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THE EFFECTS OF TRADE AND CONCESSION POLICIES IN BOLIVIA'S FOREST SECTOR: A Methodological Framework for Analysis

Final Draft

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THE EFFECTS OF TRADE AND CONCESSION POLICIES IN BOLIVIA'S FOREST SECTOR: A Methodological Framework for Analysis

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GLOSSARY OF ABBREVIATIONS

CAO	=	Cámara Agropecuaria del Oriente
CBBA	=	Cochabamba
CDF	=	Centro de Desarrollo Forestal
CIDOB	=	Central Indígena del Oriente Boliviano
CNF	=	Cámara Nacional Forestal
CNRA	=	Consejo Nacional de Reforma Agraria
CORDECRUZ	=	Corporación Regional de Desarrollo de Santa Cruz
FAN	=	Fundación Amigos de la Naturaleza
FONAMA	=	Fondo Nacional del Medio Ambiente
INC	=	Instituto Nacional de Colonización (Colonization)
MACA	=	Ministerio de Agricultura y Asuntos Campesinos
SENMA	=	Secretaría Nacional del Medio Ambiente

SPECIES IDENTIFICATION

Common Spanish Name	Scientific Name	English Name
Ajo Ajo	*Gallesia integrifolia*	
Cedro	*Cedrella* Sp.	Spanish Cedar
Eucalipto	*Eucaliptus* Sp.	Eucalyptus
Jichituriqui	*Aspidosperma* Sp.	
Mapajo	*Ceiba pentandra*	
Mara	*Swietenia macrophylla*	Mahogany
Morado	*Peltogyne* Sp.	
Ochóo	*Hura crepitans*	
Palo María	*Calophyllum brasiliense*	
Quebracho Colorado	*Schinopsis lorentsii*	
Quebracho blanco	*Aspidospera quebracho*	
Roble	*Amburana cearensis*	
Serebó	*Schizolobium parahybun*	
Tajibo	*Tabebuia* Sp.	
Virola, Cuángare	*Virola* Sp.	Banak
Yesquero	*Cariniana estrellensis*	

UNITS OF MEASURE

One cubic meter (m^3) of lumber = 424 board feet (bf) of lumber
One thousand board feet (1MBF) = 2.36 m^3 of lumber

YIELDS USED

There is a wide variation in actual efficiencies among mills, species, log sizes, log quality and product mix. Scaling rules and practices also vary from mill to mill and affect the way inputs and outputs are measured. All volumes are solid measures.

One m^3 of stumpage yields 0.80-0.85 cubic meters of logs;
One m^3 of logs yields 0.43- 0.60 m^3 of green lumber;
One m^3 of logs yields 0.20-0.33 m^3 of dry sliced veneer;
One m^3 of logs yields 0.41-0.45 m^3 of finished hardwood plywood;
One m^3 of lumber yields 0.60 m^3 of plank parquet;
One m^3 of green lumber yields 6.5 finished, solid, raised panel doors.

CURRENCY

The local currency is Bolivianos (Bs), and the exchange rate was Bs 4.05 - 4.10 per US$ during late November and December, 1992.

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Rigoberto Stewart
Hector Claure
David Gibson

EXECUTIVE SUMMARY

The objectives of this study were to determine the actual magnitudes of trade distortions and estimate their effects on the value of the forests; identify the weaknesses of the stumpage fee and concession systems; and identify and prioritize policy reforms intended to remove trade and other distortions, increase the efficiency of exploiting forest resources, improve the profitability of forest processing activities, foster conservation, and encourage investment in more sustainable management.

The log export ban is the only important trade distortion in the forest sector. It was estimated that during 1991/92 domestic log prices of softwood, like serebó, and of fine species, like mahogany, were only about 25 and 40 percent, respectively, of what they would have been without the log export ban. Also, primarily because of this distortion, the returns to domestic factors of production (labor, capital, management) used to produce veneer of mahogany and plywood of serebó were about 123 and 2,142 percent, respectively, above what they would have otherwise been. Because of these high levels of returns, more domestic resources were attracted to these processing activities than was socially desirable. In fact, without the trade distortion, it is unlikely that the country would produce any more veneer or plywood than is demanded in the domestic market, because exporting these products privately would be unprofitable.

In the case of sawn mahogany, the economic value added was negative, indicating that the logs used to produce sawnwood were more valuable than the sawnwood itself, and that labor and other inputs employed contributed negatively to added value of the product.

It is generally concluded from the trade analysis that the log export ban limits the opportunity to exploit the forest sector's comparative advantage, and severely reduces both the social profitability of forest management and the timber value of the forests.

The analysis suggests that firms generally do not enjoy economic rents in forestry activities. As counterintuitive as it might seem, logging and selling logs, and sawmilling mara and tajibo are the most profitable activities. Downstream processing commands normal returns, at best, to the additional capital investment. Under free trade, only the logging activity (selling logs) would remain profitable. It would be very lucrative.

This outcome largely results from overinvestment in processing capacity, and from Bolivia's lack of the level of technology, managerial skills, human capital, and infrastructure required to supply the international market with the quality products (veneer, etc.) it demands. Therefore, it must sell the lower quality

products at lower prices, or at prices far below those commanded by higher quality products.

One important objective of this study was to determine if firms can improve management practices and still make acceptable profits. Preliminary information from on-going research in Bosque Elías Meneses was used to arrive at probable costs of sustainable management, and these were compared to profits under various scenarios. The results indicate that even under the more conservative scenario, sustainable management would be possible since profits would be much larger than additional costs. This basic conclusion was not sensitive to reasonable variations in improved management costs; these could double without changing the conclusions. Under free trade, eco-certification could be financed by loggers with only a small portion of their profits.

Neither the forest revenue nor the forest concession system provides the incentives necessary to prevent forest destruction and obtain efficient log use and high recovery rates of processed products. The revenue system owes its failure to the lack of field supervision of logging activities and to the mislocation of fee collection points, while the concession system fails because it facilitates the ownership of oversized areas which are generally not well managed.

In order to save the invaluable natural forest and to exploit the forest sector's economic potential or comparative advantage, it is recommended that the Government of Bolivia take the following actions immediately:

a) Liberalize the trade of logs, cants and flitches.

b) Change the interpretation of the Agrarian Law so that forest management legitimizes claims to the land.

c) Grant all new concessions and renewals in the form of a "adjudicación" (owning the land and forest in perpetuity as long as firms comply with management requirements), through a competitive bidding process. A one time fee should be charged, and international firms should be allowed to participate. All participating firms must be required to implement sustainable management practices.

d) Relieve the CDF of its fiscal duties and assign it a major role in forestry research and other services. Contract NGOs with strong international links to provide technical assistance and monitor and certify sustainable management.

RESUMEN EJECUTIVO

Este estudio tenía como objetivo determinar la magnitud de las distorsiones en el comercio internacional de productos forestales y sus efectos sobre el valor del bosque, identificar las debilidades del sistema de concesiones y de tasas forestales, e identificar y asignar prioridades en cuanto a reformas de políticas conducentes a eliminar distorsiones, mejorar la eficiencia de la explotación de recursos forestales, incrementar la rentabilidad de la industria forestal, impulsar la conservación, y estimular la inversión en prácticas conducentes al manejo sostenible de los bosques.

Se concluyó que la prohibición de la exportación de madera en tronca es la distorsión más importante en cuanto al comercio internacional de productos forestales. Debido a dicha distorsión, durante 1991/92, el precio doméstico de la tronca de maderas suaves, como el serebó, y de especies finas, como la mara, fueron sólo alrededor de un 25 y un 40 porciento, respectivamente, de lo que habrían sido.

Otros cálculos de protección señalaron que, debido principalmente a la prohibición de exportar madera en troza, en 1992, los retornos a los recursos domésticos (mano de obra, capital) utilizados en la producción de chapas de mara y contrachapados de serebó fueron incrementados en alrededor de 114 y 2,000 porciento, respectivamente. Estos retornos propiciaron una asignación de recursos a esas actividades por encima de la socialmente deseable. De hecho, sin la distorsión, es improbable que el país hubiese exportado esos productos, ya que esta actividad no habría sido rentable para las empresas madereras.

El análisis también indicó que el valor agregado económico fue negativo para la madera aserrada de mara, lo que significa que las troncas utilizadas tuvieron mayor valor que la madera aserrada resultante, y que la mano de obra y otros insumos utilizados contribuyeron negativamente a añadir valor al producto.

Del análisis en el área de comercio internacional de productos forestales se concluyó que la prohibición de la exportación de madera en tronca impide al sector sacar provecho de sus ventajas comparativas, y reduce severamente la rentabilidad de la silvicultura y del valor maderero del bosque.

Se concluyó también que, con excepción de vender madera en tronca, en general las empresas madereras no perciben rentas o exceso de ganancias en sus actividades; es decir, los retornos de las empresas que invierten en procesar más la madera (hacer contrachapado, por ejemplo) son apenas normales. En un marco de libre exportación de productos, todas las empresas que procesan la madera más allá del simple aserrío tendrían pérdidas.

Estos resultados son en gran medida producto de la sobre inversión en capacidad industrial instalada, y del hecho que Bolivia carece de la tecnología, capacidad empresarial, capital humano, y la infraestructura necesarias para suplir al mercado internacional con los productos y las calidades demandadas. De ahí que vende productos de menor calidad a menor precio o a precios muy por debajo de lo que recibiría por los productos de alta calidad.

Otro objetivo importante de este estudio era determinar si las empresas madereras podrían invertir en mejores prácticas de manejo y aún mantener una rentabilidad aceptable. Para ello, se utilizó información preliminar, emanada de la investigación que se está llevando a cabo en el Bosque Elías Meneses, sobre los costos probables de las prácticas consideradas como el mínimo necesario para la sostenibilidad de la actividad. Estos costos fueron comparados con los ingresos bajo diferentes escenarios. Los resultados indican que aún bajo el escenario más conservador, las prácticas se pueden implementar sin que la rentabilidad de la actividad descienda por debajo del nivel mínimo requerido. Este resultado no fue sensitivo a variaciones normales en los costos de las prácticas. Tal es así que una duplicación de los costos no cambiaría las conclusiones.

El sistema de cobros forestales (derecho de monte, regalías y reforestación) es inadecuado. La ubicación deficiente del punto de cobro del derecho de monte aunado a la falta de supervisión de varias labores a nivel de campo conduce a un uso ineficiente de la tronca y a tasas bajísimas de recuperación o transformación de la madera. Por otra parte, el sistema de concesión de áreas de corte carece de un mecanismo para limitar los tamaños. Esto no sólo produce problemas de equidad, sino de manejo y de destrucción del bosque por personas ajenas a la empresa maderera.

Las siguientes medidas o acciones son perentorias si el Gobierno Boliviano desea detener la deforestación, y explotar con sensatez las ventajas comparativas del sector forestal del país:

a) Levantar la prohibición de la exportación de madera en troza. Esto incluye fliches y madera simplemente escuadrada.

b) Cambiar la interpretación de la Ley de Reforma Agraria de tal manera que el manejo de bosques sea considerado como una actividad productiva que dé derechos sobre la tierra.

c) Toda nueva concesión o renovación de contratos debe darse en la forma de una <u>adjudicación</u>, a través de subasta o licitación pública, con participación de empresas extranjeras. El precio resultante de este proceso será el único cobro a efectuarse. Toda adjudicación llevará el requisito de implementar prácticas conducentes al manejo sostenible, y el Gobiernos retendrá el derecho de revocar, en cualquier momento, el contrato con la empresa o persona que incumpliere este requisito.

Liberar al Centro de Desarrollo Forestal de sus obligaciones fiscales y asignarle un rol preponderante en la investigación y en la provisión de servicios. Contratar a ONGs con fuertes lazos internacionales para dar asistencia técnica y velar por el cumplimiento del requisito de manejo. Estos podrán servir para verificar el cumplimiento de la "Target 2000" de la ITTO.

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1. INTRODUCTION

1.1. Background

An estimated 12 million hectares of lowland tropical forest are destroyed or converted to marginal agriculture and other non-forest uses every year in the Latin America and Caribbean (LAC) region. The cumulative effect of this activity has been so devastating that, with the exception of Bolivia, every AID-assisted country in LAC is currently a net importer of forest products, and the current trade deficit for those countries combined is approaching a yearly US$500 million.

Because of the natural tropical forest's contributions to the world's biodiversity and to the mitigation of global warming, it is generally agreed that developing tropical forest management strategies which are profitable and sustainable would greatly benefit both the developing nations and the health of the global ecosystem. However, the evaluation of costs and long-term benefits associated with forest cover loss is limited and deficient. Most of the literature refers to paradigms and limited cost-driven analyses in Africa (Grut et. al., 1991) and Asia (Gillis, 1988; Vincent, 1992; Mendoza, 1992). In addition, most studies, regardless of location, have often contained incomplete and dubious cost analyses, resulting in anecdotal computations.

Despite the dearth of serious evaluations, it is now recognized that restrictive forest product trade policies, cumbersome and ineffective cutting permit and concession systems, misguided agrarian reform, and ill-conceived subsidies for other land uses all combine to undervalue timber and non-timber forest products, and to act as major disincentives for forest industry and woodland owners to operate in a more sustainable fashion (Johnston et. al., 1992; Stewart, 1992). International trade policies often include log export bans or taxes and high tariffs on imported forest products, which combine to subsidize and protect what is oftentimes inefficient local industries.

This conclusion is supported by limited empirical evaluations of the profitability of forest industries, which show that excessive profits are not being gleaned by loggers or millers, and strongly suggests that, when present, economic rents are captured mostly by highly protected and lucrative domestic secondary forest products industries (Stewart, 1992).

1.2. Problem Summary

The literature worldwide (Southgate, 1992; Stewart, 1992; World Bank, 1992) suggests that the four problems listed below are the direct outcome of ill-conceived forest policies. In this sense, regrettably, Bolivia is not the exception, and its forest sector is burdened by the same problems as are found throughout the world.

Deforestation. Loss of forest assets is accelerating. Bolivia's forest lands are being converted to other uses at a rate of 80,000 to 200,000 hectares per year. Despite its unsuitability for such uses, it is reported (CAO, CNF) that most of the converted land is being used for shifting agriculture and cattle ranching.

Mismanagement. Forests leased out to firms for harvest are simply not being managed, least of all sustainably. Not even the minimally accepted number of silvicultural practices are being carried out. Tenure insecurity, the lack of enforcement capability, and inadequate knowledge of sustainable management techniques seem to be the causes of this outcome.

Waste of forest raw materials. A large proportion of usable timber goes to waste in Bolivia. Again, the hypothesis is that the policy environment contributes largely to this outcome.

Sector's contribution is well below potential. Bolivia's forest sector generates only about US$80 million in export earnings and employs a negligible labor pool. Foreign exchange earnings from nature-oriented tourism are also negligible. With a total forested area of about 51 million hectares, of which at least 50 percent is production forest, the sector has great potential for increasing income and employment by exploiting its comparative advantage.

In addition, the magnitude of domestic value added is far below expectations: although transport costs represents up to 25 percent of export prices, sawnwood accounts for 70 percent of the value of forest product exports. This is counterintuitive and should be explained.

1.3. Study Objectives

The general consensus is that tropical forests are invaluable in terms of their environmental services, such as the contributions they make in mitigating global warming, protection against soil erosion, and maintaining biodiversity (World Bank, n.d., and World Bank, 1991). It is also recognized that because of the economic value of their timber (among other resources) as well as alternate uses of the land, these forests are a source of livelihood to many inhabitants of the tropics. Sustainable management is the only alternative use that reconciles the differences between the private

interests of farmers and loggers and the public interest of conservation and preservation.

A major premise of this study is that sustainable management is accepted as one of the goals of forest sector policies. Therefore, its purpose is not to contribute to the on-going debate regarding the environmental value of tropical forests as opposed to other values, but to concentrate on the effects of forest policies on the timber value of the forests, and the links between these effects and sustainable management and deforestation.

This is one in a series of three case studies designed to better understand the dynamics among timber trade policy, forest revenue systems and sectoral economics. The purpose of this individual case and a future synthesis of the collective results is to: 1) borrow the methodology from the field of international trade and use it to determine actual magnitudes of current price and trade distortions; 2) determine the profitability of different activities in the forest sector and assess their impacts on the residual timber value of the forests; 3) identify distortions in the stumpage fee and concession systems and suggest alternatives for their improvement; and 4) identify and prioritize policy reforms intended to encourage investment in more sustainable management strategies.

2. OVERVIEW OF BOLIVIA'S FOREST SECTOR

The objective of the following overview of Bolivia's forest sector is to present the reader with the information needed to better understand the problems to be addressed and the solutions to be proposed in this study. In this regard, the sections are concise and broad in scope. Additional information can be found in the appendices.

2.1. Forest Resources

About 50 percent of Bolivia's 110 million hectares is covered by forests, and about half of the forested area is located in the Department of Santa Cruz (Table 1). Four departments alone account for 87 percent of all remaining forests: in addition to Santa Cruz, Beni accounts for 18 percent and La Paz and Pando 11 percent each. These 49.4 million hectares of forests are all in the low lands.

Table 1. Forest areas of Bolivia

Department	Total Area	Forest Area	Forest Area / Total Area	Forest Area / Total Forest Area	Area of Timber Contracts	
	(Km²)	(Km²)	(%)	(%)	Ha (X10⁶)	Percentage
Beni	213,564	105,083	49	18	4.1	18
Cochabamba	55,631	26,664	48	5	0.3	2
Chiquisaca	51,524	17,798	35	3	0.2	1
La Paz	133,985	61,381	46	11	3.3	15
Pando	63,827	60,816	95	11	-	-
Santa Cruz	370,621	266,478	72	47	14.3	63
Tarija	37,623	26,464	70	5	0.3	1
Potosí	118,218	-	-	-	-	-
Oruro	53,588	-	-	-	-	-
Total	1,098,581	564,684	51	100	22.5	100

Source: Goitia and Gutiérrez (1992), based on Geobol-ERTS, 1978.

There are three distinct forest systems in the lowlands[1]. The Tropical and Sub Tropical Forests (Ilea Amazónica) cover parts of northern Santa Cruz, southeastern and northwestern Beni, northern La Paz and areas of southern Pando; the Temperate Forests of semi-dry regions are located in eastern Santa Cruz; and the Dry Land Forests, located in southern Santa Cruz, eastern Chiquisaca and

[1]The piedmont region of Cochabamba contains temperate forest species, like pines and eucalyptus.

Tarija, are the main sources of railroad ties and charcoal used in mineral smelters (Figure 1).

Most of the existing forest inventories were presented to CDF as a requisite (a formality) for obtaining cutting permits, and are highly inaccurate. They, nonetheless, serve as broad indicators of forest composition. A summary of 22 such inventories from the Nuflo de Chávez province indicated that the average volume for all species with a dbh $\geq$ 8 inches was 74 m^3/ha, with a range of 29 to 126 m^3/ha. The twenty-one species with the highest listed volumes averaged 37 m^3/ha or 50 percent of total volume. The five species with the highest listed volumes averaged 15 m^3/ha or 20 percent of total volume.

Table A.1 of Appendix A, which presents selected statistics on the composition of three forests, shows that the volume per hectare of high-valued species, like mara (mahogany[2]) is relatively low, especially in disturbed forests.

In the Temperate Forests of the semi-dry region (most of Santa Cruz), species like mara, roble and cedro have been exploited so intensively (high graded) that, at present, they are considered commercially extinct. This relative scarcity of high-valued logs is forcing loggers to increase the number of different species extracted from the forests. Nonetheless, only an average of 16 percent of available species are currently being harvested (**Table A.2** of Appendix A). **Table 2** shows that during 1986-90, five species accounted for 96.6 percent of all the sawnwood produced in Santa Cruz, and mara alone accounted for 76 percent. Mara also accounted for 70 percent of total lumber extracted in the Department of Beni during 1980-90 (Table A.3 of Appendix A).

Table 2. Average percentage composition of sawnwood produced in Santa Cruz, 1986-90

Species	Percent
Mara	76.0
Roble	14.3
Cedro	0.9
Ochóo	4.5
Morado	0.9
Tarara	2.1
Others*	3.3
Total	100

* Include Tajibo, Serebó, Almendrillo, Palo María, Bibosi.

[2]Refer to table on p. iii for scientific names of species

figure 1 (map)

This corroborates the selectiveness of logging in Santa Cruz during the recent past.

Broadening the number of exploited species may actually be beneficial. Current technical assessment indicates that decreasing high-grading and increasing the number of exploited species will foster more intensive harvesting of smaller areas and, as a result, improve the biological as well as economic sustainability of the forests (Gullison and Hardner, 1992).

2.2. Non-timber Forest Resources

Although commercial forestry is dominated by timber, other non-timber products accounted for about 26 percent of the value of forest product exports in 1991. By order of economic importance, these products are: Brazil nuts (*Bertholletia excelsa* H.B.), latex and heart of palm. The first two, which move easily across the border to Brazil, are major sources of cash income for the rural populations of the department of Pando (Riberalta is the main nut production center). The nuts are collected in forest concessions and sold to six processing plants.

Brazil nuts are the most important non-timber forest product. In part, due to their depletion in Brazil, Bolivia has become the world's largest Brazil nut exporter (mostly to Brazil). The share of nuts in the value of exports of non-timber products increased from 48 percent in 1986 to 87 percent in 1991.

Latex extraction has lost importance. Its share in the value of exports of non-timber forest products declined from 52 to 8 percent, due to the increase in nuts and to a fourfold decline in exports from a 1980 all time high. Because latex is extracted from the same forests as Brazil nuts, and often by the same collectors, Riberalta is also the production center for latex. Following an agreement between the Bolivian and Brazilian governments, in the past all latex was sold to Brazil. Under this agreement, Bolivian collectors and processors benefitted from a Brazilian incentive program (PROBOR), initiated in 1972. Latex prices were subsidized under this agreement and latex was sold in Brazil at about twice the international price. Brazil terminated the program in the late 1980s, and prices plummeted. Because of difficult access to trees, only 7 to 11 percent of usable trees are currently being tapped.

There is very little information on the collection and marketing of heart of palm. It is extracted by small collectors, without any management intervention, and processed in two outdated plants.

Because of time limitations and transportation problems, this study was limited to the Santa Cruz region[3]. For the same reason, and despite their importance, the effects of policies on the economy of non-timber forest products were not analyzed.

2.3. The Forest Industry

At the core of Bolivia's forest product industry is a large number of logging firms, which usually own forest cutting rights, and exhibit different degrees of vertical integration, some all the way up to the production of veneers, plywood, doors and furniture. In 1990 there were 274 firms of different categories (see **Table A.4** of Appendix A), 112 in the Department of Santa Cruz alone.

The processing industry is comprised mostly of relatively rudimentary sawmills (**Table A.5**). In addition, there are about 37 mills devoted to the production of railroad ties; a few sophisticated plants, located mainly in Santa Cruz, that manufacture sliced veneer and plywood, particle board, and parquet; two preservation plants, producing mining timber and utility poles; five dry kilns, and two manufacturers of doors, windows and furniture. In 1992, total timber processing capacity in Santa Cruz was about 860,000 m^3, concentrated in about 127 plants (Stolz and Quevedo, 1992). Processing capacity for the whole country was estimated at about one million m^3 (Claure, n.d.).

Wild rubber, Brazil nut and heart of palm harvesters and packers are also part of the forest industry subsector. There are also several paper mills using a combination of waste paper and imported pulp.

2.4. Institutions Affecting The Forest Sector

The modern history of Bolivian forestry started with the passing of the 1974 Forestry Law and the creation of the Forestry Development Center (CDF) under the jurisdiction of the Ministry of Agriculture and Peasant Affairs (MACA). CDF's single major function is to process requests for timber harvesting areas, monitor approved permits, and collect data on timber harvests. Its mandate also includes: formulation of the country's forestry policy; administration of forest resources, and execution of forest inventories and silvicultural research.

In practice, the CDF has been unable to comply with its mandate. The granting of cutting areas and permits, which is based on administrative discretion, has been plagued by political

[3] Owing to this concentration in Santa Cruz, the results must not be extrapolated to the rest of the country. This is not a serious limitation of the study, however, since the Santa Cruz area contributes more than 50 percent of total forest sector production, and provides 86 percent of total processing capacity.

influence and corruption, and established procedures are not followed[4]. Because of shortages in personnel and financial resources, there has been only negligible supervision of cutting areas at the field level. The logging firms themselves mark and cut the trees and keep harvesting statistics. In addition, less than 30 percent of potential stumpage fees are collected, making it essentially a voluntary payment.

Rural lands with natural forests also fall under the jurisdiction of two other MACA entities: Agrarian Reform (CNRA) and Colonization Institute (INC). CNRA provides land mostly to peasants migrating from the highlands, who deforest in order to practice shifting agriculture. INC affects the forest sector by the choice of location of its settlement programs. Lack of coordination and planning among the three institutions has led to a situation in which the government often ignores which lands are occupied or who owns them, when it grants logging permits. It has been common for the CDF to grant cutting rights over large areas, including private lands and lands traditionally settled and exploited by indigenous groups. At the same time, INC and CNRA have often granted titles to land within cutting areas (concessions) and even within protected forest reserves, including national parks.

2.5. Environmental Impacts of Forestry Activities

The forest industry has developed, to a large extent, beyond any kind of effective government control, and it has not been subject to prudent regulations that would bridge the gap between the foresters' private interests and those of the general public. This undoubtedly has led to unsound forest management practices that fortunately have not yet caused irreparable damage to the country's environment.

By all accounts, logging firms have not themselves been the direct cause of serious deforestation and forest damage (Gullison and Hardner, 1992). They have rather caused this indirectly by facilitating spontaneous colonization through road building. A 1988 report by MACA, for example, indicates that massive deforestation resulting from colonization has created serious eolian erosion in the Department of Santa Cruz.

In terms of wildlife and biodiversity, the direct impact of commercial logging activities is yet unknown. A report by FAN-WCI, based on preliminary observations in the wildlife reserve of Ríos Blanco y Negro, indicate that at a site intensely logged for six years the structure of the forest was seriously altered and there

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[4] Given that CDF has been financed by stumpage fees collected over areas granted for cutting, there has been a strong incentive for it to grant permits even when that action is inappropriate. This has been a classical case of conflict of interest.

was less diversity of bird species than expected. It further indicated that wild animals are the workers' main source of protein, and that the area's fauna density and diversity have been dramatically reduced. As explained by Robin Foster, a consultant to FAN, reduction in the fauna, especially large mammals, is likely to foster serious loss in plant species diversity.

These conclusions are supported by research conducted elsewhere. In a study of the influence of selective logging on bird species diversity in the Guianan rain forest, Thiollay argues: "whereas logging removed little more than 3 trees per hectare, 38 percent of the forest undergrowth was destroyed and a higher proportion of the canopy was opened to damage. An overall 27-33 percent decrease of species richness, frequency, and abundance occurred after logging, with a less marked decline of diversity and evenness indices, a substantial increase in the proportion of dominant species, and a 45 percent difference in species composition, weighted by frequency, between logged and undisturbed forest communities. Microhabitat selection was the main correlate of sensitivity to disturbance. Most affected by logging were species associated with the understory of tall mature stands especially terrestrial species. After 10 years of regeneration, the dense regrowth produced a uniform habitat type that still had not recovered the high species richness exhibited by the primary forest under an intermediate level disturbance" (Thiollay, 1992).

Redford (1992) addressed the issue of defaunation of tropical forests, concentrating on the forests of the Amazon basin. He states that one of the most important type of indirect defaunation is probably forest-extraction activities by humans; that logging can remove fruit-bearing trees and destroy nesting and other critical areas. For example, the enormous quantities of Brazil nuts removed from a patch of tropical forest undoubtedly affect the animals that otherwise would have fed on those nuts. He wrote: "As many are beginning to realize, game is becoming rare in many areas inhabited by rubber tappers, affecting not only the game animals, but also the ability of the people to live in the forests. Animals are important not only as food for humans, but also as pollinators and dispersers of economically important plant species, as regulators of pest populations, and as providers of myriad other ecological services.

There are currently several commendable efforts taking place to protect biodiversity by establishing protected areas. These efforts need to be complemented by a forestry policy that will promote sustainable management of all the forest resources and stimulate sustainable management in the non-protected areas.

3. TRADE MEASURES AND THE PROFITABILITY OF FORESTRY ACTIVITIES

Worldwide experience indicates that a number of trade measures --typically, export bans of unprocessed products, exchange rate interventions, and direct export taxes and subsidies-- which are implemented with the purpose of stimulating more domestic processing have often reduced the profitability of primary forestry activities and diminished stumpage prices and forest timber values (Grut et. al., 1991; Gillis, 199?; Vincent, 1990; Stewart, 199[illegible]).

The objective of this section is to identify the most relevant trade measures (current and in the recent past) and indicate how they have affected and are continuing to affect the private and social profitability of forestry activities and the timber value of the forests.

3.1. Trade of Forest Products

3.1.1. Exports of Forest Products

More than 70 percent of all forest products exported are in the form of rough sawnwood. Railroad ties, moldings and veneer account for only about 10 percent of the total (**Table B.1** of Appendix B). More than 75 percent of total exports of forest products go to Argentina and the United States (**Table B.2** of Appendix B). A small proportion of less than 10 percent in value is exported to Germany, Japan and other countries. More than 95 percent of total exports to the United States are made up of mahogany, at least 7 feet long, of the classification No.1 Common and Better. Argentina imports the shorter cuts of mara, No.2 and No.3 Common, and cuts of hardwood for railroad ties. The European countries and Japan import veneer, moldings and other products.

The principal ports through which forest products are exported are Arica, in Chile and Corumbá, in Brazil. Additionally a large proportion of forest products is exported to Argentina, by rail, through the Yacuiba/Pocitos border (**Table B.3** of Appendix B).

3.1.2. Imports of Forest Products

Data on forest products imports were unavailable. According to specialists at CNF and CDF, Bolivia imports newsprint, printing and writing paper, other papers and paperboard, and wood pulp. There is no report of imports of other forest products like veneer, plywood or sawnwood.

3.1.3. Trade Measures

Almost all restrictions on imports and exports were removed during the 1985 trade liberalization. A common tariff of 10 percent was set for imported final goods and 5 percent for inputs and capital goods. Only very few luxury items were taxed at higher rates, but never above 60 percent (Cámara de Industrias y Comercio). In addition, foreign exchange generated by exports of forest products is redeemed at market rates, there are no export taxes, and there is virtually no tariff being levied in the importing countries on forest products exported from Bolivia. The implication of the above is that exporters do indeed receive border prices[5] for their products.

In addition to border prices, some exporters receive a small subsidy. Beginning in 1985, the subsidy was equivalent to 10 percent of the net value of non-traditional exports. It was first reduced to 6 percent and later to 4 percent of FOB value to furniture exporters and 2 percent to exporters of other manufactured forest products, like veneer and plywood. No subsidy is paid to exporters of sawnwood.

The only important trade distortion in the forest sector is the ban on log exports[6]. The ban remained even after the 1985 overall trade liberalization, and its continuation is still being contemplated in the new forestry law presented to the Congress.

3.2. Measures of Protection

Nominal protection measures indicate to what extent policies contribute to drive a wedge between domestic and border prices of a given product. The nominal rate of protection (NRP), which is the indicator used in this study, is defined as ((pd-pb)/pb)*100; where pd is the domestic price and pb, the border price. Given that the only relevant trade distortion is the log export ban, this study estimates nominal protection for logs and not for products unaffected by similar trade measures.

Effective protection not only accounts for policies that affect product prices, but also for those that cause domestic prices of tradable inputs of the productive process (e.g. logs) to deviate from their border equivalents. This is why effective protection estimates are important for semi-processed and processed

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[5] In the case of an exporting country, the border price is the price foreign buyers are willing to pay for the product at ports (border) or at given points within the country. For Bolivia it would be at accessible ports, like Arica or Corumbá; at border points, like Pocitos, or within the country, like in Santa Cruz.

[6] It is actually a ban on the export of all unprocessed wood more than four inches thick; therefore, exports of flitches and cants are also banned.

products like plywood, doors and furniture, which use tradable inputs from the forest or from primary industries.

The effective rate of protection (ERP) is defined as the ratio of domestic to border value added: $(((Pd-\sum a.YPda)/(Pb-\sum a.YPba))-1)*100$; where Pd is the domestic product price, a is the quantity of tradable input per unit of product, Y is the product unit, Pda and Pba are domestic and border prices of the tradable input.

3.2.1. Nominal Protection

The nominal rates of protection estimates (see **Tables B.4 and B.5** of Appendix B) indicate that, in 1992, domestic log prices of softwood, like serebó, were only about 25 percent of what they would have been without the log export ban (NRP = -0.75). The NRPs for mara for 1991-92 were about -0.6, indicating that prices in Santa Cruz were only about 40 percent of what they would have been without the ban.

These results were confirmed by information obtained through personal contacts with industry participants in Chile, Argentina, and even Bolivia. They indicated that logs of species like virola, ochóo, serebó, morado, picana negra and palo maría, which are not being exported currently, could fetch good export prices in Argentina and Brazil[7]. Potential importers demand logs of these species for the purpose of producing veneers tailored to their own needs.

Because transport costs from the forest to assembling points to Santa Cruz are the same for domestic and border calculations, NRP estimates at the forest level were roughly the same as in Santa Cruz.

3.2.2. Effective Protection

The nominal rates of protection estimates were used in conjunction with detailed 1992 production costs provided by firms (see Appendix A) to estimate effective rates of protection for sawnwood of mara, plywood of serebó, and veneer of mara (Tables

[7] There is evidence —though not substantiated— that cants and flitches of fine species have been demanded from Bolivia at FOB prices higher than those for sawnwood of same species and quality. The only explanation for this phenomenon is that importers prefer less processed wood from which they can obtain various products of desired quality, which Bolivia lacks the technical capacity to deliver.

B.6-B.8 of Appendix B). Given that a high proportion is exported, FOB, Santa Cruz prices, and not reported domestic prices, were used as a basis for estimating private revenues. Since, as expected, domestic prices are somewhat higher than FOB export prices (same location), the consequence of this decision is a slight underestimation of the levels of effective protection, which provides a safety margin.

Estimated ERPs for mara veneer and serebó plywood were 123 and 2,142 percent, respectively, indicating that primarily because of the log export ban, the returns to domestic factors of production used to produce veneer and plywood (labor, capital, management) were 114 and 2,142 percent, respectively, above what they would have been without the trade distortion. These high levels of effective protection attract much more domestic resources to these activities than is socially desirable. In fact, without the trade distortion, it is unlikely that the country would export any veneer and plywood, since it would not be privately profitable.

In the case of sawnwood of mara, the economic (social) value added at border prices was negative, indicating that the logs used to produce sawnwood were more valuable than the sawnwood itself, and that the labor and other inputs employed contributed negatively to add value to the product. If the country exported logs instead of sawnwood, it would gain not only from the higher product price, but also from lower production costs. This conclusion emphasizes the fact that the log export ban is economically counterproductive.

3.3. Effects on the Profitability of Forestry Activities

Given that stumpage prices fall by 60 to 75 percent, one important effect of the trade measure evaluated is a sharp decrease in the profitability of primary forestry activities (when firms are not vertically integrated), including agroforestry, plantations, and other forms of lumber production. A positive change in policy --meaning liberalizing exports of logs, flitches and cants of species not in danger of extinction--, would trigger sharp increases in stumpage prices and forest timber values. It would also increase the profitability of forestry at the farm level, and stimulate plantations and natural regeneration.

Another effect of the distortion is to subsidize downstream processing industries to the degree that they become profitable private sector ventures, some even capturing economic rents. Without the distortion, all of the three processing activities evaluated would be unprofitable, at least for exports. The data indicate that further processing, like manufacturing furniture and doors, would be even more unprofitable without the trade distortion.

3.4. Effects on Forest Timber Values

Despite data limitations, it is very clear from the determined range of protection rates that trade distortions have contributed greatly to undermine stumpage prices and hence forest timber values. In all likelihood, stumpage prices for soft species like serebó and virola are only 25 percent of what they would otherwise be; likewise, stumpage prices of mara are only 40 percent of what they would be without the distortion. Given that log exports of other species are also banned, it is expected that their stumpage prices are similarly reduced. It is thus safe to say that, as a result of trade distortions, timber values of Bolivian forests have been reduced by 60 to 75 percent.

4. PROFITABILITY OF DIFFERENT FORESTRY AND COMPETING ACTIVITIES

The different forestry activities to be evaluated are: logging, sawing and exporting sawnwood, and manufacturing plywood, veneer, parquet and doors for export.

It is important to assess the profitability of these activities in order to determine if and identify by whom economic rents are being captured, as well as from which activities the greatest forest timber values are derived. The forest sector's comparative advantage can thus be determined. Given the importance of transport costs, the expectation is that those activities involving more processing (with more value added) should provide the highest residual timber value of the forests. The higher the value of the product per m^3, the lower the proportion needed to defray transport costs, and the higher the potential residual going to stumpage.

This exercise also permits us to compare the profitability of forestry activities to that of competing land uses, thereby determining if policy distortions in other sectors (or in the forest sector vis a vis agriculture) are undermining forest timber values and contributing to deforestation. It will also permit us to determine which changes might foster better land allocation between forestry and agriculture.

It is appropriate to note here that the reader should be aware of data limitations and exercise caution when interpreting these results. The data were obtained from a small number of firms and was quite variable, indicating wide intervals around true values. Further, costs and prices were provided by firms under self-imposed, extreme time limitations and, at times, with reluctance. In many cases the firms lacked adequate accounting procedures, and only "ball-park" figures were provided from memory.

The data and calculations used to arrive at profit and residual value estimates for the different activities are contained in **Tables A.6** through **A.20 of Appendix A.**

4.1. Profitability of Forestry Activities Under Current Practices and Trade Regime

Logs. Profitability of the logging activity[8], for four species, was estimated using cost data provided by cooperating firms and log market prices reported by Claure, 1992 (**Table 3**). The few firms devoted to this activity were making economic rents on mara and

[8] For simplicity, in this study, the logging activity consists in cutting trees and selling logs.

normal profits on roble. Selling logs was not profitable in the cases of tajibo and ochóo, two species sold only in the domestic market.

Table 3. Profitability of the logging activity, 1992

	Mara	Roble	Tajibo	Ochóo
Market price of logs US$/m3 *	105	93	40	20
Logging Costs US$/m3				
Felling, cutting, skidding	18	33	10	24
Road construction and maintenance	8	8	10	10
Fixed logging costs	8	23	21	23
Stumpage fees	17 10 7 5			
Total	51	74	48	62
Profits	54 19 -9 -42			
Profits as percent of costs	106	26	-16	-68

* Delivered at points where manufacturing plants buy logs.

Source: Tables A.6-A.19 of Appendix A, and Claure, 1992.

Data limitations not withstanding, this result begins to explain, even at this basic level, why firms log primarily the most valuable species, why they high-grade.

Next, the profitability of further processing was explored. The middle portion of **Table 4** (second and third columns), which summarizes the results, shows profits for the production of sawnwood, veneer, plywood, parquet and doors, using actual logging costs reported by cooperating firms. However, since these firms are vertically integrated, it is virtually impossible to determine the contributions of logging to overall returns (profitability) if that activity is not separated from the others. This is done on the right portion of the table (fourth and fifth columns), where the market prices for logs were substituted for actual logging costs. This substitution simulates the case in which manufacturing firms buy logs on the open market or from a subsidiary firm at market prices, thus separating logging profits or losses from profits (or losses) earned at the next level. It also allows us to determine whether further processing is itself profitable.

Table 4. Summary of the profitability of different forestry activities, US$/m³ of logs

Activities	Based on reported logging costs: Profits (US$/m³)[1]	Profits (% of costs)	Based on market prices for logs: Profits (US$/m³)	Profits (% of costs)
Logging[1]				
Mara	na	na	54	106
Roble	na	na	19	26
Tajibo	na	na	-8	-16
Ochóo	na	na	-42	-68
Sawnwood				
Mara	135	110	72	39
Roble	-6	-4	-15	-9
Tajibo	52	66	60[a]	85
Ochóo	-2	-3	26[a]	41
Veneer				
Mara	150	24	142	22
Morado	387	35	na	na
Plywood				
Serebó[3]	na	na	36	21
Serebó[4]	na	na	25	13
Serebó[5]	na	na	56	29
Parquet	na	na	199[b]	23[b]
Door	na	na	-2[c]	-3

na = not available; not applicable.
[1] This is profit per m³ of logs, except in the cases of parquet and doors.
[2] Based on log market price and logging costs.
[3] Plywood of 9mm, 100% serebó.
[4] Plywood of 9mm, 70% serebó, 30% mara.
[5] Plywood of 3.2mm, 70% serebó, 30% mara.
[a] This is the unusual case where market prices were lower than reported logging costs.
[b] Profit per m³ of parquet, not logs.
[c] Dollars per unit.

Sawnwood. The logging costs columns show that if a firm integrates vertically into the sawing business, it will make profits (and actually obtain rents) on mara and tajibo. Profits on roble drop dramatically, the reason being a reported FOB, Pocitos, Argentina price of US$275/m³ compared to US$487/m³, FOB, Arica, Chile for mara. The negative number, however, is perhaps an artifact of the sample obtained. Since firms are still sawing roble, the actual number is unlikely to be negative. Tajibo, which is not exported, commands a price of US$246/m³ in Santa Cruz. This is higher than roble's equivalent Santa Cruz price, which, after deducting transport costs to Pocitos and port and handling charges, is roughly US$207/m³. In addition, reported logging costs for roble was 1.5 times as high as the reported logging costs for Tajibo (Table 3). This is also likely a result of the small sample. The low profitability of ochóo (negative as a sampling outcome) is due mainly to its low value in the domestic market. The price of ochóo's sawnwood was only US$169/m³ in Santa Cruz, but its production costs were similar to those for the other species (Tables A.10-A.11 of Appendix A).

As expected, when market prices for logs were the basis for profit calculations, thus separating returns to logging from returns to sawing, profits dropped in the case of mara and roble (the latter became more negative, but rents were still being captured in the case of mara) and increased in the case of tajibo and ochóo. In the latter two cases, profits increased because reported logging costs were higher than log market prices. In the case of tajibo (and probably many other species) firms must integrate up to the milling level in order to make profits; that is, milling or sawing overcome the negative profitability of logging alone; it adds value to the raw material. Data limitations (sample size and accuracy) not withstanding, the conclusion is that investment in milling capacity is likely to be justified economically only for highly valued species like tajibo, for the domestic market, and mara, for exports. In the case of ochóo (and probably similar soft species) the results indicate that investment in milling would be worthwhile only if logs are bought at reported prices. This implies essentially buying from colonists, the only ones that can afford to sell logs below the logging costs incurred by established firms.

But, if milling is really unprofitable, why would lower valued species like ochóo and serebó be extracted? There are two possible uses that would justify their extraction: 1) export in the form of logs (difficult with a log export ban in effect); and 2) convert the logs to veneer or plywood. From the previous chapter, it is known that the first alternative would be profitable; the profitability of the second alternative will be explored below.

Veneer. Is it profitable to integrate vertically up to the level of veneer manufacture? The figures on the right side of the table indicate that in the case of mara, firms recoup only the returns necessary to stay in the activity[9]; there are no economic rents, but the investment is worthwhile. Unfortunately, data needed to estimate the profitability of the veneer of other species (like market prices for logs of morado) were not available. This is one important data limitation of the study and it is hoped that further studies explore this issue more fully.

Plywood. What about integrating vertically to produce plywood? Like in the case of veneer, the figures indicate that returns to investment in plants and equipment to produce two types of plywood are below the minimum returns demanded by firms (25%). In the case of plywood of 3.2mm with 30 percent mara, returns are above the minimum demanded. One concludes then that profits are not enough to justify the investment, and that low valued, soft species cannot be used profitably to make plywood. Under current circumstances, processing does not add value to these species.

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[9] Current annualized interest rates are between 12 and 15 percent (in dollars), and firms require additional returns primarily to cover their risk and for management costs as well. Due to this, and in consideration of the opinions of plant managers interviewed, we chose a minimum return of 25 percent for firms to be attracted to and remain in the industry. Although the subject is open for discussion, we are confident that the minimum required is no lower than 20 percent.

Parquet and doors. From the limited information available, the case of parquet is similar to that of veneer and plywood. The manufacture of doors for export, however, appears to be unprofitable. Whether this is due to faulty data or reflects the actual situation is difficult to determine since the information on doors was obtained from only one manufacturer. A larger sample would be necessary in order to arrive at definite conclusions.

In summary, the following observations can be made about the profitability of processing forest products:

a. Contrary to expectations, the activity with the least value added (logging), generates economic rents for some species. Despite this outcome, only few small firms specialize in this activity (colonists sell logs, but this is not their main activity). The majority of firms are vertically integrated, capturing some rents at the sawnwood level and normal profits at higher levels, except for doors[10].

b. Concentrating on the export market, as was done in this study, can be somewhat misleading, since 25 percent or more of all forest products are sold in the domestic market, at prices equal to or better than net export prices. This implies that firms may make higher profits from sales in the domestic market than in the export market, and that their profitability might be somewhat greater than portrayed here.

c. Processing costs are relatively high because of low utilization rates of installed capacity (20-40%). Table A.18 of Appendix A shows, for example, that fixed costs per m^3 of parquet decline from US$117.6 (US$28/m^2) to US$42 --a 64 percent fall-- in going from current utilization rate to full utilization of plant capacity; and that profits per m^3 of parquet increase by 90 percent from US$199 to US$378. Table A.19 of the same appendix depicts a similar situation for doors, where fixed costs per door experience a 42 percent fall and profits increase from US$-2.6 to US$29.8 per door.

d. Despite the availability of cheap raw materials, when evaluated separately, downstream processing do not command economic rents. Therefore, it is very likely that without the log export ban these activities would be unprofitable (at least for exports), since log prices would increase by 60 to 75 percent. This is explored in the next section.

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[10] Logging was separated from the other activities, not to determine whether vertically integrated firms are profitable overall, but to facilitate the identification of the country's comparative advantage in forestry related activities.

4.2. Profitability of Forestry Activities in A Free Trade Regime

The trade analysis results indicated that without the log export ban, log prices would increase by 60 to 75 percent, depending on the species in question. Therefore, it would be prudent to determine whether the different processing activities would be profitable under a free trade regime. In doing this exercise, it was assumed that log prices of mara would increase by a factor of 2.5 and ochóo's by 4[11]. And since NRPs were not expressly calculated for the other species, an intermediate NRP of -0.66 was assumed, which implies an increase in log prices by a factor of 3 (1/0.33), under free trade.

The results indicate, as expected, that logging becomes more profitable while all other activities using logs as inputs become more unprofitable under free trade (**Table 5**). Thus, with a change in the trade regime, it is very likely that the country would specialize in log exporting. All processing activities, however, would not necessarily stop, but there would be changes in prices and in the structure of the industry. Domestic prices would increase and more timber would be sawn for the domestic market.

It is concluded from both sets of profitability calculations that at the current level of development of the forest industry and, importantly, at current utilization rate of installed capacity, Bolivia's comparative advantage lies in the export of forest raw materials, like logs and sawnwood. It is thus not by happenstance that over 70 percent of the value of exports from the sector is in the form of rough sawnwood (the log export ban being current). The implication of this conclusion is that the ban on exports of forest raw materials is detrimental to the firms, the sector and the forests, since firms would make more overall profits by selling logs, cants or flitches, and forest timber values would increase.

Table 5. Summary of the profitability of different forestry activities, with current distortions and with free trade

Activities	With Current Distortions: Profits (US$/m³)[1]	With Current Distortions: Profits as (% of costs)	Under Free Trade: Profits (US$/m³)	Under Free Trade: Profits (% of costs)
Logging[2]				
Mara	54	106	461	904
Roble	19	26	205	277
Tajibo	-8	-16	72	150
Ochóo	-42	-68	18	29

[11] From NRP of -0.6, which gives 1/1+NRP = 1/0.4 = 2.5 for mara; and from an NRP of -0.75, which gives 1/(1+NRP) = 1/0.25 = 4 for ochóo.

Sawnwood						
Mara	72	39	-84	-24		
Roble	-15	-9	-201	-58		
Tajibo	60	85	-20	-14		
Ochóo	26	41	-34	-27		
Veneer						
Mara	142	22	-14	-2		
Plywood						
Serebó[3]	36	21	-36	-15		
Serebó[4]	25	13	-72	-25		
Serebó[5]	56	29	-41	-14		
Parquet	199[a]	23[a]	-893	-45		
Door		-2[b]	-3		-68	-44

n.a. = not available; not applicable.

[1] This is profit per m³ of logs, except in each cases of parquet and doors.

[2] Based on log market price and logging costs.

[3] Plywood of 9mm, 100% serebó.

[4] Plywood of 9mm, 70% serebó, 30% mara.

[5] Plywood of 3.2mm, 70% serebó, 30% mara.

[a] Profit per m³ of parquet, not logs.

[b] Dollars per unit.

4.3. Residual Stumpage Values

Residual stumpage values, defined as what remains to pay for the trees after all other factors of production are adequately remunerated, are probably the best indicators of forest timber values. Their calculation is very useful for comparing forestry with other land uses, for determining how different processing activities affect the value of standing trees and of tree-growing, and for identifying a country's comparative advantage in the forest sector. A summary of residual stumpage values is presented in **Table 6.**

Table 6. Summary of residual stumpage values, 1992, US$/m³ of log

Products or Activities	Under Current Trade Policy					
	Mara	**Roble**	**Ochóo**	**Tajibo**	**Morado**	**Serebó**
Logging	41	1	-58	-20	na	na
Sawnwood	124	-26	-21	41	na	na
Veneer	12	na	na	na	127	na
Plywood[1]	-24[a] 8[b]	na	na	na	na	-7.5
Parquet	na	na	na	negative	na	na

Doors	na	na	negative	na	na	na
			Under free trade			
Logging	198	187	2	100	na	na
Sawnwood	-170	-287	-50	-58	na	na
Veneer	-189	na	na	na	na	na
Plywood[1]	-146[a]	na	na	na	na	-98
	-114[b]					
Parquet	na	na	na	-1,384[c]	na	na
Doors	na	na	-73	na	na	na

na = not available; not applicable.

[1] Log prices were used to impute the cost. This implies that the residual reported would have to be over and above current returns to loggers. The negative values are thus not unexpected.

[a] Plywood of 9mm, 70% serebó, 30% mara.

[b] Plywood of 3.2mm, 70% serebó, 30% mara.

[c] This residual is for a m^3 of parquet, not stumpage.

In the case of logging (or log sales), residual stumpage values were obtained by subtracting logging costs from log market prices. Under the current trade policy, only mara had positive residual values; roble's was close to zero, and the residual stumpage values for ochóo and tajibo were negative, indicating that standing ochóo and tajibo trees are of little timber value in terms of logging and selling logs.

The sawnwood activity yielded positive residual stumpage values only for mara and tajibo; residual stumpage values for roble and ochóo were negative, indicating that roble trees are worth very little when converted to sawnwood for export, and that ochóo trees are also worthless when converted to sawnwood for the domestic market.

Mara trees are of little value when converted to veneer, whereas morado is worth much more in the same use. When converted to plywood, mara and serebó trees are worthless, meaning that converting to plywood does not add more value to the trees. Ochóo and tajibo trees are of no value when converted to parquet and doors[12].

Under free trade, the logging activity, as expected, exhibited much higher residual values for all species than under the current trade regime. All processing activities yielded negative residual values.

Data limitations not withstanding, the implication of the results is that at the logging activity confers high timber value

[12] It should be noted that in the case of parquet, what have been estimated are the residual values of sawnwood used in its production. Residual values for sawnwood derived from its use in the production of parquet and doors were below sawnwood market prices, indicating negative residual stumpage values for species used to produce these two products (Tables A.18 and A.19 of Appendix A). In order to obtain the free trade results, we used log market prices and not reported logging costs.

to the forests, only for mara when log exports are banned, and for a wider range of species under free trade. As more processing is added to logs beyond sawnwood, trees in the forest become less valuable in terms of timber, to the point where their values become negative when converted to plywood, parquet and doors. This result, although counterintuitive in principle, is even more dramatic under free trade, and can be explained by the lack of technological sophistication in Bolivia's processing infrastructure. Because of the strong influence of transport costs, it was expected that the higher the value of the product (the more value added), the higher the residual stumpage values.

The results constitute a phenomenon that can be explained on the basis of cost and quality. Cost. It was pointed out that unit processing costs are very high because of the low utilization rates of plant capacity. Quality. Bolivia lacks the technology, managerial skills, human capital, and infrastructure to supply the international market with the quality veneer, plywood, parquet and other products it demands (see UPSA, p.32). This was also confirmed by plywood and veneer buyers visited in the United States by one of the authors). Therefore, it must sell the lower quality products at lower prices, or at prices far below what quality products would command. Because of the quality problem, firms prefer to import raw materials --logs, cants, flitches-- and do their own processing.

4.4. Profitability Under Improved Management Practices

As pointed out earlier, very little, if any, forest management has occurred since the government began granting cutting areas to logging firms.

Thus, one important objective of this study is to determine if firms can incorporate sustainable management practices and still make acceptable profits. Since very little is known about what sustainable management entails and what costs are associated with the set of practices, the authors obtained preliminary information from on-going research in Bolivia to arrive at probable costs; the conclusions are thus somewhat preliminary. Appendix C provides a list of the activities considered by local scientists to be necessary to improve forestry practices and implement a program of sustainable management.

Estimated costs of these activities, which are described in the appendix,[13] are summarized in **Table 7**. The complete inventory and seeding trees are the two major expenses associated with sustainable management, accounting for 88.5 percent of total improved management costs. Without these, the per hectare management cost would be very low.

Table 7. Summary of costs associated with sustainable management, US$/ha/yr

Activity	Cost
Compartmentalization	0.29
Forest inventory	13.00
Pre-harvest liberation	3.68
Seeding trees	30.00
Biodiversity pockets	0.06
Fauna protection	0.07
Monitoring	1.47
Total	48.57

Source: Ing. Lincoln Quevedo, personal communication.

Given these costs, an important question is, will the activity remain profitable if improved management practices are used? In order to answer this question, per hectare profits under two different scenarios were estimated: one very conservative (based on estimates of harvestable densities provided by Ing. Quevedo for high-valued species, and by V. Molinos for lower-valued species), and another based on the utilizable densities reported for the Elías Meneses forest (see Table A.1 of Appendix A). The results are presented in **Table 8**.

These preliminary calculations indicate that even under the conservative scenario, sustainable management would be possible since profits are much larger than the additional costs. In fact, profits remain at about 44 percent of the new total cost in the conservative scenario, and at about 60 percent in the more realistic scenario[14]. This means that the basic conclusion is not sensitive to reasonable variations in improved management costs; these could double without changing the conclusions.

Table 8. Estimated profits per hectare under two scenarios

	With Current Trade Distortions					
Species	Scenario 1[a]			Scenario 2[b]		
	Harvest m³/ha/yr	Unit profit[c] US$/m³	Total Profit US$	Harvest m³/ha/yr	Unit Profit[c] US$/m³	Total Profit US$
Mara	0.1	72	7	0.1	72	7
Cedro	0.2	60[d]	12	0.2	60	12
Tajibo	0.6[e]	60.	36	5.0	60	300
Others[f]	0.6[e]	26	16	5.0	26	130

[13] This list of activities was developed by Ing. Lincoln Quevedo and colleagues at SENMA from on-going research at Reserva Forestal Elías Meneses. He also provided most of the costs. Some of the cost figures were developed by Rigoberto Stewart working closely with Ing. Quevedo. To our knowledge, this is a first attempt in Bolivia to estimate the likely costs of improved practices. In this regard, the comments and information provided by Guiermo Castilleja, Michael Kiernan, Amanda Jorgenson and Jack Putz are highly appreciated.

We would like to remind the reader that the imputed costs are only the increments in costs represented by the change in a given practice, not the total cost of the activity itself. For example, if harvesting is done more carefully, only the increment in harvesting costs would be included.

[14] These percentages were calculated using the profit as percent of total costs figures reported in Table 5 plus the sustainable management costs of Table 7.

Total	3.3		71	10.3		449
			With Free Trade[g]			
Mara	0.1	461	46	0.1	461	46
Cedro	0.2	72d	14	0.2	72	14
Tajibo	0.6[e]	72	43	5.0	72	360
Others[f]	0.6[e]	18	11	5.0	18	90
Total	3.3		114	10.3		510

[a] Very conservative harvest figures.
[b] Based on figures of utilizable volume in Elías Meneses forest, reported in Table A.1.
[c] Estimates based on sawnwood produced from logs bought at market prices.
[d] Profit estimates for this species were unavailable, hence those of tajibo were used as a proxy.
[e] Based on Vicente Molino's estimates.
[f] Represent all other species of commercial value; ochóo's profits are used as a proxy.
[g] In this scenario unit profits from logging were used since all other activities would be unprofitable.

Despite data limitations, the preliminary nature of the calculations, and the variability in harvestable volumes from site to site, we believe that, even with current trade distortions, profits will be closer to those estimated for the second scenario, and that practices conducive to sustainable management can be undertaken without rendering forestry unprofitable.

Under free trade, profits per hectare would increase and an even greater number of improved practices could be required without danger to the activity[15]. For example, eco-certification could well be financed by loggers with only a small portion of their profits.

4.5. Alternative Land Uses

In terms of land use, the alternatives to forestry in the lowland areas are agriculture (cotton, rice, soybean, maize, sorghum, beans, sunflower, wheat, pineapple, potato, and others) and cattle ranching. Agriculture has gradually substituted for forestry in the 50 to 150 km radius around Santa Cruz; cattle ranching occurs on more distant lands, and in other departments, like Beni.

Using production, yields, costs and farm price data reported by the farmers' association (CAO), we estimated average profits per hectare for the main agricultural activities and for raising

[15] In the current case (with trade distortions) we used profits from sawnwood activity since most firms do not specialize in logging and because sawnwood exports are not banned. In the free trade scenario, firms would specialize mostly in logging and exporting logs, and profits per m3 and per hectare would increase. We thus based the free trade scenario on the logging activity.

cattle, for 1992 (**Table 9**). Despite data limitations[16], the main conclusion drawn from the figures reported is that profitability of agricultural activities, in general, is low. Six of the 11 activities yielded negative profits; and only mechanized maize, cattle and potato production reported profits equal to or above 18 percent of total costs. The figures of Table 8 indicate that forest management is likely to be more profitable than agriculture and cattle ranching, even with investments in improved forestry practices.

Therefore, how can the conversion of forested lands to agricultural activities be explained? Furthermore, how do we explain the fact that land with forest is being sold at US$30 to US$40 per hectare, while cleared land fetches US$500 to US$600 per hectare? There are at least three factors contributing to this apparently irrational conversion. Firstly, forest management in Bolivia requires very high capital investments for such things as heavy equipment. In addition, the government has set minimum capital requirements for entry[17]. Cattle ranching and agriculture do not require such high initial investments, especially if shifting cultivation is practiced. Secondly, the negative policy environment serves as a deterrent to investment in forestry activities. Thirdly, there is high social status associated with owning a cattle ranch.

Table 9. Production costs, income and profits for various agricultural activities and cattle raising

	Production Costs		Income		Profits	
Crop	US$/ha	US$/tm	US$/tm	US$/ha	US$/ha	% cost
Rice	578.2	231.3	254.8	636.9	58.7	10.1
Soybeans	287.5	143.7	145.0	290.0	2.5	0.8
Maize	338.9	94.1	115.2	414.7	75.8	22.4
Sorghum	297.1	92.8	86.5	276.8	-20.3	-
Beans	353.4	294.5	320.0	384.0	30.6	8.6
Cotton	714.6	1,553.0	1,023.3	477.0	-237.6	-
Sunflower	211.8	151.3	130.0	182.0	-29.8	-
Wheat	268.7	191.9	180.0	252.0	-16.7	-
Pineapple	6,632.6	0.44/unit	0.3/unit	4,500.0	-2,132.6	-
Potato	2,015.9	155.1	230.0	2,990.0	974.1	48.0
Cattle	8.1	1.1/kg	1.5/kg	10.6	2.5	31.0

Note: Yields in 1990/91 were used for these calculations because of the flooding in 1991/92 that decreased yields well below normal. The cost of land is not included in total costs.
Source: Cámara Agropecuaria del Oriente, 1992.

[16] It is realized that these reported figures, as is normally the case, are approximate at best. Therefore, the results must be interpreted with caution. With only three weeks in the country to do this study, these figures could not be improved beyond correcting for yield problems in 1992 by using 1991 yields instead.

[17] In order to obtain cutting areas and a contract of short, medium or long term, firms are required to have a sawmill and a certain level of investment. Recall that firms are categorized according to their investment levels, and contracts are given according to categories.

Plantation forestry. Plantation forestry was evaluated as an alternative land use in the areas currently devoted to agriculture or cattle raising. Data were scarce and only preliminary information on the likely costs and benefits associated with planting eucalyptus in the Santa Cruz area was available. Conservative calculations, which are presented in detail in **Table A.21** of Appendix A, indicate that a project with a 50 year horizon yields an internal rate of return (in dollars) of 23 percent. Since this is higher than the return on investments in agricultural activities, plantation forestry (eucalyptus, serebó, and other species) should be further explored as a promising alternative land use that could also ease the pressure on the natural forests.

The prospect is promising since future demand for eucalyptus and other species (like serebó) will likely rise in the near future. Eucalyptus is currently being used successfully as electric power poles. Also, Wood Based Panel International reported that eucalyptus is being used in Brazil to produce premium grade hardboard. A processing plant for the exclusive production of hardboard is currently being transferred from Sweden to Bolivia. The owner is planning to plant a large number of hectares of his own, as well as enter into contract agreements with individuals willing to invest in eucalyptus plantations. Owing to these developments, a future study should seriously evaluate the profitability (private and social) of this alternative.

5. THE FOREST REVENUE SYSTEM AND OPTIONS FOR ITS IMPROVEMENT

5.1. The Forest Revenue System

The current forest revenue system comprises three monetary charges: "derecho de monte" "regalías" and "plantaciones forestales". Derecho de Monte, which is a stumpage fee, is considered the price charged by the government for timber, and is set by the CDF annually through interministerial resolutions. According to the law, stumpage is the legal base for setting the fee, but in practice the fee is levied on sawnwood after conversion to approximate the original roundwood volume. **Table A.22** of Appendix A shows the fees set for the most important species during 1992.

Regalías is a nominal 11 percent tax levied on sawnwood for development of the areas from which timber is extracted. It is based on the value of sales of sawnwood less administrative, marketing and transport costs, and is collected by the Regional Development Corporations (RDCs). In Santa Cruz, CORDECRUZ decided that the "regalía" would be a fixed dollar amount, by species, per m^3 extracted. Mara, for example, now pays US$8/$m^3$. This is much more than what the CDF collects as "derecho de monte". Although, in theory, the taxes are for regional development, in reality most of the proceeds from this tax stay in the cities where the RDCs are installed.

"Plantaciones forestales" is a reforestation fee paid to the CNF voluntarily by logging firms. This fee was set at 50 percent of the derecho de monte. In practice, reforestation has been negligible (CDF reports a reforestation rate of 10,000-11,000 hectares per year for the whole country), in part, because only a few firms seem to make this voluntary contribution.

5.2. Problems With The Forest Revenue System

As was pointed out above, stumpage fees (derecho de monte) are paid per cubic meter of logs, but since forest products are first measured and fees assessed at the sawnwood level, the effect is tantamount to basing forest fees on sawnwood. The implication of this is that firms are given a free hand in the forest (no supervision) to choose the trees and trunk parts to be "bought". And since they only pay for what is hauled out, undoubtedly they will only transport the best parts of the best trees, even when it would be profitable, albeit less so, to transport other parts of the tree. Therefore, the fee collection point, coupled with the lack of field supervision, leads to inefficient log use and low recovery of processed products, and penalizes efficient log

utilization. It is reported that not more than 30 percent of utilizable raw material is recovered at the sawnwood level (Claure, 1992).

Because of its limitations, the CDF relies on harvesting reports of logging firms in order to assess the "derecho de monte", and there are accounts of under-reporting. In addition, payments are normally delayed for several months or even years. As a consequence, CDF indicates that not more than 30 percent of actual fees are being collected[18].

It was also mentioned that the "regalías" collected by the RDCs, are not used to support the forest sector, and seldom reach the communities for which they are earmarked. Under these circumstances, the current fee system seems to be neither efficient nor equitable.

5.3. Equity of Forest Fees

Grut et al. make a strong case for minimum forest fees, on the basis that these fees are appropriate to ensure that the timber cutting benefits to the country adequately compensate the costs to society involved, which include the cost of forest protection, administration and sales; regeneration and environmental costs, such as contributions towards mitigating global warming; social costs; possible loss of non-timber forest outputs like game animals and fruits; and possible revenue foregone if stumpage values increase in real terms in the future. It is very likely, however, especially in Bolivia's case, that in order to cover these costs, fees would have to be set at levels at which logging would be privately unprofitable, except probably in the case of mara.

Another approach to this issue is to assume that logging firms provide a service, and that their returns should be equal to the cost of that service; any surplus above that cost should go to the society by means of the government. In this scenario, forest fees are designed to extract all possible rents associated with timber extraction. If this approach were taken, current forest fees, which are often 12 to 14 percent of residual stumpage values (see **Table 10**), would be far too low.

On the other hand, it has been argued that there is a long tradition in sharing out Bolivian natural resources (like mines and land for agriculture and cattle ranching) to private citizens at no cost, and that the natural forests should not be treated differently.

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[18] At the time of this study (December 1992), CDF reported that loggers were behind in their payments by about US$2 to 3 million in Santa Cruz alone.

Table 10. Residual stumpage values and stumpage fees

Identification	Mara	Roble	Ochóo	Tajibo
	US$/m³			
Residual stumpage values *	124	-26	-21	41
Stumpage fees and taxes	17	10	8	5
Stumpage fees as % of RSV	14	na	na	12

na = not applicable, since the residuals were negative.
* Based on sawnwood, under current trade distortions.
Source: Table 6 and Table A.22 of Appendix A.

Proponents of this argument believe that forest fees should serve purposes other than to extract rents from concessionaires; that they should provide sufficient resources to the government for servicing and administering the sector, as stated in the forestry law, and probably serve as a mechanism for reducing waste in the forest. In light of this argument, it would be necessary to determine the level of resources required for servicing and administering the forest sector adequately in order to assess whether current fees are too low.

5.4. Forest Fee Options

A better alternative to the current system is a per tree fee[19], which does not require scaling for revenue purposes by species and would be constant regardless of tree diameter or volume. If charged on all trees felled, whether utilized or not, it would discourage the wasteful felling of trees that are then left non-utilized, thus benefiting forest management (see Grut. et.al., 1991). But given the Bolivian Government's incapacity to monitor trees felled and collect fees, an area fee would be more appropriate. It would discourage waste, be cheaper and easier to collect (compatible with a weak control and collection system) and, as will be seen shortly, contributes to equity by providing a non-arbitrary mechanism for limiting concession areas and relating fees to distances from major markets.

[19] Grut et. al. (1991) point out that a fee based on the inventory volume of merchantable trees (standing-volume fees) has advantages, but it would require an accurate operational inventory and very close control of logging operations. It has advantages for plantation forests, but is not necessarily appropriate for natural tropical forests.

6. THE FOREST CONCESSION SYSTEM AND OPTIONS FOR ITS IMPROVEMENT

6.1. The Concession System

The 1974 Law spelled out the sequence of steps that a firm must follow in order to obtain a "Contrato de Aprovechamiento Forestal", which is actually a permit to extract given volumes of certain species from a particular forest area[20]. The steps included registration with the CDF on a yearly basis; presentation of a request for an "Area de Corte" (cutting area); presentation of a forest inventory of that area, accompanied by a feasibility study and a management and harvest plan; and the signing of a contract.

There are five different types of contracts (see **Table 11**). Single use contracts are used for converting forested land to pasture or agriculture and apply mostly to colonization areas. Annual contracts, for which firms are not required to have processing facilities, are used for logging operations on private lands or, temporarily, on public lands. These contracts are often used by independent loggers supplying the domestic market. Firms must own a processing facility in order to qualify for the short, medium and long term contracts. Long term contracts were extremely difficult to obtain during 1974-92 because they required a presidential decree.

Table 11. Types of contracts and eligibility for accessing timber rights, 1974-1992

Type of Contract	Duration (years)	Decision by entity	Maximum annual harvest (m^3)	Firm Cate-gory	No. of firms (S. Cruz)
Single use	0	CDF	any	no firm	-
Annual	1	CDF	1,000	1-4	-
Short term	3	CDF	3,000	1-3	101
Medium term	10+5	CDF+MACA	10,000	1-2	5
Long term	20	Presidential decree	10,000 +	1	5

Source: CDF

[20] The system never granted forest concessions per se. The law provided only user contracts called "Contratos de Aprovechamiento Forestal", and beneficiaries paid no fees beyond the costs incurred to meet the requirements.

The vast majority of contracts were short term, and until early 1992, they had to be renewed on a yearly basis. This implied tenure insecurity, which led to mining rather than management of the forests. Mining implies quickly felling only valuable species during the short logging season, and not investing in such forest management practices as leaving seeding trees, directional felling, or area improvement.

Another weakness of the current system is that it allows invasion of "concessions" by migrant peasants who destroy patches of forest in order to practice shifting agriculture. It is not unusual for these peasants to be granted titles to land within contracted cutting areas (even when these lands are not suitable for sustainable agriculture), thus creating a disincentive for better management by "concessionaires".

The system is also flawed by official barriers to entry. Access to concessions is highly concentrated, and it is very difficult for small and medium-sized firms, loggers' cooperatives, and the like to obtain cutting areas. Also, indigenous groups have difficulties obtaining rights to exploit the resources within their traditional community areas; oftentimes cutting rights in these areas have been granted to logging firms.

According to CDF's regulations, the maximum size of a cutting area is 300,000 hectares; nonetheless, because a few firms own several contracts under different names, some cutting areas have approached a million hectares. **Table A.23** of Appendix A presents a summary of the sizes of areas given out under user contracts.

6.2. Problems With The Forest Concession System

First, contract lengths are too short and property rights too vague for firms to invest in better management practices. It is recognized that tenure security is a necessary, albeit not in itself sufficient condition, for better management. Second, the current system lacks a non-arbitrary mechanism for limiting areas assigned to each firm and for determining the value of concessions. Third, the system discriminates against small firms and organizations, and very importantly, against indigenous groups and communities.

6.3. Forest Concession Alternatives

An alternative open to the government is contained in the draft of the new forest law. It calls for setting a concession fee of about one dollar per hectare per year and giving out concessions to all qualifying firms for a period of 40 years, renewable in perpetuity if firms comply with management practices. Concessions, however, would still be given out through administrative discretion. This alternative has at least three important disadvantages. First, it does not provide an adequate mechanism for setting the original fee nor for modifying the fee in the future when conditions change. Second, the time period is too short if sustainable management is the goal. Third, it does not provide the legal framework that will guarantee a halt to the invasions by colonists.

In our view, a better alternative is what the Bolivians term "adjudicación". It means that firms are granted full property rights and are the legal owners of the forest (and land) as long as they comply with certain forest management obligations. That is, the state can reclaim the property if a firm is found in non-compliance. We propose that the "adjudicación" be done through competitive bidding or auction[21] through sealed bids or closed tenders, and that the only fee be the price per hectare that results from this process[22].

Since the tenure security that results from this process would not be sufficient to ensure sustainable management (which is the underlying official and international community goal), all participating firms would be required to comply with specific management practices in order to receive an "adjudicación". Compliance could be monitored by an NGO with strong international links and credibility; this NGO would also serve as a certifying agency for the ITTO "Target 2000".

If this alternative is complemented with measures to ensure that indigenous groups are granted rights to their native (traditional) communal lands and forests for sustainable use[23], it

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[21] Gillis points out correctly that auctions are feasible only when there is an inventory of the timber resource adequate to permit parcels to be auctioned. A first step in the process would therefore be the development of sound forest inventories. As for the process itself, there is the fear that firms might collude and render the bidding uncompetitive. In order to reduce the likelihood of collusion, foreign firms should be allowed to participate in the process, but without any financial or other advantages over domestic firms. The competitive auction mechanism has been successful in Malaysia and Venezuela (Gillis).

[22] This would be equivalent to a sale price, which would take into account such factors as the forest composition, present and future income potential and distances from major consuming centers.

[23] Indicating how this should be done and on what basis, although very important, is beyond the scope of this study. This is a task that will demand specific attention by very qualified social scientists and government officials. CIDOB indicated to us that some indigenous groups would like to manage concessions commercially on a sustainable basis, but lack investment capital and technical expertise; and would thus require financing and technical assistance.

could potentially solve all the problems inherent to the current forest concession system. The per hectare charge might be inequitable in terms of how natural resources are traditionally treated in Bolivia, but it serves as a non-arbitrary allocation mechanism, which is also more equitable in terms of distribution of user rights for the forest resource base.

7. CONCLUSIONS AND RECOMMENDED ACTIONS

7.1. Conclusions

This section summarizes the main conclusions of this study, which are explained in detail in the previous chapters.

a. The 1974 Forestry Law and its accompanying regulations led to the prevalence of administratively determined, short term contracts, and to tenure insecurity, which shortened the time horizon of logging firms. As should be expected in this business environment, firms did not manage the forests but rather mined them. This situation was aggravated by a lack of knowledge of sustainable management practices and by confusion among MACA agencies.

b. As a consequence of the export ban, log prices and stumpage values are only 25 to 40 percent of what they would otherwise be. This offers very high levels of effective protection to downstream processing; in one case the estimated effective rate of protection was more than 2,000 percent. But downstream processing is a wasteful use of the country's resources. The value added at border prices in some processing activities is negative, indicating that the raw material (logs) is more valuable than the final product derived from it.

c. Because Bolivia lacks the technology, managerial skills (which has led to chronic underutilization of processing capacity), human capital, and infrastructure to produce the quality products that command high prices on the international markets, its comparative advantage[24] lies in the export of raw materials like logs, cants and flitches. If these products were exported, the profitability of logging and the timber value of the forests would increase. This would facilitate the implementation of better management practices.

d. Except for the extraction of mara and its conversion to sawnwood, firms generally do not enjoy economic rents in forestry activities. Contrary to expectations, the most profitable activities are logging and sawing. Under the current trade regime, downstream processing commands only normal returns to additional capital investment. Under a free trade regime, downstream processing would be

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[24] Comparative advantage, which is not static but dynamic, is strongly influenced by the levels of technology of an industry or country.

unprofitable and the additional capital investments would not be warranted.

e. The inadequate forest revenue system and control promote corruption and waste of forest raw materials.

f. The forest concession system is inequitable because it promotes oversized areas and discriminates against small firms, cooperatives and indigenous groups.

7.2. Recommended Actions

In order to save the invaluable natural forest and to exploit the forest sector's economic potential, the Government of Bolivia should take the following actions.

7.2.1. Immediate Actions

a. Liberalize trade of logs, cants and flitches so that this sector can match its supply with demand in the international markets, and exploits its comparative advantage.

b. Change the Agrarian Law or its interpretation so that forest management legitimizes claims to the land as agriculture currently does.

c. All new concessions and renewals should be in the form of a "adjudicación", and this should be done through competitive bidding. A one-time fee should be charged, and international firms should be allowed to participate in the process. All participating firms must be required to implement sustainable management practices.

d. Relieve the CDF of its fiscal duties and contract NGOs with strong international links to provide technical assistance and monitor and certify sustainable management (eco-certification). It must re-organize CDF and assign it a major role in providing services and conducting research.

7.2.2. Further Actions

e. CDF and other institutions should continue research in the area of sustainable management. This includes determining forest composition and potential uses of a larger number of species.

f. In collaboration with the private sector, the Government should conduct aggressive product development, both internationally and locally, to market the wide range of species and products which will result from better silvicultural practices.

g. Evaluate and invest in transportation infrastructure of all types and in all locations. This will greatly increase Bolivia's competitiveness in many sectors and broaden the forest sector's comparative advantage.

h. Design a system of technical assistance in the area of forest management, for colonists, small farmers, logging cooperatives and indigenous communities.

i. Continue and expand the effort to document current land use classification. This is essential to implement a complete agrarian plan.

7.2.3. Future Studies

1. In collaboration with other entities, the Government should seriously evaluate of plantation forestry (Eucalyptus, Serebó and others) as a viable alternative to agriculture and cattle ranching in many areas. This forestry alternative can go a long way to ease the pressures on the irreplaceable natural forests.

2. Explore the profitability of downstream processing activities, under a free trade regime, with and without a better road system, using larger samples representing more species. This study should determine what technical and administrative limitations confront the forest industry.

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APPENDIX A: TABLES WITH DETAILED CALCULATIONS

Table A.1. Some average statistics for Bolivian tropical forests

Forest	Variable	Intervened forest	Primary forest	Observation
Bosque Experiment al Elías Meneses	Utilizable volume per ha	HV:0,4 to 0.6 m³ MV:9.4 to 10.6 m³ LV:26.0 to 31.0 m³ Total: 35.8 to 42.3 m³ mara:0.1 to 0.15 m³	HV and MV: 31.8 (mara - 3.3; ochóo 25.2) Total: 97.8	Source: Carden (1991)
	Utilizable trees per ha	106	HV: 5 (mara - 0.6; ochóo - 2.5) MV: 1.6 mara: 2 to 3	Source: Vega (1991)
	Total Volume ha (DAP>10)	61.1 m³	97.8 m³	Source: Vega (1991)
	Total trees per ha	250.8		Source: Vega (1991)
San Ramón	Number of trees per ha (mara)		DAP 60-80 cm:0.621 DAP 80-100 cm:0.283 DAP > 20 cm: 1.339	Source: CDF (1988)
	Volume (m³) per ha (mara)		DAP 60-80 cm: 0.738 DAP 80-100 cm:1.178 DAP > 20 cm: 3.346	Source: CDF (1988)
	Volume per tree (m³) (mara)		DAP 60-80 cm: 1.18 DAP 80-100 cm:4.16 DAP > 20 cm: 2.49	Source: CDF (1988)
Guapay	Number of trees per ha (mara)		DAP 60-80 cm: 0.4 DAP 80-100 cm: 0.1 DAP > 20 cm: 2.39	Source: CDF (1988)
	Volume (m³) per ha (mara)		DAP 60-80 cm: 0.68 DAP 80-100 cm: 0.34 DAP > 20 cm: 1.37	Source: CDF (1988)
	Volume per tree (m³) (mara)		DAP 60-80 cm: 1.7 DAP 80-100 cm: 0.34 DAP > 20 cm: 1.71	Source: CDF (1988)

Notes: HV=high value; MV=medium value; LV=low value; DAP=diameter at chest height.
Source: Stolz and Quevedo, 1992

Table A.2. Available and exploited tree species

Department	Available species	Species used	Percentage of species used
Beni	186	8	4.3
Cochabamba	84	12	14.3
Chiquisaca	34	10	29.4
La Paz	32	13	40.6
Pando	323	15	4.6
Santa Cruz	182	67	36.8
Tarija	69	23	33.3
Total	910	148	16.2

Source: CDF

Table A.3. Composition of tree harvest in different departments, average percentages for 1980-1990

Species	Departments			
	Sta Cruz	Beni	La Paz	Cochabamba
Mara	51	70	-	-
Roble	15	-	-	-
Ochóo	10	6	6	32
Palo María	-	10	-	-
Ajipa	-	-	10	-
Mascajo	-	-	12	-
Ajo Ajo	-	-	6	-
Bibosi	-	-	6	-
Eucalyptus	-	-	-	19
Almendrillo	-	-	-	6
Mapajo	-	-	-	4
Total of these species	76	86	40	61

Source: Claure, no date.

Table A.4. Distribution of logging firms by departments and category in 1990

Department	Category				
	First	Second	Third	Fourth	Total
Santa Cruz	22	31	31	28	112
Beni	14	5	2	10	32
La Paz	15	17	2	-	34
Cochabamba	-	4	29	20	53
Tarija	-	-	-	31	31
Chiquisaca	0	0	0	12	12
Total	51	57	64	101	274

Source: CDF, Diagnóstico Forestal, 1990

Each Bs 13,000 investment accounts for one point. Points according to processing capacity are assigned as follows: up to 1,000 m³ of logs per year, zero point; between 1,001 and 4,000, 5 points; between 4,001 and 10,000, 10 points; above 10,000, 20 points. Points from investments and processing capacity are summed and firms are classified into categories as follows: First, above 150 points; Second, between 71 and 149 points; Third, between 21 and 70 points; and Fourth, up to 20 points.

Table A.5. Composition of the timber processing industry

Type of industry	Departments						
	Sta Cruz	CBBA	La Paz	Beni	Tja	Chiq	Total
Sawmills	85	49	31	34	13	5	217
Veneer mills	5	-	-	-	-	-	5
Parquet Manuf.	1	1	-	-	-	-	2
Particle board	2	-	-	-	-	-	2
Railroad ties	12	-	-	-	18	7	37
Doors and windows	1	1	-	-	-	-	2
Matches factory	-	-	1	-	-	-	1
Preservation plant	1	1	-	-	-	-	2
Drying plants	4	1	-	-	-	-	5
Total	111	53	32	34	31	12	273

Source: Regional CDFs and Cámara Nacional Forestal

Table A.6. Profitability and residual stumpage values: rough sawn mara

Items	Current Case
Price FOB, Arica, Chile US$/m³	487.3
Port charges	10.2
Transport Sta Cruz to Arica	58.9
Grading and handling	2.1
Trans. mill to Sta Cruz	29.7
Value ex-mill US$/m³	386.4
Milling costs	
Variable costs (not logs)	30.1
Fixed costs	22.9
Total	53.0
Logging costs (milling yields 53%) *	
Felling, cutting, logging	34.0
Road construction and maint.	15.1
Total	49.1
Stumpage fees	28.3
Profitability	
Total revenues	487.3
Total costs	231.2
Profit per m³ of sawnwood	256.1
Profits per m³ of log	135.5
Profits as % of total costs	110.8
Residual stumpage values	
Total revenues	487.3
Total costs, excluding stumpage fees	202.9
Profits = 25% of costs	50.7
Residual stumpage values, m³ sawnwood	233.7
Residual stumpage value per m³ log	123.7

* Implies 1.89 m³ of logs per m³ of sawnwood.

Table A.7. Profitability of rough sawn mara
(Based on market prices for logs)

Items	Current Case
Price FOB, Arica, Chile US$/m³	487.3
Port charges	10.2
Transport Sta Cruz to Arica	58.9
Grading and handling	2.1
Trans. mill to Sta Cruz	29.7
Value ex-mill US$/m³	386.4
Milling costs	
Variable costs (not logs)	30.1
Fixed costs	22.9
Total	53.0
Logging costs (milling yields 53%) *	
Market price Bs 420/3m ³**	196.6
Profitability	
Total revenues	487.3
Total costs	350.5
Profit per m³ of sawnwood	136.8
Profits per m³ of log	72.4
Profits as % of total costs	39.0

* Implies 1.89 m³ of logs per m³ of sawnwood.
** Reported market price was roughly Bs 420 per m³ at mills in Buena Vista, Santa Rosa and Rincón de Palometas.

Table A.8. Profitability and residual stumpage values: rough sawn roble

Items		Current Case
Price FOB, Pocitos, Chile US$/m³		275.4
Port charges		10.2
Transport Sta Cruz to Pocitos		55.9
Grading and handling		2.1
Trans. mill to Sta Cruz		29.7
Value ex-mill US$/m³		177.5
Milling costs		
Variable costs (not logs)		30.1
Fixed costs		0.0
Total		30.1
Milling yields 53%		
Logging costs for 1.89 m³ of logs		
Felling, cutting, skidding, logging	62.4	
Road construction and maint.		26.5
Fixed logging costs		43.5
Total		132.3
Stumpage fees		26.8
Profitability		
Total revenues		275.4
Total costs		287.1
Profit per m³ of sawnwood		-11.7
Profits per m³ of log		-6.2
Profits as % of total costs		-4.1
Residual stumpage values		
Total revenues		275.4
Total costs, excluding stumpage fees		260.3
Profits = 25% of costs		65.1
Residual stumpage values, m³ sawnwood		-49.9
Residual stumpage value per m³ log		-26.4

Note: Since yield is 0.53, 1.89 m³ of logs is needed per m³ of sawnwood.

Table A.9. Profitability of rough sawn roble
(Based on market price for logs)

Items	Current Case
Price FOB, Pocitos, Chile US$/m³	275.4
Port charges	10.2
Transport Sta Cruz to Pocitos	55.9
Grading and handling	2.1
Trans. mill to Sta Cruz	29.7
Value ex-mill US$/m³	177.5
Milling costs	
Variable costs (not logs)	30.1
Fixed costs	0.0
Total	30.1
Milling yields 53%	
Market price Bs 372/m³	175.8
Profitability	
Total revenues	275.4
Total costs	303.7
Profit per m³ of sawnwood	-28.3
Profits per m³ of log	-15.0
Profits as % of total costs	-9.3

Note: Since yield is 0.53, 1.89 m³ of log is needed per m³ of sawnwood

Table A.10. Profitability and residual stumpage value: rough sawn ochóo

Items	Current Case
Value at lumber yard in Sta.Cruz	169.5
Trans. mill to Sta Cruz	29.7
Value ex-mill US$/m³	139.8
Milling costs	
Variable costs (not logs)	30.1
Fixed costs	0.0
Total	30.1
Milling yields 53%	
Logging costs for 1.89 m³ of logs	
Felling, cutting, skidding,logging	45.4
Road construction and maint.	18.9
Fixed logging costs	43.5
Total	107.7
Stumpage fees	6.6
Profitability	
Total revenues	169.5
Total costs	174.1
Profit per m³ of sawnwood	-4.6
Profits per m³ of log	-2.4
Profits as % of total costs	-2.6
Residual stumpage values	
Total revenues	169.5
Total costs, excluding stumpage fees	167.5
Profits = 25% of costs	41.9
Residual stumpage values, m³ sawnwood	-39.9
Residual stumpage value per m³ log	-21.1

Note: Since yield is 0.53, 1.89 m³ of log is needed per m³ of sawnwood.
Note: Ochóo is sold domestically in Santa Cruz.

Table A.11. Profitability of rough sawn ochóo
(Based on market prices for logs)

Items	Current Case
Value at lumber depot in Sta cruz	169.5
Trans. mill to Sta Cruz	29.7
Value ex-mill US$/m³	139.8
Milling costs	
Variable costs (not logs)	30.1
Fixed costs *	22.9
Total	53.0
Logging costs for 1.89 m³ of logs **	
Market price Bs 80/m³	37.8
Total	37.8
Profitability	
Total revenues	169.5
Total costs	120.5
Profit per m³ of sawnwood	49.0
Profits per m³ of log	25.9
Profits as % of total costs	40.7

* We used the fixed milling costs reported for mara.

** Since yield is 0.53, 1.89 m^3 of log is needed per m^3 of sawnwood.

Table A.12. Profitability and residual stumpage values: rough sawn tajibo *

Items	Current Case
Value at lumber yard in Sta.Cruz	245.8
Trans. mill to Sta Cruz	29.7
Value ex-mill US$/m³	216.1
Milling costs	
Variable costs (not logs)	28.0
Fixed costs	0.0
Total	28.0
Milling yields 53%	
Logging costs for 1.89 m³ of logs **	
Felling, cutting, skidding,logging	18.9
Road construction and maint.	18.9
Fixed logging costs	39.7
Total	77.5
Stumpage fees	12.9
Profitability	
Total revenues	245.8
Total costs	148.1
Profit per m³ of sawnwood	97.7
Profits per m³ of log	51.7
Profits as % of total costs	65.9
Residual stumpage values	
Total revenues	245.8
Total costs, excluding stumpage fees	135.2
Profits = 25% of costs	33.8
Residual stumpage values, m³ sawnwood	76.8
Residual stumpage value per m³ log	40.6

* Tajibo is sold domestically in Santa Cruz

** Since yield is 0.53, 1.89 m³ of log is needed per m³ of sawnwood.

Table A.13. Profitability of rough sawn tajibo
(Based on market prices for logs)

Items	Current Case
Value at lumber depot in Sta cruz	245.8
Trans. mill to Sta Cruz	29.7
Value ex-mill US$/m³	216.1
Milling costs	
Variable costs (not logs)	28.0
Fixed costs	0.0
Total	28.0
Milling yields 53%	
Log costs for 1.89 m³ of logs *	
Market price Bs.160.m³	
Cost of 1.89 m³ of logs	75.6
Profitability	
Total revenues	245.8
Total costs	133.3
Profit per m³ of sawnwood	112.5
Profits per m³ of log	59.5
Profits as % of total costs	84.4

* Since yield is 0.53, 1.89 m³ of log is needed per m³ of sawnwood.

Table A.14. Profitability and residual stumpage values: sliced veneer of mara

Items	Actual US$
Price FOB, Arica US$/m²	1.14
Subsidy (drawback)	0.03
Export costs[1]	0.02
Transport Sta Cruz-Arica	0.05
Gross revenue at plant US$/m²	1.1
Gross revenue at plant US$/m³ [2]	1,833.7
Variable manufacturing costs	
Fuel	na
Electricity	48.0
Adhesives	na
Total (without logs)	515.0
Fixed manufacturing costs	603.0
Total manufacturing Costs	1,118.0
Logging costs per 1m³ of veneer[2]	
Yield m³ finished veneer/m³ log[3]	0.4
Felling, logging, etc.	175.0
Road building and maintenance	27.5
Transport to plant	100.0
Stumpage fees	37.5
Total	340.0
Profitability	
Total revenues	1,950.4
Total costs	1,574.7
Profit per m³ of veneer	375.7
Profits per m³ of log	150.3
Profits as % of total costs	23.9
Residual stumpage values	
Total revenues	1,950.4
Total costs, excluding stumpage fees	1,537.2
Profits = 25% of costs	384.3
Residual stumpage values, m³ veneer	28.9
Residual stumpage value per m³ log	11.6

na = not available.

[1] Port charges, documentation, packaging

[2] Implies 2.5 m³ of logs.

[3] Conversion factor m² veneer to m³ of veneer = 1,667

Table A.15. Profitability of sliced veneer of mara
(Based on market price for logs)

Items	Actual US$
Price FOB, Arica US$/m²	1.14
Subsidy (drawback)	0.03
Export costs[1]	0.02
Transport Sta Cruz-Arica	0.05
Gross revenue at plant US$/m²	1.1
Gross revenue at plant US$/m³ [2]	1,833.7
Variable manufacturing costs	
Fuel	na
Electricity	48.0
Adhesives	n.a.
Total (without logs)	515.0
Fixed manufacturing costs	603.0
Total manufacturing Costs	1,118.0
Logging costs per 1m³ of veneer[3]	
Yield m³ finished veneer/m³ log	0.4
Cost according to 1992 market price[4]	260.5
Transport to plant	100.0
Total	360.5
Profitability	
Total revenues	1,950.4
Total costs	1,595.2
Profit per m³ of veneer	355.2
Profits per m³ of log	142.1
Profits as % of total costs	22.3

na = not available.
[1] Port charges, documentation, packaging.
[2] Conversion factor m² veneer to m³ of veneer = 1,667.
[3] Implies 2.5 m³ of logs.
[4] Price reported for logs placed at loading points.

Table A.16. Profitability and residual stumpage value: decorative veneer of morado

Items	Actual US$
Price FOB, Arica US$/m² [1]	1.291
Drawback (3%)	0.039
Transport Sta Cruz-Arica	0.016
Port charges	0.020
Revenue at plant US$/m²	1.294
Plus value of by-products[2]	0.170
Total revenue at plant US$/m²	1.464
Variable manufacturing costs	
Fuel	na
Electricity	0.043
Adhesives	na
Total variable (no logs)	0.153
Fixed manufacturing costs	0.428
Total manufacturing costs	0.581
Yield m² veneer/m³ log[3]	1,000
Cost of logs (per m² veneer)	
Felling, logging, etc.	0.380
Road building and maintenance	0.001
Transport patio to plants	0.100
Stumpage fees	0.015
Total cost of logs	0.496
Profitability	
Total revenues	1.500
Total costs	1.113
Profit per m² of veneer	0.387
Profits per m³ of log	386.8
Profits as % of total costs	35
Residual stumpage values	
Total revenues	1.500
Total costs, excluding stumpage fees	1.098
Profits = 25% of costs	0.275
Residual stumpage values, m² of veneer	0.127
Residual stumpage value per m³ log	127

na = not available.

[1] 10-20% first quality @US$ 1.8/m²;80-90% second @ US$1.2/m²

[2] Air dried lumber for handles,posts.US$ 1000/m³ fob Arica

[3] Yields: log to flitch 50%,flitch to 0.2 mm sliced veneer 35-40%

Table A.17. Profitability and residual stumpage values: tropical plywood[1]

Items		Plywood 9mm Serebó	Plywood 9mm 30% dec.[2]	Plywood 3.2mm 30% dec.
Price FOB, Arica US$/m³ [3]		453	483	548
Drawback (2%)		10	10	11
Transport Sta Cruz-Arica[4]		43	43	43
Export costs (Port charges, etc.)		4	4	4
Revenue at plant (US$/m³)		416	446	512
Variable manufacturing costs				
Fuel				
Electricity		1.98	1.98	2.42
Adhesives[5]		29.00	29.00	36.00
Total (no logs)		196	196	193
Fixed manufacturing costs[6]		87	87	87
Total manufacturing costs		283	283	280
Cost of logs				
Yield m³ product/m³ log		0.45	0.45	0.45
m³ of log needed per m³ of plywood	2.22	2.22	2.22	
Cost of logs (1992 prices)[7]		53.43	106.81	106.81
Profitability				
Total revenues		462.6	492.6	559.0
Total costs		383.4	436.8	433.8
Profit per m³ of plywood		79.2	55.8	125.2
Profits per m³ of log		35.7	25.1	56.4
Profits as % of total costs		20.6	12.8	28.9
Residual stumpage values				
Total revenues		462.6	492.6	559.0
Total costs, excluding stumpage fees		383.4	436.8	433.8
Profits = 25% of costs		95.9	109.2	108.5
Residual stumpage values, m³ plywood		-16.7	-53.4	16.7
Residual stumpage value per m³ log		-7.5	-24.1	7.5

[1] Common 1.22*2.44 m, double thickness.
[2] Implies that 30% of it is made up of fine wood like mahogany.
[3] Average prices would be US$30 and US$40 lower without decorative faces.
[4] From US$ 85/t and 0.5 tons of plywood per m³.
[5] US$465/ton FOB Buenos Aires for UF resin with 30% water.200 gr/m² spread
Other mill reports US$650 ton powder resin,10% import duty,US$.85/kg mixed
[6] Administrative expenses US$24,000/mo; interest US$48,000/mo.
[7] According to prices paid in 1992 per m³ of logs; Bs 97 for Serebó and Bs.420 for mahogany.

Table A.18. Profitability and residual stumpage value: plank parquet[1]

Items	Current[2] levels	Full production with Mgt[3]
Price FOB, Arica US$/m²	25.0	25.0
Drawback (2%)	0.5	0.5
Transport Sta Cruz-Arica	2.0	2.0
Export costs (Port charges, etc.)	0.5	0.5
Export certs/docs	0.5	0.5
Revenue at plant (US$/m²)	22.5	22.5
Variable manufacturing costs		
Fuel		
Electricity		
Adhesives		
Total (no logs)	2.0	2.0
Fixed manufacturing costs	2.8	1.0
Total manufacturing costs	4.8	3.0
Lumber and wood costs		
Wood raw material[4]	6.5	7.0
Wood waste (net cost)	6.5	3.5
Total	13.0	10.5
Profitability		
Total revenues	25.5	25.5
Total costs	20.8	16.5
Profit per m² of parquet	4.7	9.0
Profits per m³ of parquet[5]	199.1	378.0
Profits as % of total costs	22.8	54.5
Residual stumpage values		
Total revenues	25.5	25.5
Total costs including lumber input	20.8	16.5
Profits = 25% of costs	5.2	4.1
Residual after paying for lumber	-0.5	4.9
Residual per m³ of parquet	-18.9	204.8

[1] 22mm thickness.
[2] Production of 1,500 m²/month; 50% yield.
[3] Better management; 4,000 m²/month; 66% yield.
[4] 50% yield from input, US$0.65/bf present level.
[5] Used 42 m² per m³ of 22mm thick parquet.

Table A.19. Profitability and residual stumpage value: finished doors

Items	Current levels[1]	Full production[2]
Price at destiny, CIF, US$/door[3]	90	90
Freight and insurance[4]	6	6
Price FOB, Arica or other	84.0	84.0
Drawback (2%)	1.7	1.7
Transport Sta Cruz-Arica	5.0	5.0
Export packing	4.0	4.0
Export certs/docs	1.0	1.0
Revenue at plant (US$/m³)	75.7	75.7
Manufacturing costs		
Finishing costs[5]	18.0	10.0
Variable costs (no lumber)[6]	14.0	13.0
Fixed costs[7]	24.0	14.0
Total manufacturing costs	56.0	37.0
Margin for profits and lumber	19.7	38.7
Lumber and wood costs		
Wood raw material[8]	19.0	19.0
Wood waste (net cost)[9]	3.0	0.0
Total	22.0	19.0
Profitability		
Total costs	88	66
Profits	-2.3	19.7
Profits as % of total costs	-2.6	29.8
Residual Stumpage Values		
FOB value or export revenue	85.7	85.7
Total costs, excluding lumber	66.0	47.0
Profits = 25% of total costs	16.5	11.8
Residual Value of lumber per door	3.2	26.9
Yields 6.5 doors/m³ lumber		
Residual value per m3 of lumber	20.7	175.0
Price of lumber US$/m³	159.0	159.0
Residual above market price	-138.3	16.0

[1] Production of 600/month.
[2] Production of 1,200 per month.
[3] One finished door of ochóo or similar species
[4] Price: US$2,400/container with 400 doors, or US$2,000/container, Arica
[5] Assume US$100,000 investment in drying, finishing equip.
[6] Labor US$%, drying US$7; energy, maint., repair US$
[7] Depreciation US$5,000/mo. General Admn US$9,000/month
[8] Yields 6.5 doors/m³ of lumber input.
[9] Purchased green, mix grades for integrated plant.

Table A.20. Residual stumpage values calculated from price of logs only

Items			Mara		Roble	Ochóo		Tajibo
Market price of logs US$/m³			105		93	20	40	
Logging Costs US$/m³ *								
Felling, cutting, skidding			18		33	24		10
Road construction and maint.	8		8		10	10		
Fixed logging costs			8		23	23		21
Stumpage fees and taxes	17	10		5	7			
Sub-total			51		74	62		48
Profits: 25% of costs		13			18	16		12
Total			64		92	78		60
Residual stumpage values			41		1	-58		-20

* Delivered at points where firms buy and collect logs.

Table A.21. Projected cost and revenues for a eucalyptus plantation
(Cost of land not included)

Year	Costs	Revenues	Net Revenues
1	4,800	0	(4,800)
2	7,220	0	(7,220)
3	7,220	0	(7,220)
4	7,220	0	(7,220)
5	7,220	0	(7,220)
6	7,220	0	(7,220)
7	7,220	0	(7,220)
8	7,220	0	(7,220)
9	7,220	0	(7,220)
10	7,220	0	(7,220)
11	8,725	50,000	41,275
12	7,300	50,000	42,700
13	7,300	50,000	42,700
14	7,300	50,000	42,700
15	7,300	50,000	42,700
16	7,300	50,000	42,700
17	7,300	100,000	92,700
18	7,300	50,000	42,700
19	7,300	50,000	42,700
20	7,300	50,000	42,700
21	7,300	50,000	42,700
22	7,300	50,000	42,700
23	7,300	100,000	92,700
24	7,300	100,000	92,700
25	7,300	100,000	92,700
26	7,300	100,000	92,700
27	7,300	50,000	42,700
28	7,300	50,000	42,700
29	7,300	100,000	92,700
30	7,300	100,000	92,700
31	7,300	100,000	92,700
32	7,300	100,000	92,700
33	7,300	50,000	42,700
34	7,300	50,000	42,700
35	7,300	100,000	92,700
36	7,300	100,000	92,700
37	7,300	100,000	92,700
38	7,300	100,000	92,700
39	7,300	50,000	42,700
40	7,300	50,000	42,700
41	7,300	100,000	92,700
42	7,300	100,000	92,700
43	7,300	100,000	92,700

44	7,300	100,000	92,700	
	45	7,300	50,000	42,700
	46	7,300	50,000	42,700
	47	7,300	50,000	42,700
	48	7,300	50,000	42,700
	49	7,300	50,000	42,700
	50	7,300	50,000	42,700
			IRR	23%
			NPV	51,523

Table A.22. Stumpage fees for the most important species, 1992

Species	Fee (Bs/m^3)	Conversion factor (bf/m^3)
Fine species		
Cedro	18	318
Guayacán	176	318
Jacaranda	176	318
Mara	24.6	318
Moradillo	98	318
Morado	90	318
Picana negra	98	318
Roble	18	318
Secondary species		
Almendrillo	16	297
Jichituriqui	8	297
Yesquero	11	297
Railroad ties	27	167
Palo Blanco	16	297
Palo María	16	297
Quebracho Blanco	11	297
Tajibo	14	297
Tarara	11	318
Verdolaga	11	297
Ochóo	5	297
Tertiary species		
Ajo Ajo	5	297
Mapajo	8	297
Serebó	5	297

Source: Claure, 1992.

Table A.23. Cutting areas by provinces and departments, 1990

Department	Province	Number of firms	Total cutting area	Average cutting area	Range cutting area
			------ X000 of hectares ------		
Santa Cruz	Chiquitos	13	2,152	165	40 - 524
	N Chávez	41	4,821	118	26 - 347
	Busch	4	851	213	152 - 319
	Velasco	22	3,955	180	91 - 371
	Florida	2	163	81	57 - 106
	Sara	12	312	26	13 - 50
	Ichilo	10	646	65	9 - 133
	Total		13,635		
Beni	Ballivan	13	1,301	100	39 - 299
	Marban	6	505	84	40 - 120
	Moxos	5	412	82	52 - 114
	Itenez	2	392	196	140 - 251
	Total		2,804		
La Paz	Iturralde	16	2,890	181	84 - 290
	Total		3,334		
Cochabamba	Carrasco	5	350	70	48 - 140
Tarija	O'Connor	4	147	36	14 - 72
	Total		393		

*Some firms have more than one contract in the same province and contracts in different provinces under the same name, and sometimes under different names. This implies that averages and ranges could be much higher than presented here.

Source: Claure, 1992.

APPENDIX B: TRADE AND PROTECTION OF FOREST PRODUCTS

Exports of Forest Products

Products. Table B.1 shows that more than 70 percent of all forest products exported are in the form of simply sawn wood and that another 10 percent or so is comprised of railroad ties, moldings and veneer.

Table B.1. Exports of forest products, 1988-91

Products	1988	1989	1990	1991
	---- millions of US dollars -----			
Sawnwood	17.3	33.2	36.4	41.6
Railroad ties	1.1	5.1	5.2	0.2
Moldings	0.5	0.6	1.7	2.0
Veneer	0.6	0.3	1.2	0.0
	---- Percent of total exports -----			
Sawnwood	70.7	75.7	74.4	85.0
Railroad ties	4.7	11.7	10.7	0.3
Moldings	2.1	1.5	3.5	4.1
Veneer	2.7	0.7	2.8	0.0
Total	80.2	89.6	91.4	89.4

Source: DICOMEX and Cámara Nacional Forestal

Ports. Table B.2, using 1991 figures, shows that the principal ports through which forest products are exported are Arica, in Chile and Corumbá in Brazil. Additionally a large proportion is exported by rail to Argentina, through the Yacuiba/Pocitos border.

Destination. Table B.3 shows that more than 75 percent of total exports of forest products go to Argentina and the United States. A small proportion (less than 10 percent in value) is exported to Germany, Japan and other countries. More than 95 percent of total exports to the United States is comprised of mahogany (mara) of the classification No.1 Common and Better, FAS of at least 7 feet long. Argentina imports the shorter cuts of mara, No.2 and No.3 Common, and cuts of hardwood for railroad ties. The European countries and Japan import veneer, moldings and other products.

Table B.2. Value of exports of forest products by countries, average for the period 1986-90

Country	Amount (X000 US$)	Percent
United States	9,271	43.55
Argentina	6,737	31.65
Japan	1,129	5.30
Brazil	881	4.14
Germany	384	1.80
Others	2,885	13.56

Source: Cámara Nacional Forestal

Table B.3. Principal ports and border crossing points through which forest products were exported in 1991

Destination	Ports	Border points	Points origin	Per-cent	Products
Argentina	-	Yacuiba	Sta Cruz	43	Sawn mara, roble
Argentina	-	Villazón	La Paz	4	Sawn mara, cedro
USA/Europe	Corumbá	P Suarez	Sta Cruz	13	Sawn mara, veneer
USA	Arica	-	La Paz		Sawn mara, cedro
			Sta Cruz	40	veneer

Source: Claure, 1992; Boletín Estadístico, 1991.

Imports of Forest Products

There are few statistics on the imports of forest products. We learned from CDF's officials that Bolivia imports newsprint, printing and writing paper, other papers and paperboard. As reported above, there are some imports of pulp from Chile for paper production. According to FAO (Yearbook 1984), Bolivia imported US$12 million of these products. There is no report of imports of other forest products like veneer, plywood or sawnwood.

Nominal Rates of Protection

Given that log exports have been banned for a long time, there were no border price quotes, and we applied data from other countries in the area to arrive at nominal protection estimates for logs of soft species, like serebó, and high-valued species like mara (mahogany).

The only actual log export data available were from Ecuador, where logs of soft species (from the virola group) were exported in 1988 and 1989 to Mexico and the United States. Since Serebó and species from the virola group are roughly equivalent in quality and uses, and fetch the same prices in Ecuador, we used the Ecuadoran FOB prices to estimate FOB prices in Santa Cruz, Bolivia for Serebó (Table B.4). There is an additional US$20 to US$30 per m^3 to transport forest products from ports used by Bolivia to the same markets where Ecuador sold the logs, and another US$50 to US$70 to transport the logs from Santa Cruz to Pocitos, Corumbá or other border points (Claure, 1992). It was assumed that serebó log prices in 1992 were roughly the same in 1988/89 in dollar terms. This might overestimate the domestic serebó price and underestimate the level of negative nominal protection, thus providing an additional margin of safety for the estimates.

Table B.4. Estimates of nominal rates of protection (NRP) for logs of soft species

Year	Name	Scientific name	FOB Price US$/m³	Domestic Pr. US$/m³	NRP (%)
		ECUADOR			
1988	Sande	Brosimun utile	250	14	-95
	Virola	Virola Sp.	252	14	-95
	Pachaco	Schizolobium parahyba	250	14	-95
1989	Virola	Virola Sp.	274	39	-86
		BOLIVIA			
1992	Pachaco	Schizolobium parahyba	150-180	39	-73 to -78

Table B.5. Estimates of nominal rates of protection (NRP) for mara logs, 1991-92

BOLIVIA	
INTERNATIONAL	DOMESTIC

Year	CIF, USA US$/m³	Transport from S. Cruz US$/m³	FOB Santa Cruz US$/m³	Domestic Pr. at terminals US$/m³	Transport to Santa Cruz US$/m³	Price in Santa Cruz US$/m³	NRP (%)
1991/2	411	90-110	301-321	105	22	127	-0.58 to -0.6
1992/1	416	90-110	306-326	105	22	127	-0.58 to -0.61

1991/2 = second quarter
1992/1 = first quarter
Note: According to experts, logs are not dried for export from Brazil nor would be from Bolivia.
Source: USDA, Bulletin of Hardwood Market Statistics, Fall 1992, and Claure, 1992.

Effective Rates of Protection

Tables B.6-B.8 show how effective rates of protection were calculated for rough sawn mara, veneer of mara and plywood of serebó alone and serebó with mara.

Table B.6. Effective rates of protection for rough sawn mara
(Based on market prices for logs)

Items	Current Case	Cost of Tradables Private	Cost of Tradables Social
Price FOB, Arica, Chile US$/m³	487.3	487.3	487.3
Port charges	10.2		
Transport Sta Cruz to Arica	58.9	41.2	41.2
Grading and handling	2.1		
Trans. mill to Sta Cruz	29.7	20.8	20.8
Value ex-mill US$/m³	386.4	425.3	425.3
Milling costs			
Variable costs (not logs)	30.1		
Fixed costs	22.9		
Total	53.0	37.1	37.1
Logging costs (milling yields 53%)			
Market price Bs 420/3m [1]	196.6	196.6	491.6
Profits before stumpage fees	136.8		
Ex-mill value of sawnwood		425.3	425.3
Total costs of tradables		233.7	528.7
Value added		191.6	-103.4
Effective rate of protection (%)[2]			

[1] Social value is 2.5 times the private value because NRP = -0.6
[2] Equals (191.6/-103.4)-1; but loses meaning when negative.

Table B.7. Effective rates of protection of sliced veneer of mara
(Including stumpage subsidy)

Items	ACTUAL	TRADABLES Private	Social	Comment
Price FOB, Arica US$/m³	1900.38	1950	1900	
Subsidy (Drawback)	50.01			
Export costs[1]	33.34	33.34	33.34	Taking all none tradable
Transport Sta Cruz-Arica	83.35	58	58	70% tradable, no distortion
Gross revenue at plant US$/m³	1,833.7	1,858.7	1,808.7	
Variable Manufacturing Costs				
Fuel	na			
Electricity	48.0			Taken as all none tradable
Adhesives	na			
Total (without logs)	515.0	467.0	444.8	Rest 100% tradable, 5% tariff
Fixed manufacturing costs	603.0	301.5	301.5	All none tradable
Total Manufacturing Costs	1,118			
Yield m³ finished veneer/m³ log	0.4			
COST OF LOGS (for 1m³ of veneer)[2]				
1992 market prices Bs.420/m³ [3]	260.5	260.5	651.3	
Transport to plant	100.0	70.0	70.0	
Total cost	360.5			100% tradable; assume -20% NRP
Gross revenue at plant US$/m³		1,859	1,809	
Cost of Tradables		1,099	1,468	
Value added		760	341	
Effective Rate of Protection (%)[4]		123		

[1] Port charges, documentation, packaging
[2] Implies 2.5 m³ of logs.
[3] Prices reported for logs placed at loading points.
[4] Equal to (760/341)-1 times 100.

Table B.8. Effective rate of protection of tropical plywood of serebó, 1992

Items	Total	Cost of Tradables		Comment
		Private	Social	
Price FOB, Arica US$/m³	453	462.6	453	
Drawback (2%)	10			
Transport Sta Cruz-Arica	43	43	43	70% tradable, no distortion
Export costs (Port charges, etc.)	4	4	4	All none tradable
Revenue at plant (US$/m³)	416	416	406	
Variable Manufacturing Costs				
Fuel	na			
Electricity	1.98			All none tradable
Adhesives	29.00			
Total (no logs)	196	194.0	184.8	Rest 100% tradable, 5% tariff
Fixed Manufacturing Costs	87			All none tradable
Total Manufacturing Costs	283			
Yield m³ product/m³ log	0.45			
m³ of log needed per m³ of plywood	2.22			
Cost of logs (1992 prices)[1]	53.43	53.4	213.7	100% tradable, assume -75% NRP
Total revenues at plant (Product value)	415.6	406.0		
Total costs of tradables		247.5	398.5	
Value added at plant level		168.2	7.5	
Effective Rate of Protection (%)		2,142		

[1] The social (border) value of logs is four times higher than the private value.

APPENDIX C: SUSTAINABLE MANAGEMENT IN THE BOLIVIAN CONTEXT

It is common knowledge that, generally, and especially in the Bolivian context, there is no agreement as to what constitutes sustainable management of natural tropical forests. Nonetheless, different specialists seem to agree on a number of activities that, regardless of the definition adopted, must form part of a management program. In this regard, Ing. Lincoln Quevedo of SENMA, drawing from his limited experience in the forest reserve Elías Meneses, provided a list of 12 activities that, in his view, should constitute a minimum set of practices required for sustainable management. Following is a discussion of these activities and likely costs of their implementation.

1. Compartmentalization of concessions. This activity consists of dividing up the concession into a number of areas of equal size (physical or in terms of timber content) for organizing a rotation system. The number of areas will depend on the average cycle of the most important species. That is, if the average cycle is 40 years, the concession would be divided in 40 parts, and one and only one would be harvested each year. The same area would be thus harvested only every 40 years, a seemingly sensible practice not currently being followed. Given that the concessions are very large (forest is not a limiting factor, yet), firms basically move in one direction while harvesting, or in an haphazard manner with no provision made for rotational cutting.

What's the cost? The cost associated with this activity were estimated using an average concession of 200,000 ha and an average rotation period of 35 years. This implies that only 5,714 hectares could be harvested each year, which is the size of each compartment. If we assume that 25 percent of the area cannot be harvested because of low areas that are frequently flooded, the net compartment drops to 4,286 ha. Since firms concentrate on the extraction of mara, roble and cedro, assuming harvesting densities of 0.1m^3/ha for mara and 0.2m^3 for the other two, total yearly harvest would be equal to [4,286*0.1+4,286*0.4] 2,143 m^3 of logs. The profits on the difference between this harvest and the amount currently being harvested provides an indication of the costs. Data on current harvest per firm were not available, except for one firm which reports harvesting about 748 m^3 of mara in an area equivalent to the compartment being considered. Following these figures alone, the cost would be equivalent to the profits on 320 m^3 of mara [(4,286*0.1)-748]. The figures of Table A.4 showed a profit per m^3 of mara of US$135. The cost would thus be equivalent to [320*135] US$43,360 or US$0.29 (43,200/150,000) per hectare per year.

2. Forest inventory. Given that tree and species density is heterogeneous, a forest inventory would be necessary in order to determine the size of the individual compartments (annual harvest area) necessary for an equal yearly harvest volume. A detailed pre-harvest inventory would also be necessary. The team at Elías

Meneses estimate the cost of both inventories to be roughly US$13/ha.

3. Cutting cycle. The cutting cycle is inversely related to compartmentalization. The longer the cycle, the smaller the compartments, which improves regeneration, and encourages the more efficient use of roads. Any additional costs or benefits would be hard to separate from the cost of compartmentalization.

4. Careful harvest. This implies modifying current harvesting methods. Firms would map the trees (100% inventory) of 50 cm or more in diameter, and lay out an extraction route, determining the path to be followed by skidders in order to protect saplings and streams. This job is currently done by contractors under no supervision. There are costs involved in marking the trees, planning the routes and harvesting more slowly, however there are benefits in terms of improved regeneration. The World Bank reports that in Malaysia more careful techniques actually reduced harvesting costs (World Bank, Malaysia's Forests: a Subsector Study, no date). We do not have estimates of these costs for Bolivia, but if there is any, most of it would be covered by the inventory costs; since we included the latter as if it were a yearly cost.

5. Limit annual cutting volume. This activity limits harvest to the amount of annual growth, which is estimated at 1 to 1.5 m^3/ha/year. This does not seem to entail any cost to firms since current harvest is less than annual growth.

6. Pre-harvest liberation operation. This implies removing vines and other materials that might make harvesting difficult or damage the forest. The cost associated with this operation was estimated at US$3.68/ha.

7. Leave seeding trees. This implies identifying and deciding which trees to leave for this purpose. Seeding trees should be dominant, vigorous, well formed, relatively young, and well distributed. For mara this might imply leaving one tree in every six to 12 twelve hectares, which is about 0.1 tree/ha, or about 0.22 m^3/ha. The cost is roughly US$30/ha since the current practice is not to leave any for this purpose.

8. Minimum cutting diameter. This will vary by species and by location. Mara in Choré grows faster than mara in Baja Paraguá, and the MCD would be between 50 and 70 cm at chest height. Trees under minimum diameter yield about 50 percent of the yield of those meeting the minimum. This implies that the gains from cutting younger trees are significantly lower than would be expected. The number of m^3 per log is lower, as are log yields and lumber quality. The cumulative effects of all of these factors nullify the simplistic approach of comparing the growth rate of a young tree to the interest rate. The tree not only grows in diameter, the yield of logs and sawnwood and the quality also increases. This means that respecting the MCD might be profitable in the long run, as

long as firms are confident about their rights to the product. Under uncertainty, as is currently the case, it will be better to harvest, even when the gains are seriously diminished. Since the data are lacking, we will not impute a cost to this activity.

9. Biodiversity pockets. This implies leaving about 10 percent of total area untouched, in order to maintain floral diversity and provide fauna refuge. Since this requires a 10 percent lower harvest, the cost would be equivalent to the profits that firms would have made on that portion of the harvest. According to the figures used in calculating the costs of compartmentalization, there would be a reduction in harvest of 43 m^3 of mara and 85 m^3 each of cedro and roble. Total cost then would be roughly [(137*43)+(2*19*85)][25] US$9,121. A concession of 200,000 hectares would be effectively reduced to 150,000 harvestable hectares, meaning a cost of US$0.06/ha.

10. Endangered species. If the population of a given species declined to the danger point of extinction, harvesting would be halted until the population density recovered to a safe level. Certainly, in terms of the firms, there would be some short term costs associated with this activity, but for now we will not impute any cost.

11. Fauna protection. This activity prohibits all hunting. In this way, the animals help preserve the flora by spreading seeds. The cost could be measured as the costs of the additional food firms would need to furnish workers as a substitute for the meat they currently obtain through hunting. Using data reported by SOBOLMA, we estimated this cost to be roughly US$0.07/ha (considering a 20 percent increase in food cost).

12. Monitoring. This would be done to see if additional silvicultural practices are needed. This cost was estimated at Elías Meneses to be roughly US$1.47/ha.

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[25] Note that profits on sawnwood of mara was US$ 137/m3; on roble it was negative. We thus used profits on logs for roble instead (Table 3), and applied this to cedro also.

APPENDIX D: TERMS OF REFERENCE

APPENDIX E: LIST OF PERSONS CONTACTED

Hermes Justiniano, FAN
Cristian Vallejos, FAN
Mercedes Nostras, CIDOB
Mario Baudoin, SENMA
Esteban Ubranovic, SENMA
Allan Bojanic, SENMA
Lincoln Quevedo, SENMA
Carlos Quintela, FONAMA
Carlos Arce, FONAMA
Esteban Cardona, CDF
Máximo Vera Masa, CDF
Ing. Saavedra, CDF
Ing. Maldonado, CDF
Jorge Calvo, USAID
Mike Yates, USAID
Jorge Marcos y Salvador, CNF
Arturo Bowles, CNF
Mario Barberí, CNF
Mario Serrata, CNF
Jorge Avila, CNF
Marcelo Sommerstein, Maderera Moira
Ivo Vranjican, Maderera Moira
Guillermo Roig, Marabol
Motel Schwartz, Schwartz Imports
Nestor Ruíz, CORDECRUZ
Mario Ribera, CORDECRUZ
Francisco Kempf, CORDECRUZ
Juan de Dios Algarañaz, CORDECRUZ
Alejandro Guamán, CORDECRUZ
Roberto Rivera, CORDECRUZ
Federico Bascopé, UAGRN
Milton Parra, Aserradero San Juan
Guillermo Rivera, ANAPO
Juan Kuljis, ANAPO
Aldo Sacre, CIMAL
Andrew Tabew, WCI
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Alberto Arce, Lam Yubol
Chris Carden, HBAFA S.R.L.
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Antonio Parada, Aserradero Quebrada Blanca
Jorge Rojas, Aserradero San Francisco
Wilfredo Jurado, ITC/Bolivia
Rocío Pinto, FAO
Mario Arrieta, ILDES