and is generally paid as a fixed fee prior to issuing a license for use. The license fee is very easy to administer and offers little opportunity for evasion.

Area taxes: area taxes are similar to license fees but are generally paid on an annual basis and are proportional to the area of land under contract. This fee is administratively simple, with little opportunity for evasion.

Standing timber volume taxes: this tax is based on an inventory of the commercial trees in the area under contract and requires an extensive appraisal of the forest resources if it is to be properly applied.

Per-tree harvest charges: per-tree charges are paid prior to harvest and are generally set as a uniform charge that is undifferentiated by species fails to reflect stumpage value.

Volume charges on extracted timber and non-timber products: a charge applied after scaling and grading extracted timber. These charges are administratively more demanding but, if properly implemented, can more accurately reflect the value of the resources extracted than the taxes discussed above.

Charges for direct services: the most common charge for a direct service is a reforestation tax. Although such taxes should be based on the cost of reforestation services, they are more often based on production. If properly applied, a reforestation tax could fund large-scale nurseries that would supply various forest contractors with the seedlings and technical guidance needed for reforestation. In reality, however, reforestation is rarely implemented in the context of natural forest management in the humid tropics and applying a reforestation tax is generally viewed by loggers as an unnecessary burden.

Charges based on profits: producers and non-extractive users can be charged on their profits, profit-based royalties are derived from the per-unit profitability of forest resource production and can be calculated from a business' profits. Using an income tax in developing countries as a basis for user charges has the disadvantage of having to rely on accurate record-keeping for auditing. Both systems can be used for

non-extractive uses as, for example, in eco-tourism. Eco-tourism operations that have contracts for using a forest can be charged based on or the per-unit royalty for services provided the income tax on their revenues.

Privatization

A forest utilization contract is only one of several possible resource use arrangements for public lands. The government or public agency responsible for forest resources may choose among several options: to utilize and manage the forests itself; to capitalize on the experience and efficiency of the private sector through forest resource utilization contracts; or to transfer the property to private entities through privatization.

Privatization occurs when public forests or forest lands are sold to private entities. In an efficient market, the sale price of private lands should reflect the net present value[1] of the forest's productive capacity or services in perpetuity. Naturally, markets can affect land prices via speculation and other behavior associated with uncertain information regarding the future value of forest land. Privatization can generate revenue from the one-time sale of the property, but it only reflects the current assessment of the long-term value of the forested land. In addition, the government receives income from annual taxes on production and volume harvested. The income flows resulting from these taxes relies largely upon the property regime of the country. It is imperative to acknowledge that a private owner may have no incentive to manage the forest and may choose to liquidate it instead.

Interest in privatization of forest resources in countries such as Peru has been driven primarily by a desire to improve the efficiency of domestic industries. Following the logic of Coase (1960), private property rights are fundamental to market economies since they facilitate the efficient allocation of resources. A growing amount of literature focuses on the role of property rights in natural resource management in developing countries. The common themes in this literature are the relationship between land rights and investment, and the mitigation of possible negative environmental effects.

If forest management is profitable for the private sector, privatization of forests may result in the long-term management of those resources by private entities. However, there are serious financial and silvicultural constraints to long-term forest management in Latin America. Specifically, the nonmarket environmental benefits of privatization (with the objective of promoting long-term forest management) are not realized if the owner clears away the forest. As a result, provisions in the privatization agreement that restrict activities on privatized forest lands will most likely be necessary, especially those that regulate the conversion of forest land to agriculture.

Forest lands can be privatized for uses other than timber extraction. Eco-tourism, hunting and fishing, and non-timber forest products (NTFP) are all possible uses for such lands. For example, land designated as permanent forest may be privatized, with the provision that the new owners only use the land for forest resource management. If such management no longer makes sense for the responsible entity, it may exercise the option to sell the land to another private entity or to the state. Use restrictions on privatized forest should be made in conjunction with land-use planning and zoning.

[1] The net present value of a forest's future productive capacity is the maximum amount one is willing to pay for the sum of financial returns from the forest expected over its lifetime. Such returns are "discounted" according to inflation and risk, reflecting estimated change in currency values.

Protection of Permanent Forests

Whether through contractual utilization or privatization, mechanisms must be established to prevent forest degradation. Three currently used mechanisms are 1) contract renewal provisions, 2) performance bonds, and 3) other liability insurances.

Renewal provisions: these apply to contractual use only. The provisions may include an assessment of the contractee's performance as a forest manager (in terms of forest damage caused during extraction), payment of taxes, reforestation, forest health and productivity resulting from silvicultural treatments, etc.

Performance bonds: a performance bond may be used under both forest utilization contracts and privatization. A performance bond is paid by the private entity that wishes to manage a specified area of forest land. The value of the bond reflects the expected renewable resource value of the forest that could be lost if the forest were improperly managed. This bond remains in public hands until the contractee ceases using the forest and demonstrates that the forest remains in a healthy and productive condition, at which point the bond is returned to the contractee.

Other liability insurances: although the performance bond is the most straightforward liability insurance, more sophisticated systems may be developed. These could include a forestry insurance industry and tort standards for compensating affected stakeholders.

Contract Objectives

There are two general objectives of a forest use contract for public land: economic development, and conservation of forest resources. The success of a forest resource use contract is measured by how well these objectives are fulfilled.

Economic Development

The measurement of economic development is widely disputed, but the most common objectives of economic development are the efficient use of resources for economic growth and equitable access to those resources. The goal of the policies is to promote a multiplicity of competitive economic activities that contribute to a country's overall growth. The standard measure of success for achieving an efficient use of forest resources is the maximization of the net present value (NPV). It is important to note, however, that rarely do estimates of NPV include comprehensive valuation of positive and negative ecological externalities. Admittedly, even incomplete measures of NPV are helpful in determining efficient allocation of resources. In Latin America, where land reform has defined economic history, equitable access to resources begins with land use rights.

The primary constraint to maximizing profits is enforced regulations. Regulations are intended to protect forest resources, but they frequently cause unnecessary economic distortions in the forestry sector. Significant opportunities for maximizing economic efficiency generally exist in areas where the conditions do not require intensive regulation to protect the forest's health.

Equal access to forest resources is often constrained by several factors: the lack of access of local communities to bidding documents and inability manage profitably commercial forest concessions; political corruption in the contract allocation process; and the implementation of norms for exclusive rather than integrated forest resource management. Nevertheless, opportunities exist for alternative forest use contracts that allow local

users to benefit from public forest resources, such as NTFP contracts and integrated commercial/community forest management plans.

Conservation

The measurement of success in forest conservation ranges from the maintenance of forest cover, erosion control, watershed protection, and habitat preservation, to the conservation of biological diversity. The primary constraints to achieving conservation via forest resource use contracts are the lack of regulatory enforcement and scientific knowledge needed to design regulations that are environmentally sound. Forest use contracts need to include conservation set-asides. Other essential elements are the creation of conservation and ecotourism concessions, and the promotion of other environmentally friendly economic activities—specifically those that compliment conservation goals.

Sustainable Forest Management

At present there is a great deal of confusion regarding the objectives of forest resource use contracts. The various definitions of sustainable *forestry* treat economic development and conservation of forest resources as complementary. While the larger objectives of economic development and environmental quality are strongly related, at the level of a managed forest, conservation and economic development may often be at odds. As a result, forestry regulations that are designed under the rubric of "sustainability" often fail to accomplish the goals of either economic development or conservation.

Sustainable forestry plans often focus on the continuous yield of timber from a forest, ad infinitum. In many cases, this approach fails to maximize the net present value of forest resource use (see Appendix C, Forest Economies in Central and South America). Indeed, continuous yield forestry often results in economic loss in the neo-tropics. Economic development might best be served by maximizing the net present value from selective species harvesting in production forests with minimal environmental impact *and* subsequent forest protection, followed by an allocation of public forest revenues to infrastructure, education, health care, and private sector investment in growing sectors of the economy. Failure to understand this concept will result in a continued misdirection of forest resource use policy and in economic failure of many forest use contracts.

Conclusions

In order to evaluate forest resource use contracts, the objectives of the contracts must be clearly defined. The ability to achieve these objectives must be evaluated considering the economic, ecological, political, geographical, and cultural constraints and opportunities. By tailoring the objectives to fit the context of forest use contracts, the potential for their success increases.

Achieving the objectives of conservation through forest resource use contracts is an uphill battle. Both the contracts that suffer economic failure due to the regulations imposed by sustainable forestry and those that succeed due to the evasion of such requirements may result in significant harm to forest health. It is a misconception that economic behavior does not necessarily correspond with forest resource conservation. Conservation must often be addressed as a separate objective.

Constraints to Achieving Contract Objectives

Forest resource use contracts are established in various contexts, including the economic, ecological, and political constraints commonly found throughout Latin America. In particular, the prevailing norms view forest use contracts to be hindered by the following:

- Financial incentives that strongly favor selective logging rather than long-term management in tropical forests that includes investment in regeneration;
- Lack of a technical basis for adequate silviculture in neo-tropical forests;
- Governments that lack administrative capacity and political will to impose sound management; and
- Cultural and social norms that fail to recognize the local users of forest resources.

The failure of resource use contracts to achieve economic and conservation objectives can largely be attributed to one or more of these constraints.

Financial Context of Forest Management in the Humid Tropics

Fundamental to the economics of renewable resources is the *productivity* of the natural resource. Foresters understand productivity to be the volume of timber that grows in a forest. Foresters also understand that productivity can be increased by the use of silvicultural techniques designed to improve the growing conditions for commercial trees and to otherwise manage the health of the forest environment. Such treatments incur costs and are thus viewed as investments whose return will be realized upon the eventual harvest of the trees.

Financing Renewable Resource Management

The first principle of finance is to invest in anything that will provide a positive net return. The net present value (**NPV**) discounting formula may be used to measure the profitability:

$$NPV = \sum_{t=1}^{n} \left(\frac{NCF_t}{(1+r)^t} \right)$$

where $\mathbf{NCF_t}$ net cash flow in year **t**, **r** is the discount rate and **n** is the number of years of the planning horizon until harvest. The financial yield of a forest is a function of several parameters: timber growth rates; timber prices; management costs; extraction costs; and the chosen discount rate. The basic formula for calculating a forest's financial return for one rotation (**T**) was formally derived by Faustman (1849):

$$I = \frac{P(V(1+g)^T - C}{(1+r)^T}$$

where income **I** is a function of product price **P**, product volume **V**, annual growth rate of the forest **g**, rotation time **T**, the cost of extraction **C** at time **T**, and the chosen discount rate **r**. Naturally, the volume increment of growth is not constant over the life of most trees. The Faustman formula has been used to optimize net income generation as a function of rotation of growth declines with age. Annual growth, real price appreciation and

the discount rate have a strong effect on the optimal cutting time. When all factors are considered, the trees should be cut when the proportional rate of growth of their value equals the discount rate (Neher 1990).

The discount rate should be chosen as a representative measure of the return on alternative investments, adjusted for risk. Where alternative investments are available (such as other land use options or the investment of harvest returns in financial markets), the decision to harvest forest resources will be made when forest appreciation is less than the net returns on competing investments (Clark 1976).

Natural forest management is rarely economically viable for the private manager under the conditions prevailing in the neo-tropics. This is not to say that forest management will *never* be economically viable, but rather that forest utilization contracts must take economic constraints into account. With this in mind, expectations should be tempered that private interest exist for long-term forest management and conservation. In the following various factors are analyzed which affect the profitability of forest management. The include interest rates, timber certification and the economist non-timber forest production.

Interest Rates vs. Growth and Price Appreciation

Latin American countries tend to have high interest rates due to public economic policies and to a strong preference for capital in the present (rather than the future), by members of those economies. This combination makes the discount rate a crucial considerations for long-term investments in land use in the region (Schneider et al. 1993). Recently, annual real interest rates in many Latin American countries have exceeded 10 percent for periods of years. As a consequence, long-term investments in natural resource management are discouraged (Costanza and Daly 1990).

Reid and Rice (1997) estimate that annual growth rates of non-temperate natural forests in Latin America range between zero and four cubic meters per hectare, with most between one half to two cubic meters per hectare. The range of annual growth rates is approximately 0.5 to 4 percent. Empirical data from Bajo Calima in western Colombia indicate that many species of trees may require substantially more than 30 years to recover from harvesting, indicating that previously anticipated rotation periods of 30 years or less for natural forest management are unrealistic (Faber-Langendon 1992).

Price appreciation for tropical timber is equally discouraging. Real annual price appreciation for tropical timber from 1950 to 1992 was 1.2 percent (Varangis 1992). According to the FAO (1994), non-coniferous sawnwood prices from Latin America showed a depreciation of 3.74 percent from 1981 to 1992. The supply of non-specialty woods has been abundant in the past, on the global market and shows little or no demand pressure (Vincent 1992; Sedjo and Lyon 1990).

A series of studies demonstrates this point with empirical evidence and simulation models of profitability. Reid and Howard (1994) compared non-managed timber extraction with two alternative management systems for a humid tropical forest in Guatemala. They found that without management the NPV of forest production was 21 to 55 percent more profitable than that of the management alternatives. Hardner and Rice (1994) used a simulation model to test various parameters, such as rotation length, interest rates, growth and mortality rates, and management expenditures. They found that, under normal growth and mortality rates for a managed forest in the Eastern Amazon, the opportunity cost of postponing the harvest of all commercial trees in a stand resulted in a negative return on management investments. Howard et al. (1996) simulated four alternative management systems for the Chimanes forest in Bolivia and found that current unregulated logging is two to four and a half times more profitable for the logger than the potential returns from management. This analysis,

however, does not include in its accounting the rents forgone by the government, nor the value of the negative externalities caused by the unregulated logging operation.

Timber Certification

Timber certification is one possible method to provide a financial incentive for long-term forest management. It is based on a price premium offered by "green" markets (timber harvested in an ecologically sound manner). There are two problems with this approach. First, the financial incentive required to make long-term management profitable is a guaranteed real price appreciation that matches the discount rate used by forest managers. It is unrealistic to assume that the market price appreciation could match the extremely high discount rates affecting forest management in Latin America (Hardner and Rice 1994).

Secondly, the global market for ecologically harvested tropical timber is currently estimated to be less than two-tenths of one percent of the total tropical timber market (Varangis et al. 1995). Even if all tropical timber imported by the United States and Europe were certified, it would only represent 3/4 of 1 percent of the total production of tropical timber (ITTO 1995). The bulk of tropical timber demand comes from producing countries whose domestic markets cannot, or are not inclined to, absorb the green market premium.

Economics of Non-timber Forest Products

Despite bold assertions of the relative economic potential of NTFPs over alternative land uses (Peters et al. 1989; Fearnside 1989; Schwartzman 1989; Allegretti 1990; Grimes et al. 1994), formal efforts to harness these benefits have been disappointing (Browder 1990; Pinedo-Vasquez et al. 1990). Multiple problems plague NTFPs, including production irregularities, inadequate market demand, production and transportation costs, and lack of management experience at the local production level (Flynn 1995). The most significant constraint to relying on NTFPs as a land use option is the pressure from alternative land use activities.

Three examples illustrate this point. Among the most advanced multiple-use integrated forest management programs in Latin America is the Maya Biosphere Reserve (MBR) in Guatemala. The core of the MBR is a protected area, surrounded by a forested buffer zone and multiple-use zone. Among the variety of services and products that the MBR generates, NTFP production is a centerpiece; but due to the low profitability of these activities, NTFP production alone is not a suitable alternative for sustainable socio-economic development of affected local communities (Salafsky et al. 1991).

On the Pacific coast of Ecuador, *tagua* nuts are collected and sold to button manufacturers in Europe and the United States. Collection of the nuts typically takes place in unoccupied and unmanaged forests and its sale supplements local families' income. Tagua is not an especially lucrative product (Southgate 1996), but it is a viable option for income generation among the very few in the area, given the isolation of the producing region from markets and roads. Hardner (1995a) interviewed tagua producers in this region and found that they chose tagua as a second-best activity to clearing forest for more intensive uses that were not possible due to capital constraints.

Natural latex production, or rubber-tapping, is widely held as a sustainable forest activity in the Brazilian Amazon. This activity has also fallen prey to market forces, as national price supports for this product become increasingly important for its viability. The inability of latex producers to compete in the global rubber market is understandable considering the transportation costs, production techniques, and the production limits of the forest to produce natural latex.

Forest Management Techniques

Silviculture is the application of scientific principles of forest ecology to increase the utility of a forest. The utility of a forest can be ascertained from its role in watershed protection, wildlife habitat, recreation, and most commonly, for timber production. Silviculture involves the control of forest structure, process, composition, and regeneration. The basis of silviculture is *silvics*, or the principles underlying the growth and development of individual trees and of the forest as a whole ecological unit. The management of a forest, especially when the objective is to produce timber, requires knowledge of the regeneration mechanisms and growth characteristics of the constituent species in the forest. It also requires an understanding of the dynamics of the whole forest that play out as a result of the interactions between species within the ecological parameters of the forest.

In the neo-tropics, very little is known of the silvics of even the most common native commercial species. Indeed, it is uncommon for a forest owner in the humid tropics of Latin America to be able to name all the species within his forest! A literature search on the silvics of neo-tropical forests quickly demonstrates the scarcity of information available to forest managers in the region. Furthermore, humid tropical forests are generally characterized by a high diversity of species that are mixed in varying levels of stratification—a situation considered by silviculturalists to be among the most difficult to manage, if not simply to understand (Smith 1986). It is therefore not surprising that Poore et al. (1989) found that only 0.1 percent of neo-tropical forests were under management for a sustained timber yield.

What is known about neo-tropical forest ecology is that these forests are generally composed of a stratified mixtures of species, are highly diverse and dynamic, and they depend on disturbances for regeneration. In addition, many species may not exhibit "density dependence," an important regeneration characteristic that determines the resilience of that species to harvesting. All of these factors in combination result in a level of ecosystem complexity that makes the controlled and systematic management methods used in more simple temperate forests extremely difficult to transfer.

The scientific fundamentals of humid forest management in Latin America are currently inadequate to reliably implement silviculture there. Though some experiments in forest management have shown promising results, they are experiments nevertheless, and have a long way to go before they become useful as management models. Regulations that demand forest management plans are therefore unrealistic and are often treated as such by both private firms and regulators alike. Forest policy that aims at promoting silviculture should acknowledge that much of the information and experience necessary to make it happen are either nonexistent or non-transferable between different ecosystems. In the following the impacts of this situation in natural regeneration, increasing the growth and production of forests, and biodiversity.

Natural Regeneration

Disturbances within a forest contributes to the ecosystem's vitality. Disturbances create a dynamic and ever-changing landscape and generate greater species diversity. Although silviculture relies on natural ecosystem dynamics to design its management practices, the harnessing of this dynamism is difficult if it is not well understood in the different vertical strata of the forest. However, a disturbance-prone forest is difficult to study since the forest rarely progresses through all its successional stages during a time period that would allow for its systematic observation.

The factors that drive tropical forest systems are numerous and highly complex, and much attention has been given to naturally occurring forest gaps and the regeneration dynamics within them (Brokaw 1982; 1985a,b). Hartshorn (1990). A common index used for neo-tropical forest dynamics is the interval within which the entire forest regenerates as a result of naturally occurring disturbances (see Uhl 1982; Rankin-de-Merona, et al. 1990).

At Costa Rica's La Selva Biological Station, total forest regeneration was measured as a function of gap formation and tree mortality. The half-life of the forest, as measured by the frequency of gap disturbance occurrences, ranged from 30.9 to 38.5 years (Lieberman et al. 1990). Using the same measure, Terborgh and Gentry (1990) calculate a stand's half-life at Cocha Cashu, Peru, of 40.2 years.

Gaps created by tree falls are not the only disturbances that drive stand dynamics in the neo-tropics. Indeed, many species do not appear to regenerate under conditions provided by a tree-fall gap in the canopy. At Barro Colorado Island, Panama, Hubbell and Foster (1990) found that changes in species composition of that forest were the result of a massive large-scale disturbance. Though frequent disturbances that cause gaps in the canopy are a fundamental factor in the regeneration of tropical forests, they nevertheless do not create the necessary environment for the regeneration and successful recruitment of all the species.

The prize commercial hardwoods of the neo-tropics, such as mahogany (*Swietenia macrophyla*) and Spanish cedar (*Cedrela odorata*), require large gaps and exposed mineral soil in order to regenerate successfully. The large-scale random disturbances that create such conditions include: hurricanes (Lamb 1966; Snook 1993); the movement of large rivers, or "meander" (Salo et al. 1986; Foster 1990; Salo and Kalliola 1991); or other hydrological anomalies such as massive flooding (Gullison 1995). Fire also serves to create the regeneration conditions for a variety of species. Although fire is not very common in undisturbed, closed moist forests, in disturbed, open forests there is an increased fire susceptibility (Uhl and Kauffman 1988). In some regions, such as Central America, fire following hurricanes is cited as an important disturbance (Snook 1993).

The silvicultural implication of these varied disturbance mechanisms is that neo-tropical forests that are currently harvested commercially may require a diversity of special silvicultural treatments to ensure regeneration of commercial species. Unfortunately, both the knowledge of management and funds for research are lacking.

Studies indicate that any reduction in the adult population of a species would necessarily reduce the amount of that species' regeneration. The silvicultural implication of this finding is that populations of commercial species may be susceptible to local extinction by commercial logging unless special silvicultural techniques are developed for different ecosystems.

Examples of selective cutting of only high-value species can be found in the *Proyecto Chimanes*, an ITTO-sponsored experimental forestry program in Beni, Bolivia (Synnott and Cassells 1991; Gullison 1995), and the Quintana Roo Pilot Program in Mexico (Snook 1991). In both of these projects, the standing populations of mahogany and cedar were systematically harvested without any suitable silvicultural treatments to ensure their regeneration or the release of established seedlings in the understory. As a result, the commercial populations of these two species in those areas may never recover. Logging equipment and sawmills has been devoted increasingly to extracting and producing lesser-known and lower-valued species, again with no silvicultural treatment.

Management to Increase the Production of Existing Forest

In Guatemala's Peten region, the regeneration of *xate*, an ornamental plant harvested for export to a lucrative U.S. market, does not compensate for the heavy harvesting of this plant, and formal management systems for xate still do not exist (Dicum and Tariffa 1994; Cabrera-Madrid et al. 1990). In contrast, the harvest of products such as natural latex, chicle, and Brazil nuts is documented as not adversely affecting the natural populations of these species. Simply put, much remains to be learned about the ecology of these species.

Most silvicultural concepts assume an even-aged collection of trees in the forest canopy, with small differences in height. The humid tropical forests of Latin America are better described as having distinct horizontal strata that may be of equal ages and composed of multiple species. Given the difficulty in aging such trees in the humid tropics, it is challenging to discern the stand dynamics that may have led to the formation of these forests. In his authoritative text, *The Practice of Silviculture*, Smith notes:

> While the concept of the stratified mixture was originated in these complex tropical forests, neither it nor any other mode of interpretation has led to any universally satisfactory silvicultural procedure. With such complexity it is logical to suppose that a large number of procedures, many of them yet unimagined, will be developed. Much of the more theoretical kind of silvicultural and ecological thought has always gravitated toward the perpetuation of the very complicated "primary" or climax forests of evergreen broad-leaved species on those sites that are biologically the most favorable. It must be recognized that there is no silvicultural magic that will enable such forests to be harvested and regenerated without altering them in some degree. This has not happened with any other kind of forest. There are all sorts of reasons, including the guidance of silvicultural practice, to safeguard significant areas of old, natural forests as areas of vegetation that are simply preserved and not treated. There have been many efforts to achieve natural regeneration by partial cutting in these forests but so far success has been achieved only in somewhat exceptional cases. (Smith 1986)

Lack of Forest Management Techniques

Silvicultural methods remain to be developed for the long-term management of commercial species in humid neo-tropical forests (see Boot and Gullison 1997). This statement runs directly counter to the flurry of literature produced in this decade in support of "sustainable" forestry (e.g., Johnson and Cabarle 1993) and to nonprofessional interpretations of the results from the CELOS forest management project in Suriname, the von Humboldt project in Peru, and other forest management experiments.

Current forest management in much of Latin America can be categorized as multi-cyclic selective harvesting systems with no basis in silvicultural principles. The result of this type of management is a progressive “high-grading” of the forests that begins with first extracting the very highly-valued species such as mahogany and Spanish cedar, then eventually turning to lesser-known hardwood species or even "secondary," early successional species. The latter are easily regenerated to produce lower quality wood for such uses as construction (Brown and Lugo 1990). Once the selective harvesting of the small number of high-valued species is finished and the demand for the lower-valued wood does not support production and transportation costs, commercial logging stops.

Other acclaimed forestry experiments in Latin America have succeeded in minimizing damage during harvest and have increased the growth rates of existing commercial trees, but they are still a far way from managing the regeneration and stand dynamics of specific species. Perhaps the most often cited programs are the CELOS

Management System in Suriname, the *Instituto do Homen e Meio Ambiente na Amazonia* (IMAZON) experiments in the Eastern Amazon, and the Tapajos National Forest. All of these programs have done an excellent job of systematically reducing logging damages and controlling harvests. The CELOS and Tapajos projects demonstrated significant increases in the growth rates of commercial species through thinning operations (DeGraaf 1990; DeGraaf and Rompaey 1986; Silva et al. 1995), and the IMAZON project may soon conduct similar experiments. However, none of these programs has been financially attractive enough for commercial management, and therefore are yet to be implemented by the private sector.

Much attention was drawn to the operation of *Carton de Colombia*'s concession in Bajo Calima, Colombia, where a sophisticated clear-cutting technique was utilized for the production of cellulose. This project was touted as an example of sustainable forestry (Johnson and Cabarle 1993). The concession was abandoned due to regulatory problems long before the silvicultural system could be tested, but studies by the Missouri Botanical Garden indicate that *Carton de Colombia* vastly overestimated forest regeneration (Faber-Langendon 1992). The company planned to harvest each clear-cut area every 30 years, but evidence suggests that 90 years would actually be required to replace the biomass removed by the first harvest. Furthermore, if *Carton de Colombia* harvested every thirty years, many species would be eliminated from the local population due to their inability to reestablish themselves in so short a period of time. The formal knowledge about NTFP extraction is even more sparse than that of timber. Several studies indicate that long-term management plans for many NTFPs are lacking, while many result in the decrease of commercial populations of these species (Hall and Bawa 1993).

A recent FAO survey of natural forest management throughout Latin America concluded that:

> ...notwithstanding all the numerous research and development projects undertaken here and there in Latin America, in most of the countries tropical forest management exists only in theory, and has practically never been put in practice in the field, though governments require submission of a forest management plan before issuing a logging permit. (FAO 1993)

Biodiversity Impacts

Another important perspective on forest management and logging is their impact on biodiversity. Although a great deal of international attention has been focused on the conservation of biodiversity, we remain woefully ill-informed about the ecosystem dynamics that regulate diversity especially in the humid tropics and the effects of such ecosystem manipulations as timber extraction and forest management. Indeed, very little is known about the detailed species composition of most tropical forests. The discovery of new species, for example, is commonplace in virtually all taxa, including those, such as primates, that have been heavily studied. In Brazil alone, six new species of monkeys have been discovered since 1990. For the bulk of species described so far in tropical forests, the abundance, population distributions, life histories, habitat requirements, and responses to natural and man-made disturbances are completely unknown. In short, there is little scientific basis for the development of management plans to ensure the conservation of biodiversity within the context of timber production in tropical forests.

What is known, in general terms, is that timber extraction can significantly impact forest ecosystems, such as the forest canopy. For species dependent on high density of trees for habitat, this change in forest structure can be every bit as dramatic as converting the forest to pasture. Studies in temperate forests indicate that some species dependent on old growth for a portion of their life cycle, can nevertheless survive in a managed forest, provided that it is in sufficiently close proximity to a relatively undisturbed forest. How these findings relate

to species conservation in the tropics is only beginning to be addressed in scientific studies. In view of our ignorance, however, the retention of significant areas of undisturbed forest in and around areas devoted to logging would appear to be prudent if conserving biodiversity is an objective of forest policy.

Political and Regulatory Constraints

The implementation of good forest policy is also constrained by governments that lack the administrative capacity and political will to enforce forestry regulations. On paper at least, Latin America has sophisticated and rigorous forest management requirements governing the design of forest management plans, the volume and diameter limits for extracted timber, reforestation practices, and tax obligations for forest resource users. In reality, however, it is often difficult to discern whether forest resource use is governed by much other than the contract holders' business management decisions. The enforcement of forest regulations is further weakened by possible corruption among inspectors, inadequate staffing and resource allocation for enforcement, lack of technical expertise to determine whether management plans submitted by contract holders are valid, viable, or being executed properly, and a lack of political accountability to people who are affected by the misuse of forest resources.

However, despite the many advantages to forest resource contract holders that result from the lack of regulatory enforcement, these parties often suffer from the inability of the government to maintain its contractual obligations. Contracts often explicitly guarantee state-assisted reforestation programs, and implicitly guarantee infrastructure support as well as the enforcement of land-use regulations that prevent colonization on forest areas under contract with a private firm. For many of the forest resource use contracts, such obligations are not met by the accountable government agencies.

Tax revenues from the contractual utilization of forest resources are essential for the provision of the services by the government, but are often mismanaged or not collected properly. The common problems experienced with revenue systems in Latin America are: (1) fees and taxes are too low to fully capture the potential funds from forest use contracts; and (2) most of the revenue systems are administratively complex and costly to operate. For example, in Peru, the *Camara Nacional Forestal* (CNF) argues that state reforestation taxes have rarely been used for reforestation (Razetto 1996). The CNF argues that if reforestation is to occur, private firms will either have to pay for it themselves, in addition to the fees already paid to the state, or eliminate the tax altogether and place reforestation into private hands. In Colombia, the large industrial concessions of *Carton de Colombia* and *Pizano* were permanently abandoned because the government did not control colonization on the land under contract (Rodriguez 1996). Without the proper realization of basic government functions (such as enforcing regulations), it is difficult to imagine a successful forest sector in any country.

Whether such problems can be remedied is doubtful given the current level of responsibility assigned to governments and the limited resources it has to execute its duties. Recent efforts to re-design forestry bureaucracies in Bolivia and Suriname revealed that the proper management of public forest resources would require management agencies whose size far exceeded their revenue-generating capacity and could possibly dwarf all other government agencies. Without an adequately staffed, technically sound, and properly equipped forest authority, the breakdown in enforcement that is witnessed in many regions of Latin America will continue to occur.

Constraints Due to Property and User Rights by Local Communities

Local uses for forest resources are often overlooked in the design of national-level forest policies. Utilization contracts that protect the usufruct rights[2] of local populations are uncommon (Davis and Wali 1994). Land-use conflict most often erupts when property rights are not clearly defined. This is particularly common for indigenous groups and customary users of forest resources such as the Brazilian rubber tappers.

However, the definition of property rights is often complex. When resource use contracts provide for the exclusive use of a resource, they often neglect the non-timber and fuelwood resources that local populations use from these forests. Another example is found in small-scale agricultural clearings that unofficially occur in areas under forest concessions. Additional complications may occur in new activities such as when botanical resources are extracted for pharmaceutical purposes. In those cases intellectual property rights be included in forest resource use contracts.

When land-use conflicts erupt as a result of poorly delineated property rights or delimitation of borders, then forest resource use contracts are placed in jeopardy. The key to resolving such conflicts is to acknowledge that local users hold usufruct rights that must be respected if land-use conflict is to be avoided. Unfortunately, it is rare that these usufruct rights are respected or even perceived by commercial users (Hardner 1995b).

The economics of NTFP production for national and international markets has not been promising, but the potential for the production of a variety of goods in the future may warrant the inclusion of NTFP in forest resource use contracts. Nevertheless, these are other obstacles in addition to low demand or prices of potential products. The Extractive Reserves Project in Brazil provides evidence that one of the greatest barriers to success is deficient organization among NTFP producers.

Hunting and fishing activities may also warrant the allocation of a contract, especially where managing wildlife for local populations is necessary (TCA 1994b). Experience to date indicates that eco-tourism has a great potential for revenue generation in certain limited areas with natural points of attraction, with adequate infrastructure, political stability and personal security for tourists. The potential for eco-tourism sites in Latin America should not be overestimated in terms of geographical extent. However, where suitable areas exist agreement should be established for their sustainable use and management.

Conclusions

Forest policy planning must reckon with the various constraints to achieving economic and conservation objectives through forest resource use contracts. If forest policy objectives take account of the constraints in a particular area, then forest use contracts may be successful. The next section presents case studies that exemplify such constraints and offer some opportunities for revising forest use contracts.

[2] The customary informal right to utilize parts of a resource.

Case Studies

The following five cases illustrate the constraints and opportunities for forest use contracts in Latin America. In the first case, Peru's proposal to replace the system of public forest resource use contracts with a privatization plan reveals innovative opportunities to resolve constraints of the government to administer forests but also demonstrates the dangers of overlooking financial and silvicultural constraints. The second case illustrates how economic efficiency and conservation are achieved in Bolivia, despite regulatory failure. The third case describes an innovative alternative forest use model in Colombia that integrates commercial forestry with satisfying the needs of local communities and individual users. This model satisfies the dual objectives of economic development for local users, as well as logging activities for the commercial timber sector. The last two case studies analyze programs for extractive reserves in Brazil and for eco-tourism in Chile.

Peru: Privatization and Public Participation

Public Forest Use Contracts

Peru is estimated to have 68 million hectares of natural forest. Of this total area, more than one million hectares are currently under contractual utilization, and are regulated by the most recent (1975) forest law. Under this law, forest utilization contracts fall into two categories:

Bosques de Libre Disponibilidad: ten-year renewable contracts for areas of 1 to 100,000 hectares, with management plans required for contracts of 1,000 hectares or more; and
Bosques Nacionales: contracts for areas of 20,000 to 200,000 hectares, with management plans required for all contracts.

The total area of outstanding contracts in *Bosques de Libre Disponibilidad* is approximately one million hectares. Contracts for large areas in *Bosques Nacionales* total 220,000 hectares.

Despite the requirement of forest management plans, the majority (approximately 90 percent) of forest utilization (as calculated by area and volume extracted) occurs in contracts of less than 1,000 hectares (Romero 1996). According to the forestry faculty at the *Universidad La Molina* in Lima (Ojeda 1996), the allowance of small-scale forest contracts without management plans is responsible for the degradation of Peru's forests and the lack of forest management in the country. Utilization contracts for areas of less than 1,000 hectares have been more common under the 1975 forest legislation. This is mainly due to the paperwork requirements and correspondingly long delays (often as long as seven years), associated with utilization contracts for larger areas that require management plans (ibid.). Despite the tedious process involved in approving management plans for these larger concessions, the poor state of silvicultural knowledge has limited their success. Often the plans are not even tailored to the actual forest under contract, due to the costs of preparing large management plans (Romero 1996).

In 1990, the *Canon de Reforestación* was passed, requiring that a volume tax be administered on forest utilization contracts also with areas of less than 1,000 hectares. The funds were to be invested in nurseries and technical reforestation support for small forestry operations. To date, little has been accomplished with these funds, possibly because of disruptions caused by *Sendero Luminoso* (a revolutionary group) and by management problems in the administering agency (Razetto 1996).

The most common complaint that contractees have had about the governments' compliance with the agreements has been their propensity to revoke concessions in order to allocate that land to colonization projects. Strong precedents for usufruct rights have been established, thus allowing informal colonists to take over many forest lands that were under contract between private firms and the government (Brack 1996). The result of this government behavior has been a loss of faith by contractees (Ojeda 1996), and a corresponding reduction of investments in managing forests and processing forest products.

Privatization of Public Forest Lands in ***Peru***

In 1993 the Peruvian constitution was rewritten, in large part reflecting the economic reforms of President Fujimori. Privatization of public entities and the allocation of private property rights shaped the new constitution, including the *Ley de Tierras*, that establishes clear private property rights for individuals, including indigenous peoples, and the *Ley Forestal*, under consideration of the time of this writing (December 1197), which will provide private property rights for forest lands. In this case study we examine proposals for the *Ley Forestal* and analyze how they address the various problems of forest utilization contracts in Peru under current law. The proposals merit praise for their innovative approach to solving the political problems of present forest policy, but the economic and ecological constraints to forest utilization contracts on public forest lands are still not adequately addressed. If the long-term objectives were clearly stated for the proposed production forests of Peru, the presence of these constraints would become more apparent; but, as currently stated, the objectives are hazy and forest policy debate is still tightly focused on the political constraints to successful commercial forestry.

BOX 1

Consultations on a New Forest Law

Multiple proposals for a new forest law have been submitted by one or more stakeholders involved in forestry concessions. These proposals present legal and administrative mechanisms for correcting the problems that currently affect their interests. In some cases, multi-stakeholder processes were implemented in an attempt to draft proposals that would coordinate the interests and concerns of disparate groups (Hidalgo 1996). The fundamental advantage of these stakeholder processes is the avoidance of formal legal and political disputes once a proposal is made into law. However, a common complaint is that few stakeholders are ever entirely satisfied with the final product (Suarez 1996). The major issues of concern for the principal stakeholder groups are summarized in Table 1.

Table 1. Stakeholder Issues

Stakeholder	Concern
Forest industry	Security of accessing resources Acceptance of forest investment as collateral Limitations on usufruct rights of colonists Administration of a reforestation tax

Stakeholder	Concern
Government	Utilization of forest resources Conservation obligations from the UNCED Conference and international conventions (biodiversity, climate change, CITES) Protection of indigenous peoples rights on land
Indigenous groups	Protection of indigenous peoples rights on land
Local users	Security of accessing resources, usufruct rights
Conservation NGOs	Protection of biodiversity, sustainable forest management

Privatization of Forest Resources

The central focus of proposals for the new *Ley Forestal* is the privatization of public forest resources. The mode of implementation and regulation of privatization will reflect not only the ultimate importance of stakeholder concerns, but also the constitutional restrictions on privatizing national forests.

Privatization is sponsored strongly by two stakeholder groups in particular: the government and the forest industry. The government views privatization as a means of improving the efficiency of forest resource utilization and of reducing the administrative burden of publicly managing the expansive public forest resources. The forest industry supports privatization because it increases the security of access to forest resources and the industry would like to see a better administration of forest utilization contracts and forest tax revenues by the government.

To a lesser extent, other stakeholder groups have favored privatization as well. Some conservation NGOs believe that secure resource access could lead to more financially attractive forest management, thereby providing private firms with a vested interest in maintaining forest cover. Opposing conservation groups see privatization as a giveaway for private industrial forest resource users. These groups see no merit in privatization and would prefer continued government regulation of public forests, preferably with regulatory reforms.

Local users of forest resources have supported privatization to the extent that forest land rights might be allocated to them, though many indigenous peoples are less affected by the *Ley Forestal* than by the *Ley de Tierras* that makes indigenous land holdings divisible and alienable (transferable to another's ownership). Some groups fear that Peru's indigenous peoples will lose the security of their land holdings through the actions of individuals who will capitalize on (or be exploited by) the alienability of indigenous lands (Garcia 1996). By granting private property rights over forest lands, well-capitalized industry may be more likely to acquire transferable indigenous forest lands.

Despite the heated debate concerning privatization, the 1993 Constitution does not permit the private ownership of natural forest. Although land rights may be held for forest lands, the trees and other vegetation itself remain public property. This obviously restricts any plans for privatization, but it may provide a means of slowing

down a privatization process. Private entities acquire the rights over forests created through plantations rather than over natural forests. Trees planted as part of a reforestation program are the property of the entity that planted them. With time, a natural forest could be transformed into a fully managed forest which, by virtue of silvicultural investments, would eventually become private property. The merit of this system is that the transfer of property rights would require a substantial demonstration of forest management on the behalf of the private entity. Unfortunately, there are no legal restrictions that would prevent a managed natural forest from being cut in order to become a forest plantation: a substantial concern when considering the implications for conservation of biological diversity (Hubbell and Foster 1992).

What Has Been Proposed

The prominent themes in the proposals relating to privatization are summarized as follows:

- zoning of forest lands for permanent forest estates, protected areas, indigenous lands, and local use;
- gradual allocation of property rights over forest land to those who show evidence of management investments;
- creation of management units by small producers in areas determined as permanent forests; and
- transfer of forest lands between private entities or to the state.

One proposal recommends that permanent productive forests in Peru be zoned to cover an area of approximately six million hectares (Razetto 1996); the others 33 million hectares of commercially viable forest would remain unutilized. This type of zoning of forest lands is a concept that may have been overlooked in the past (Brack 1996). By defining areas of permanent forests, protected areas, indigenous lands, and lands for local use, three major objectives are met. First, by zoning according to land use potential, natural resource utilization and agriculture may occur in more appropriate areas. Second, land use conflict should be reduced if planning precedes both colonization and resource utilization activities. Third, areas with environmental or ecological importance can be identified for protection before usufruct or other rights impede the establishment of protected areas.

The gradual allocation of property rights is intended to provide private entities an incentive to invest in forest management, especially reforestation. Forest resources extracted from the natural forest would be subject to public fees and regulation like any other public resource. However, forest resources that were the product of management (indicated by a investment by the private entity), would become private property and represent that entity's interest in the long-term management of the forest. Once the private property right is established, the utilization of these resources would incur no public fees and would be under no regulation other than the stipulation that the forest not be converted to agriculture or other uses. A major limitation of this proposal is that while the lack of property rights may be an obstacle to investments in reforestation (as noted above), privatization in itself is not likely to make these investments financially attractive in the context of Peruvian humid tropical forests because of the low market value of most planted timber species. In addition, even where such investments are encouraged by a transfer of property rights, there is no clear legal basis in the current proposal to distinguish between natural forest management and plantation forestry.

Forest management units have been proposed to improve the access of small producers to forest resources and to develop economies of scale for services such as reforestation, road building and maintenance. These units would be composed of several private entities with contiguous forest land holdings. Each management unit would be responsible for collecting fees from its member on a regular basis and using those fees for the management activities. These units would effectively replace many of the current responsibilities of the state.

The management unit concept allows entities that are too small to provide technical and marketing services themselves. In addition, because the management units are distributed over several small holdings, they effectively dispel the concern that privatization could create forest *latifundios* (large estates).

The objective of the transfer of forest lands between private and public entities to ensure that land is allocated as efficiently as possible. If private forest management proves unprofitable, then forests will fall back into the hands of the state. The merits of allocating resources using a market mechanism are obvious. A more interesting issue is the transfer of property rights for unprofitable forest lands back to the state. This transfer is likely to incur a cost to the state to compensate the private entity for investments made in forest management (Razetto 1996; Suarez 1996).

The compensation rate is likely to become the subject of negotiation. It will probably be a percentage of the investment in order to prevent practices wherein the government would be "insuring" management investments by guaranteeing to repurchase the property in the event the entity fails to manage it properly. Establishing a market between the private and public sector for forest lands will facilitate the valuation of forest management investments and discourage government revocation of forest lands without, at least, proper compensation -- a major issue for the private sector. An easy reversion of forest property to the state could also result in no investment in forest management, but rather mere exploitation, followed by a transfer of valueless property to the state. The prospect of compensation may also give rise to exaggerated claims of management expenses or result in that investments are made not in the interest of management, but simply to discourage repossession by the state.

Conclusions

The efforts to design a new forest law in Peru must be commended for their innovative approaches. The routine appearance of proposals presented by different stakeholders represents a significant step towards consensus-oriented decision making. It also heralds a recognition by the traditional players and all those affected by forest policy that they must work together towards common goals. Their efforts to reduce the role of the government in the forest sector through privatization addresses the issue of deficient regulation and enforcement of forest contracts in Peru.

What remains to be demonstrated is the viability of forest management on these lands. In no way does privatization affect all the silvicultural and economic limitations that constrain the management of tropical forests. Nor would privatization necessarily lead to a greater protection of non-market resources such as biodiversity. Secure resource access could merely encourage more investment in extraction that will in turn facilitate the exploitation of the natural forest. In the "worst case" scenario, forest privatization could lead to the further degradation of Peru's tropical forests.

Bolivia: Industrial Forest Use and Conservation

Bosque Chimanes

The Chimanes region occupies an area of 1.4 million hectares in the Amazon Basin of west-central Bolivia. This region includes the 422,000 hectare Chimanes Permanent Production Forest, the 81,000 hectare Beni Biosphere Reserve, the 392,000 hectare Chimanes Indigenous Territory, the 355,000 hectare Multi-Ethnic Reserve, and the 130,000 hectare Yacuma Regional Park. Bosque Chimanes is classified as a humid forest with an average precipitation of 2,180 mm and four to six dry months per year.

Industrial Forest Use Contracts in Bosque Chimanes of Bolivia

The case of *Bosque Chimanes* illustrates many of the difficulties encountered in the efforts to employ forest use contracts to encourage long-term management in primary tropical forests. In this case, light selective harvesting, or extensive forest management, prove to be both efficient and of relatively low impact despite failed regulatory oversights. It is an example of both the ineffectiveness of controls in a typical remote forest concession, and the relative insignificance of their absence. This case study demonstrates the opportunity for other countries with similar characteristics to achieve the objectives of economic efficiency and forest conservation in areas where government oversight is limited.

BOX 2

In 1986, two logging firms established themselves in Bosque Chimanes to extract mahogany which is the species of highest commercial value. In 1987, the Programa Chimanes was created to implement a model of sustainable tropical forestry for the Amazon region; and in 1988 it was chosen by the International Tropical Timber Organization (ITTO) to be funded. By 1990, six major logging concessions were established in Bosque Chimanes under the guidance and regulation of the program.

Fourteen indigenous sub-groups reside in Bosque Chimanes. The largest of these sub-groups are shown in the table below.

Table 2. Indigenous Populations in *Bosque Chimanes*

Indigenous Group	No. of Inhabitants
Mojeno	2,188
Chimanes	2,170
Yuracares	181
Movimas	28
TOTAL	**4,567**

Failure of the Sustainable Forestry Management Plan

Forest management in *Bosque Chimanes* was subject to both national regulations (promoted by the former *Centro de Desarrollo Forestal* – CDF), and local guidelines (designed and enforced by the *Programa Chimanes)*. Due to the lack of silvicultural knowledge about mahogany, an approximation of silviculture was devised that preserved a minimum density of seed trees and guaranteed a second harvest by leaving smaller trees behind. The management plan for the region also required the extraction of lower-valued species to eliminate reliance on a single species (mahogany), and to generate interest in managing these forests for multiple species. The success of this management plan relied on four factors: 1) adhering to the terms of forest utilization contracts and regulations; 2) presence of a significant population of small trees of commercially valuable species for future harvest; 3) natural regeneration of commercial species for future production; and 4) economic incentives to adhere to the management plan. Unfortunately, the project has failed in each factor.

Regulatory guidelines for *Bosque Chimanes* allowed the harvest of selected trees above 80 cm. diameter and a maximum total annual area and volume of harvest for each of the six concessions to allow a 30-year rotation. In addition, all harvested trees were to be approved and marked for extraction by an officer of the *Programa Chimanes* prior to cutting.

Despite such careful planning, the reality of the harvest within these concessions more closely resembled a maximized extraction of mahogany rather than a planned and controlled harvest of a wide variety of species. The majority of wood extracted from *Bosque Chimanes* is mahogany, followed at a distant second by cedar and some other species. This practice results from the high value of mahogany relative to other forest species. Since the initiation of the management plan, extracted volumes and harvested areas have greatly exceeded those intended by the management plan (Synnott and Cassells 1991). The marking of harvestable trees by project technicians often included trees below the 80 cm. diameter limit and failed to provide the minimum amount of seed trees indicated by the management plan. In some cases logging included unmarked trees (Gullison 1995). This lack of compliance to the contractual clauses may be explained by weak or non-existent enforcement mechanisms combined with understaffing and possible corruption. However, the underlying cause is most likely a lack of political will on behalf of policy makers to enforce the regulations.

One year after the official beginning of the project, it appeared as if the commercial population of mahogany would be depleted in short order. By 1995, the entire harvestable population of mahogany was exhausted in at least one concession (Gullison 1995).

The stand structure of mahogany in *Bosque Chimanes* reflects its disturbance-driven regeneration characteristics, resulting in stands of even-aged trees. Statistical analysis of the stand structure in *Bosque Chimanes* indicates that very few mahogany trees actually exist in diameter classes below 80 cm., thereby making this diameter limit of little use in ensuring a second rotation (ibid.). In addition, according to studies the regeneration of mahogany in *Bosque Chimanes* relies on large hydrological disturbances, a process that does not correspond with the availability of seed trees. Gullison (1995) found that after logging, the population density of mahogany was reduced from 0.25 trees per hectare to 0.036 trees per hectare and that seed trees were generally with low fertility. Gullison concludes that this reduction in the density of mahogany had dramatically reduced the probability that mahogany seedlings would become established in gaps generated by natural but infrequent hydrological disturbances.

Another inherent weakness of the management plan was its lack of financial logic. The greatest source of resistance to adopting the management plan was its impact on company profits. Given the high value of mahogany, combined with prevailing interest rates and low tree growth and projected price appreciation, loggers have a strong incentive to clear the standing mahogany as quickly as possible. Howard et al. (1996) found that the net present value of current practices that do not adhere to the management plan is much greater than that with simulated management plan designed to promote regeneration of mahogany and extract a greater variety of species. They conclude that the voluntary adoption of long-term forest management practices by concessionaires in *Bosque Chimanes* is unlikely given the financial disincentives. The lack of regulatory enforcement in the area demands that private agents be motivated by other means (especially by financial returns), to manage the forest. In the case of *Bosque Chimanes*, such incentives have not existed.

Failure of the Revenue System

Concessions in *Bosque Chimanes* are subject to several fees, as described below:

Derechos de Monte: a fixed fee paid per cubic meter of roundwood extracted, payable to the CDF. The volume of roundwood is back-calculated from the volume of sawnwood that leaves the sawmill. This is the primary revenue vehicle for the CDF.
Pago para Plantaciones Forestales: a fixed fee set equivalent to one-half the value of the *Derechos de Monte*, paid to the *Programa Chimanes* to reforest logged areas.
Regalias: an 11 percent royalty on the profit margin; it is based on market prices in the Departmental capital. This tax is paid to the regional economic development agency.
The total fees and royalties paid for mahogany and lesser-valued species are shown below in Table 3.

Table 3. Royalties and Fees for Selected Timber Species

Species	Sum of Fees and Royalties ($/cu.m.)
Mahogany	21.25
Cedro	17.67
Almendrillo	17.30
Verdolago	15.46
Roble	14.70
Bibosi	13.06
Ochoo	13.06

In theory, the revenue system should capture funds generated by the extraction of timber from the natural forest. In practice, Rice and Howard (1997) found that only a small percentage of the fees were collected. Instead, the bulk of these monies accrued to companies as windfall profits.

Failure to Define Resource Rights

In 1990, hundreds of indigenous residents of *Bosque Chimanes* marched 650 kilometers to La Paz to protest the designation of their lands as a forest reserve, and later, the allocation of timber concessions on their lands. In response to this march the Bolivian government enacted Supreme Decree No. 22611, which limited future forest concessions in *Bosque Chimanes* and protected indigenous lands from third parties. With the assistance of the Amazon Cooperation Treaty (TCA 1994a), indigenous lands were demarcated and a policing system was designed that involved members of the indigenous communities.

Despite the decree and the assistance of the TCA and NGOs, the indigenous lands in *Bosque Chimanes* have been aggressively harvested for mahogany by third parties. The diminishing supply of accessible commercial mahogany on these concessions has generated a great pressure to use the indigenous lands as a supplementary source of timber. Independent loggers commonly entered the indigenous lands to cut trees for the big concessions. According to a report by CIDDEBENI (Center for Research and Documentation for the Development of Beni 1995), as many as 300 chainsawers were registered in a nearby town, San Borja, presumably to work on indigenous lands. Access roads skirt the indigenous lands and skid trails enter the

indigenous territories in many places as a result of harvesting trees on these lands.

In 1992, 2,800 trees illegally felled by chainsawers in the Multi-Ethnic Territory were auctioned to two of the six concessions in *Bosque Chimanes*. The auction served to legitimize the sale of illegally felled timber and eventually led to the sale of 3,130 additional trees in 1994 alone. Despite the prohibition of these transactions by the forest law, the CDF approved each of these sales (CIDDEBENI 1995).

This breakdown in forest utilization contracting and in regulating resource rights has resulted in great animosity between the various groups in the region. These failures are the consequence of inadequate resource rights allocation and enforcement in the *Bosque Chimanes* from the outset.

Conclusions

Many lessons can be learned from *Bosque Chimanes*. First, its regulations have been more of a burden on industry and government than an aid to sustainable forest management—successive high-grading occurred despite the regulating agency's efforts to control it. Second, even if the administration of *Bosque Chimanes* had been perfect, the ecological basis of the forest management plan was inadequate. Third, the lack of property rights delineation at the outset of the contract design led to unnecessary conflicts.

Despite these failings, the overall damage to *Bosque Chimanes* was rather limited. The light selective extraction of commercial species occurred at a very low density and resulted in limited damage to the forest cover (Gullison and Hardner 1994). The objective of conservation through forest management was achieved in spite of the failed designs of the regulating agency to achieve this objective. In addition, the extraction of timber was more efficient than would have occurred had loggers left abundant commercial trees in the forest for future harvest. If efficiency and conservation were the objectives for the management of *Bosque Chimanes*, they could have been achieved at much less cost and effort on behalf of the regulating agency through the use of limited, effective regulatory tools, such as those discussed in the following section.

Colombia: Commercial Forestry and Community Needs

Recent History of Forest Concessions in Colombia

Forest policy in Colombia is in a transitional phase. With the establishment of a new Ministry of the Environment, a new set of guidelines for forest resource utilization on public lands is being created, and a technical staff to facilitate this transition is forming. The new forest policy will revise the current concession paradigm by the following means:

- Acknowledging corporations of small producers;
- Creating stringent concession renewal terms;
- Establishing new revenue systems;
- Devising new forest resource allocation systems;
- Setting new standards for industrial processing; and
- Developing regional parameters for forest resource management.

The Ministry of the Environment concedes that the Achilles' heel of the new forest policy is the persistent lack of knowledge regarding the silviculture and ecology of the nation's forests (Cifuentes 1996).

The Pizano S.A. Industrial/Community Interface in Colombia

Pizano S.A. is one of Colombia's largest commercial producers of wood. This case study examines an innovative program of Pizano S.A. to integrate local populations into forest management for commercial-scale wood production. The history of forest resource use contracts in Colombia that led to Pizano's initiation of this project is characterized by conflicting commercial and local forest resource use. The Pizano model satisfies the dual objectives of economic development for local users as well as profits for the commercial timber sector. It does not address the objective of conservation of biological diversity, as forest management for the two chosen purposes will result in the simplification of the forest ecosystem to produce select, fast-growing, commercial trees

BOX 3

The new forest policy will replace the old forest concession system established in 1974 by Decree No. 2811. Under the 1974 forest concession system, five types of forest utilization contracts are available:

1. Extraction permits for local users limited to 20 m^3/year, with no management plan required;
2. Extraction permits between 21 and 200 m^3/year for 10 years, with no management plan required, and technical assistance available from the government;
3. Extraction permits between 201 and to 2,000 m^3/year for 10 years, with a technical extraction plan required;
4. Extraction permits between 2001 and 10,000 m^3/year for 10 years, with technical extraction and management plans required; and
5. Concessions of unlimited size requiring a sophisticated management plan.

Concessions have not been granted during the last 20 years due to the inability of applicants to provide a suitable management plan, except for *Carton de Colombia*. It was granted a 30-year concession on 61,000 hectares of humid tropical forest with a projected production of 80,000 m^3/year of mixed hardwoods for pulp. The concession was initiated in 1974 and rapidly became recognized for its innovative extraction and management methods, which included clear cutting and natural regeneration of mixed species. An environmentally friendly aerial cable system was designed for removing cut timber in steep terrain.

Carton de Colombia was cited as an example of a promising sustainable forestry initiative by Johnson and Cabarle (1993). Unfortunately, the concession was abandoned due to the hihg cost of production and the uncontrollable occupation by colonists of production forest lands within the concession. *Carton de Colombia* now relies exclusively on plantation forests of eucalyptus and pine on private lands in the Andes. The failure this concession is an example of the financial and regulatory difficulties that have plagued forest utilization contracts in public lands in Colombia.

The Pizano S.A. Project

The history of Pizano S.A. is also one of a shift from natural forest utilization contracts with the government to private plantations for the supply of timber. The company relied for years on public forest land through extraction permits, but increasingly was plagued with land conflict from colonization (Rodriguez 1996) and customary rights disputes with indigenous groups (Espinosa 1996). Pizano’s shift towards plantation forestry

on private lands is balanced by an innovative project aimed at organizing local users and small land holders to commercially produce timber on an industrial scale.

In the Pacific coast state of Choco, Colombia, the population of descendants of freed African slaves holds communal property rights over forest land (*Ley 70*). Pizano S.A. believes these forests to be very productive, and contends that it has developed a viable silvicultural system for producing *ceiba roja* (*Bombacopsis quinata*), *gmelina* (*Gmelina arborea*), and *camajon* (*Sterculia apetala*) on these lands. Much like the *ejido* system of southern Mexico, industry can enter into an accord with the community in order to utilize their forest lands. Pizano S.A. is entering into such accords with the intention of integrating the local use of the forest into a timber management plan in which local users will maintain a vested interest in management. In return, Pizano S.A. will compensate the local "forest managers" by paying them on the basis of the annual growth increment of the commercial species in their management units. Pizano S.A. itself will benefit from the final harvest and use of the timber produced on this land.

What is interesting about this plan is that it directly addresses several of the traditional problems in forest utilization in Latin America in very innovative ways. For example, it avoids the exclusive use of the land for only one purpose by producing timber concurrently with many non-timber and non-commercial timber products and forest services. This integration has multiple benefits, such as increasing the economic value of the standing forest by broadening its productivity and addressing the economic equity concerns of exclusive land use. It can also serve as a model for avoiding land-use conflict, because the economic value of the forest is increased and the benefits on distributed to the various users, thereby diminishing any motivation for converting the forest to agriculture.

Pizano S.A. still has had some of the difficulties shared by other models of community forestry. The main challenges lie in organizing the communities; ensuring that forest management is more economically attractive than agriculture to local populations; and reversing the negative sentiment about commercial timber producers, especially with regards to their failure to distribute economic benefits from resource utilization to local communities.

Organizing the communities has required more than conventional "deal-making" and business arrangements. Pizano S.A. approached this problem from the rather unconventional angle of assessing the rural anthropology of the area before devising an organizational strategy. Based on its experience with cooperatives and community production in this region, Pizano S.A. concluded that the political dynamics of these groups tended to lack an effective distribution of power in decision-making.

In an effort to avoid relying on cooperatives, Pizano devised a household-level organizational strategy. Pizano representatives visited villagers in an area covering approximately 40,000 hectares and explained their proposed forestry plan. Each household would manage a specified area of forest, perform minor silvicultural treatments, protect the forest from conversion to agriculture, and still be able to extract forest products. Pizano S.A. developed educational tools (such as taped dialogues with corresponding picture books) to further explain how the system would work.

Pizano S.A. ensures that forestry will be more profitable than agriculture by paying each household for the annual growth increment of commercial trees in their management area. The company is absorbing the entire risk that their projected financial and silvicultural outcomes are correct. They plan to divide the 40,000 hectare area into a 20,000 hectare production forest and a 20,000 hectare protected area. From the production forest, Pizano S.A. expects to extract 35-75 m^3/ha of *cativo* (*Prioria copaifera*), and reforest with *ceiba roja*, *gmelina*

and *camajon*. The *ceiba roja* is projected to produce 170 m^3/ha every seventeen years, and the *gmelina* and *camajon* are projected to produce 110 m^3/ha every six years.

Conclusions

The Pizano S.A. plan is commendable in its efforts to manage multiple-use forestry while integrating local and commercial objectives for forest utilization. This project may serve as a model in the region for its innovative social aspects in forest management. Reversing the negative sentiment among local forest users towards industrial timber producers will be a long process, but hopefully will be speeded along by the success of this project. The annual compensation paid to local households for their forest management should facilitate the process.

It is important to note that this case study also illustrates from the simplification of the structure of a natural forests facilitates its management. Forests with few high-yielding species (plantations at the extreme), tend to be more profitable than mixed natural forests with relatively low yields the most commonly embraced paradigm of "sustainable" forestry. While this style of management is promising from the perspective of ensuring successful long-term management, it is at odds with maintaining biodiversity.

Brazil: Extractive Reserves

Context

Commercial forest extractivism was once a major part of Brazil's economy. The rubber boom of the nineteenth century contributed greatly to the settlement of the Amazon and growth of the cities of Manaus and Belem. Rubber production in Brazil resulted in the migration of individuals and families to the interior of Brazil seeking a livelihood from rubber-tapping. The descendants of these rubber-tappers, in addition to more recent rural migrants, continue to inhabit the interior, some of them still dependent on rubber-tapping for a living.

The accelerated development of the interior of Brazil in the 1970s and 1980s led to a land use conflict between extractivists and colonists. The extractivists, battling for land tenure, allied with the growing environmental movement of the 1980s, which embraced the extractivists as sustainable users of the Amazon's forests. This alliance proved powerful and the establishment of extractive reserves was among their accomplishments.

There are now four extractive reserves in the Pilot Program: Chico Mendes and Alto Jurua in Acre; Rio Ouro Preto in Rondonia; and Rio Cajari, located in Amapa. The creation of the Chico Mendes Reserve has been supported financially by the IDB. In each of these reserves, inhabitants produce one or more traditional non-timber forest products. With the assistance of the National Center for the Sustainable Development of Traditional Populations (CNPT–IBAMA), economic development programs are underway to diversify the non-timber forest production within the reserves, organize production, and develop education and health services. Conservation is an overarching goal of all projects, including the restriction of forest clearing beyond the minimum required for subsistence agriculture.

Extractive Reserves in Brazil

In 1992, representatives of the Group of Seven (G-7) nations agreed to support the conservation of Brazil's tropical forests and created the Pilot Program for the Protection of Brazil's Tropical Forests. Among the projects within the Pilot Program was the establishment of four *extractive reserves*, forest areas designated for non-timber resource use. The objective of the extractive reserves was to provide an alternative land use to logging that is environmentally and economically sustainable. The traditional producers of non-timber forest products in Brazil, already occupying the forests of the extractive reserves, were expected to execute a development strategy, with the assistance of the Brazilian Government. The objective of the strategy was to provide improvements both in the quality of life of the population and conservation of the tropical forests in which they live.

BOX 4

Economic Plan of the Extractive Reserves

Forest production in extractive reserves can be classified into traditional and alternative categories. Traditional products include natural latex and Brazil nuts—products originally produced in the reserves and sold in international commodity markets. Alternative products are those that have been introduced to, or developed in, the reserves since their establishment. They include fruits such as *acai* and *cupuacu*, the *guarana* seed, and rattan-like forest vines. Additional products continue to be developed.

The economic plan for reserve inhabitants is to organize the production of both traditional and alternative products to the extent that losses to middlemen can be minimized and value-added activities can be developed within the reserves. One example is the creation of *vegetable leather*, an ecologically friendly leather substitute made by coating light fabric with natural latex. Additional opportunities for the production of a variety of other products manufactured with vegetable leather exist, such as shoes, bags, and articles of clothing.

Opportunities and Barriers

Extractive reserves present an opportunity to create a model for long-term productive management of tropical forests. Through the development of non-timber forest products, conservation goals may be achieved in tandem with economic development. In the case of the extractive reserves in Brazil, the attention to achieving these goals has resulted in the empowerment and organization of previously disenfranchised people involved in traditional forest production. With increased political and economic power, real gains in quality of life can be observed.

Many barriers stand in the way of this process, though. One problem is the difficulty of organizing a dispersed population of traditional producers who have little history and experience with mutual cooperation and local governance. Associations of producers that were formed within the reserves still suffer from incomplete membership participation and poor organizational decision-making. Integration of collection and production activities has been difficult. The slow progress in efficient industrial processing of Brazil nuts is an example of this.

Another large barrier to the success of the extractive reserves has been the diminishing market value of traditional forest products such as latex and Brazil nuts. At the time of this writing, latex prices have fallen to levels that hardly justify production in the reserves. Reserve inhabitants are looking more and more to alternative products that are as yet unproven sources of income.

Conclusions

The extractive reserves represent a strong endeavor to establish non-timber forest production as a long-term forest management strategy in tropical Latin America. The success of this endeavor will rely upon adequate market prices of the natural products, diversification and vertical integration of economic activities, and organization of the producers to succeed in competitive markets. Even with its weaknesses the models of extractive reserves in Brazil could serve as a example for non-timber forest extractivism throughout Latin America.

Chile: Eco-tourism

Chile is currently proposing to grant concessions in national protected areas to private eco-tourism enterprises. The Chilean government has two objectives: 1) generate revenue and reduce the government burden of managing protected areas; and 2) improve the quality of eco-tourism sites, including the conservation of these areas. Although the implementation details remain undetermined at this time, the case warrants attention as a potential model for eco-tourism in government lands also in other Latin American countries.

The Legal and Administrative Context

The *Corporacion Nacional Forestal y de Recursos Renovables* (CONAF), the state forest service would be direct beneficiary of the proposal. CONAF was created in 1973 under Law No. 18.348 and was given the mandate of coordinating Chile's forest sector. Among CONAF's designated responsibilities are regulating forestry, managing protected areas, controlling forest fires, and managing watersheds. CONAF has an annual budget of US$36 million.

Park Administration in Chile

CONAF administers 34 national parks, 43 reserves, and 12 natural monuments, totaling 14.4 million hectares. It indicates that its current resources are insufficient to adequately protect and maintain these areas while fulfilling its other mandates. According to CONAF, only 22 percent of the protected areas under its mandate are effectively controlled by the staff which includes only 350 guards. Given the enormity of trying to keep up with the daily maintenance and control of resource utilization in and near these areas, CONAF has chosen to look for private sources of capital to assume some of these responsibilities.

BOX 5

The Concession Proposal

In April 1996, the government of Chile announced that it would accept proposals for private concessions on public lands for the purposes of eco-tourism. Thirty-year concessions will be granted to those private entities

that present the best management plans for the five chosen protected areas, totaling 521,000 hectares. The state tourism agency, SENATUR, chose the areas on the basis of their revenue-generating potential. During 1997, the best proposals will be selected and implementation of the eco-tourism concessions will commence. The areas offered for concessions are shown in Table 4.

Table 4. Protected Area Locations

Protected Area	Location
Lauca	Region I
Los Flamencos	Region II
Pan de Azucar	Regions II, III
Laguna de Laja	Region VIII
Vicente Perez Rosales	Region X

Advantages of Eco-tourism Concessions

The expected advantages of eco-tourism concessions are calculated from the development of profit-generating tourism activities in Chile's protected areas. If successful, the profitability of these activities will give private entities an incentive to maintain and conserve the areas. At the same time that sufficient revenue is being generated, profits can be shared with the state and reinvested in conservation or resource management programs. The potential for reducing the burden of CONAF's mandate will allow a greater concentration of that agency's resources on proper forest management and administration in other strategic forest areas, as a response to criticism from domestic environmentalists. In sum, the expected advantages are:

- Improved management and conservation of protected areas;
- Revenue generation for the government;
- Reduced administrative burden for CONAF; and
- Development of the private tourism sector.

Disadvantages of Eco-tourism Concessions

There are specific foreseeable dangers to the allocation of eco-tourism concessions on public lands. First, profit maximizing behavior by concessionaires can lead to environmental degradation as a result of road building, construction, and providing excessive amenities within the protected areas. Two controls will be required: 1) an environmental impact assessment for any proposed activity in the protected area; and 2) an insurance mechanism such as a conservation bond that will discourage the degradation of the area by means of a financial penalty.

Second, if a private enterprise fails, it may be difficult to guarantee the protection of the area. In such an instance, the concession should either be immediately contracted to another firm or returned to the management of CONAF. However, if CONAF proceeds with its plan to allocate its resources to alternative activities, it may not have ample funds available to resume its regulation of an area on short notice. Additionally, private sector management of protected areas may either fall short of expectations and be poorly implemented. Therefore, a continued, albeit less intensive, supervision of the use of natural resources in the area by CONAF is needed.

Third, as CONAF's resource allocation for protected areas diminishes, unanticipated conservation losses may occur despite private management of eco-tourism concessions. Costa Rica provides a perfect example: it generates a substantial portion of its GNP from eco-tourism sites and has established an international reputation for its eco-tourism attractions. However, despite the enormous benefits derived from eco-tourism, government support for the conservation of these protected areas continues to be relatively weak.

Conclusions

The results from granting concessions in Chile's national protected areas merits close observation over the coming years. If implemented properly, the private/public partnership for protected area management may prove a useful model for other countries.

Opportunities and New Models

Experiences to date with forest resource use contracts and ecotourism concessions in Latin America have shown that policies and norms must be matched with the capacity of the private and public sectors to implement them. Over the last several years much hard work has been poured into technical and policy studies of sustainable forest management in Latin America. The discouraging results of these efforts can be attributed to unrealistic goals, or worse yet, to the lack of clearly defined goals altogether. Nevertheless, the specific objectives of economic development and conservation that are often blended into sustainable forestry plans can be achieved if innovative means are applied that acknowledge constraints and capitalize on opportunities. This chapter identifies a series of opportunities for meeting the economic and conservation objectives of forest management and presents three forest use contract models that exploit these opportunities.

There are models for forest resource use contracts that define realistic objectives and acknowledge the constraints to, and opportunities for, long-term management of humid tropical forests in Latin America. Some examples of such models are:

- Extensive timber extraction contracts, with reduced management requirements;
- Intensive forestry with regulated adaptive management strategies; and
- Multiple use areas.

The three models are appropriate for different forest management objectives, and in each case the trade-offs implicit to achieving those objectives should be recognized. By doing so, forest policy makers will acknowledge contextual constraints and opportunities rather than continue to reinforce current models with hazy objectives of "sustainability."

Opportunities for Change

This section does not include an exhaustive list of opportunities, nor are these opportunities appropriate for all contexts, as each will be subject to its own set of constraints. In more general terms, any opportunity to simplify forest resource use contracts should be examined. The following five criteria are examples of simplified approaches to achieving many of the objectives embraced by the definitions of sustainable forest management.

Performance over Compliance

Among the most important changes in environmental policy today is the transition from the previous “command-and-control” enforcement systems to performance-based regulations. The basis of this transition is the realization that enforcing environmental regulations is too costly and administratively complex given the public resources devoted to it. Furthermore, in many cases the same level of environmental performance could be achieved by the regulated firm with greater efficiency if the firm were allowed to design its own methods for meeting environmental objectives. This principle tends to apply to a broad range of industries, from chemical manufacturers in the U.S. to loggers in Bolivia.

Supervision of a contracting company performance can be simplified to periodic audits on the basis of specific criteria and indicators. In the case of forest management, an examination of forest health would include

measurements of the total disturbed area, stand composition, reforestation rates and remediation efforts (if necessary). Such monitoring would reveal ample information about the behavior of the contracted firm to judge whether it is meeting contract obligations. If not, the management contract could be terminated, and a financial penalty could be assessed through the seizure of a performance bond.

A tremendous advantage of this system is its potential for honest evaluations. Performance audits could be conducted by third party auditors, or multiple entities, to ensure the validity of the audit, reduce opportunities for corruption, and make information available to any interested stakeholders.

An important requirement for the audit to function properly is the definition of criteria and indicators used to judge a firm's performance on its management plan. Failure to clearly define them could result in disagreement after irreparable damage has already occurred in the forest. Defining these criteria at the outset will also assist in clarifying management goals and in careful consideration of their feasibility.

Area Tax

Hand-in-hand with the simplification of the regulatory process is the simplification of the forest revenue system. The most straightforward means to do so is to tax forest resource use by area rather than by an estimation of the volume of resources extracted. The "area tax" is not a perfect mechanism, but it is simple, and therefore more likely to be administered properly and less likely to be evaded. An additional advantage of the area tax is that it can facilitate the creation of protected areas within concessions. They should not be subject to area tax. It is in the firm's interest to place land with the least commercial value into tax-deferred protected areas. This also accomplishes the dual objectives of encouraging the firm's efficiency and creating protected areas with little appeal for future exploitation.

The area tax is not as economically efficient as a volume or production tax. Since the area tax is assessed on the average stumpage value of the entire forest, it lacks the accuracy of taxes that charge only for the amount of resource removed from the forest. The determination of the average stumpage value will likely be a point of contention between the government and the contracting firm when the area tax is established. Indexing the area tax to the commercial value of the timber would require a specific detailed agreement on the species to be considered in the index, the frequency of revising the index, and a fair mechanism for adjusting it to reflect inflation, price changes, and alteration in the composition of marketable species.

Protected Area Set-Asides for Conservation

Conservation objectives (including maintaining biological diversity, protecting watersheds, sequestering global carbon, and providing long-term sources of forest resources), have to be determined in the forest management plans. In theory, sustainable natural forest utilization achieves these conservation objectives. However, in reality conservation objectives are often the greatest victim of forest use practices in Latin America. In contrast, protected areas and biological reserves have fared much better in Latin America over the past decades, while managed forest resources in national forests have dwindled. There are abundant problems with protected areas in Latin America, most of which correspond to local user conflicts, but the clear exclusion of commercial interests in these areas has benefitted conservation greatly.

There are many advantages in conditioning forest utilization with the establishment of a minimum set-aside within each contract. First, it acknowledges that conservation objectives may not be met through normal forest management practices. Second, protected areas may serve as a genetic reserve for seeds and other biological

resources and as habitat for fauna that is not provided for in a production forest but will benefit it. They may also provide an important research area for adaptive management (see below) for forest managers. Third, protected zones would be established within the contracted area, and maintained by the firm as a contract renewal criterion. This would reduce the financial and regulatory burden on the government for monitoring and enforcing the protection of these areas. Fourth, the geographical distribution of protected areas may vary. It may be directed to maintaining a more varied forested landscape through several set-asides. Alternatively, protected areas could be concentrated to minimize the negative effects that occur when areas are preserved in fragments rather than as one larger unit.

Adaptive Management

It is clear that natural forest management in the neo-tropics will require more ecological knowledge than is currently available. One way to work around this deficiency is to use an "adaptive management" strategy. Adaptive management requires a constant appraisal of the effects of forestry activities, and periodic revision of management plans as a result of evaluations. If executed properly, adaptive management has the advantages of buttressing the current state of knowledge on neo-tropical forestry, and providing an opportunity to reassess forestry activities to maximize their chances of achieving the objectives of sustainable management.

Implementing adaptive management corresponds very well with the use of a periodic audit. Audit criteria should be related to the measurements used in the self-monitoring necessary for adaptive management. Audits can serve as a verification of this self-monitoring process and can provide an opportunity for outside experts, government technicians, environmental watchdogs, or other third parties to evaluate the progress of the management plan in achieving its objectives as well as provide guidance for the plan's revision.

Integrate Multiple Users

Traditionally, forest resource use contracts in Latin America have granted the exclusive use of forest resources to one contractor. The FAO's (1977) definition of a forest resource use contract cited before stresses *exclusivity*. There are important reasons for providing exclusive rights to a contractor, such as making it easier to administer the contract, provide security for investments in forestry, and assign accountability for the proper management of the forest resources. However, exclusive rights are not entirely possible nor desirable in areas with multiple local users with usufruct claims to forest resources. Substantial local economic development could be encouraged by integrating the commercial forestry sector with the interests of these users. The Pizano example from Colombia detailed earlier serves as an excellent illustration of the potential for cooperation in management objectives between the various actors.

Rethinking Forest Resource Use Contracts: Three Models

Acknowledging the constraints described in earlier chapters and exploiting opportunities to overcome them will demand new models for forest resource use contracts. Three generalized models for forest resource use contracts are presented here, each addressing specific objectives. In the first model, a contractual use scheme is recommended that accommodates remote forest areas where transportation costs or the lack of a developed value-added wood processing industry often eliminates the demand for lower-valued products. This is the predominant case in the Western Amazon basin as well as in the forests of Suriname, Guyana, and French Guyana. This model corresponds with the objectives of maintaining forest cover, conserving biodiversity, maximizing profitability of the forest industry, and minimizing damage from logging.

In the second model, a contractual use scheme is proposed for highly populated areas where extreme pressure is put on the forest for timber of various species and qualities. This context better describes some areas of Central America and the Eastern Amazon (though *public* forest contracts are uncommon in this region). In this model, vigilance is required to prevent serious environmental harm where the conservation of forest cover is a primary objective.

In the third model, alternative modes of forest resource use are contemplated, including NTFP production, eco-tourism concessions, and the integration of commercial resource management with local users in areas where land use conflict between commercial and local users is prevalent (as was the case in Colombia). The objective of this model is economic equity and the maintenance of forest cover through multiple-use management.

For each model the use of a highly simplified forest revenue system based on an area tax is recommended. Forest revenue systems in Latin America most often break down when their administrative complexity exceeds the institutional capacity. An area tax remedies this problem by virtue of its simplicity, the low cost of its administration, the lack of opportunities for corruption, and the difficulty in evading it. Areas that are under contract for harvesting are paid for on an annual basis by the contractor. The charge is uniform across an entire area, and payment compliance is easily monitored.

Model #1: Extensive Extraction of Timber without Management

This model recognizes that light selective logging as it occurs throughout the humid tropics of Latin America can be both economically efficient and of relatively low impact without intensive regulatory oversight. This option includes also the establishment of protected forest areas. In this model of extensive forest utilization the contracts should have following characteristics:

- Require minimum silvicultural treatments in reforestation;
- Provide no diameter limits or volume constraints;
- Require a carefully designated system of protected area set-asides;
- Be of short (five-year) duration with renewal contingent upon satisfactory performance;
- Charge an area tax; and
- Require a performance bond to promote compliance with contractual conditions.

The behavior of contractors under this model will not differ greatly from the effective behavior of contractors under more sophisticated forest management regulations that are *not* enforced. At present, in areas with low densities of commercial trees, the selective extraction of timber without management or reforestation causes relatively little damage to the forest, as indicated earlier in this chapter (Gullison and Hardner 1994). Indeed, less damage may occur under this model if contractors are allowed not to carry out exploitation when profitability diminishes, rather than be held responsible to unprofitable extraction and management activities that would require maintaining and/or reopening the road infrastructure in the forest with direct and possible indirect negative environmental impacts through encroachment. In those regions where a large demand for many species of wood exists, and consequently results in larger harvests, this system would not be appropriate.

The advantages to this model are its minimization of forest damage from light selective harvesting and the efficiency it gains by eliminating unscientific and unenforced regulations. The limited resources allotted to forest controls should be directed to the more manageable task of periodic performance audits on the basis of pre established criteria and indicators of good practices. Satisfactory results from these periodic audits should be a prerequisite for periodic contract renewal.

Model #2: Intensive Forestry and Redirecting Regulatory Activities

As indicated in the preceding chapters, it is unlikely that the long-term management of natural forests for selective harvesting of only some species will prove a feasible land-use option in highly populated area. It is more likely that in areas with a substantial commercial demand for lower-valued species, intensive forestry will take one of two forms: intensive extraction with heavily enriched natural forests and plantations of fast growing species. The reality today in these areas is almost exclusively one of intensive extraction without management, but it is possible that plantations will take over some forest lands in these areas.

In such a context, this intensive model for contractual use aims to promote sustainable production and to protect the area as much as possible from severe environmental harm. It also intends to regulate improved natural enriched and plantation forests in such a way as to promote the maintenance of forest cover in these areas that might otherwise be entirely converted to agriculture or pasture. If such styles of forest management are the only timber utilization schemes that can compete with alternative, non-forest land uses, it would be wise to encourage them and regulate them properly. In either case, conservation of biological diversity must be accomplished also through the use of protected area set-asides.

In this model, forest utilization contracts should:

- Require a plan that outlines the best management practices for reducing forest and environmental damage;
- Use periodic audits of forest conditions, with the specific criteria and indicators stated in the contract;
- Make contract renewal contingent upon satisfactory audits;
- Require adaptive management plans the facilitate periodic modification in forestry or rewriting the plans on the basis of self-monitoring;
- Provide resource access (prevent colonization in the contracted area) for the contractor;
- Reinvest public forest revenues into forestry research and technical assistance;
- Require the provision and protection of conservation set-asides by the contractor;
- Charge an area tax; and
- Require a performance bond by the contractor.

The basic idea of this option is to minimize damage as much as possible given the available regulatory capacity by the government, and provide an opportunity for intensive management if it becomes viable. In theory, the risk in this model is that management will never occur, and the environmental harm of intensive forest extraction will not be mitigated by regulations because of institutional weakness. In practice, the adoption of this model incurs little risk, as intensive extraction without management is already the status quo in many areas with high commercial demand for lower-valued species.

This model relies upon the open-ended innovation of adaptive management. Management plans may be rewritten periodically to integrate new knowledge about neo-tropical silviculture and the responses of the site itself to forest management. The results of audits concerning the compliance with pre-established criteria and indicators would determine the need for rewriting the management plans.

The regulatory emphasis in this model is on the periodic audit of the health of the production forest and the maintenance of conservation set-asides. The audit results, as in the first model, can be used as a criterion for continuing or terminating the forest use contract. If the stake in achieving a satisfactory audit is backed by a performance bond, a substantial incentive will be created for the contractor to maintain the forest's health. The

periodic audit of forest health has the advantage of requiring fewer regulatory resources and personnel than constant monitoring, and *emphasizes performance rather than process*. Regulatory resources would thus be reallocated from command-and-control methods that was enforce non-viable natural forest management activities, to the encouragement of practices that reduce damage and provide the opportunity for innovative adaptive management methods.

Model #3: Multiple Use Areas

There are alternative methods of forest resource use to logging of timber, though fairly little experience exists from which to draw lessons on the implementation. Three compelling ideas are NTFP contracts; eco-tourism concessions; and integrated commercial and community resource management. The emphasis of these alternative forest use models is in economic equity (derived from involving local users in the economic activity of public forest resource use), and maintenance of forest cover (as encouraged by multiple resource management).

A number of lessons have been learned from NTFP development projects, in particular the extractive reserves in Brazil:

- NTFP production may not be profitable enough by itself as an economic activity to support local populations.
- The extractive reserves may provide sufficient income to local populations only if their area is sufficiently large for continuous use. Therefore, restrictions on land use may be necessary, especially for clearing forest for agriculture.
- If NTFP production is to be combined with timber extraction, resource rights must be clearly defined, and timber activities must be planned in order to minimize unnecessary damage to the use of NTFPs.
- NTFP use contracts are almost never made between the government and a private commercial entity. Associations of producers are generally the contracting entity, and therefore may have social and legal characteristics that require special contract requirements.

Based on these limited experiences, the following criteria for establishing NTFP and hunting and fishing contracts should be considered:

- Ensure that NTFP production is financially viable and is the most suitable activity for that area;
- Control forest clearing in the contracted area;
- Ensure that the contracted entity is capable of managing the operation, is representative of the producers, and demonstrates presence in the area; and
- Look for opportunities to place NTFP production in areas where non-destructive logging has already occurred.

Probably the most promising method of non-timber forest utilization may be eco-tourism, which provides a service rather than a product in areas of natural beauty. Revenues from eco-tourism have increased may be dramatically in Latin America over the past decade. Two examples of national-level eco-tourism planning are found in Costa Rica and Chile. Costa Rica supports the most visited tropical forests in Latin America and arguably derives a higher proportion of income from nature-based tourism than any other country in the region. Ironically, the public sector invests little in the protection or management of these areas. The protected areas of Chile also attract many tourists. Currently the majority of forests visited are managed by the government, but Chile plans to grant eco-tourism concessions on these lands in the near future. The privatization of these

services represents a significant change in natural resource management: one that, if successful, could expand the government's supervisory capacity to currently unattended areas. The implementation of this plan may serve as a model for future forest utilization plans for eco-tourism also in other countries.

Conclusions and Recommendations

The foundation for any forest policy reform needs to be based on the clear definition of objectives, the development of ways to measure progress towards those objectives, and the establishment of the means to achieve those objectives given the constraints and opportunities of the regulatory context. Following these guidelines will result in a more realistic and effective forest policy. Substantial opportunities exist for improving forest resource contracts in a way that will greatly benefit all those relying on the economic development and conservation roles that forests play in Latin America.

The governments of Latin America will need to acknowledge the various constraints to forest resource use contracts and exploit any opportunities to overcome them. To begin this process, clear management objectives must be defined and rational means to achieve them should be developed. Policy recommendations to this effect can be made in four general categories:

- Work *with* and not *against* financial forces;
- Replace costly command and control mechanisms of forest resource use contracts with periodic performance audits;
- Promote participation of affected interest groups; and
- Increase technical knowledge.

Countries need to step up efforts to review rural development projects for their potential direct and indirect impacts on forests environment and social affects in local communities. Financial institutions should be incorporated in order to fund necessary institutional strengthening, project preparation and execution to improve the economic conditions of affected communities and improve the environment.

Work with and not against Financial Forces

Forcing the implementation of management plans that are not financially viable will always result in failure. Forest policy makers must recognize that incentives leading to improved financial performance do not necessarily correspond with conservation objectives. They should seek opportunities to implement profit-maximizing logging in ways that do not cause substantial, irreversible harm to forest health. Where conservation objectives are not clearly achieved by forest management contracts, provisions should be made to meet them through alternative methods such as conservation set-asides.

A classic error to be avoided is the financing of infrastructure for value-added forest resource processing in areas where long-term management is not financially viable. Value-added processing may generate more profitability from forest resources, but it does not change the economics of forest management. Many regions of Latin America do not necessarily have a comparative advantage in value-added timber processing and have substantial difficulty penetrating markets for processed wood products.

Replace Command and Control Mechanisms with Periodic Performance Evaluations

Governments must simplify their regulations and revenue systems. Regulatory agencies tend to have too few resources to fulfill their mandates and are vulnerable to corruption. Two means to overcome these constraints

are to redesign the regulatory scheme to emphasize performance rather than command-and-control compliance, and to replace complex revenue systems with an area tax.

The distinction between performance and compliance-based regulations is that performance-based regulations rely upon indicators, where compliance-based regulations rely upon the satisfaction of procedural requirements. For example, a common compliance-based regulation is the diameter cutting limit for timber harvesting. This forest management requirement is only reasonable for certain species and is difficult and costly to control. A performance-based regulation would monitor the actual regeneration of managed species to ensure that the management plan and harvesting techniques correspond with the management objectives for the forest, as well as monitoring overall forest health. This shift in regulatory focus places more emphasis on site-specific methods and technologies appropriate for the area, determined by the forest managers themselves. Monitoring is periodic for such a performance-based system, rather than daily—as is the case for a compliance-based system. Success is measured by the regeneration and health of the managed forest instead of constant control of details of forest exploitation.

Performance-based regulations may require substantially fewer regulators, as monitoring is less frequent and not as intensive. If performance reviews are public, and allow multiple auditors, the process should be less susceptible to corruption. When hinged directly with adaptive management, performance audits should lead to appropriate changes in the forest management plan. When all factors are considered, performance-based regulation of forest management should result in a lighter regulatory burden for the public sector, cost-savings for the private sector through reduced regulatory compliance requirements, and above all, better forest health.

Specifically, performance-based forest resource use contracts should include:

- Regulation and enforcement of environmental performance using defined standards rather than current regulations based on command-and-control techniques;
- Straightforward monitoring of forest use contracts, including mechanisms for adaptive management, as well as public sector performance audits and independent review; and
- Simplified forest revenue systems, like an area tax.

Promote Public Participation in the Political Process

Political participation by the various groups affected by forest resource use contracts is important for the integrity and success of forest policy. Political support for forest resource management is weak in many regions. This may be the result of government representatives defining policy priorities without the input of the affected constituencies. One means of encouraging participation by these groups is to empower them with information and to facilitate the exchange of ideas with NGOs. Where forest management is concerned, monitoring data should be made available to the public, and collected or verified by independent parties. The public availability of data related to management performance provides citizens and NGOs with a source of evidence that can be used to endorse or criticize forest policies and the politicians who support them. This process, in turn, provides politicians with incentives to design accountable forest policies. In cases where multiple use conflicts arise, forest policy should facilitate the adoption of new management schemes.

Increase Technical Knowledge

The ecological knowledge upon which forest management plans and regulations are based is insufficient in many areas of Latin America. Discussions with the region's forest managers often reveal claims that

silvicultural systems for their particular forests have been developed. Though some systems are in place especially for temperate forests knowledge still remains to be discovered to many tropical forest ecosystems in the region. Two conclusions can be drawn from this situation: first, knowledge of neo-tropical silviculture must be increased and disseminated; and second, management plans must be adaptable to new knowledge as it becomes available.

Adaptive management accompanied by monitoring can accomplish these two goals. Adaptive management (as described in the previous chapter), is a management system that allows the management plan to be revised to respond to observed results from current practices and new knowledge. It also has the additional advantage of systematic data collection, which is useful for both the forest manager and other actors in forest development and conservation.

It is highly recommended that policies be adopted demanding adaptive management plans that include specific criteria and indicator and periodic revisions. Such policies will integrate well with simplified regulatory schemes, and with collection and dissemination of reliable performance information on forest resource use contracts.

References

Allegretti, M.H. 1990. Extractive Reserves: An Alternative for Reconciling Development and Environmental Conservation in Amazonia. In *Alternatives to Deforestation: Steps toward Sustainable Use of the Amazonian Rain Forest*. A.B. Anderson, ed. New York: Columbia University Press, 252-264.

Boot, R. and R.E. Gullison. 1997. Approaches and Barriers to Developing Biologically Sustainable Extraction Systems for Tropical Forest Products, with Examples from Bolivia. *Ecological Applications* (in press).

Brack, Antonio. 1996. Personal communication. (Regional Coordinator for UNDP, *Tratado de Cooperacion Amazonica*)

Brokaw, N. 1982. Treefalls: Frequency, Timing, and Consequences. In *The Ecology of a Tropical Forest: Seasonal Rhythms and Long-Term Changes* E. Leigh, A. Rand and D. Windsor, eds. Washington, DC: Smithsonian Institute Press, 101-108.

Brokaw, N. 1985a. Gap-phase Regeneration in a Neotropical Forest. *Ecology* 66: 682-687.

Brokaw, N. 1985b. Treefalls, Regrowth, and Community Structure in Tropical Forests. In *The Ecology of Natural Disturbance and Patch Dynamics*, S. Pickett and P. White, eds. New York: Academic Press, 53-69.

Browder, J.O. 1990. Extractive Reserves Will Not Save the Tropics. *BioScience* 40: 626.

Brown, S and A. Lugo. 1990. Tropical Secondary Forests. *Journal of Tropical Ecology* 6: 1-32.

Cabrera-Madrid, M., R. Heinzman, S. Lopez, C. Reining, and A. Solorzano. 1990. *Non-timber forest products in the Maya Biosphere Reserve: Results of ecological and socioeconomic surveys and recommendations for management and investigations.* Unpublished Report to Conservation International.

CIDDEBENI (Center for Research and Documentation for the Development of Beni). 1995. Reflections on a proposal for forest management and harvest in the multi-ethnic indigenous territory of Beni, Bolivia. in *Case Studies of Community-Based Forestry Enterprises in the Americas*. Presented at the symposium, Forestry in the Americas: Community-Based Management and Sustainability. University of Wisconsin-Madison Land Tenure Center/Institute for Environmental Studies.

Cifuentes, Maria Victoria. 1996. Personal communication. (*Coordinadora General* of the Ministry of Environment of Colombia)

Clark, C. 1976. *Mathematical BioEconomics*. New York: Wiley & Sons.

Coase, R.H. 1960. The Problem of Social Cost. *Journal of Law and Economics* 3: 1-31.

Condit, R., S.P. Hubbell, and R.B. Foster. 1993. Mortality and Growth of a Commercial Hardwood '*El cativo*', *Prioria copaifera*, in Panama. *Forest Ecology and Management* 62: 107-122.

Costanza, R. and H. Daly. 1990. Natural Capital and Sustainable Development. *Conservation Biology* 6: 37-46.

Davis, S.H. and A. Wali. 1994. Indigenous Land Tenure and Tropical Forest Management in Latin America. *Ambio* 23(8): 485-490.

DeGraaf, N.R. 1990. Managing natural regeneration for sustained timber production in Suriname: The CELOS silvicultural and harvesting system. *Man and Biosphere* Series, Vol 6.

DeGraaf, N.R. and R. Van Rompaey. 1986. The CELOS experiments on silviculture with natural regeneration in Suriname. Workshop on the Management of Low Fertility Acid Soil, Paramaribo.

Dicum, G., and R. Tarifa. 1994. *Plan de Manejo de Xate en la Area de Carmelita, San Andres, Peten.* Report to Conservation International.

Espinosa, Jose Oswaldo. 1996. Personal communication. (Division Chief for Environmental Planning, DNP, Colombia)

Faber-Langendoen, D. 1992. Ecological Constraints on Rain Forest Management at Bajo-Calima, western Colombia. *Forest Ecology and Management* 53: 213-244.

FAO. 1977. *Forest Utilization Contracts On Public Land*. Rome: FAO.

FAO. 1993. *Management and Conservation of Closed Forest in Tropical America, #101*. Rome: FAO.

FAO. 1994. *Forest Products Yearbook.* Rome: FAO.

Faustman, M. 1849. On the determination of the value which forest land and immature stands possess in forestry [English translation from German]. In: *Martin Faustman and the evolution of the discounted cash flow.* Edited by Gane, M. Commonwealth Forestry Institute Paper no. 42.

Fearnside, P.M. 1989. Extractive Reserves in Brazilian Amazonia. *BioScience* 39: 387-393.

Flynn, S. 1995. Local Heritage in the Changing Tropics: Innovative Strategies for Natural Resource Management and Control. International Society of Tropical Foresters Conference at Yale University School of Forestry and Environmental Studies, New Haven, Connecticut.

Foster, Robin B. 1990. Long-term Change in the Successional Forest Community of the Rio Manu Floodplain. In *Four Neotropical Forests*. Edited by Alwyn Gentry. New Haven: Yale University Press.

Garcia, Pedro. 1996. *Territorios Indigenas y la Nueva Legislacion Agraria en el Peru*. Lima, Peru: Racimos de Ungurahui.

Grimes, A. S., P. Loomis, M. Jahnige, M. Burnham, K. Onthank, R. Alarcon, W. Palacios, C. Ceron Martinez, D. Neil, M. Balick, B. Bennett and R. Mendelsohn. 1994. Valuing the Rain Forest: the Economic Value of Nontimber Forest Products in Ecuador. *Ambio* 23: 405-410.

Gullison, R.E. 1995. Conservation of tropical forests through the sustainable production of forest products: The case of mahogany (*Swietenia macrophylla* King) in the Chimanes Forest, Beni, Bolivia. Doctoral Dissertation, Princeton University, Princeton, N.J.

Gullison. R. E. and J. J. Hardner. 1994. The effects of road design and harvest intensity on forest damage caused by selective logging: Empirical results and a simulation model from the *Bosque Chimanes*, Bolivia. *Forest Ecology and Management* 59: 1-14.

Hall, P. and K. Bawa. 1993. Methods to assess the impact of extraction of non-timber tropical forest products on plant populations. *Economic Botany* 47: 234-247.

Hardner, J. J. 1995a. Report to Conservation International on the Economic Potential of the Tagua Initiative Program.

Hardner, J. J. 1995b. Indigenous Land Rights: Local Peoples and Natural Resource Management. *Journal of Environment and Development* 4: 221-225.

Hardner, J. J. and R. E. Rice. 1994. Financial constraints to 'sustainable' selective harvesting of forests in the eastern Amazon: Bioeconomic modeling of a forest stand in the state of Para, Brazil. Development of Strategies for Fragile Lands (DESFIL) working paper. USAID, World Bank. Washington, D.C.

Hartshorn, Gary. 1990. An Overview of Neotropical Forest Dynamics. In *Four Neotropical Forests*. Edited by Alwyn Gentry. New Haven: Yale University Press.

Hidalgo, Jessica. 1996. Personal communication. (Attorney at the *Sociedad Peruana de Derecho Ambiental*, which orchestrated a multi-stakeholder based proposal for the new Forest Law)

Howard, A., R. Rice, R. E. Gullison. 1996. Simulated economic returns and environmental impacts from four alternative silvicultural prescriptions applied in the Neotropics: A case study of the Chimanes Forest, Bolivia. *Forest Ecology and Management*. December 1996.

Hubbell, S. P. and R. B. Foster. 1990. Structure , Dynamics, and Equilibrium Status of Old-growth Forest on Barro Colorado Island. In *Four Neotropical Forests*. Edited by Alwyn Gentry. New Haven: Yale University Press.

Hubbell, S. P., and R. B. Foster 1992. Short-term dynamics of a neotropical forest: Why ecological research matters to tropical conservation and management. *Oikos* 63: 41-61.

ITTO (International Tropical Timber Organization). 1995. *Tropical Forest Update* 5: 9.

Johnson, N. and B. Cabarle. 1993. *Surviving the Cut: Natural Forest Management in the Humid Tropics*. Washington, DC: World Resources Institute.

Lamb, F. 1966. *Mahogany of Tropical America: Its Ecology and Management*. Ann Arbor: University of Michigan Press.

Lieberman, Diana, Gary Hartshorn, Milton Lieberman and Rodolfo Peralta. 1990. Forest dynamics at La Selva Biological Station, Costa Rica 1969-1985. In *Four Neotropical Forests*. Edited by Alwyn Gentry. New Haven: Yale University Press.

Neher, Philip. 1990. Natural resource economics: *Conservation and exploitation*. New York: Cambridge University Press.

Ojeda, W. 1996. Personal Communication. (Faculty member in the Forestry School of Universidad La Molina in Lima, Peru)

Peters, C.M, A.H. Gentry and R.O. Mendelsohn. 1989. Valuation of an Amazonian Rain Forest. *Nature* 339: 655-656.

Pinedo-Vasquez, M., D. Zarin, P. Jipp and J. Chota-Inuma. 1990. Use-values of Tree Species in a Communal Forest Reserve in Northeast Peru. *Conservation Biology* 4: 405-416.

Poore, D., P. Burgess, J. Palmer, S. Rietbergen and T. Synnot. 1989. *No Timber Without Trees*. London: Earthscan Publications.

Rankin-de-Merona, J., R. Hutchings and T. Lovejoy. 1990. Tree mortality and recruitment over a five-year period in undisturbed upland rainforest of the central Amazon. In *Four Neotropical Forests*. Edited by Alwyn Gentry. New Haven: Yale University Press.

Razetto, Fernando. 1996. Personal communication. (President of the *Camara Nacional Forestal*)

Reid, J. R. and Howard, A. F. 1994. Economic analysis of the proposed timber concession at Arroyo Colorado: Are there incentives for management? Report to the U.S. Agency for International Development.: Washington, DC: Conservation International.

Reid, J. and R. E. Rice. 1997. Natural forest management as a tool for tropical forest conservation: Does it work? *Ambio* (in press).

Rice, R. and A. Howard. (forthcoming). Profitability in the forest sector of Bolivia: A case study of the Chimanes Forest.

Rodriguez, Miguel. 1996. Personal communication. (Director of Natural Resources at Pizano S.A.)

Romero, Marco. 1996. Personal communication. (Former Director-General Forestal of Perú)

Salafsky, N., B. Dugelby and J. Terborgh 1991. Can extractive reserves save the rain forest? An ecological and socioeconomic comparison of nontimber forest product extraction systems in Petén, Guatemala and West Kalimantan, Indonesia. *Conservation Biology* 71: 39-52.

Salo, J., R. Kalliola, I. Hakkinen, Y. Makinen, P. Niemela, M. Puhakka and P. Coley. 1986. River dynamics and the diversity of Amazon lowland forest. *Science* 322: 254-258.

Salo, J. and R. Kalliola. 1991. River Dynamics and Natural Forest Regeneration in the Peruvian Amazon. In *Rain Forest Regeneration and Management*. Edited by A. Gomez-Pompa, T.C. Whitmore and M. Hadley, 245-256. Park Ridge: Parthenon Publishing.

Sampaio, E., I. Salcedo and J. Kauffman. 1993. The effect of different fire severities on copicing of *caatinga* vegetation in *Serra Talhada*, PE, Brazil. *Biotropica* 25(4): 452-460.

Schneider, R., G. Platais, D. Rosenblatt and M. Webb. 1993. Land Abandonment, Property Rights, and Agricultural Sustainability in the Amazon. LATEN Dissemination Note #3. Washington, DC: World Bank.

Schwartzman, S. 1989. Extractive Reserves: the Rubber Tappers' Strategy for Sustainable Use of the Amazon Rainforest. In *Fragile Lands of Latin America: Strategies for Sustainable Development.* Edited by J. Browder. Philadelphia: Westview Press.

Sedjo, R. A. and K. S. Lyon. 1990. *The Long-Term Adequacy of World Timber Supply*. Washington, DC: Resources for the Future.

Silva, J., J. de Carvalho, J do C.A. Lopes, B. F. de Almeida, D. Costa, L. de Oliveira, J. Vanclay and J. Skovsgaard. 1995. Growth and Yield of a Tropical Rain Forest in the Brazilian Amazon 13 Years after Logging. *Forest Ecology and Management* 71: 267-274.

Smith, D. 1986. *The Practice of Silviculture*. Eighth edition. New York: Wiley and Sons, p. 504.

Snook, L. 1991. Opportunities and Constraints for Sustainable Tropical Forestry: Lessons from the Plan Piloto Forestal, Quintana Roo, Mexico. Presentation at the Humid Tropical Lowlands Conference Development Strategies and Natural Resource Management, Panama City, Panama.

Snook, L. 1993. Stand Dynamics of Mahogany (*Swietenia Macrophyla* King) and Associated Species after Fire and Hurricane in the Tropical Forests of the Yucatan Peninsula, Mexico. Doctoral Dissertation, Yale School of Forestry and Environmental Studies. University of Michigan Microfilms: Ann Arbor.

Southgate, D. 1996. What roles can ecotourism, non-timber extraction, genetic prospecting, and sustainable timber production play in an integrated strategy for habitat conservation and local development? Draft Final Report to the Inter-American Development Bank.

Suarez, Gustavo. 1996. Personal communication. (Executive Director of *ProNaturaleza* in Lima, which orchestrated a multi-stakeholder based proposal for the new Forest Law)

Synnott, T. J. and D. S. Cassells. 1991. Evaluation Report on Project PD 34/88 Rev.1(F) Conservation, Management, Utilization and Integrated and Sustained Use of the Chimanes Region Department of Beni, Bolivia. Report to the International Tropical Timber Council of the International Tropical Timber Organization.

Terborgh, J. and A. Gentry. 1990. Composition and Dynamics of the Cocha Cashu 'Mature' Floodplain Forest. In *Four Neotropical Forests*. Edited by Alwyn Gentry. New Haven: Yale University Press.

TCA (*Tratado de Cooperacion Amazonica*). 1994a. *Zonificacion ecologica-economica: instrumento para la conservacion y el desarrollo sostenible de los recursos de la Amazonia*. Lima, Peru: TCA.

___. 1994b. *Uso y conservacion de la fauna silvestre en la Amazonia*. Lima, Peru: TCA.

Uhl, C. 1982. Tree Dynamics in a Species Rich Tierra Firme Forest in Amazonia, Venezuela. *Acta Cientifica Venezolana* 33: 72-77.

Uhl, C. and B. Kauffman. 1988. Fire in the Venezuelan Amazon 2: Environmental Conditions Necessary for Forest Fires in the Evergreen Rainforest of Venezuela. *Oikos* 53: 176-184.

Varangis, P. 1992. Tropical Timber Prices: Own Trends and Comparisons among Them and with Other Timber Prices. Washington, DC: The World Bank.

Varangis, P., R. Crossley and B. Braga. 1995. Is There a Commercial Case for Tropical Timber Certification? World Bank Policy Research Working Paper #1479. Washington, DC: The World Bank.

Vincent, J. R. 1992. The Tropical Timber Trade and Sustainable Development. *Science* 256. Pages 1651 through 1655.