Introducing Lesser-Known Wood Species from Certified Forests in Bolivia to the U.S. Market

by

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Thesis submitted to the faculty of the Department of Wood Science and Forest Products of Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Master of Science
in
Wood Science and Forests Products

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July 10, 2007
Blacksburg, Virginia

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(ABSTRACT)

A nationwide mail survey was conducted among importers and other members of the supply chain linked to the importation of tropical hardwood products to assess the market potential for Bolivian lesser-known wood species (LKS) in the U.S. market. One hundred and eleven companies responded to the questionnaire and provided information on their interest in importing lesser-known wood species, their willingness to pay for a Bolivian wood species substitute, percentage of their imports that are environmentally certified, and important factors considered to try new wood species. The results indicate that tropical hardwoods represent 33% of the product mix of companies that purchased wood products. Typically, companies imported less than 100 MBF in 2006. Sawnwood was the product that was imported the most, followed by plywood, veneer and flooring. Six Bolivian LKS are among the top 16 new wood species purchased by respondent companies in 2006 and three Bolivian LKS are part of the top 12 common tropical wood species imported in the U.S. Sixty-seven percent of overall respondents stated that they have plans to increase the imports of tropical hardwoods in 2007. Typically, members of the supply chain tried 1 to 2 new wood species in 2006. Retailers were the sector that tried the most, on average 5 new species. Price and availability were the major reasons to try new wood species. A MS-Access database was developed that allows comparisons of 20 potentially marketable Bolivian LKS with 10 common U.S. domestic hardwoods and 20 common tropical hardwoods imported into the U.S. Finally, strategic marketing recommendations are suggested to promote Bolivian LKS in the U.S. Results indicate that there are good opportunities for Bolivian LKS in the U.S market.

Dedication

This study is dedicated to my mother Ercilia for her continued love and support, to my father and brothers for their support and words of encouragement, to the new members in my heart: Bernardo, Nicolas and Nicole for giving me invaluable smiles. I look forward to spending more time with my family in Bolivia. Also, I am dedicating this study to my friends and colleagues of the wood industry in Bolivia.

Acknowledgements

I would like to thank the following people and agencies for there support throughout this project:

My most sincere appreciation to Dr. Robert L. Smith for providing me the opportunity to work on this project. He has provided me with support, guidance and hospitality over the past two years. Thank you very much.

My thanks to Dr. A. L. Hammett and P. Araman for their support and service as my advisory committee.

My thanks to the USAID, Virginia Tech, Pablo Pinell from The Nature Conservancy, and BOLFOR II for their support and funding for this project.

My thanks to Omid Parhizkar, and Brian Perkins for their help throughout this project.

Preface

This thesis consists of five sections. Chapter one starts with an overview of the project, reviews literature relevant to the Bolivian forest products sector and the U.S. hardwood market, provides the justification of this research and defines the objectives. Chapter two discusses the results obtained during the mail survey and the follow-up personal interviews. Chapter three discusses the characterization of Bolivian lesser-known wood species. Chapter four suggests strategic marketing recommendations to introduce Bolivian lesser-known species into the U.S. Chapter five consists of a summary of the results and conclusions, prescribes recommendations for future research, and outlines the limitations of this study.

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Abbreviations Used

ABI	Agencia Boliviana de Información [Bolivian Agency of Information]
ATFS	American Tree Farm Systems
BF	Board Foot (MBF=Thousand Board Feet, MMBF=Million Board Feet)
BOLFOR	Bolivia es Forestal [Bolivia is Forestry] *Sustainable Forestry Management Project*
CADEFOR	Centro Amazónico de Desarrolo Forestal [Amazonian Center for Forestry Development]
CCA	Chromated Copper Arsenate
CFB	Cámara Forestal de Bolivia [Forestry Chamber of Bolivia]
CFV	Consejo Boliviano para la Certificación Forestal Voluntaria [Bolivian Council for Voluntary Forestry Certification]
CLA	Canadian Lumbermen's Association
CoC	Chain of Custody
CSA	Canadian Standards Association
ENGO	Environmental Non-Governmental Organization
ESP	Environmental Stewardship Program
FAS	Foreign Agricultural Service; First and Seconds (hardwood grading)
FSC	Forest Stewardship Council
GDP	Gross Domestic Product
HMR	Hardwood Market Reports
IBCE	Instituto Boliviano de Comercio Exterior [Bolivian Institute of Foreign Trade]
INE	Instituto Nacional de Estadística [National Institute of Statistics – Bolivia]
ISO	International Standards Organization (International Organization for Standardization)
ITTO	International Tropical Timber Organization
IWPA	International Wood Products Association
KCMA	Kitchen Cabinet Manufacturers Association
LEED	Leadership in Energy & Environmental Design
LKS	Lesser-Known Wood Species
MBF	Thousand Board Feet, (MMBF = million board feet)
NAICS	North American Industry Classification System
NAWLA	North American Wholesale Lumber Association
NHLA	National Hardwood Lumber Association
NTFPs	Non-Timber Forest Products
NOFMA	National Oak Flooring Manufacturers Association
NWFA	National Wood Flooring Association
MFMA	Maple Flooring Manufacturers Association
PEFC	Programme for the Endorsement of Forest Certification
SFI	Sustainable Forest Initiative
SFM	Sustainable Forest Management
SPIB	Southern Pine Inspection Bureau
TFT	Tropical Forest Trust
TNC	The Nature Conservancy
USAID	U.S. Agency for International Development
WWF	World Wildlife Fund

CHAPTER 1. GENERAL OVERVIEW OF THE PROJECT

Introduction

Recently a worldwide movement for environmental friendly forest practices was initiated by environmental non-governmental organizations (ENGOs), and other forest stakeholders in several countries. This is the case of Bolivia, a landlocked South American country that has become a worldwide leader in certification of natural tropical forests. This process initiated another important issue, the marketing of a variety of wood species that are until now relatively unknown in international markets.

Besides harvesting traditional species such as mahogany (*Swietenia macrophylla*), South American oak (*Amburana cearensis*) and Spanish cedar (*Cedrela odorata*) Bolivia may include non-traditional species within its "wood processing chain". This contributes to national economy and sustainable forest management. In such a way, an increasing demand for lesser-known wood species will assist in the sustainability of forest resources (Barany et al. 2003).

Traditionally, logging involved harvest of individual trees (i.e. mahogany) – 2 or 3 per Ha. Other trees (species) were left (as waste) in the forest, were cut down, or were damaged during the harvest and extraction of desirable species. Now, with certification, the full forest needs to be managed –not just extracting a few desirable species. Hence, there are a variety of wood species that need to be managed (harvested sustainably). Now these species, many unknown in international markets, are being processed and sold.

The results of this study will be a useful decision-making tool for companies and institutions involved in the forest products sector in Bolivia. Increasing markets for lesser-used, abundant species in Bolivia implies not only an important contribution to the economy of indigenous people in Bolivia, but also for the forestry sector. In addition, the marketing of these wood species could be translated into increased demand that encourage the sustainability of Bolivian rainforests. Otherwise they could be converted to agricultural or other non-forestry uses. If lesser-known wood species have more marketability, then farmers will be less likely to clear forestlands for agriculture.

The following sections describe the current situation of the Bolivian forest products sector, and Bolivian and U.S. forest certification trends. The major U.S. hardwood market

segments also are described. Based on the literature review and the analysis of market segments, it can be assumed that Bolivia can find potential target markets in the U.S. The increasing trend in house remodeling and constructing in the U.S. support this assumption. Therefore a justification to this research is stated at the end of the chapter.

Bolivian Forest Products Sector

The forest product sector plays an important role in Bolivia. In 2003 eleven percent of overall Bolivian exports were forest products ($117 million), in 2004 the exports were $145.1 million, and from 2001 to 2005 Bolivia has exported more than $700 million. (BOLFOR II 2005, Cámara Forestal de Bolivia [CFB] 2005). The U.S. Agency for International Development (USAID) estimates that with well-planned intervention the Bolivian exports could increase from $150 million to $600 million annually, and increase the employment from 50,000 to 80,000 jobs (USAID/Bolivia 2005). Currently, the Bolivian forest products sector supports 63,000 jobs and sales of $300 million (domestic and exports) (Instituto Boliviano de Comercio Exterior [IBCE] 2006).

In twelve years the Bolivian exports of value-added forest products increased from $14.8 million (1992) to $115.7 million (2004), showing that Bolivia is switching from exporting primary forest products to secondary forest products. In general, the exporting of forest products shows an increasing trend since 2002 (CFB 2005). Some factors that contributed to this trend were: the promulgation of the forestry law (1996) that controlled the illegal harvesting of species, and the fall of Argentinean market that affected mainly the economy of primary processing (Sacre 2002). Figure 1-1 shows these trends and the exports of environmentally certified forest products, which have had an increasing trend since 1998, reaching $16.7 million in 2004 (CFB 2005). Figure 1-1 also shows the percentage that wood-products industry represents of the overall Bolivian GDP. Bolivian forestry sector accounts approximately 3% of the GDP (Hjortsø et al. 2006). The wood processing industry (primary and secondary) represented 0.8% in 2004, i.e. decreased from 0.97% in 1994 (Instituto Nacional de Estadistica [INE] 2005).

The aforementioned indicates that for maintaining the annual 3% contribution to the GDP, other forest products such as agricultural or non-timber forest products (NTFPs) are contributing more to the GDP than wood manufactured goods. Figure 1-2 corroborates this

assumption; it shows the trend of the exports of Bolivian forest products and indicates the increasing trend in the exports of NTFPs. In 2004, 93% of Bolivian NTFPs exported were Brazilian nuts and the remaining 7% were palmettos and cocoa butter (CFB 2005). Other changes in the trend include: decrease in the exports of furniture and furniture parts, increase in the exports of lumber, and an increase in the exports of miscellaneous such as handicrafts, carving, posts, paneling, and so forth (Cámara Forestal de Bolivia [CFB] 2006).

The five major importing countries of Bolivian non-coniferous sawn lumber in 2004 were the U.S. (10,126 tons), Argentina (5,107 tons), China (4,253 tons), Paraguay (3,745 tons) and Indonesia (3,030 tons) (FAO 2006). Other markets that had important participation in 2004 were Brazil (imported 2,128 tons) and Chile (2,213 imported tons). Although the U.S. is the major importer of Bolivian forest products, it has recently shown the lowest growth for Bolivian exports. The European Union showed a 49% growth in imports of Bolivian forest products between 2003 and 2004, while the U.S. showed only 16.25% growth. Furthermore, the Southern Common Market (Brazil, Argentina, Uruguay, Venezuela and Paraguay) showed a growth of 102%, and Asia increased 154% its imports from Bolivia in the same period (CFB 2005). This suggests that other markets would be more attractive than the U.S. for Bolivian wood products.

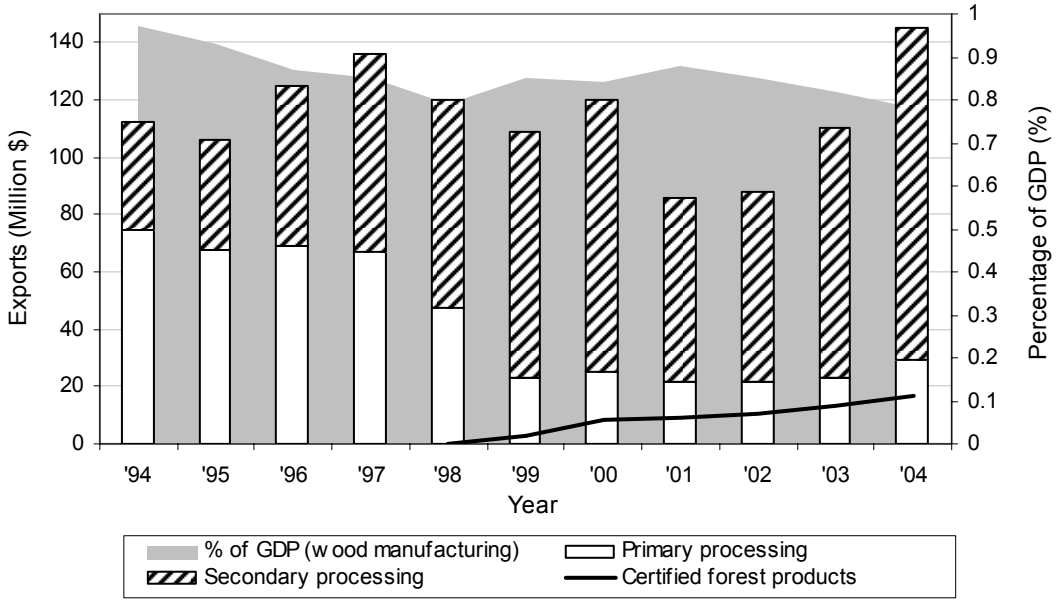


Figure 1-1. Exports of Bolivian Forest Products and Percentage that the Wood Industry Represents of the Overall Gross Domestic Product, 1994-2004 (CFB 2005, INE 2005)

BOLFOR II (Sustainable Forestry Management Project) is the most representative organization dedicated to encourage and support the activities of the forest products sector in Bolivia. BOLFOR's main objective is to promote sustainable forestry management and started operations in 1994 through the support of the Ministry of Sustainable Development of Bolivia, the U.S. Agency for International Development (USAID) and Chemonics International Inc. At that time, BOLFOR I concentrated its efforts in technical assistance, environmental certification, and preparation of norms and guidelines for the forestry sector (Chemonics International Inc. 2004). As a result the new forestry law was enacted in 1996, a great victory of the forest products sector in Bolivia. After that, several institutions such as the *Superintendecia Forestal* and the Bolivian Council for Voluntary Forest Certification (CFV) emerged to control, regulate and standardize the forest products management in Bolivia (BOLFOR II 2006).

BOLFOR's second phase started in 2003 (called BOLFOR II) with the support of USAID and The Nature Conservancy (TNC) and focuses its activities in improving the benefits of indigenous communities and encouraging business practices toward exportation. Several institutions are involved to this purpose, such as the Amazonian Center for Forestry Development (CADEFOR) and Tropical Forest Trust (TFT) (BOLFOR II 2006, USAID/Bolivia 2005).

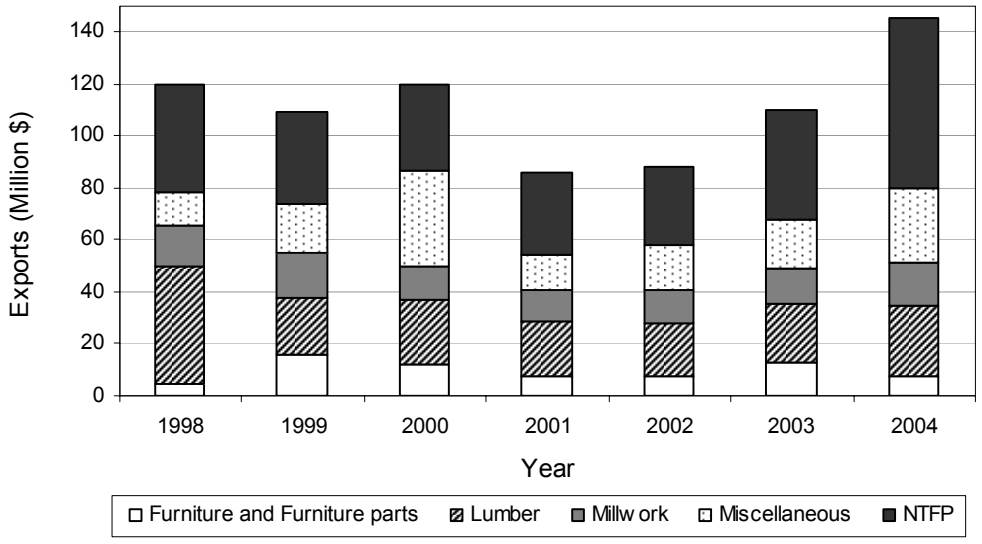


Figure 1-2. Bolivian Forest Products Exports by Market Segment, 1998-2004 (CFB 2006)

More than 2,000 species of tree and shrubs have been identified in Bolivia. (mostly tropical and deciduous) (FAO 2003). Seventy-two Bolivian wood species are exported as sawn lumber or value-added wood products. Spanish cedar (*Cedrela odorata*) is in the largest export with $11.2 million exported in 2004. South American oak (*Amburana cearensis*) is second place with $10.7 million exported. Mahogany (*Swietenia macrophylla*), that was first in 2003, exported $9.5 million in 2004 followed by tornillo (*Cedrelinga catanaeformis*) with $6.3 million and yesquero (*Cariniana spp.*) with $4.7 million (CFB 2005).

The major Bolivian wood specie harvested in 2004 was ochoo (*Hura crepitans*) with 45.6 MMBF (14.7% of overall wood processed). The rest of the important species harvested in 2004 were: ipe (*Tabebuia spp.*) with 21.1 MMBF; South American oak (*Amburana cearensis*) with 17.7 MMBF; Spanish cedar (*Cedrela odorata*) with 17.5MMBF; yesquero (*Cariniana spp.*) with 17 MMBF; mapajo (*Ceiba pentandra*) with 13.1 MMBF; and tornillo (*Cedrelinga catanaeformis*) with 11 MMBF (CFB 2005).

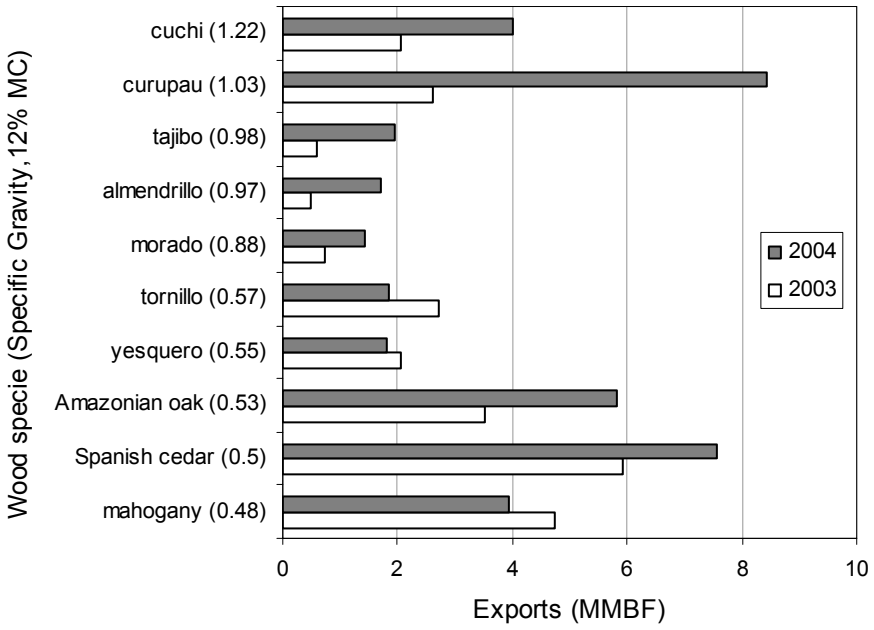


Figure 1-3. Bolivian Forest Products Exports by Wood Species, 2003-2004 (CFB 2005)

The Bolivian forest products sector has worked extensively in certification, promotion and classification of wood species involving indigenous communities and the government. In this endeavor BOLFOR II (2005) has identified approximately 20 marketable species based on certified area and available volume among other factors. Another consequence of this effort is

the growth in the exports of Bolivian high-density wood species. Figure 1-3 shows Bolivian wood species exported in 2003 and 2004.

It is important to note that current information on the Bolivian forest products sector has improved since the promulgation of the forestry law (Morales et al. 2001). But, it is likely that there exists a bias in the information collected regarding exports data, GDP participation, volume harvested and production of Bolivian wood products. For instance, one factor that affects reliability of the data is illegal logging, which hinders the estimates of volumes of tree species harvested and exported (Agencia Boliviana de Información 2006). In addition there are other factors such as the misclassification of wood species (voluntary or not), the inaccuracy in the classification of finished products that are exported (i.e. in many cases several types of products are grouped in a single set), and the inconsistencies of conversion units (Goetzel 2005). In any case, the actual total production of Bolivian wood products should be higher than the levels shown in official data.

Lesser-Known Wood Species

In this research we use the term lesser-known species (LKS)[1] to describe species whose (regional) forest potential is greater than its current use. The use of the term lesser-used instead of lesser-known follows the rationale of the International Tropical Timber Organization and states that the knowledge about these species is no longer the most important problem to resolve to increase their use (Forster et al. 2003).

The marketing of LKS has been the interest for many years. Erfurth and Rusche (1976b) characterized several South American LKS and also suggested some strategies for marketing these species. The authors emphasized that marketing efforts should be focused on introduce and use harmonized grading rules, the Malaysian grading rules can be used as an example. Marketing should also offer dry kiln sawnwood, this plays an important role because South American tropical exports (i.e. majority of LKS) are suitable for furniture making, window manufacture and other specific uses, which require low wood moisture content. Lastly, marketing should seek

1 In this document Lesser-known Species (LKS), Lesser-used Species (LUS), or "non-traditional" all indicate the same set of species.

premium prices, because LKS have good average properties and at least one additional outstanding feature, often related to the decorative aspect.

Freezaillah (1984) with ITTO summarized some problems in marketing, promotion strategies, and the future of LKS. He suggested that the construction industry has the greatest potential for utilizing LKS. The biggest potential for the LKS is in marketing by end-use grouping rather than by specie, timbers with roughly equivalent properties can be grouped and marketed together for a particular end-use. Data on technical and other properties such as strength, hardness, natural durability are fundamental to the promotion of LKS (Barany et al. 2003).

Some experiences and constraints were drafted about the potentialities of Central American and Mexican lesser-known species (Vlosky and Aguirre 2001). For example in Costa Rica the marketing strategy of a big furniture, chair and door manufacturer was to use non-traditional species (e.g. caobilla –*Carapa guianensis*) with similar quality than traditional species (such as mahogany –*Swietenia macrophylla*), but a substantially lower price for export to Puerto Rico and the U.S. The keys to success for this company in the U.S. were: meet strictest standards of quality, constant monitoring of consumer preferences from offices in the U.S., low inventory at wholesale and retail level, and short delivery time. The same company also found good marketing opportunities participating in trade fairs and using internet information.

Forster and others (2003) studied opportunities and limitations in marketing lesser-used species of Mesoamerica. Historically the marketing of LKS were focused on finding substitutes for mahogany (*Swietenia macrophylla*) and cedro (*Cedrela odorata*), and find markets for species independent of mahogany. The U.S. and European buyers found substitutes for mahogany in species such as: carapa (*Carapa guianensis*) from South America (such as Colombia and Brazil), African mahogany (*Khaya, Entandophragma*) and species of the meranti group (*Shorea spp.*) from South-East Asia. In general the LKS market in Mesoamerica has decreased, e.g. medium and heavy species for truck beds, railway crossties, piers and musical instruments. On the other hand, there were increases in the use of LKS in flooring, painted furniture and some exports to "green markets".

Some of the limitations found in LKS and consequently reduced potential in market entry are: 1) small volumes that lead to inconsistency and unpredictable supply; 2) lower wood quality,

e.g. low diameter of tree, shape of the log, high percent of sapwood, etc.; and 3) reduced rates of recovery, i.e. high percentage of waste and high unitary cost. A good strategy is to concentrate the marketing efforts on few species that account for 90% of available volumes. The promotion of LKS should not necessarily mean incorporating more species, but rather increasing sales of currently-known species that are not used much in the market (Forster et al. 2003).

Forster et al (2003) recommended some guidelines for successful marketing of LKS: 1) increase business capacity of community forestry operations; 2) improve relationships between community forestry operations and private regional businesses; 3) improve capacity of private businesses to orient themselves to market demand; 4) elevate quality of forest regulations; and 5) reinforce technical assistance for processing and marketing wood. It seems that it would be better to leave the challenges of exporting to private businesses or NGOs.

Mater Engineering, Ltd (1998) conducted market research in the U.S. and found substitutive characteristics in North American species and market strategies for four Bolivian LKS: yesquero negro (*Cariniana estrellensis*), ochoo (*Hura crepitans*), cambará (*Erisma uncinatum*) and murure (*Claricia racemosa*). In a recent study, Barany, Hammett and Araman (2003) identified barriers to and incentives for marketing Bolivian lesser-used tropical hardwoods. They found a gap between the growing dominance of LKS in forest inventories and the lack of markets. It is necessary to promote and provide information about wood properties and uses of those species.

In South America the efforts of indigenous communities of Shipibo-Konibo in Peru is an example of success in the NGO supported commercialization of LKS (Cass 2006). In an earlier study the WWF found that the big leafed mahogany (*Swietenia macrophylla*) in Peru will be commercially nonviable within next ten years (Cass 2006). With the support of the WWF and a Peruvian NGO this community is harvesting and trading FSC-certified LKS. Their strategy is as follows 1) total involvement of five indigenous communities in managing, harvesting and marketing trees of their own forests; 2) WWF and the Global Forest & Trade Network are helping to find international markets; 3), look for marketable substitutes for mahogany such as cachimbo rojo (*Cariniana domesticata*) and quinilla tree –Peruvian cherry (*Maninkara bidentata*); and 4) increase educational opportunities, not only in forestry skills (such as learning species' technical information, and low impact methods of extraction), but also in accounting,

pricing, marketing and negotiation. This community has begun selling flooring in domestic markets and will sell high-end furniture in the U.S. through South Cone Co. (a California based retailer of fine furniture), which has plans to buy cachimbo rojo from certified forests in Shipibo-Konibo.

Many communities now manage forests in Bolivia and are beginning to process wood products for sale. We can learn from the following example in Brazil. Estevão do Prado Braga (2005), based on a study among designers, architects, and timber consumers in Sao Paolo and FSC-certified communities in the State of Acre in Brazil, developed a six-step tool to improve the marketing of community forest products. These steps are: 1) understand market rhythms, 2) research the possibilities and choose the best option, 3) build awareness to make the buyers' demands flexible, 4) create trade networks, 5) make products stand out, and 6) implement a program of continuous improvement. The author also stated some guidelines to commercialize FSC-wood products in Sao Paolo. Bolivian exporters should consider this as well. However, it is unrealistic to expect that communities behave in a similar way to a large company. It is important to understand the culture of communities before expecting theses new enterprises to regularly supply the market. It is difficult for communities to understand that quality and regular delivery are more important than price. Designers demand commercial warehouses (a kind of "forest supermarket") to find new products; it is not only important to see new products (catalogues) they want to feel and smell them. Other important considerations include: provide samples in significant volumes, the market for high-end furniture has good opportunities for alternative species, the use of scientific names rather than common names would be better, and the creation of an association definitively will help in the access to new markets.

Certified Forest Products

Perhaps the most pressing interest in sustaining forest resources worlwide is the reduction of poverty. More than 1.6 billion people depend on forests, to varying degrees, for their livelihoods including some 400 million people who live in, or around, forests (Patosaari 2004). Forest certification is a system for identifying well-managed forestland. In this context, the main purpose of forest certification (or green certification) is to promote forest practices that are environmentally, socially and economically sustainable over the long term (Hansen et al. 2006). Products from certified forestland can, through chain-of-custody certification, move into

production streams and receive labeling that allows customers to know the product came from a certified, well-managed forest (Hansen et al. 1998).

Chain-of-custody (CoC) is the mechanism that tracks the wood from well-managed forests to the end consumer at each stage of the marketing chain. It is based on controlling the inventory of certified forest products through the supply chain from the rain forest to the final consumer (Duery 2006). Chain-of-custody often is seen as a significant challenge and cost, especially by operations such as paper mills that have hundreds of suppliers and use continuous processing, making it difficult to keep certified fiber separate from non-certified fiber. The direct cost of certification to the mill typically is less than $3,000. But little is known about the indirect costs of potential changes in production practices (Hansen et al. 1998). This is a very important issue because of the complexity of variability of the supply chain management. It is estimated that over 80 percent of the certified lumber is sold or used as uncertified (Duery 2006).

Certification can greatly contribute to economically, socially and ecologically sustainable development also in the developing countries. It is possible to obtain benefits of mutually reinforcing processes of certification and policy, and institutional reforms. In countries such as Bolivia, Brazil, and South Africa the benefits observed by Patosaari (2004) were:

> Certification can increased acceptance of community representatives in policy foray.
>
> A raised awareness of the potential of sustainable forest management (SFM).
>
> Certification has advanced more participatory and decentralized forest policy process.
>
> Contributed to better policy definition.
>
> Potential increase in supply-chain transparency; improve worker rights and income, and establish workplace safety standards.

Forest certification has many dimensions and many stakeholders with different interests: 1) for industry and trade it provides an instrument for marketing and market access; 2) for buyers and consumers it provides information on the impacts of products they purchase; 3) for forest owners it is a tool for market access or market advantage; 4) for governments it represents a policy instrument to promote SFM; 5) for ENGOs it can be a means to influence management and 6) the costs of certification tend to be higher for primary producers than for processors, since processors gain from market access. The last seems a contradiction, since the benefits apparently do not go to the forest, how is certification contributing to sustainable development?

Certification Schemes

Several different certification schemes that have international application have emerged during last decade. Each one has a different set of principles and set of actions. The major schemes are: Forest Stewardship Council (FSC), Canadian Standards Association (CSA), Programme for the Endorsement of Forest Certification scheme (PEFC), Sustainable Forest Initiative (SFI), and the American Tree Farm System (ATFS). Table 1-1 summarizes the characteristics of these schemes, including the International Organization for Standardization system (ISO 14001).

Table 1-1. Major Third-Party Forest and Wood Product Certification Systems

General feature	ATFS	FSC	SFI	CSA	ISO 14001	PEFC
Sponsor	American Forest Foundation	Forest Stewardship Council	Sustainable Forest Board[4]	Canadian Standards Association	International Organization for Standardization	Independent, nonprofit, NGO
Primary scope	USA	Worldwide	USA and Canada	Canada	Worldwide	Worldwide
Year[a]	1941	1993	1995	1996	1994[5]	1999
Standard develop-ment	Internal	Committees of stakeholders with public input	Sustainable forest board with public input	CSA multi-interest technical committee, including broad stakeholder involvement	Internal	Certification organizations within countries that seek PEFC endorsement
Eco-label	No	Yes	Yes	Yes	No	Yes
CoC[b]	No	Yes	Yes	Yes	No	Yes
Acres[c]	35	169	130	171	N/A	444 (in 20 countries)

Note. [a] year of forest standard established; [b]Chain of custody; [c]Total system certified in million acres as of December 2005; [4]originally American Forest and Paper Association; [5]not forestry specific; (Hansen et al. 2006).

The scope of FSC, PEFC and ISO is worldwide; SFI primarily is focused on large-scale forests in the U.S. and Canada; CSA is focused on all type of forests in Canada; and ATFS is focused on private non-industrial forests in the U.S. All schemes are voluntary, but SFI is required for member companies of AF&AP. CSA and FSC are represented by academic, government, consulting and industry sectors; a general assembly of 30 member countries

represents PEFC. The standards for all schemes are developed by stakeholders (i.e., academics, environmental organizations, landowners and forest products industry) through working groups, panels, or technical committees (Forest Certification Resource Center 2006):

The standards of all schemes have environmental, silvicultural, social and economical scope; except ATFS that has only environmental and silvicultural scope. All standards are subject to public review. Updating of standards and accreditation is required every five years. CSA, FSC, SFI and PEFC use the chain of custody (CoC) to track the products from the forest to each stage of manufacturing and distribution. SFI also can use an auditable monitoring system to account to all wood flows. ATFS does not use a tracking system. ATFS does not label products. CSA has three product labels (100% from certified forests, product line of minimum 70% certified, and product with minimum 70% certified content). FSC has three product labels (100% pure certified, mixed with minimum 10% certified and 60% post consumer content, and 100% recycle label). PEFC also has label but requires a minimum 70% of certified content threshold. SFI has seven product labels (one for primary producers, four labels for secondary producers, 100% from certified forests, and xx% content).

CSA, FSC and SFI accept non-certified sources in their labeled products, but prohibit the use of illegally harvested sources. FSC in addition prohibits the use of products derived from high conservation value forests. Use of non-certified sources is not applicable under ATFS. The complexity of the forest products market, geographic areas and influences of different organizations brought about and seems will bring about new systems of certification in the future. But there are four forces that can determine the future of certification systems: proliferation, competition, evolution, and convergence (harmonization) (Hansen et al. 2006). New systems will proliferate, but weaker ones will fall aside; competition between schemes: FSC and SFI in U.S. and Canada, FSC and PEFC in Europe, U.S. and Canada, for example. Worldwide the evolution of Certification schemes will be an important force in the future influencing changes in the market place (e.g. new standards for particleboard, or products contained both certified and non-certified materials). The convergence to a harmonized system will be crucial to avoid confusion in consumers.

Certification in Bolivia

The success of the forest certification depends of good forest management practices. Bolivia, with its Amazonian rainforest constitutes a valuable source of new materials such as exotic-tropical lumber, and non-timber forest products. Almost half of its territory, i.e. 131 million acres, is covered by natural tropical forests and most of the country's forests are located in the north and eastern regions (see Figure 1-4). Twenty four million acres are considered forest territory for permanent timber production which includes reserves of approximately 134 billion BF and a sustainable production of 8.5 billion BF (BOLFOR II 2006).

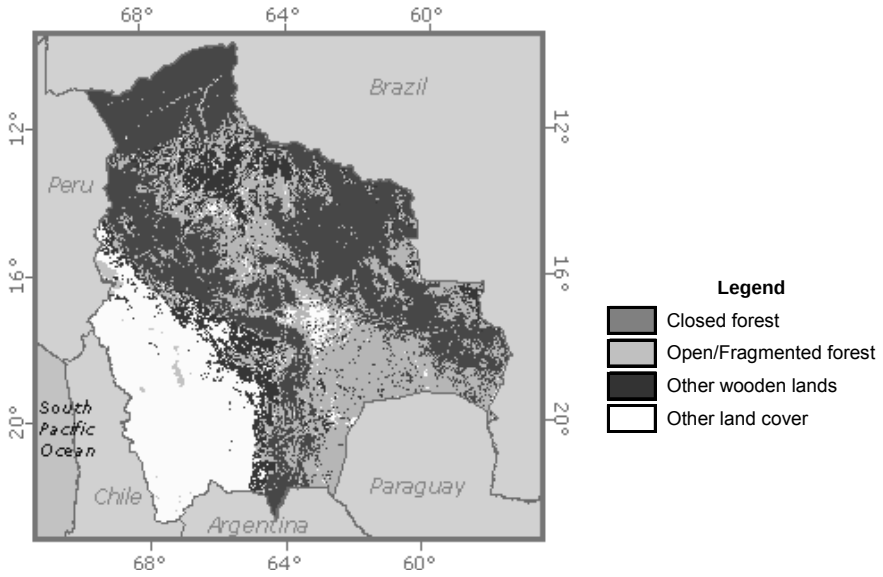


Figure 1-4. Forest-Cover in Bolivia (FAO 2003)

Forest certification in Bolivia was introduced by the Forest Stewardship Council in 1993 and formally established in 1995 with the Council for Voluntary Forest Certification (CFV) (Chemonics International Inc. 2004). The Bolivian Forestry Law promulgated in 1996, the forest exporting dependency, and the national and international support to forest management and certification has facilitated the development of certification in Bolivia.

Benefits of the certification in Bolivia include: improved forest management practices in the field, reduction of social conflicts between forest products firms and local communities, maintenance or access to new markets, supervision cost-reduction for the *Superintendencia Forestal*, and support to the consolidation of the forest practices and its norms (Quevedo 2004).

In October, 2005 Bolivia has become the world leader in certification of natural tropical forests with more than 5 million acres of certified lumber (Rainforest Alliance 2005). The aforementioned consolidates Bolivia in the first place of certified natural tropical lumber acres in the world. The growth of certified acreage in Bolivia is shown in Figure 1-5. The area of certified forest grew slowly until 2002, when it has increased greatly. This increasing trend also allowed for an increase in the exports of certified forest products (see Figure 1-1).

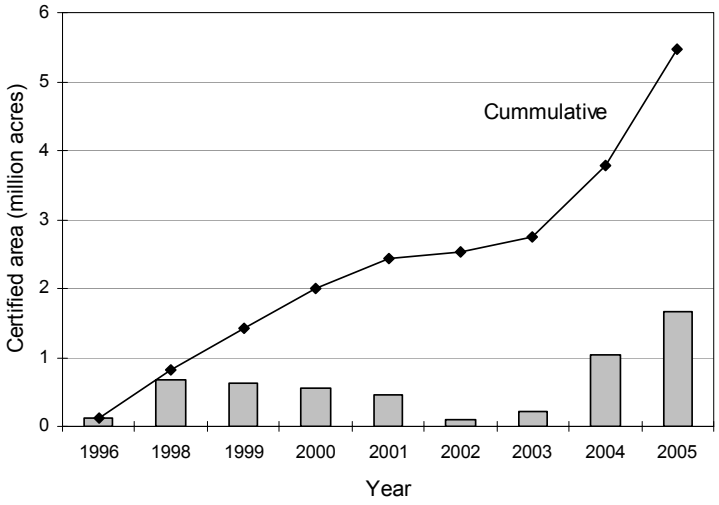


Figure 1-5. Certified Forest Acreage in Bolivia, 1996-2005 (CFB 2005)

Certification in the U.S.

Hansen et al. (2006) identified the advantages, limitations and future of certification in the U.S. The benefits that landowners can obtain of certification include: image and reputation, credibility to environmental claims, risk reduction of environmental noncompliance, premium prices, create or access to new markets, market share, improved decision-making, and profitability. The limitations discussed were: limited demand, small but growing market, chain of custody must be maintained from the forest to the customer, continuous changing standards, and confusion due to different certification systems.

Several studies have been conducted to determine the customer acceptance for certified wood products in the U.S. Ozanne and Vlosky (1997) studied the market in 1995 and found that the consumers were willing to pay premium prices from 4.4% to 18.7% depending of the product. However, 37% of the consumers were not willing to pay any premium for environmentally certified products. The authors also identified a consumer segment (about 16

million) who would seek and buy environmentally friendly wood products at a premium price. They described themselves as politically liberal, members of Democratic Party, and environmental organizations and primarily female.

In 2000 Ozanne and Vlosky (2003) found that the overall consumer understanding of the concept of certification increased since 1995. The willingness to pay premium prices for environmental friendly wood products had decreased, except for the following products: dinning room set, kitchen remodeling, and new homes. Five clusters were identified concerning attitudes against certified wood products and the ideal market identified was practically the same as the study in 1995 (politically liberals, member of environmental organizations and females).

Roper Starch Worldwide (Hansen 2004) says that the market place for certified wood products in the U.S. seems to be divided in five segments: 1) True-blue Greens (10%) –being environmentally aware is a way of life, well educated and affluent; 2) Greenback Greens (5%) – moderately active in environmental causes, younger than average, likely live in West or Midwest, most likely hold white collar jobs; 3) Sprouts (33%) –well educated and high incomes, they adjust their lifestyle to reflect their environmental beliefs; 4) Grousers (15%) –slightly less educated than average, more politically conservative, likely live in the South; and 5) Basic Browns (37%) –environmental deadbeats, lowest incomes and least educated. In short an ideal target market in the U.S. for environmental friendly products would be: females, married, above 44 years, high incomes, they live in the northeast or west, well educated, executives, and member of the Liberal Party (Mater et al. 1992).

In 2002 Smith and Gomon (2003) conducted research to examine the consumer purchase decision for environmentally certified forest products. The experiment was based on two different levels of promotion for surfaced four sides lumber (S4S) of red oak and yellow-poplar. The research was conducted in twelve home centers throughout the southeast U.S. (Florida, Georgia and Alabama). Their results suggest that changes in the price of S4S hardwood lumber may not have effect in the demand, inelastic price. They conclude also that the consumer may misinterpret the term “certification”, linking it more to a measurement of quality rather than environmental issues, and that certified hardwood boards have positive market potential.

An experiment conducted within two retailers in Oregon (Anderson and Hansen 2004) regarding the purchase of eco-labeled plywood, suggested that there was not special interest to

pay premium prices for eco-labeled products. The authors also concluded that relatively detailed labels are more beneficial for consumers than simpler eco-seals, i.e. eco-seals are the least credible type of label and do not provide enough information to the consumer to differentiate the product (Teisl 2003).

In a study of the primary wood sector in Wisconsin, Hubbard and Bowe (2005) found that manufacturers are not aware of environmental certification, including certain confusion surrounding certification. The authors inferred that the costumer demand for certified products is small, because the majority of primary wood manufacturers are not familiar with chain of custody certification. They also found, like similar studies, that price premiums are often unrealized on certified forest products. Duery (2006) assessed the U.S. market for certified tropical hardwoods. Her most important conclusion was that the U.S. market is not a good target market for "premium-price" certified wood products, thus a niche market should be identified. This suggests that other markets such as Europe or Japan could be better target markets for tropical hardwoods if the objective is to seek premium prices. Perhaps environmental certification is not a good indicator for market potential of Bolivian wood in the U.S.

Building standards such as the Leadership in Energy & Environmental Design (LEED) Green Building Rating System is a good example of the current trend in the use of environmental friendly products in the design, construction, and operation of high performance green buildings. LEED promotes a whole-building approach to sustainability in five key areas: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality (US Green Building Council 2006).

The U.S. Wood Market

The anatomical classification of woods (i.e., hardwoods and softwoods) has been translated to the market in the U.S. forest products industry. Thus the U.S. wood market is commonly divided by softwood and hardwood markets. These markets differ in lumber grading, primary and secondary processing, and commercialization. The hardwood lumber falls into three basic marketing categories (Hoadley 2000, p. 218): factory lumber, dimension parts, and finished market products. Factory lumber and dimension parts are both expected to be used for producing finished products, which include such items as flooring, millwork parts and molding. The National Hardwood Lumber Association (NHLA) generally establish the grading rules for

factory lumber, which are Firsts (highest quality), Seconds, Selects, No. 1 Common, No. 2 Common, No. 3A Common and No. 3B Common (lowest quality). Often Firsts and Seconds are combined to produce one grade (FAS).

Although some softwood lumber is used for remanufacture, most softwood lumber is for general construction and falls into three categories: appearance lumber, nonstress-graded lumber, and stress-graded lumber. The American Softwood Lumber Standard PS 20-94 through the American Lumber Standards Committee established the most classification and grades of softwoods (Hoadley 2000). Bolivia traditionally has been operating in the hardwood market. Therefore U.S. market segments for value-added hardwood products (secondary processing) have more relevance for the purpose of this research. But the softwood market segments, wood engineered products, or plastic-based products are analyzed to identify potential competitors, market preferences and price analysis.

Under the context of this research different segments of the U.S. hardwood industry were analyzed focusing on their importance for Bolivian forest products and certified LKS. The following sections describe the relevant U.S. hardwood market segments: flooring, decking indoor and outdoor furniture, millwork and molding, cabinets and dimension and components. Table 1-2 summarizes those segments, its North American Industry Classification System (NAICS), the number of establishments in the U.S., and a brief description of each segment. This information (including levels of income per US metropolitan areas, IWP member's headquarters, or certified wood products sellers) will help to determine the population size of potential buyers of Bolivian LKS, the geographical location of competitors, and segmentation of target markets.

The domestic hardwood lumber consumption of these segments can be seen in Figure 1-6 and Figure 1-7 (Hardwood Market Report 2006). The furniture industry has shown a tremendous reduction in consumption due to increasing imports from China. Domestic consumption declined from 3.45 billion BF in 2000 to an estimated 1.36 billion BF in 2005. The pallet industry also reduced its consumption from 5 MMBF in 2000 to 3 MMBF in 2004, but it has stabilized at 3.2 MMBF. The main reason is the use of recycled lumber instead of "new hardwood lumber" to manufacture pallets. Almost 4 billion BF of recycled lumber were used to build wooden pallets, and this amount is expected to grow in the future. Another factor is the increased use of softwood lumber.

Table 1-2. Relevant Markets Segments in the U.S Secondary Wood Products Sector

Segment	NAICS[a]	Number of Establishments[b]	Remarks
Lumber	321113	3,807	Sawmills, dimension lumber, ties, railroads, boards, beams
Furniture	337211	569	Wood office furniture manufacturing,
	337212	1,557	custom architectural woodwork, chairs, desks, tables
	337121	1,946	Upholstered Household Furniture Manufacturing
	337122	4,114	Non-upholstered Wood Household Furniture Manufacturing (outdoors, garden furniture)
Cabinet	337110	9,557	Bathroom and kitchen, stock or custom wood manufacturing, countertops,
	337129	203	Wood Television, Radio, and Sewing, Machine Cabinet Manufacturing
Millwork	321911	1,440	Doors, window frames, door jambs
Flooring	321918	2,064	Include other millworks, moldings, ornamental woodwork, parquetry, shutters, stairs, baseboards
Decking	238350	35,087	Finish carpentry contractors: flooring, deck construction, residential-type, millwork installation

Note. [a](U.S. Census Bureau 2006a, 2006b, 2006c);[b](U.S. Census Bureau 2002).

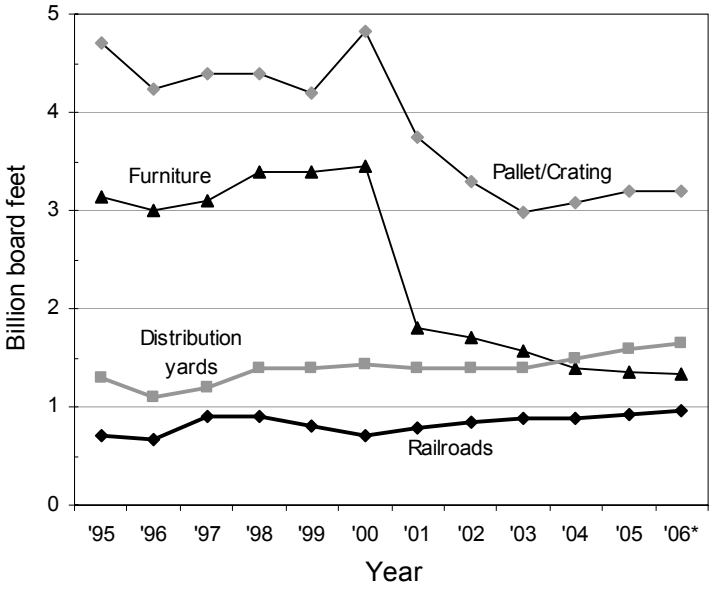


Figure 1-6. U.S. Domestic Hardwood Lumber Consumed in Selected Markets, 1995-2006 (WHR 2006, Barany 2006)

Figure 1-7 represents additional market segments. The cabinet industry has increased its consumption, from approximately 0.55 billion BF in late 90s to 0.9 billion BF in 2005. Amount,

that is not enough to cover losses of furniture and pallet production. The flooring industry will decrease its consumption in 4.4% for 2006, and the distribution yards will increase their consumption almost in the same proportion. The demand for strip flooring, sports flooring and truck trailer flooring will not be as high as in 2003 and 2004.

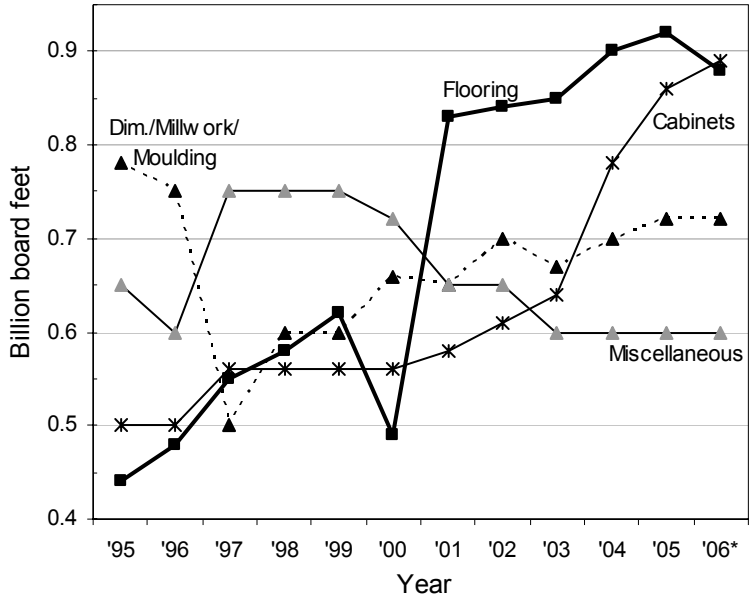


Figure 1-7. U.S. Domestic Hardwood Lumber Consumed in Selected Markets, 1995-2006 (WHR 2006, Barany 2006)

Canada is the largest provider of hardwoods to the U.S. supplying about 60% of overall imports. Figure 1-8 shows the trends of the major exporter countries of hardwood to the U.S. during last three years. There has been an increase of imports from Uruguay (approx. 40% between 2005 and 2004), and a significant increase in imports from, Ecuador and Philippines. However, Brazil continues by far to be the second largest exporter of hardwoods to the U.S. The exports to the U.S. from other countries have not recently shown significant changes (USDA-FAS 2006).

South America is the major exporter region of tropical lumber to the U.S, with 60% of the overall imports (85 MMBF) (USDA-FAS 2006) (Figure 1-9). So it would seem natural the U.S. would import from Bolivia. The next most important source regions for the U.S. are: Asia (30 MMBF); Africa (24 MMBF), and Caribbean and Central America (5 MMBF) (USDA-FAS 2006). A general decrease in the imports occured between 2001 and 2003, but imports have

increased during the subsequent two years. Africa showed a significant increase in its exports to U.S. in 2004 and 2005. Asia and the other regions have remained constant during the same period.

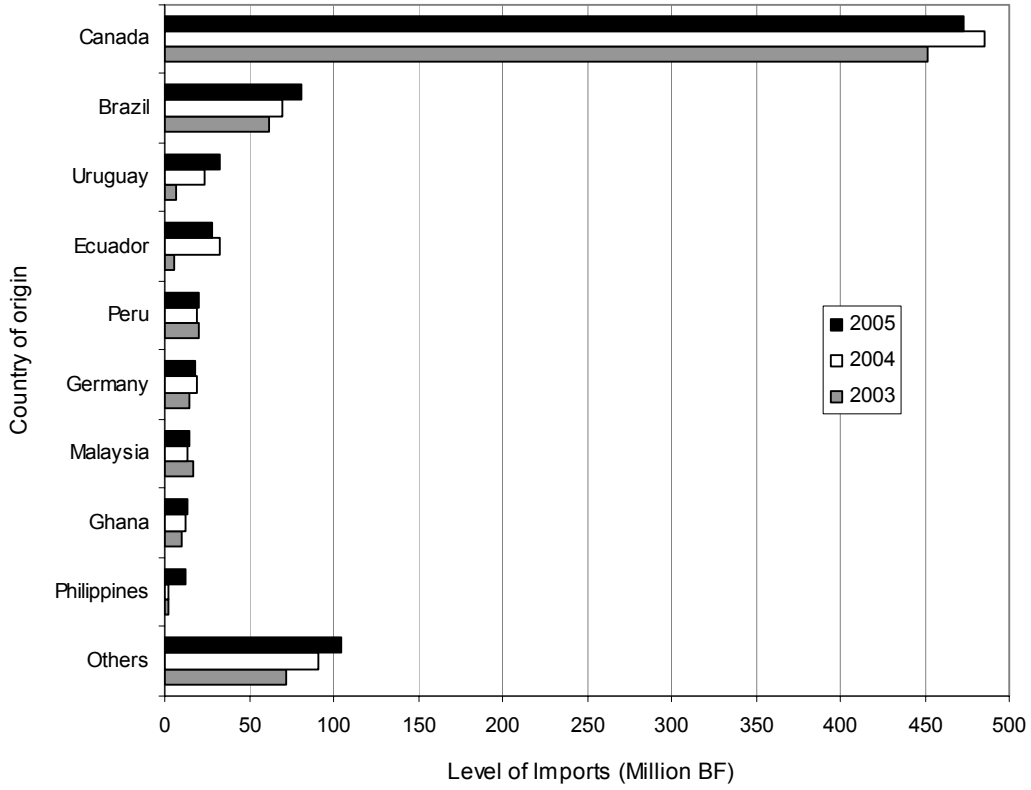


Figure 1-8. Sources of U.S. Imported Hardwoods by Country of Origin, 2003-05 (USDA-FAS 2006)

Brazil is the leader in the exports of tropical hardwoods into the U.S. with 52% of overall exports, followed by Cote d'Ivoire (8%), Ghana (8%), Cameroon (7%), Congo (5%), Peru (5%) and Bolivia (2%) – the rest of the countries total about 13% (Barany 2006). It is difficult to track the overall imports of tropical hardwood species due to a possible confusion on species names and misclassification of species by importers and exporters. This is an important factor because there is growth in the import of "Other Tropical" hardwoods (Figure 1-10). Factors such as the quest for substitutes for mahogany or teak, and the trade of new species might be causing this phenomenon. More over, wood species new to market are marketed using brand names similar to current marketed species. It is difficult to obtain precise information about the species used (Hoadley 1990, pp. 3-4).

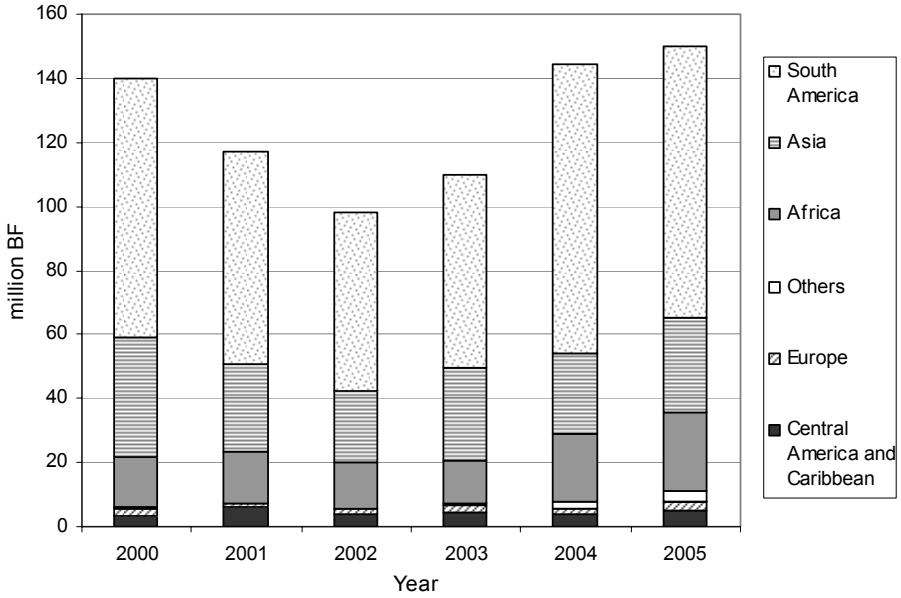


Figure 1-9. Tropical Hardwood Lumber Imported to the U.S., 2000-05 (USDA-FAS 2006)

Bolivian exporters should take into account this to introduce new species. For instance the Chilean specie lenga is marketed in the U.S. as "Chilean cherry" or the Bolivian specie ochoo (*Hura crepitans*) is promoted as Pine, South American poplar by a Peruvian company or as "ochoo pine" (Spartan Lumber Industries 2006). Other examples include: "Tasmanian oak" (eucalyptus), "Brazilian maple" (pau marfin), "Malaysian oak" (rubberwood) (American Hardwood Information Center 2006). Another notable point is the growth in the imports of balsa; Bolivian companies could find substitutive species in niche markets such as sporting goods, aircraft modeling, toys, and so forth (Hans 2006).

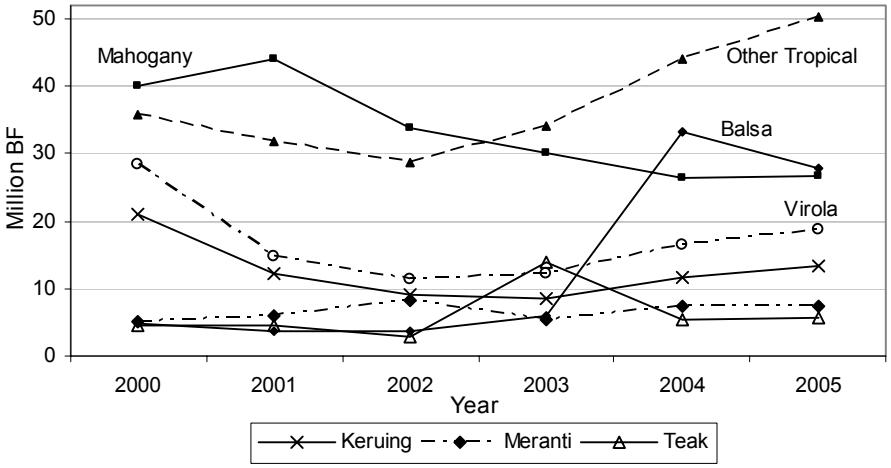


Figure 1-10. Trend of Tropical Hardwood Species Imported into the U.S. (USDA-FAS 2006)

According to the membership directory of the International Wood Product Association (IWPA), tropical species like meranti (*Shorea spp.*), jatoba (*Hymenaea courbaril*), ipe (*Tabebuia spp.*), sapele (*Entandrophragma cylindricum*), or cumaru (*Dipterix spp.*) are becoming more marketable (Figure 1-11). Manufacturers, architects and designers are taking advantage of the globalization in the forest products industry (38% increase in imports between 2003 and 2004) to use imported woods in their production lines, and providing distinctiveness and variety to their designs (International Wood Products Association 2006a)

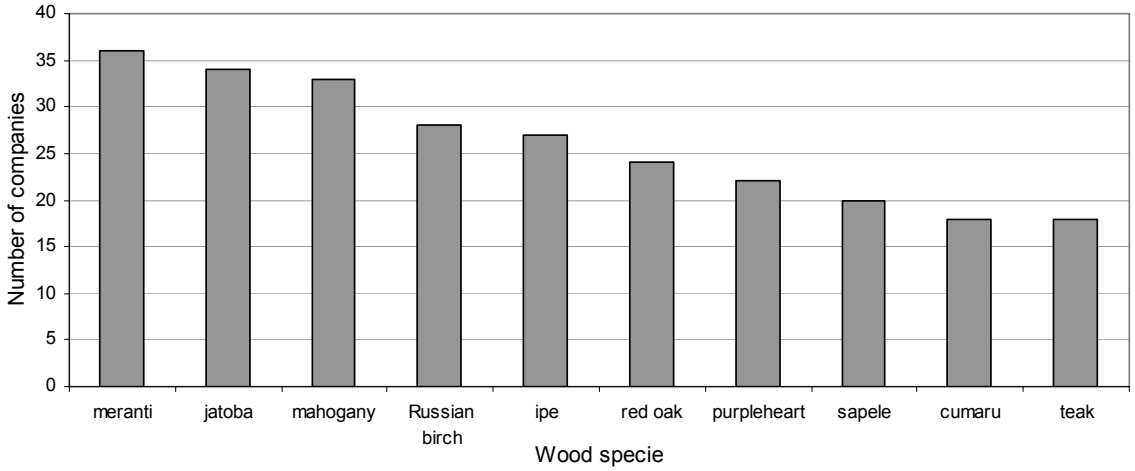


Figure 1-11. Common Species Promoted by IWPA Members in 2006 (2006b)

Market Segments

The U.S. marketplace has been one of the most important markets for Bolivian forest products, and it is expected that new Bolivian species can be introduced in this market. To this purpose it is important to understand the different wood products market segments in the U.S., as well as its trends and characteristics that would impact importing Bolivian species.

This section describes the major hardwood market segments in the U.S. with emphasis on the potential markets for Bolivian LKS. Bolivian forest products sector could use LKS to target specific market segments in the U.S. such as outdoor furniture, doors and decking (Barany et al. 2003). The structure of Table 1-2 helps to categorize these segments. The knowledge of wood species preferences of each market segment is very important in our quest to identify Bolivian LKS that offer similar or better market characteristics to over existing export species. Nicholls and Roos (2006) identified the major species preferred by some business types, which were:

Cherry and walnut are preferred by furniture manufacturers,

Douglas-fir and mahogany are preferred by door and windows manufacturers,

Maple and oaks (red and white) are preferred by kitchen cabinet manufacturers, and

Pine is preferred by millwork and moulding manufacturers.

The following sections describe imports, trends and species utilization of relevant market segments in the U.S. wood industry for Bolivian LKS.

Flooring

The National Wood Flooring Association (NWFA 2006) represents all segments of the U.S. wood flooring industry. The types and styles of wood flooring include: factory finished, unfinished, solid, engineered, strip, plank, parquet, and acrylic impregnated. The styles of flooring (e.g. strip, plank or parquet) vary in dimensions and give different appearances to the wood floor. The types of flooring (e.g. solid, engineered or acrylic) provide desired properties and uses in special purposes. The term flooring is applied indistinctly to different segments of hardwood flooring (solid flooring, sports flooring and truck trailer flooring), but those segments have important effects. Regarding sports flooring, it seems that schools and civic buildings make up the largest part of the market (Hardwood Market Report 2006). Wood is the material of choice and the species currently most preferred is red oak, followed by white oak and hard maple.

Figure 1-12 shows the trends of solid strip flooring shipments, residential housing unit starts (annually), and the board feet used per start unit. The wood flooring market has strong correlation to residential housing starts. The use of flooring per start increased from less than 100 BF in the mid 80's to around 350 BF or so since the turn of the century (Brindle 2006). The product offerings have changed dramatically over past several years. There are wider possible products: parquet, pre-finished flooring; wider range of colors and finishes; and a growing variety of wood species. Demand of hardwood flooring fluctuates due to buyer habits, thus is impacted by the variation of product offerings.

Overall imports of flooring have increased notably since late 90s, Figure 1-13 shows this trend. While European imports show a slow growth (from approximately $49 million in 1999 to almost $70 million in 2004), Chinese imports increased almost exponentially from less than $20

million in 1999 to almost $350 million in 2004. Figure 1-14 shows the major importer countries of hardwood flooring (million sq.ft.) into the U.S. in 2002, 2003 and 2004, including parquet and excluding engineering flooring. The volume of flooring imported from China into the U.S. increased from 14.5 million square feet (sq. ft.) in 2002 to 96.8 million sq. ft. in 2004. Brazil also showed significant growth, from 7.1 million sq. ft. (2002) to 57.3 million sq. ft. (2004), while Canadian exports remained stabilized at 72 million sq. ft. in 2003 and 2004 (Brindle 2006).

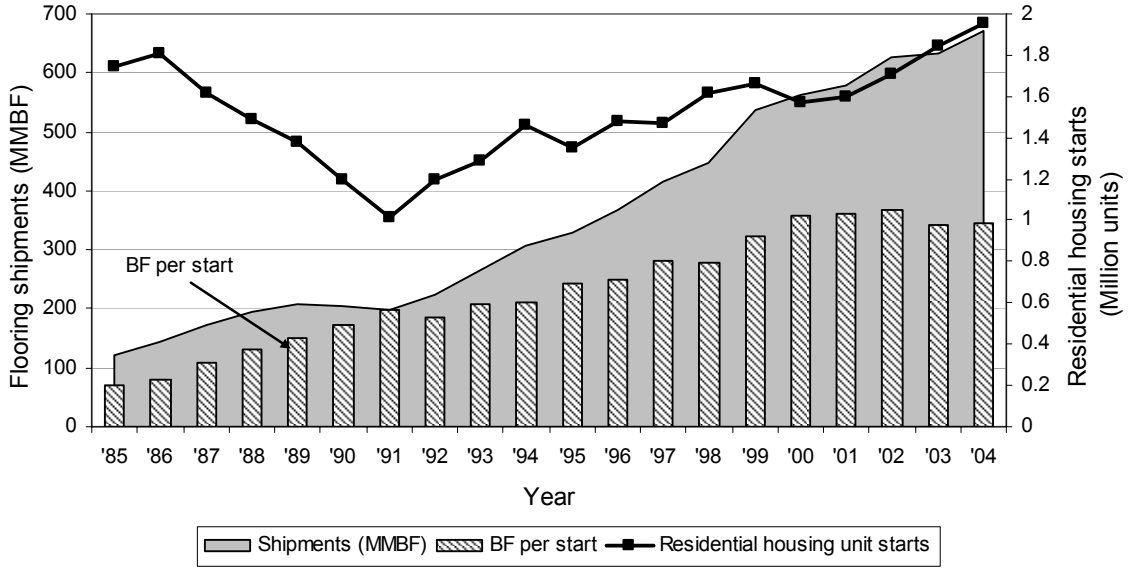


Figure 1-12. U.S. Flooring Shipments, Residential Housing Units Starts and BoardFeet Flooring Used per Housing Start, 1985-2004 (Brindle 2006)

While some countries, such as Canada, Chile or Germany, have seen a decrease in their exports of flooring to the U.S., the future seems optimistic for South American exporters of flooring. In 2005 Brazil was the second major exporter of flooring to the U.S.after China (approximately 55 million sq.ft.), Paraguay (6th place) with 4.7 million sq.ft., Peru (10th place) with 1.45 million sq.ft., Colombia (12th place) with 1 million sq.ft., and Bolivia (18th place) with 0.75 million sq.ft. (USDA-FAS 2006). This suggests that there could be increased market opportunities for tropical hardwoods species in the U.S. flooring market.

This segment is characterized by a high diversity of wood species. About fifty species are traded in the U.S. (NWFA 2006). Solid-wood based flooring applications demands high density and decay resistant species. Red oak, white oak, maple, cherry, ash, beech, and black walnut are common flooring species and manufacturers generally prefer FAS to No. 2 Common lumber

grades. Oak, maple, ash, and cherry are common veneers used in wood-composite flooring segment, but many other species are used (Punches 2002). The common imported species are: Brazilian cherry, jatoba, jarrah, santos mahogany, iroko, cumarú, purple heart, sapele, ipe, Brazilian teak, wenge and bubinga.

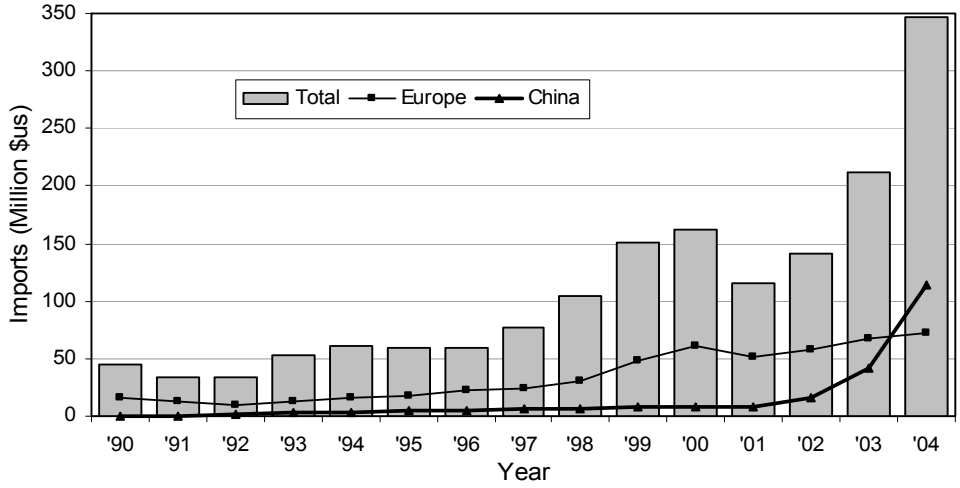


Figure 1-13. U.S. Imports of Hardwood Flooring, 1990-2004 (Vlosky 2005)

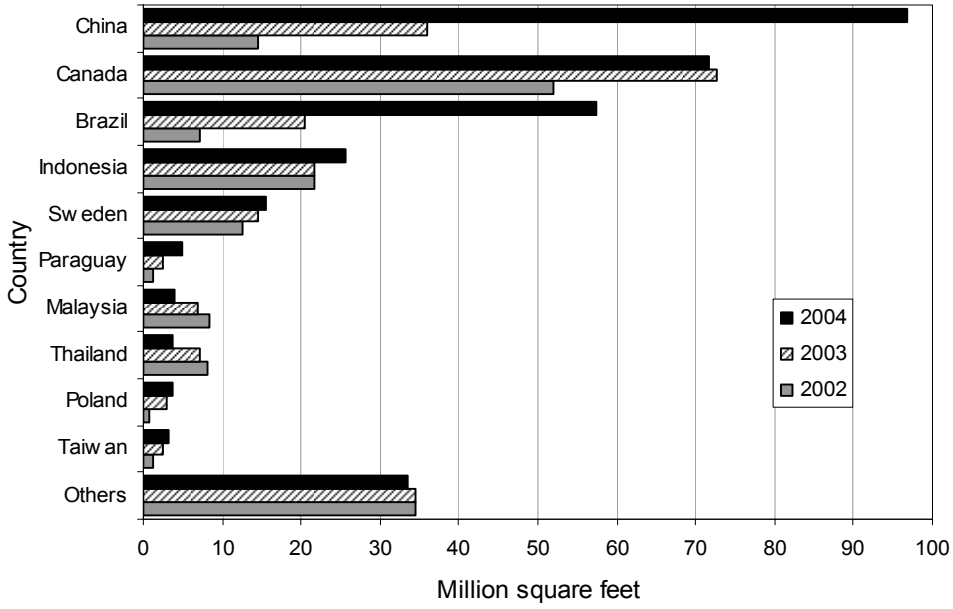


Figure 1-14. U.S. Imports of Hardwood Flooring by Country, 2002-2004 (Brindle 2006)

The certification of wood flooring in the U.S. is conducted from two perspectives: one related to how it is manufactured and the other certified that the raw material comes from

properly managed forests. The National Oak Flooring Manufacturers Association (NOFMA) has been certifying that members' flooring products are correctly manufactured. The Maple Flooring Manufacturers Association (MFMA), the Canadian Lumbermen's Association (CLA), and the Southern Pine Inspection Bureau (SPIB) also certify the manufacture of wood flooring. That is, they guarantee that the wood flooring fulfill grading standards, correct moisture content and correct configuration (dimensions). The environmental certification of wood flooring is recognized by chains of custody (Moore 2004).

Decking

In a study by The Freedonia Group (2005), the demand for decking was projected to increase at a rate of 2.8% per year through 2009. This market is due to more than 85% of the demand is generated by remodeling and improvements. The same study predicts that despite the increasing alternatives for decking construction, like plastic or aluminum, wood decking will remain the preferred material to produce and repair decks in the U.S., accounting for 81% of total decking demand in 2009.

Although pressure treated wood has the highest market share, for outdoor decking it is also ranked as the material "having the most problems" (Damery 2001, p. 1). The most important factors in the purchase decision include: quality, durability and installed stability (to reduce the risk of a deck to crash). Cost has an average impact. Tropical hardwoods were ranked as having the least performance problems. It is expected that the use of treated wood will change next years due to regulations in the use of chemicals like CCA (Morrison 2004).

In 2004 the Center for International Trade in Forest Products (CINTRAFOR) performed a study of home builders and deck builders across the U.S. to identified the material most used in decking construction (Eastin et al. 2005). In general, treated lumber is the preferred material for decking construction with 90% of market share (91.2% of decks use treated lumber in their substructure, 28.3% in the surface, and 27.8% in deck accessories). They also found that the material used in "deck surface applications" was dominated by wood-plastic composite products (39.6% of decks surfaces use this material). Wood-plastic composites are also the preferred material for accessories used in deck construction (29.5%). The third preferred material was western red cedar (10.8% of decks surface; 17.5% of deck accessories). Table 1-3 shows the percentage of material used in each part of a deck (e.g. 60% of deck accessories were built using

wood-plastic composites and treated lumber, and 18% were built from western red cedar) (Eastin et al. 2005). So decking may be a viable market target for Bolivian exporters since the majority of Bolivian lesser-known wood species are very durable, strength and accepatable installed stability.

Customers' purchase decisions (home builders or deck builders) is based primarily on material quality, and less on price. Consumers give more importance to high quality, durability (long life), visual appearance, and ease of maintenance (Eastin et al. 2005). Damery (2001) found that tropical hardwoods, eastern white cedar and Douglas fir also are utilized in decking construction in the U.S. Northeast, though in less extent.

Table 1-3. Percentage of Materials Used in Decking Construction in the U.S. (Eastin et al. 2005)

Material	Substructure	Surface	Accessories
Alaska yellow cedar	-	0.9	0.9
Western redcedar	0.7	10.8	17.5
Redwood	-	5.3	6.6
Treated lumber	91.2	28.3	27.8
Untreated lumber	6	1.5	1.8
Wood-plastic composite	0.6	39.6	29.5
Tropical hardwood	0.7	5.8	4.4
Plastic	-	4.2	4.8
Other	0.8	3.5	5.6

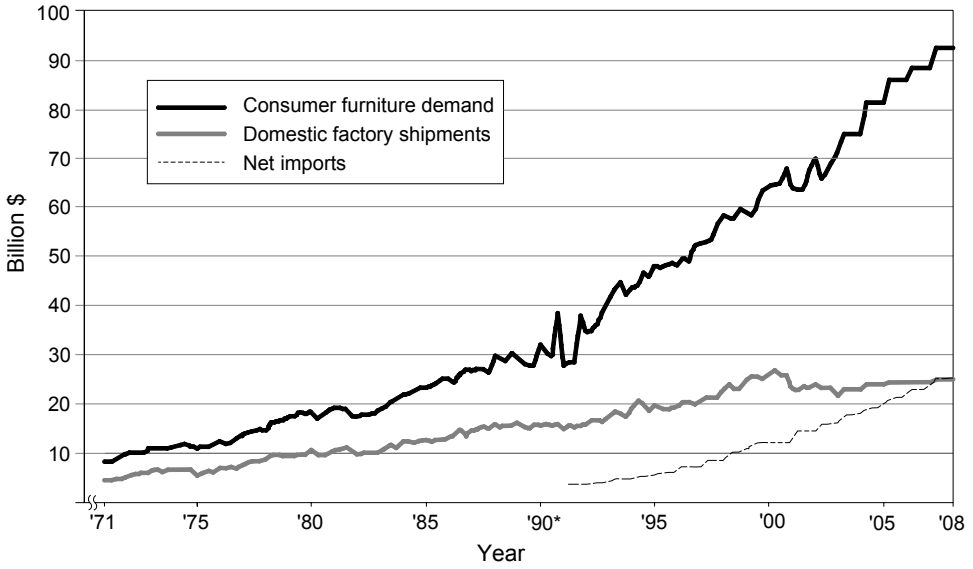
Indoor Furniture

Another area of the market where Bolivian exports may find promise is the furniture industry. Figure 1-15 illustrates the trend in furniture consumption (Vlosky 2005). Since the 1990's there has been an increase demanding for imported furniture, at the same time a decrease in domestic factory shipments. Both factors and the natural demand due to population growth projects important increases in furniture imports in the future. Vlosky states (2005) that imports represented 54% of all wood household furniture sold to U.S. retailers in 2004 and there have been substantial decreases in the furniture industry employment trend. In North Carolina there was a decrease from approximately 78,000 to 60,000 jobs between 1992 and 2003.

The implications of these changes in the furniture industry are: increasing trend in the use of imported furniture and components, decrease in the capital investment percentage of annual

revenues of wood furniture makers, less promotion of solid wood and hardwood species. In short, steady growth for furniture sales, strong imports, weaker preference for hardwood use is expected in the future (Raymond 2006).

The wood-furniture of the U.S. market is dominated by Asian imports (Christianson 2006b), as seen in Table 1-4, where Asian countries experienced an incredible growth between 2004 and 2005. There was an appreciably growth in the office furniture segment with a change of 11.8% between 2004 and 2005 (Koenig and Jenkins 2005). This sector also is emphasizing in the use of environmental friendly raw materials. They go beyond, for example they monitor suppliers in order to make sure the components bought are environmentally sensitive as possible.



Note. Vertical columns are recessions; data forecasted by Mann A. & Epperson Ltd.

Figure 1-15. Trends in Consumer Demand, Factory Shipments and Imports in the Wood-Furniture Industry of the U.S., Forecast 2005-2008. (Vlosky 2005)

Besides the decline observed in the furniture industry, there is also a change in the mix of species used according to the customers' trends. The percentage of hardwood species can be estimated with species shown in international home furnishing trade shows (Hardwood Market Report 2006).The common species used for natural appearance applications include hard and soft maple, yellow poplar, red oak, ash, mahogany, walnut and eastern white pine (FAS No.1 Common, No. 2 Common), and Select and Better grades or the pine equivalent. For painted furniture components yellow poplar and red maple are common species (Punches 2002). Yellow poplar and red maple are also common utilized in hidden/structural applications, commonly

gleaned from falldown from higher grade products (Punches 2002). Many hidden components used plywood to bring strength and stability.

The changes in consumer trends brought about that the use of maple in the furniture industry increased by one percent in 2005 (i.e. increased 43 % from 1994). Conversely, the use of oak decreased 1 % in 2005, i.e. decreased 49% from its peak in 1994 (HMR 2006, p. 31). There is an increase in the use of cherry which makesup about 17% of the overall use of hardwood in the furniture industry. The use of walnut remains stable at 2% of the overall use of hardwood in the furniture industry. The use of red oak declined dramatically, therefore originated more growing stocks than hard maple. This fact also brought about that numerous manufacturers changed to the use of alternative species (HMR 2006).

Table 1-4. Top 10 U.S. Wood Furniture Import Sources (Christianson 2006b).

Country	2005	2004	% Change
China	5,879	4,900	+20
Canada	1,937	1,928	+0.4
Italy	721	884	-18.4
Mexico	692	543	+27.4
Malaysia	653	527	+23.9
Vietnam	599	273	+119.4
Indonesia	542	477	+13.6
Brazil	364	293	+24.2
Thailand	362	362	0.0
Philippines	200	167	+19.8

Outdoor Furniture

Outdoor furniture requires extra characteristics in wood species, weathering and decay resistances. The first one can be controlled by special finishing, and the second one by treatment of wood. Thus high natural durability and decay resistance are desirable. Species commonly used for outdoor furniture are: redwood, cedar, teak, jarrah, shorea, roble (South American oak), tropical eucalyptus. Pressure-treated pine also is used. Willow, cypress or alder can be used for bent-twig outdoor furniture (Rodgers 2006). Outdoor furniture industry has been identified as one of the best market opportunities for Bolivian LKS in the U.S. (Barany et al. 2003).

The interest of US consumers for outdoor furniture seems to be stabilized. The US deliveries of outdoor furniture (of all types) were estimated in $2.34, $2.39 and $2.17 million in 2002, 2001 and 2000 respectively. California was the major state consumer of outdoor furniture in 2001 (25% of overall deliveries), followed by Texas (7.1), Florida (5.5), New York (4.6), Washington (4.3%) and Arizona (3.9) –the rest of states totalized 50.2% (Ministère des Ressources Naturelles; de la Faune et des Parcs 2004). Because of this interest it would appear that the U.S. market might hold good potential for exporters of durable LKS.

Bolivian lesser-known wood species may find competitive advantage in the outdoor futniture industry, because they are very durable –suitable for exterior applications. In addition, the processing of wooden outdoor furniture does not require low levels of moisture content, thus kiln-drying processes can be reduced. Strenght and high stability are other desired characteristics of some Bolivian LKS that make them suitable for outdoor furniture.

Millwork and Moulding

We define millwork as building materials made of finished wood and manufactured in millwork plants including doors, window and door frames, blinds, mantels, panelwork, stairway components, moldings and interior trim. Finger-jointed pine, finger-jointed poplar and MDF continued to gain market share, cutting into the use of solid hardwoods. This was most visible in lower-end housing and tract homes. Higher-end and custom builders continued to use plenty of solid hardwoods (Barret and Barret 2006). Builders now have more choices for determining the right product for each application, for instances MDF is a good lower-priced alternative to pine mouldings (Shutt 2006). Wood is still the preferred material for moulding, with imports from Chile, New Zealand and South Africa expanding quickly. Buyers also show preference for big mouldings. Five inches becoming a standard and 10 in. moulding (crown moulding) are becoming popular.

Hard and soft maple are becoming more common in millwork and moulding applications. Designers show preferences for lighter colors, forcing millwork and moulding manufacturers to pay more attention to color variations and purchase less unselected lumber. Poplar remained the most used hardwood by millwork and moulding manufacturers (Barret and Barret 2006).

Solid doors constitute an important segment of millwork industry and have shown an increasing trend in the imports, as can be observed in Figure 1-16. Other types of doors (flush

doors and French doors) have not shown substantial changes. The U.S. demand for wood doors and windows is expected to grow 4.9% annually between 2003 and 2007 (Barany 2005).

The market for moulding is expected to grow in a rate of 3.7% annually through 2008 (Shutt 2006), This is a very diversified market, with products that meet almost any specific need and budget. The competition is not among species of wood, but among other materials such as plastic moldings (estimated growth of 7% until 2008). Metal moldings and other engineered products, including MDF, will grow by 6.1% annually, against the only 2.1% annually projected for wood-based moldings.

Table 1-5 shows that there was an increase in the overall consumption of moulding in the U.S. China is emerging as the most important exporter of moulding into the U.S. The rest of major exporters have maintained their growth, but with less share of the market. Brazil has gained participation in the market. Canada has decreased its participation, and the rest of the countries (Malaysia, Indonesia, Italia, and Taiwan) have seen a reduction in their market share. In 2005 China exported 336 million linear feet (MMLF) into the U.S., followed by Chile (76 MMLF) and Mexico (13 MMLF) (Barret and Barret 2006).

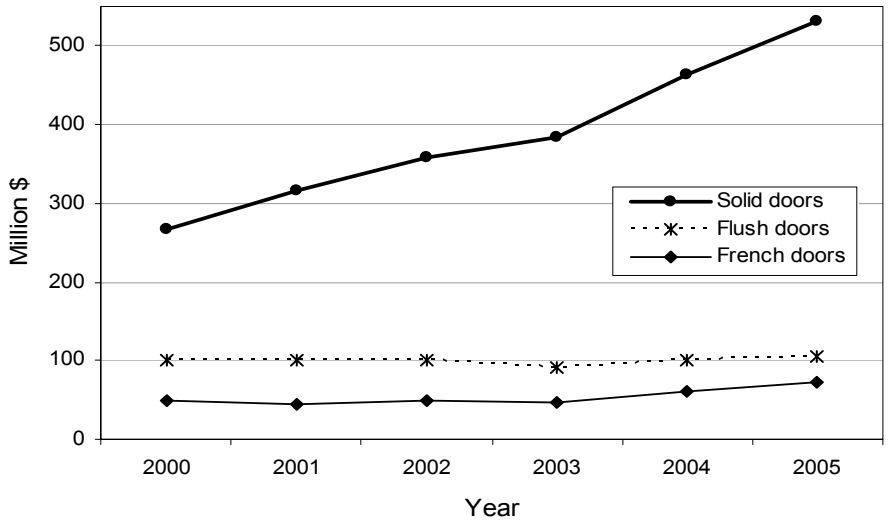


Figure 1-16. Type of Doors Imported into the U.S., 2000-05 (USDA-FAS 2006)

Architectural millwork for natural-appearance applications commonly use FAS select or higher grades of hard and soft maple, red and white oak, cherry, walnut, mahogany, and yellow poplar; and eastern white pine in equivalent high grades. Yellow-poplar and soft maple are

commonly used for painted millwork, most of them from falldown from higher grade products. Poplar is common for hidden and structural millwork applications, generally falldown from other products (Punches 2002). Windows often require straight vertical grain offered by Douglas fir. Common species for windows are: ponderosa pine, eastern white pine, radiata pine in very high grades –highest export grades or exceeding FAS.

Exterior doors are typically manufactured of eastern white pine, mahogany, white oak, and Douglas-fir with qualities FAS (hardwoods) and D and Better (pine). For painted applications yellow-poplar, Ponderosa pine, Radiata pine, and eastern pine are employed in their high grades. Hidden structural applications commonly use many species of pine, fir and hemlock in grades No. 2 Common and No. 3 Common. Both hidden-structural and painted applications also use fingerjointed material, composites such as laminated veneer lumber and laminated strand lumber (Punches 2002). Red oak, maple, cherry, yellow-poplar, eastern white pine, Ponderosa pine and hemlock in high grades (FAS, D and Better) are common species to manufacture mouldings in applications that require natural appearance. For painted applications yellow-poplar is preferred, and frequently is purchased as FAS or higher grade. Painted moulding is often from MDF.

Table 1-5. Imports of Hardwood Mouldings by Country of Origin, 2001-05 (USDA-FAS 2006)

Consumption Imports (Thousand $US)	2001	2002	2003	2004	2005
China	18,798	25,132	43,845	76,420	101,867
Canada	33,157	73,468	95,145	117,485	96,313
Brazil	13,891	19,583	22,782	46,731	43,569
Malaysia	8,893	12,224	13,138	14,145	18,970
Indonesia	14,346	14,283	12,177	15,645	18,337
Italy	13,609	15,757	12,190	13,250	15,415
Taiwain	7,449	5,546	4,969	4,939	9,411
Others	12,813	20,061	21,628	29,719	29,053
Total	122,956	186,054	225,874	318,334	332,935

The increasing demand for solid wooden doors in the U.S. suggests that Bolivia has good opportunities for exporting doors made of LKS to this marketplace. Special styles of entry doors,

rustic or French doors can be potential target markets. In contrast the market for moulding seems more competitive and several substitute materials are employed.

Cabinets

It is estimated that the demand for kitchen cabinets will increase over 6% per year through 2008 and reach a total of $16 billion (Anonymous 2006b). This projection is based on anticipations of expenditures for residential repair and improvement projects. The Freedonia Group forecasted the demand for cabinets and concluded that it will expand at 3.1% per year through 2010. The same study also found that residential construction is the primarily market for cabinets and kitchen cabinets represented about 85% of cabinet shipments in 2005 (Anonymous 2006a). In 2005, the cabinet industry exceeded the market of the furniture industry in terms of hardwood consumption, i.e. approximately 100 MBF more than 2004 were used in the manufacture of cabinetry (Hardwood Market Report 2006).

Figure 1-17 shows the trend in billion $US of the cabinet industry for the last five years, note the increasing trend (Barrett et.al. 2006). It is estimated that 10% to 15% of Stock cabinets sold in the U.S. are imported, and that some percentage of semi-custom cabinets are manufactured abroad (Hardwood Market Report 2006). Figure 1-18 shows the balance of imports and exports of cabinets for 1995-2005. This suggests that the current domestic production capacity is not enough to satisfy the increase demanding for cabinetry (influenced by housing remodeling and construction), or the cabinet industry is loosing competitive advantage.

Due to the fact that Canada shows a decline of $40.4 million in shipments to the U.S., it is evident that a great deal of the imported cabinetry comes from other countries. Figure 1-19 shows those countries, and China has taken the leadership (Barrett et.al. 2006). Chinese exports of cabinets to the U.S. have grown exponentially for five years in a row. Many of these U.S. cabinet imports correspond to stock cabinetry. U.S. manufacturers are trying to counter act to this Chinese expansion by manufacturing custom and semi-custom cabinets (Hardwood Market Report 2006). In this struggle U.S. companies worked down delivery times for semi-custom orders to as little as 12 days, and fully custom orders to 5 weeks in some cases (Barrett et.al. 2006). China increased its exports of kitchen cabinets to the U.S. from $20 million to more than $140 million during last five years (2002-2005). Italy, the second major exporter of kitchen cabinetry to the U.S., exported less than $40 million in 2005. The rest of major exporter

countries of kitchen cabinetry in 2005 were: Germany, Mexico and United Kingdom (with approximately $50 million in total) (see Figure 1-19). This implies that China has gain an important competitive advantage against the rest of the countries.

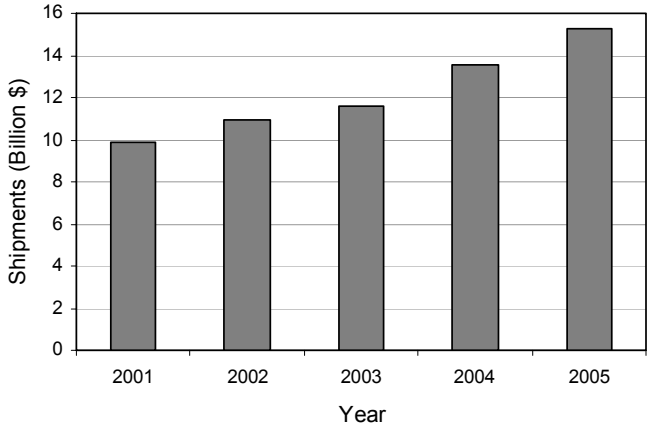


Figure 1-17. Estimates of U.S. Shipments of Cabinetry, 2001-2005 (Barrett et.al. 2006)

The changes in demand, influenced by design trends, predict shifts from "classic straight line" designs to bolder and richer appearances. Therefore an increase demanding for close grain whitewood species is observed (Hardwood Market Report 2006). The use of exotic, colored, weathered, and non-traditional materials is becoming popular, such as American walnut (Barrett et.al. 2006). The common U.S. domestic species displayed in cabinet trade shows in 1989 were approximately: red oak (56%), maple (about 8%), and other species such as cherry, hickory/pecan, birch and mahogany account for less than 1%. For 2005 the major species displayed were: maple (42%), cherry (23%), red oak (8%), birch (3%), mahogany (1%) and hickory/pecan (1%) (cf. Figure 1-20) (Hardwood Market Report 2006).

While the use of red oak is diminishing, other domestic hardwoods like hard maple or cherry are experimenting important growth and account for the majority lumber utilization. In addition, unexpected use of hickory and soft maple was also observed. The use of birch has been affected by the increasing use of Russian birch, and European beech. Alder and hickory still are the most often used for rustic look.

Figure 1-18. The U.S. Trade Imbalance in Kitchen Cabinets, 1998–2004 (Barrett et.al. 2006)

In a recent study, Olah et al. (2003) estimated the consumption of wood-based products by the U.S. cabinet industry. A summary of their results include: 1) the cabinet industry uses approximately 450 MMBF of hardwood lumber; 2) 95% of hardwood purchased were No1 Common or Better; 3) common hardwood species were red oak (44%) and hard maple (24%); 4) approximately 25 MMBF were softwood lumber; 5) common softwood species were white pine (49%) and southern yellow pine (36%); 6) the majority of U.S. companies outsourced some parts; 7) U.S. companies commonly sell certified "green" products and 8) strawboard, urban waste MDF and plastic were the most common substitute materials.

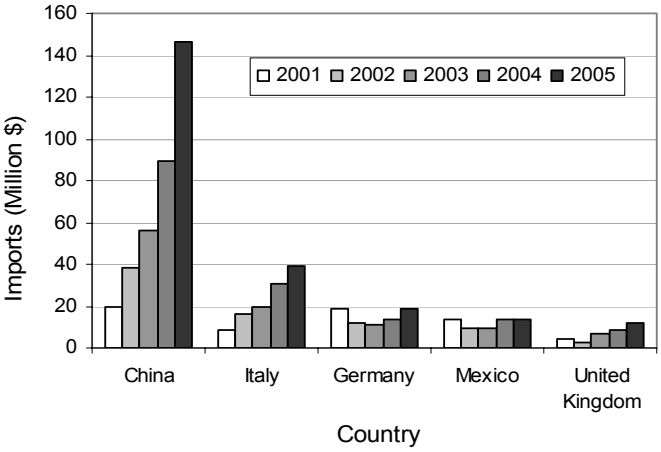


Figure 1-19. Imports of Kitchen Cabinets by Country of Origin, 20012005 (Barrett et al. 2006)

In August, 2006 the Kitchen Cabinet Manufacturers Association (KCMA) presented its new Environmental Stewardship Program (ESP) to demonstrate their commitment to sound

environmental management and sustainable practices (Christianson 2006a). Even though many cabinetmakers sell certified products, the ESP could dictate in the future of the importing of wood products destined to this market.

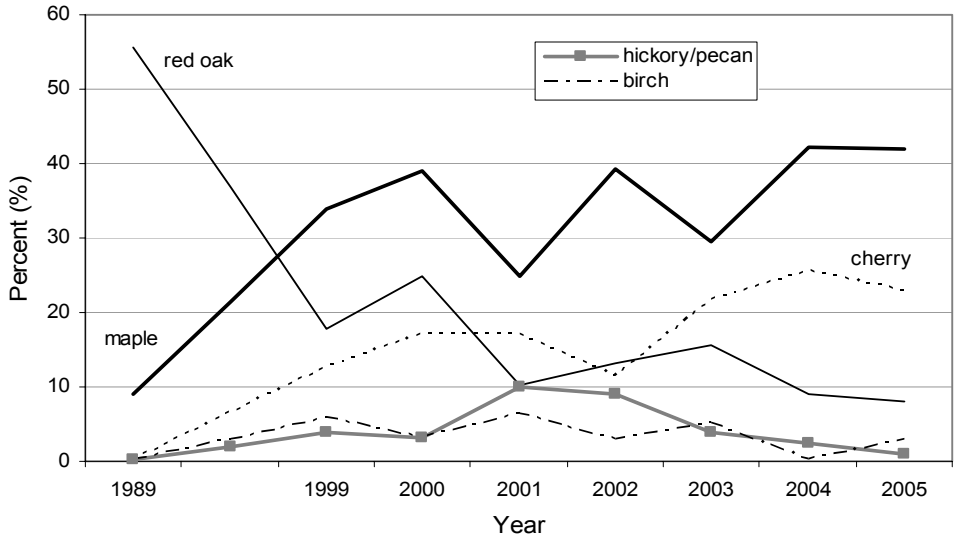


Figure 1-20. Trends in the Use of Domestic Species in the U.S. Cabinet Industry (HMR 2006)

Dimension and Components

The consumption of lumber by this segment decreased from 2.4 in 1999 to 2.0 billion BF in 2004 (Hardwood Market Report 2006). The sector destined to furnish furniture industry undergoes the major impact, in part for imported parts and furniture. It is difficult to capture accurately its size because it ranges from small operations with single moulders to large multinational corporations. This sector supplies parts for furniture, cabinet, doors, and mouldings, as well as for commercial or residential structures.

This market is highly competitive, which has caused the closure of firms, and the adoption to efficient management skills. It also is focusing on niche markets in order to compete with imports and other segments. The increasing trend of the housing industry (private and remodeling) is definitively beneficial for dimension and components manufacturers (Hardwood Market Report 2006, p. 45). The species commonly used by this segment are: red oak, hard maple, cherry, soft maple, white oak, and ash (Smith et al. 2005).

Other Markets

Other markets, different than the six major markets described before, might be also attractive for Bolivian LKS such as toys, trophy bases, decorative veneer and plywood, coffins, vehicle parts, sport goods, or agricultural implements. For instance a Bolivian company signed a $1 million contract to export sawn balsa lumber (*Ochroma pyramidale*) to the U.S. which is used to manufacture surfboards (Hans 2006). This experience could open new markets for Bolivian LKS. Wood products Bolivia has exported during 2004 (and are not part of the markets described before) include: wood fiber boards ($3.6 million), veneer and plywood ($3.4 million), trophy bases and carved boards ($320 thousand). Other products exported, but in less extent were: handicrafts, coffins, ties and posts (CFB 2005).

Figure 1-21 shows the U.S. imports of specialty wood products (ornaments, frames, cases, tableware and tools) in 2003, 2004 and 2005. Only the import of frames appears to be stabilized at $400 million annually. The imports of ornaments (such as statuettes, jewelry boxes, handicrafts or gifts) increased 5% between 2005 and 2004. In the same period the imports of wooden cases (e.g. crates or containers) increased 4.7%; the import of wooden tableware (e.g. wooden spoons, forks or kitchenware) growth 8.2%; and the imports of wooden tool handles (i.e., broom handles, brush backs, paint roller handles) increased 24.7%. In general the market of these wood articles increased 9.5% between 2004 and 2005 (USDA-FAS 2006). Even though these are small markets compared with other segments, they should be considered as well.

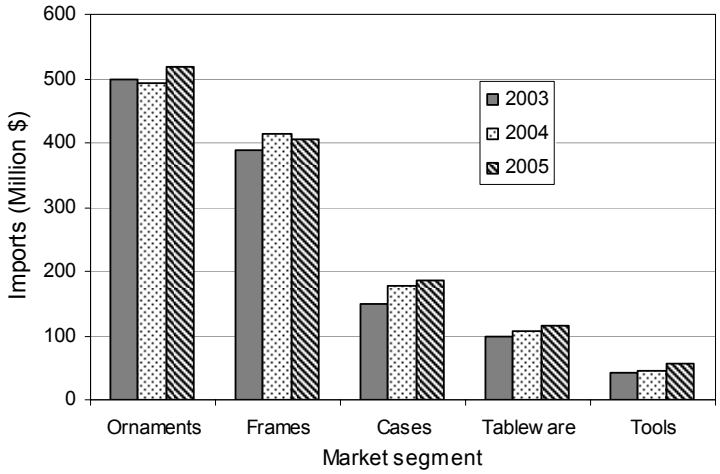


Figure 1-21. U.S. Imports of Specialty Wooden Products 2003-2005 (USDA-FAS 2006)

Justification

The marketing of Bolivian certified lesser-known wood species in the U.S. can generate several environmental, social and economical benefits for both countries. The use of FSC certified forest products guarantees the sustainability of Bolivian rain forests. The major social impact would be the improvement of the well-being of Bolivian indigenous communities. In addition, the diversification of timber harvesting will improve the effectiveness of forest products management. To increase the benefits (economic) in the long-run, and the participation of wood manufacturing in the Bolivian GDP (Figure 1-1), Bolivia has to export value-added wood products rather than logs or sawn-lumber (primary processing). For instance, looking for new markets in furniture, doors, decking and other value-added forest products markets offers new opportunities for LKS (Barany et al. 2003, Sacre 2002).

The consumer in the U.S. would benefit by the attributes and uniqueness of new tropical species. Architects can use a variety of designs and styles to match exclusive styles. Besides the exotic appearance U.S. customers should also desire other properties such as natural durability, strength or hardness. In addition, use of certified wood products that can be readily incorporated in "green construction" (i.e. building products and practices that demonstrate energy, water and natural resources efficiency (US Green Building Council 2006)).

The quality of the product itself is not enough to capture market share. Before you can introduce new wood species in a "mature" market one needs to identify needs and desires of potential customers, and to identify target market segments (or niches). More importantly an evaluation (assessment) of the current situation of Bolivian forest products that may be desired in the U.S. marketplace should be completed. This integrated approach (potential of Bolivian wood species, and understanding of U.S. market requirements) is the key of success for defining effective marketing strategies to introduce Bolivian LKS in the U.S. and to other markets.

Objectives

The primary objective of this research is to identify incentives and barriers to the introduction of lesser-known Bolivian timber species in the U.S. market. The specific objectives are:

To assess, through market research, the interest of U.S. companies to import Bolivian wood products (especially wood products based on LKS),

To characterize Bolivian lesser-known wood species, and

To develop strategic marketing recommendations for introducing Bolivian LKS into the U.S.

An indirect objective of this project is to obtain forest product market information that is useful to organizations linked to forest products in Bolivia such as the Sustainable Forestry Management Project (BOLFOR II), Amazonian Center for Forestry Development (CADEFOR), Forestry Chamber of Bolivia (CFB) or Bolivian Institute of Foreign Trade (IBCE). At the same time this research will support marketing and decision systems of Bolivian forest products companies.

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CHAPTER 2. SURVEY OF U.S. COMPANIES

Introduction

The import of tropical timber into the U.S. has increased remarkably during the last decade. In 2002 the U.S. imported $400 million in tropical sawnwood and plywood (Metafore 2004d), while in 2004 it imported $842 million (ITTO 2006). The volume of tropical timber products imported in 2001 were: 277,000 m^3 of sawn lumber, 72,000 m^3 of veneer and 1.05 million m^3 of plywood; while in 2005 imports were as follows: 356,000 m^3 of sawn lumber, 100,000 m^3 of veneer and 2 million m^3 of plywood. The import of logs remained balanced at 2,000 m^3 per year since 2002 (ITTO 2006). This trend is expected to continue in the future.

Duery (2006) assessed the demand for certified tropical hardwood products in the U.S. marketplace, among members of the supply chain. She concluded that the market is very small. Usually tropical wood products represented 1% to 9% of the overall product mix of the members of the supply chain (importers, wholesalers, distributors and retailers), and they usually import 1 to 25 containers of tropical wood products per year. The main source of information that they use to locate tropical wood products were: distributors, company sales representative, and "word of mouth." Another important conclusion stated was that the U.S. market for tropical hardwoods does not have preference for environmentally certified forest products and they are not willing to pay premium prices for certified wood.

Eastin and Wright (1998) provided some insights for marketing lesser-known wood species in the U.S. The authors surveyed 719 firms in the U.S. They surveyed importers of tropical hardwood, importers of veneer, wholesalers of tropical hardwood, wholesalers of veneer and lumber wholesalers. They found that, by far, the most important factor was the *availability of reliable supply* of LKS. Other factors, in order of perceived importance were *availability of technical data*, and *availability of small trial volumes*, and *low initial trial price*.

Recently Metafore (2004b, 2004c) conducted several studies to assess the U.S. market for tropical hardwoods, certified tropical hardwoods, and non-traditional wood species. For non-traditional species, Metafore identified three principal market opportunities: commodity lumber market, specialty lumber market, and finished products market. According to the authors, the

best opportunities for non-traditional species are markets that are not constrained by price, volume, rigid specifications, and environmental niches.

The increasing demand for tropical timbers, the increased control of illegal logging, the increased control of the exploitation of endangered species, the scarcity of formerly traditional wood species, and the increased pressure to the utilization of environmentally certified wood products are some of the factors that encourage U.S. importers to look for alternative wood species that can fulfill these requirements. Bolivia, currently has the largest number of environmentally-certified hectares of tropical rainforests (Rainforest Alliance 2005), possess extensive forest resources, and diversity of wood species that could be marketed successfully in the U.S. Hence, Bolivia could become an important source of wood products for U.S. importers.

Few research studies assessed the U.S. market for: 1) tropical wood products (Duery 2006, Goetzl and Ekström 2007, Metafore 2004d), 2) certified tropical wood products (GFTN 2004, Metafore 2004a) and 3) lesser-known wood species (Metafore 2004c). However, none of those studies focused on Bolivian LKS exclusively. The objective of this portion of the research is to assess the interest of U.S. companies in Bolivian certified lesser-known wood species. To meet the goal, the following objectives were developed:

To identify common tropical hardwood species imported in the U.S.;

To identify Bolivian lesser-known wood species those are imported in the U.S.; and

To identify marketing opportunities in the U.S. for Bolivian lesser-known wood species.

Methods

Population

The population of interest for this study was “importers of tropical hardwood”. For the purpose of this research the following types of companies were of particular interest: “importers of Bolivian wood products” and “importers of non-Bolivian wood products”. However, other members of the supply chain such as wholesalers, distributors, retailers and manufacturers were included to identify similarities and differences regarding the usage and interest on environmentally certified lesser-known wood species.

Sampling frame

Due to the lack of one complete source, several sources were needed to identify the firms such as the Big Book 2004, directory of members of the International Wood Products Association (IWPA), Directory of Importers 2003®, directory of members of the National Hardwood Lumber Association, and the Internet.

After identifying the population of interest and the companies to be surveyed, it was needed to determine the size of the sample. To this purpose, Equation 2-1 (Parasuraman et al. 2004, p. 379) was used to determine the sample frame for this study. The parameters were determined as follows:

It was desired to have 95% of confidence in the estimate ($z_q = 1.96$)

The precision level was established to ±10 percent ($H = 0.10$)

The upper limit for a standard deviation of proportions (i.e. proportion of U.S. companies that import Bolivian wood products) was used to estimate the degree of variability in the population ($s = 0.5$)

$$n = \frac{z_q^2 s^2}{H^2} \qquad \text{(Eq. 2-1)}$$

The final calculation of the sample size is shown in equation 2.2.

$$n_{\max} = \frac{0.25 \cdot z_q^2}{H^2} = \frac{0.25 \cdot (1.96)^2}{(0.1)^2} = 96.04 \approx 96 \qquad \text{(Eq. 2-2)}$$

It was expected a 25% response rate, thus it was needed to mail at least 384 questionnaires to the potential respondents; 400 questionnaires were mailed.

Data Collection

Primary and secondary research were developed during this study. Secondary data were collected from different publications (journal articles, statistics of the U.S. Census Bureau, statistics of the Foreign Agricultural Services, etc.). Additional information was gathered through discussion with industry experts and attendance at events. Descriptive statistics were collected in this phase regarding the importing of hardwood wood products, characterization of the U.S. hardwood market segments, and trends within the industry. This information offered insights to develop questions for the mail questionnaire.

Primary data on the U.S. supply chain (from importers to retailers) were collected by means of a mail survey. Based on the research objectives and secondary data a questionnaire was developed to conduct the study. Because the length of the questionnaire and the size of the sample, it was decided to use a slightly modified version of the Tailored Design Method (Dillman 2000) to collect data. The questionnaire was designed to gather demographic information, wood species importation and substitution, and marketing issues of the companies under study. Several open-ended questions aimed at obtaining the point of view of respondents. Two definitions were added at the top of the questionnaire to avoid misinterpretations: 1) "lesser-known" wood species, and 2) "environmentally certified" wood products.

The questionnaire was assessed for clarity, completeness, and content by industry experts and was frequently revised based on the suggestions received. The completed questionnaire was pre–tested by six industry experts in December 2006 and any further suggested refinements were made before conducting the study. The basic strategy to increase the response rate included: personalized cover letters, prepaid return postage for the questionnaire, guarantee anonymity and confidentiality, reminders, questionnaire of few pages, and an electronic version of the results of the study were offered as a token for completing the questionnaire (Appendix A).

A two month-long study was conducted. In January 2007 the initial questionnaires were mailed to the overall sample frame (400 companies), each 10x13 in. envelope had a cover letter and the questionnaire (as per Dillman 2000). Two weeks after the first mailing a reminder postcard was sent to those companies that had not yet responded. In February a second set of questionnaires was mailed to those companies that had not yet responded and the cover letter was modified and stressed the importance of the study, and it reminded the respondent that their input was crucial to the success of the survey. Two weeks after the second mailing was sent, a final reminder postcard was mailed to those companies that had failed to respond. In March a final questionnaire was mailed to those companies that had not yet responded and another modified cover letter was enclosed, it encouraged the respondent to return the questionnaires (in blank or completed). This last set of companies was treated as "non-respondent" in the analysis of response rate bias.

Personal interviews were conducted at the participating importing firms in May 2007. Interviews were scheduled with owners, managers, or primary-decision-makers of selected

companies. The meeting typically lasted 45 minutes. Some of the interviews also included warehouse tour which added qualitative value to the interview. Each interview opened with an explanation of the research project, terms of confidentiality were addressed, and the format of the interview was explained. The type of interview selected was the "general interview guide approach", since the purpose of the interview was to assess some areas of interest and, at the same time, to allow a degree of freedom and adaptability in getting information from the interviewee. Appendix B shows the guideline used, but it is important to note that other questions were included in a particular case during the interview.

Data Analysis

The questionnaire provided data for several variables which was cataloged and coded for appropriate data analysis. MS-Access® was used for storing and handling data, checked for errors, and facilitated further analysis. The information was compared and contrasted to determine whether or not differences existed between different groups (i.e. type of business, market segment, etc.). The appropriate statistical analysis was performed using MS-Excel®, SPSS® and SAS®. Pivot tables of Excel® were used to summarize data and generate descriptive statistics; Excel® also was used for generating almost all charts and box-plot diagrams. SPSS® was used for multivariate analysis, and SAS® was used for hypothesis testing and descriptive statistics.

The questionnaire had different type of variables (i.e., nominal, ordinal). Responses to Likert scale were treated as interval data, this allowed to calculate common metric statistics such as means and variances. This practice (even though controversial) has been adopted in previous studies (Alt 2001, Bowe 2000). Kolmogorov-Smirnov and Shapiro-Wilk tests were used to analyze the independence and normal distribution of data. Statistical tests were performed at 95% confidence interval ($p = 0.05$). Due to small sample size non-parametric ANOVA tests were used mostly.

Results and Discussion

Response Rate

A total of 138 questionnaires were returned, of those 17 were discarded because they were returned blank or with insufficient information, 111 questionnaires were considered useful

for data analysis, resulting in a 27.8% response rate. There were 46 undeliverable questionnaires, and ten companies refused to participate or they are not on issues related to the study any more. Table 2-1 summarizes the results, and the adjusted response rate calculated was 32.3%.

Non-response bias

According to the Standard 4-4-1 of the National Center of Education Statistics: "..any stage of data collection with a unit or item response rate less than 85% must be evaluated for the potential magnitude of nonresponse bias.." (NCES 2002, p. 1). Because of the response rate obtained, a non-response bias test was conducted to ensure that the sample was truly representative of the population. An approach commonly used compares mean results between respondents and non-respondents (Cumbo 2000, McDaniel 2003). For this purpose, a group of 30 companies were selected randomly among respondents. Another group of 30 companies were contacted by phone and asked a series of questions selected from the questionnaire.

Table 2-1. Mail Survey Response Rate

Description	Quantity	Percentage	Remarks
a) Returned questionnaires, and useful for data analysis	111	27.7%	
b) Returned questionnaires, but they were discarded	17	4.3	blank or damaged questionnaires, insufficient data
c) Returned questionnaires	10	2.5	nature of the companies, companies didn't want to participate
d) Undeliverable	46	11.5	Address issues
e) Non-respondents	216	54.0	
f) Total questionnaires	400		
g) Adjusted response rate		32.3%	$\frac{\text{returned questionnaires and useful for data analysis}}{\text{total questionnaires - undeliverable - returned questionnaires}}$

Question 6 and question 10 of the mail questionnaire were selected for testing nonresponse bias. Question 10 consists of nineteen factors for which respondents were asked to rate their importance, on a 5-point Likert scale, for trying new imported wood species (i.e., 1=least important, 5=very important). To shorten the phone survey, only six factors were selected: *easy to finish*, *natural durability*, *color*, *surface hardness*, *environmentally certified* and *price*. Question 6 asked participants to rate their interest in importing lesser-known wood species on a 5-point Likert scale (1=not interested, 5=very interested). Two sample t-test was used to

compare means between respondents and non-respondents with these factors (at a confidence level of 95%). Table 2-2 shows the results of the t-test. *Price* was the only factor with significant difference between respondents and non-respondents. Likely due to the error associated to the method used to collect data (phone call vs. mail); no difference was found comparing overall respondents with non-respondents.

Table 2-2. Non-Response Bias Results (Two Sample t-Test for Means)

Factor	Group	Mean	SD	Significance[a]
Easy to finish	Respondents	3.6	1.2	0.91
	Non-respondents	3.7	1.2	
Natural durability	Respondents	3.8	1.2	0.31
	Non-respondents	3.5	1.1	
Color	Respondents	3.7	1.2	0.29
	Non-respondents	4.0	1.0	
Surface hardness	Respondents	3.3	0.8	0.76
	Non-respondents	3.4	0.9	
Environmentally certified	Respondents	3.3	1.2	0.11
	Non-respondents	2.8	1.1	
Price	Respondents	4.4	0.8	**0.03***
	Non-respondents	3.9	0.9	
Interest in LKS	Respondents	3.2	1.2	0.52
	Non-respondents	3.4	1.2	

Note. [a]Two means comparison t-test, * significant difference at $\alpha = 0.05$.

Non-response bias was tested also following an extrapolation method (Armstrong and Overton 1977), assuming that persons who respond in later waves differ from those that respond readily, thus late responses are expected to be similar to non-respondents. A set of 20 questionnaires of the first wave (early-responses) and a second set of 20 questionnaires of the third wave (late-responses) were selected to this purpose. Due to the small sample size for testing this bias, a non-parametric test (Mann Whitney U-test, $\alpha = 0.05$) was used to check statistical differences. Based on the results of both non-response tests, non-response bias could be removed as a limitation to this study.

Demographics

Two questions at the beginning of the questionnaire and the last four questions were used to characterize the market in terms of business type, industry sectors, gross sales, number of employees and the volume of imported hardwood-based wood products.

Type of Business

Almost 40% of respondents were importers (38.7%), other type of businesses account to less than 20% each. The response of agents and brokers were insignificant and practically had not been considered in many statistical analyses. Table 2-3 shows the distribution of respondents according to the type of business that best described their companies. In some few cases companies mentioned that they can be catalogued under more than one type (i.e, an importer can be wholesaler and/or retailer as well); in those cases companies were considered at the top of the supply chain.

Table 2-3. Distribution of Respondents by Type of Business (n=111)

Type of business	Respondents	Percentage of total
Importer	43	38.7%
Wholesaler	18	16.2
Distributor	20	18.0
Manufacturer	16	14.4
Retailer	12	10.8
Agent	1	0.9
Broker	1	0.9

Gross Sales and Number of Employees

Figure 2-1 shows the approximate gross sales in 2006 of the companies that responded. It can be seen a bimodal distribution between small and big companies; 37% of the companies' had gross sales less than $5,000,000, while 27% of the companies reported gross sales greater than $30,000,000. The remaining, 36% reported gross sales between $5,000,000 and $30,000,000.

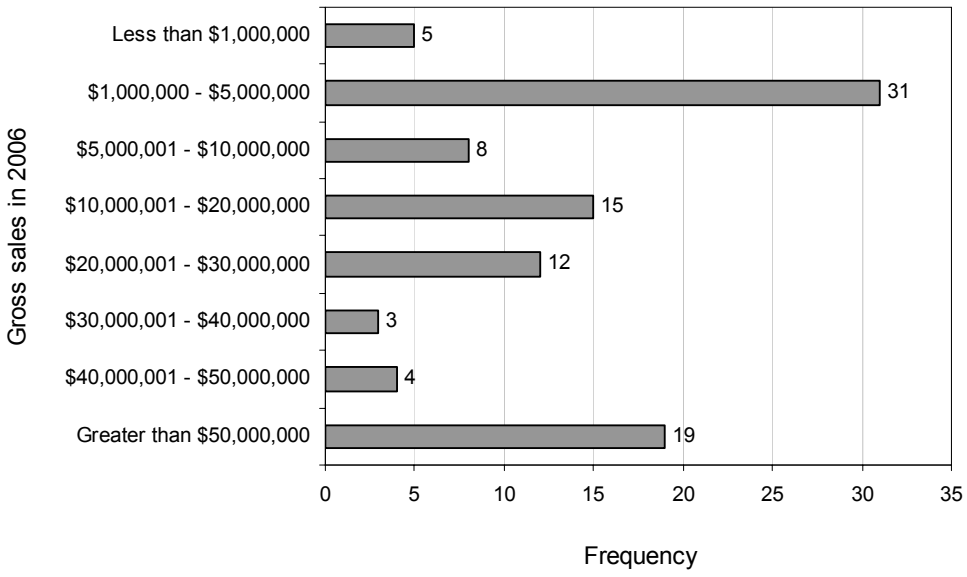


Figure 2-1. Approximate Gross Sales in 2006 of Respondent (n=97)

The average number of employees in 2006 was fewer than 50 (Figure 2-2). Sixty companies (i.e. 54% of the respondent companies) stated that they had less than 25 employees, sixteen companies (14.4%) had between 25 and 50 employees in 2006. Only 12 companies (10.8%) reported more than 200 employees. Small size of firms implies that less people are involved in sales and therefore little knowledge (or interest) in Bolivian wood products.

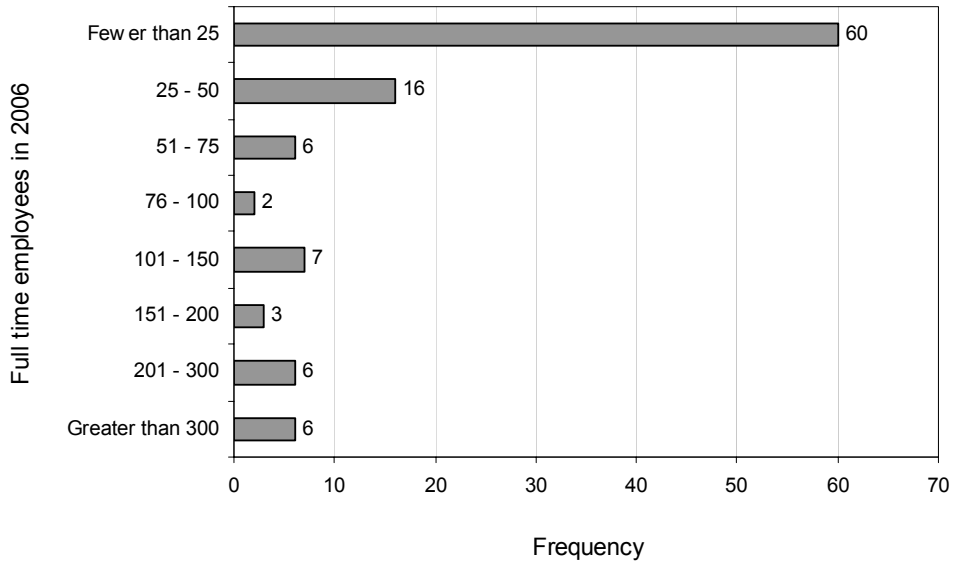


Figure 2-2. Approximate Number of Employees in Respondents' Companies in 2006 (n=106)

Imported wood products

The number of 20-foot containers of wood products imported into the U.S. varied significantly. Ten companies (9%) did not import wooden products in 2006, 50 companies (45%) imported 75 containers or less, and 46 companies (41%) imported more than 75 containers in 2006 (Figure 2-3).

Companies were asked to estimate each type of wood products purchased in 2006. Figure 2-4 shows a box-plot chart of the results. The proportions are highly variable; there are companies dedicated to purchase tropical hardwoods (8% of respondents) or only softwoods (6%). In any case, it was found companies dedicated exclusively to the purchasing of imported temperate hardwoods. On average 50% of respondents' product mix is U.S. domestic hardwoods (varying from 20% to 70%). Imported temperate hardwood, on average, represents 12% of the product mix of those companies that import it, typically vary from 10% to 25%. In any case it represents more than 75%, and 72% of those companies use less than 20% of imported temperate hardwoods in their product mix.

The product mix of those companies that purchase tropical wood products, on average, includes 33% of tropical hardwoods (commonly varying from 10% to 70% and most frequently 10%). The product mix of those companies that purchase softwoods (imported or not) vary from 10% to 80% and on average it represents 30% of their product mix.

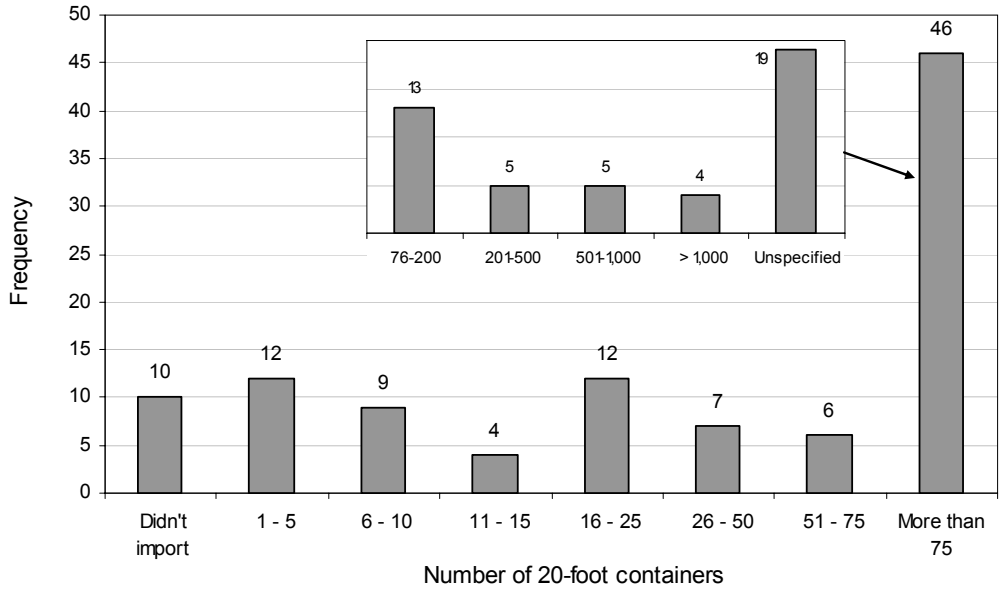


Figure 2-3. Number of 20-foot Containers Imported in 2006 by Respondents (n=106)

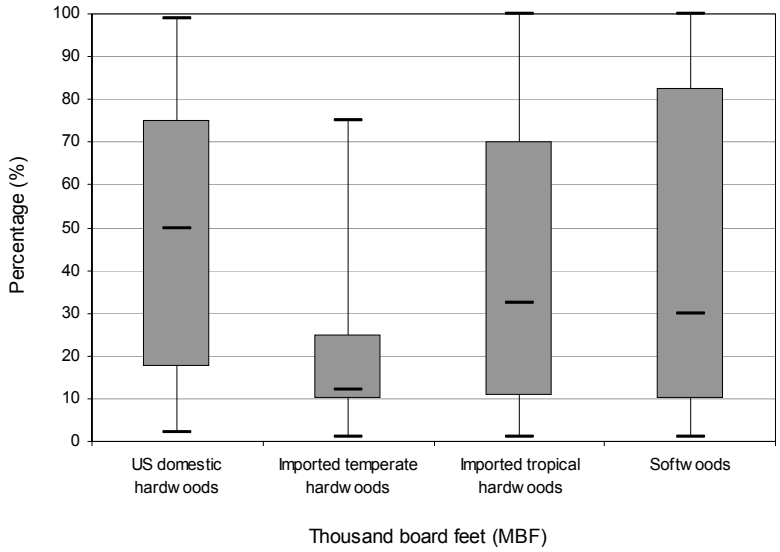


Figure 2-4. Percentage of Type of Woods Used by Respondents in 2006

For the purpose of this research we are considering only lesser-known wood species from tropical forests. One purpose of this study was to estimate the quantity of tropical hardwoods that companies usually purchase. Figure 2-5 shows this estimation. In 2006, 50% of the companies that responded purchased 100 MBF or less in tropical hardwoods, 94% bought less than 5,000 MBF, and only 1 company bought more than 5,000 MBF. Eight companies in the plywood and veneer sector (not included in Figure 2-5) responded in terms of "sq,ft". Their imports of tropical hardwoods were highly variable, ranging from 100,000 sq.ft. to 30,000,000 sq.ft.

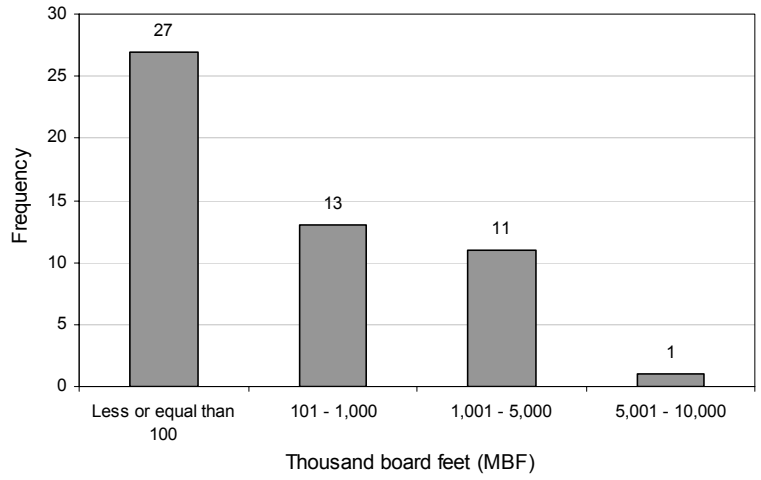


Figure 2-5. Estimated Volume of Imported Tropical Hardwoods Purchased in 2006 (n=52)

Geographic regions in the U.S.

Figure 2-6 shows the detailed distribution of respondents by state and region, the regions with high response rate also were highlighted. Companies were selected from all over the U.S. For convenience they were grouped by state and region. Table 2-4 shows the distribution of companies by state and region as well as for the sample frame and the respondents. Table 2-4 also includes the average interest of respondent companies in importing lesser-known wood species. Little variation is seen between regions with average response rate close to 30%. The same distribution can be seen in the response rate from states in the western of the U.S. However in the East some differences can be seen. For example the response rate of the states of Wisconsin, North Carolina and Georgia were 71.4%, 43.3%, 42.9% respectively. On the other hand, states such as Massachusetts and Maryland showed the lowest response rate with 12.5% and 16.6% respectively.

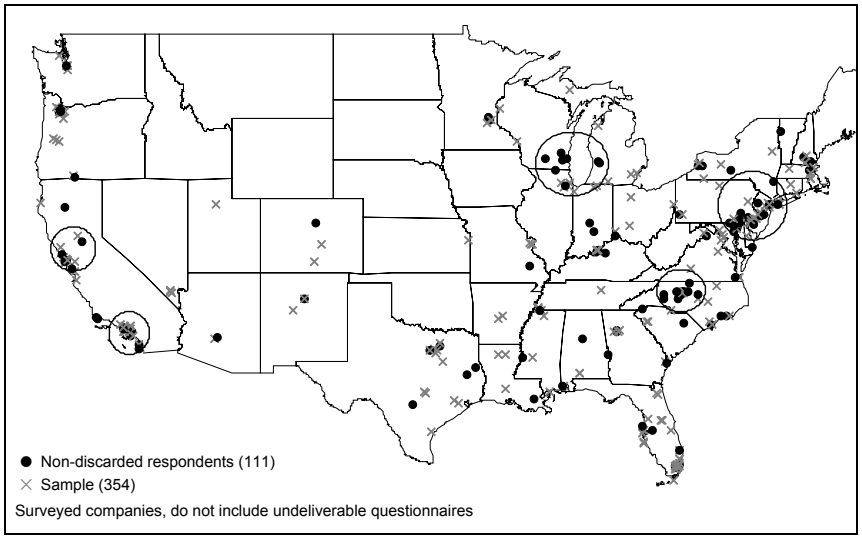


Figure 2-6. Detailed Geographic Distribution of Respondents

Table 2-4. Proportion of Respondents by Geographic Regions and Interest in LKS (n=111)

Region	State	Sample	Number of Respondents	Response rate %	Interest in LKS[a]
Western				28.2	3.6
	California	52	17	32.7	3.4
	Oregon	31	8	25.8	4.1
	Washington	8	1	12.5	1.0
	Others	12	3	25.0	4.7
Central				27.3	3.9
	Texas	16	5	31.2	3.8
	Minnesota	5	2	40.0	5.0
	Others	12	2	16.7	3.0
Southeastern				34.0	3.0
	Alabama	6	3	50.0	2.3
	North Carolina	29	14	48.3	2.5
	Georgia	9	3	33.3	4.3
	Florida	38	9	23.7	3.1
	Tennessee	8	2	25.0	4.0
	Others	7	2	28.6	3.5
Northeastern				33.0	2.8
	Wisconsin	7	5	71.4	2.0
	New Jersey	15	5	33.3	3.4
	New York	18	6	33.3	2.8
	Indiana	12	4	33.3	1.8
	Pennsylvania	17	6	35.3	2.8
	New Hampshire	4	2	50.0	3.0
	Others	48	12	25.0	3.4
Total		354	111		

Note. Undeliverable questionnaires were subtracted from the original sample frame; [a]mean value of interest in lesser-known wood species (based on Likert's scale: 1= not interested, 5 = very interested).

Imported Tropical Wood Species

Wood Industry Sectors

Respondents were asked in which industry sector they use imported tropical wood species. Fifty-three percent of respondents stated that they imported sawnwood lumber made of tropical wood species, 32% imported flooring, 26% imported plywood, 23% imported decking, 18% imported millwork, 11% imported veneer and 10% imported doors made of tropical wood species. The rest of industry sectors accounted to less than 10%. Only one company imported cabinets made from tropical wood species, and no company imported windows. However, 48% of the companies are exclusively dedicated to one industry sector. On average companies imported 2 types of wood products made from tropical wood species. In this study those market

sectors were grouped according to similar characteristics in order to simplify future analysis. Table 2-5 shows those groups.

Table 2-5. Respondents' Imported Wood Products Made from Tropical Species (n=105)

Group	Wood industry sectors	Frequency	Percentage
S	Sawnwood	18	17.1%
P	Plywood (and paneling)	15	14.3
2nd	Secondary wood products (millwork, doors, furniture, etc.)	8	7.6
V	Veneer	9	8.6
F	Flooring	6	5.7
H	Heavy construction (poles, logs, etc.)	4	3.8
D	Decking	2	1.9
S,F	Sawnwood and flooring	8	7.6
S,V	Sawnwood and veneer	3	2.9
S,P	Sawnwood and plywood	3	2.8
S,2nd	Sawnwood and secondary wood products	4	3.8
2nd, P	Secondary wood products and plywood	2	1.9
S,F,D	Sawnwood, flooring and decking	6	5.7
S,F,D,P	Sawnwood, flooring, decking and plywood	3	2.9
S,F,D,2nd	Sawnwood, flooring, decking and secondary wood products	5	4.8
Misc.	Includes several primary and secondary wood products	9	8.6

Origin of imported wood species

Most of the imported wood species came from seven countries: Brazil (23.2% of overall respondents), China (10.7%), Peru (7.4%), Indonesia (5.5%), Bolivia (4.4%), Chile (3.7%), and Russia (3.7%). Some companies did not respond for a specific country, instead they responded by region or sub-region of origin. Therefore 41% of respondents mentioned that they import from South America, 10.6% from Eastern Asia, 10.6% from South-Eastern Asia, 6.4% from Central America, 4.6% from Western Europe, 4.3% from Middle Africa, and 4% from Eastern Europe. Figure 2-7 highlights those sub-regions and countries, and the percentage of wood species imported by country.

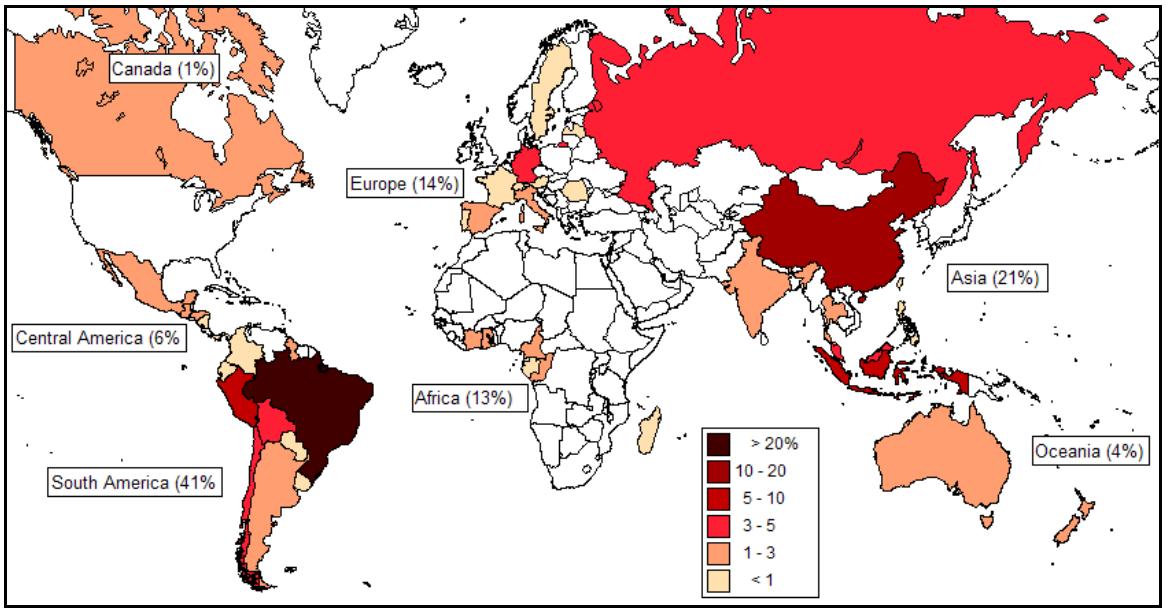


Figure 2-7. Country of Origin of Respondents' Imported Wood Products

Common Imported Wood Species

Figure 2-8 shows the most common wood species imported by respondents. Mahogany (*Swietenia macrophylla*) and jatoba (*Hymenaea courbaril*) were mentioned as the most common wood species imported with 24% (each) of overall respondents. Other species mentioned were: African Mahogany (*Khaya spp.*), ipe (*Tabebuia spp.*), sapele (*Entandrophragma cylindricum*) and meranti (*shorea spp.*).

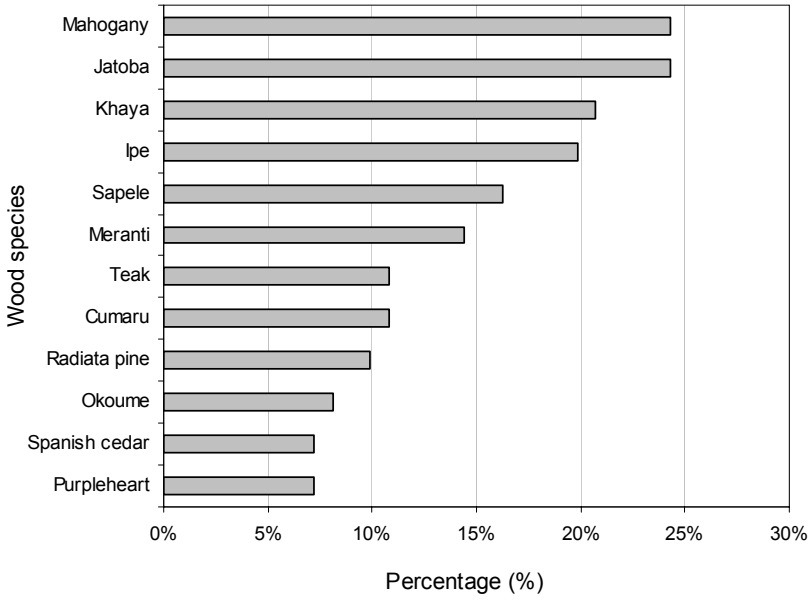


Figure 2-8. Respondents' Common Imported Wood Species

Trend in the Imports of Tropical Hardwood Species

Seventy-four companies (67% of overall respondents) stated that they have plans to increase the imports of tropical hardwoods in 2007. Most of these companies will increase imports between 6% and 10% (see Figure 2-9). Some companies will increase imports between 16% and 20%. Generally, importers will increase their imports between 6% and 20%, while wholesalers and distributors will increase their imports between 6% and 10%. Retailers will increase their imports between 11% and 20%. The only type of businesses that has plans to increase their imports of tropical hardwoods more than 20% are importers (4 companies) and manufacturers (2 companies).

Companies from North Carolina, California, Oregon, Florida, New York and New Jersey would increase their imports the most of tropical hardwoods in 2007. Companies in North Carolina would increase between 6% and 10%; companies in Florida would increase more than 10%. In general, companies that currently import environmentally certified wood products would increase their imports of tropical hardwoods more than those companies that do not import environmentally certified wood products.

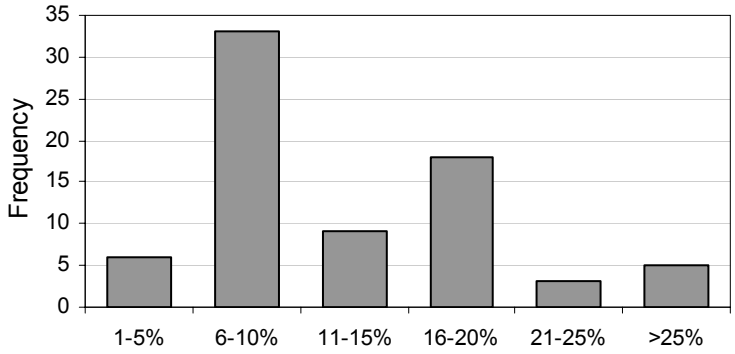


Figure 2-9. Respondents' Estimation of the Increase of Their Imports of Tropical Hardwoods in 2007 (n=74)

Imports of Environmentally Certified Wood Products

Much of Bolivian LKS are environmentally certified. Thus it was considered important in this study to assess the market for environmentally certified wood products. Respondents were asked if those products that they import are environmentally certified. Their responses were as follows (n=102):

They do not know if their products are environmentally certified	17%
Their imported products are not environmentally certified	35%
Their imported products are environmentally certified	48%

Figure 2-10 shows the proportion of certified wood products that companies import. Companies that import environmentally certified wood products are polarized between those companies that import less than 10% and those that import more than 90%. In fact 8% of respondent companies' imported wood products are 100% certified. No significant differences were found between business types, or between states. As will be confirmed in subsequent paragraphs the market of secondary processing wood products (i.e. doors, millwork, furniture, etc.) are much more concerned about environmental certification than other sectors such as sawnwood, flooring, plywood, or veneer.

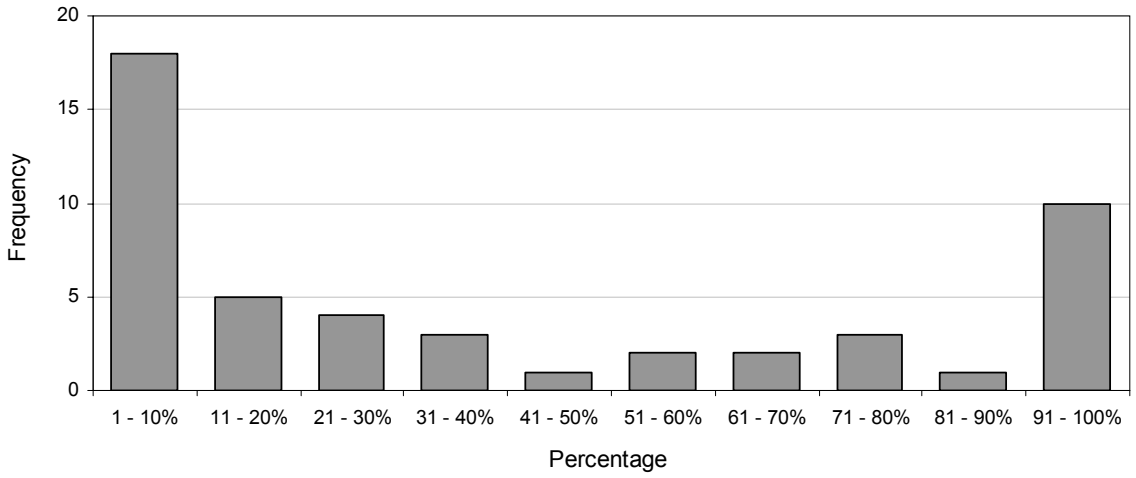


Figure 2-10. Percentage of Imports That Are Environmentally Certified

Wood Species Substitution

New Wood Species Imported

Typically respondent companies tried 1 or 2 new wood species in 2006. The boxplot chart of Figure 2-11 shows the proportion of new wood species tried by type of business. The trial of new wood species was more variable within importers and distributors than wholesalers, retailers or manufacturers. Importers and distributors, on average, tried three new wood species in 2006, but in many cases tried more, even 30 or 40 species (commonly ranged from 1 to 7). Even though retailers tried on average 5 new wood species, they did not try more than 10 species

in any case (c.f. Figure 2-11). Manufacturers, like retailers, at most tried 10 new wood species and on average tried three new wood species in 2006. Wholesalers tried maximum 4 new wood species in 2006, and on average tried 2 new wood species. These results suggest that importers and distributors may be are trying to "push" the market with new wood species. On the other hand, retailers are trying to "offer" more variety on new wood species to their customers. Meanwhile wholesalers and manufacturers are waiting for the reaction of the market. These conjectures were stressed in comments of respondents in open-ended questions.

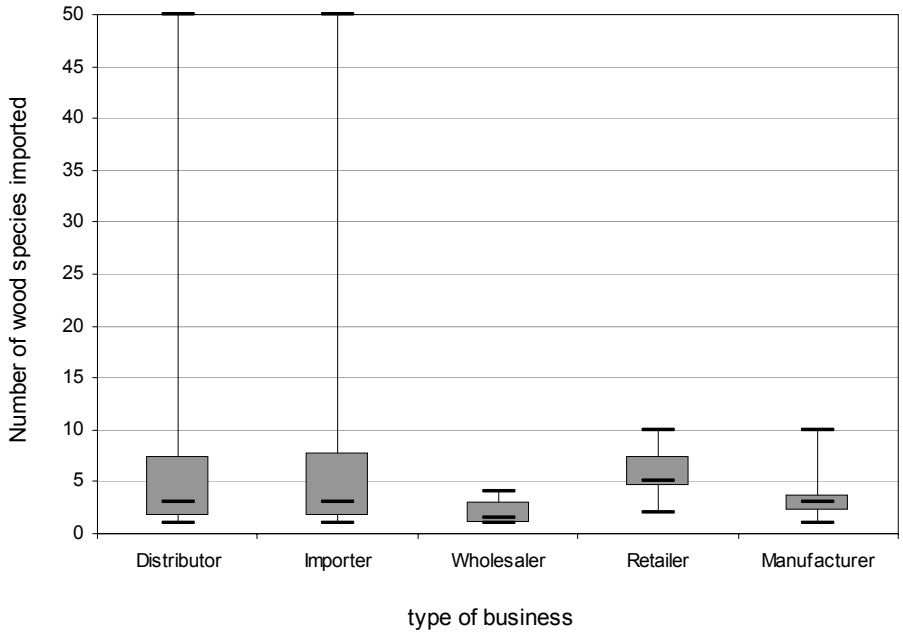


Figure 2-11. Boxplot of the Number of New Imported Wood Species Respondents Tried in 2006

In total, respondents imported 74 new wood species during 2006. This indicates that they are not afraid to try new species and because of that they would be likely to try Bolivian lesser-known species. Figure 2-12 shows the wood species mentioned more than twice. It can be seen that South American wood species garapa (*apuleia leiocarpa*), ipe (*Tabebuia spp.*) and jatoba (*Hymenaea courbaril*) were the most recently purchased wood species. It is important to note that six of these top species are Bolivian LKS: garapa, ipe, jatoba, jequitiba, Santa Maria and tigerwood.

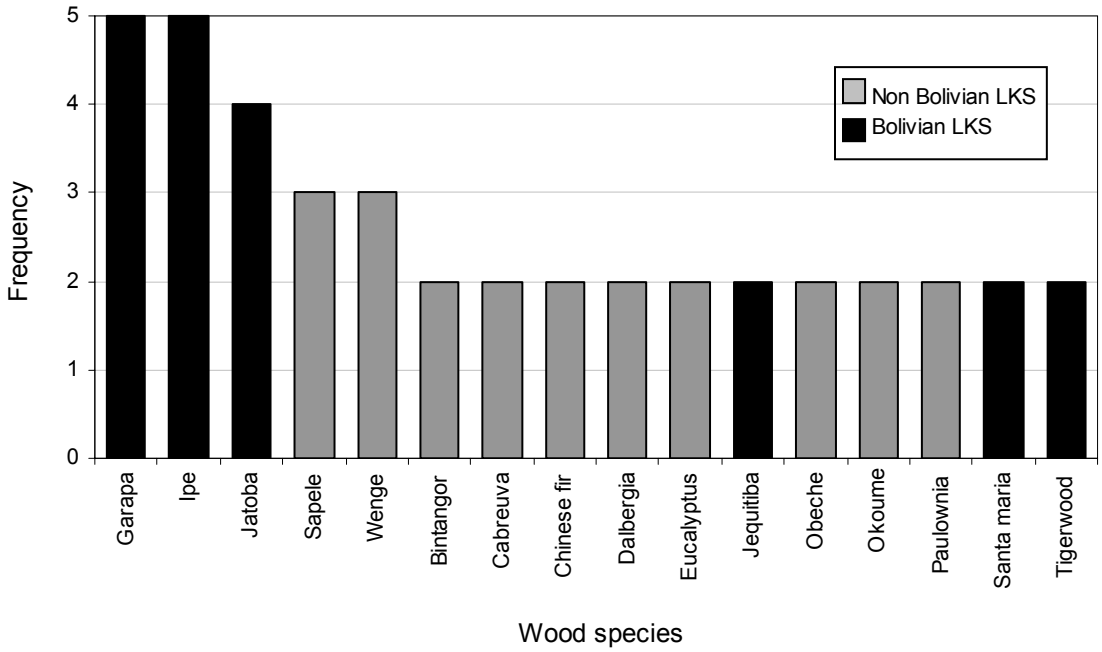
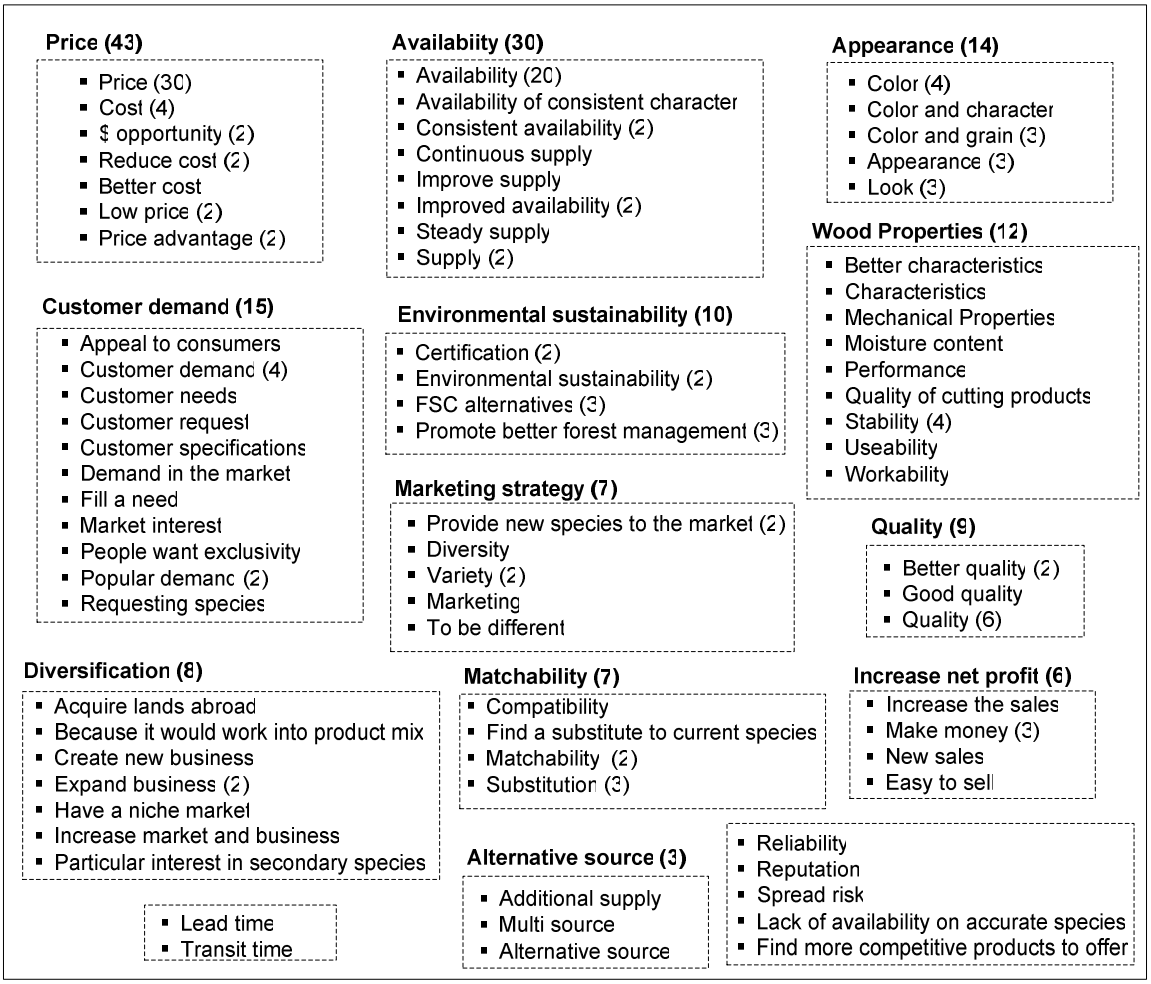


Figure 2-12. Last New Wood Species Purchased by Respondents

Reasons to try new imported wood species

An open-ended question aimed to find out why respondents look for new species. An Affinity Diagram was used to group the reasons respondents gave when they asked for their main reason to try new imported wood species (Figure 2-13). The main reasons were *price* and *availability*. Thirty-nine percent of respondents stated that price is the main reason, while, 27% of respondents stated that availability would be the main reason. Twenty-three percent stated that appearance and wood properties are the main reasons, while only 9% stated that they seek environmentally certified wood products. Other reasons, but in less extent, included customer-demand driven, quest a competitive advantage, and diversification.



Note. Numbers in parenthesis are referred to the number of questionnaires associated to the text

Figure 2-13. Respondents' Reasons to Try New Imported Wood Species

Most important factors to try new imported species

Respondents were asked to evaluate the importance of different factors when they try new imported wood species. Figure 2-14 shows those factors, mean values and standard deviations obtained for each factor in a 5-point Likert scale. In general, respondents gave more importance to *quality*, *trustworthy*, *stability*, *straightness*, *price* and *long-run availability*. On the other hand, they gave little importance to *environmentally certification*, *density* (*SG*) or *surface hardness*. But these results are general for all market sectors and all type of businesses. Thus ANOVA tests were performed to identify differences between groups.

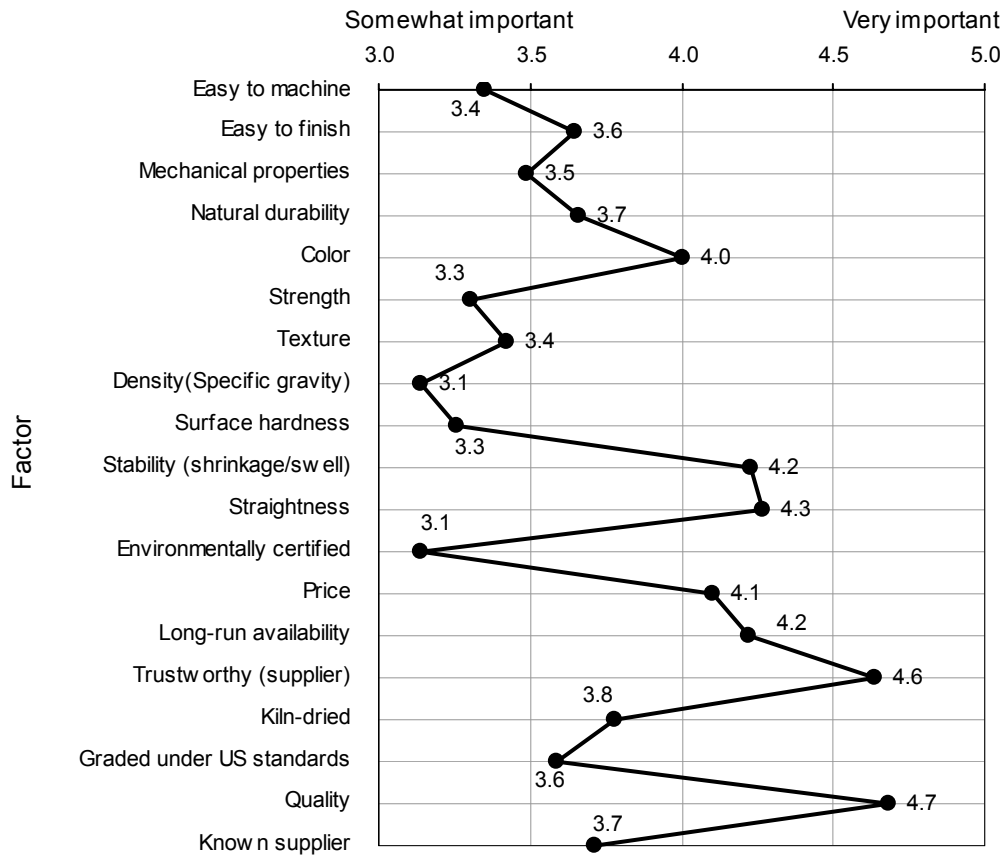


Figure 2-14. Important Factors for Trying New Imported Specie (5-point Likert scale)

Due to the small sample size and because of some factors are not normally distributed, a multiple comparisons non-parametric one-way ANOVA test using the statistics of Mann-Whitney U (Kruskal-Wallis) was performed to test the differences between wood market sectors. Table 2-6 shows the mean values of those factors and the level of significance obtained. Factors that showed significant differences between industry sectors include: *finishability*, *color*, *texture*, *surface hardness*, *environmental certification*, and *long run availability*. The secondary wood products industry (doors, furniture and millwork) give more importance to *finishability* that the rest of industry sectors. This suggests that those companies receive "clear" wood products and they have to finish them in the U.S., i.e. adding coatings, stains or varnishes. *Color* was rated of high importance in the veneer and secondary industry, while in the flooring industry this attribute seems to be less important. This suggests that the use imported wood species for decorative purposes with minimal application of stains or paints. On the other hand, the flooring industry is more concerned about the *surface hardness*. This makes sense because floors should be resistant to scratches and abrasion. Importers of flooring commonly use stains to hide imperfections and

give the desired color and texture. *Long run availability* was rated as very important factor for the plywood and veneer industries. This suggests that those segments require great volumes and consistent supply in order to fulfill their capacity needs. The plywood and sawnwood industries rated lower the *environmental certification* of wood species, while companies of the secondary processing industry (i.e. doors, millwork and furniture) rated it high. This is likely because secondary wood industries are closer to the final consumer, which the demand of environmental friendly wood products is more apparent.

Table 2-6. Important Factors Considered When Respondents Try New Imported Wood Species

Factor	Mean[a]					Significance[c] p-value
	Secondary[b] (n=8)	Flooring (n=6)	Plywood (n=15)	Sawnwood (n=18)	Veneer (n=9)	
Easy to machine	3.4	2.8	3.7	3.5	2.9	0.44
Easy to finish	4.7$^{\lozenge,\dagger,\circ}$	3.2$^{\lozenge}$	3.7†	3.4°	4.1	0.03*
Mechanical properties	3.3	3.3	3.2	3.5	3.2	0.90
Natural durability	3.7	3.8	3.4	3.4	2.4	0.36
Color	4.6$^{\lozenge}$	3.0$^{\lozenge,\dagger}$	4.0	3.9°	4.9$^{\dagger,\circ}$	< 0.01***
Strength	3.3	3.7	3.3	2.9	2.7	0.20
Texture	3.3	2.0$^{\lozenge,\dagger,\circ}$	3.6$^{\lozenge}$	3.4†	4.1°	< 0.01**
Density(Specific gravity)	2.7	3.0	3.3	3.0	2.6	0.23
Surface hardness	3.3	4.2$^{\lozenge,\dagger}$	3.3	2.9$^{\lozenge}$	2.8†	< 0.01**
Stability (shrinkage/swell)	4.1	4.3	4.3	4.1	4.0	0.80
Straightness	4.3	3.5	4.5	4.3	4.1	0.06
Environmentally certified	4.0$^{\lozenge}$	3.3	2.5$^{\lozenge}$	2.8	3.8	0.04*
Price	3.6	4.2	4.7	3.9	4.3	0.07
Long-run availability	4.1	3.5$^{\lozenge,\dagger}$	4.7$^{\lozenge}$	3.9	4.8†	0.01*
Trustworthy (supplier)	4.6	4.2	4.8	4.5	4.9	0.13
Kiln-dried	4.4	3.7	4.1	4.1	2.4	0.08
Graded under US standards	3.5	3.0	3.7	3.7	3.2	0.55
Quality	4.9	4.5	4.7	4.7	4.9	0.55
Known supplier	3.0	3.3	3.5	3.6	3.9	0.58

Note. [a] Companies dedicated exclusively to the sector and import wood products made from tropical species; [b]includes millwork, doors, cabinets and furniture; [c]non-parametric On-way ANOVA test, * significant difference at $\alpha = 0.05$, (** at $\alpha = 0.01$ and *** at $\alpha = 0.001$);$^{\lozenge,\dagger,\circ}$ significant difference between groups.

Industry sectors' trend in importing new wood species

Companies do not commonly try new wood species. Table 2-7 show how likely companies are to try new wood species in 2007, by industry sector and by type of business. Any type of business likely will try a new wood species in the lumber and rough sawnwood sector. Veneer, plywood, flooring and decking were reluctant to try new wood species in 2007.

Companies in the sector of secondary processing wood products (doors, furniture, moulding and cabinets) would not try new wood species.

Table 2-7. Industry Sectors That Are Likely to Try New Wood Species in 2007

Industry sector	Distributor (n=16)	Importer (n=29)	Manufacturer (n=11)	Retailer (n=9)	Wholesaler (n=15)	Overall
Lumber, rough sawn	4.5	4.6	4.0	4.7	-	4.6
Plywood or veneer	3.6	3.0	3.5	3.1	2.9	3.2
Decking	2.8	2.6	2.3	2.8	3.1	2.7
Flooring	2.5	2.9	2.2	2.4	2.8	2.6
Dimension	2.1	2.2	3.3	2.0	2.7	2.4
Moulding	2.7	2.2	2.0	2.3	2.2	2.3
Outdoor furniture	1.7	1.8	1.8	2.1	1.5	1.7
Doors	1.9	1.6	2.0	2.1	1.3	1.7
Kitchen cabinets	1.8	1.7	1.9	1.3	1.4	1.7
Office furniture	1.4	1.6	1.4	1.3	1.2	1.4
Windows	1.2	1.5	1.4	1.6	1.3	1.4
Parquetry	1.2	1.2	1.4	1.6	1.6	1.4

Interest in Lesser-Known Wood Species

A direct structured question, using Likert's scale, was designed to determine the level of interest by U.S. companies in the importation of lesser-known wood species (LKS). The overall interest (not normally distributed) has a mean value close to "fairly interested" (3.2 in Likert's scale; and 1.2 SD). In general companies are interested in importing LKS. Several multiple comparisons were performed using non-parametric One-way ANOVA and the statistics of Mann-Witheny U test to compare demographic variables. No significant differences were found between types of businesses ($p = 0.39$); thus importers, wholesalers, distributors, manufacturers and retailers show the same level of interest.

It was found significant differences between regions ($p = 0.02$) (cf. Table 2-4), and even between states ($p = 0.03$). Western region shows significantly more interest in LKS than Northeastern (one-sided $p < 0.01$). There is some significant difference between Western and Southeastern (one-sided $p = 0.02$). Central region also shows somewhat interest in LKS than Southeastern (one-sided $p = 0.03$), and more than Northeastern region (one-sided $p = 0.02$). No

significant differences were found between Western and Central, or between Southeastern and Northeastern regions. Table 2-4 had shown the mean values of the interest in importing LKS by state, and Table 2-8 shows the significance level between those states where the non-parametric Mann-Whitney U test (Wilkoxon statistics) was used.

Table 2-8. Significance of Respondents' Interest in LKS, by State

	California (n=17)	**Oregon (n=8)**	**Texas (n=5)**	**Florida (n=9)**	**North Carolina (n=14)**	**Pennsylvania (n=6)**	**Wisconsin (n=5)**
Mean	3.4	4.1	3.8	3.1	2.5	2.8	2.0
California		0.09	0.22	0.41	*0.02*	0.18	*0.03*
Oregon			0.27	*0.04*	*< 0.01*	0.05	*< 0.01*
Texas				0.24	*0.02*	0.11	*0.03*
Florida					0.12	0.34	0.07
North Carolina						0.32	0.25
Pennsylvania							0.19

Note. (p=0.032). One-sided Wilcoxon normal approximation test

No significant differences were found between those wood industry sectors that imported tropical wood products and where the non-parametric test was used (Kruskall-Wallis' H test, $p = 0.699$). However companies that imported sawnwood, flooring, decking and secondary wood products showed somewhat interest than those companies that import plywood and veneer (Table 2-9).

Importation of Bolivian Lesser-Known Wood Species

One binary question aimed to find out if respondent companies import any of the 20 potentially marketed Bolivian lesser-known wood species (BOLFOR II 2006). To validate the responses, four commonly wood species imported into the U.S. were introduced in the question as well. The results (Figure 2-15) show that three Bolivian LKS hardly can be classified as lesser-known, because they are well-known by respondent companies. Those species are paquio (58.5% of respondents import it), tajibo (52.3%) and cumarú (33.3%). Almost in the same proportion than mahogany (see Figure 2-15). Other Bolivian LKS imported, but in lesser extent, were sangre de toro (21.6% of respondents import it), cambará (14.4%), yesquero negro (13.5%), sirari, curupau, cuta, and palo maria. The rest of imported Bolivian LKS account to less than 5%

each (see Figure 2-15). Three Bolivian LKS were not imported by respondent companies: cuchi, verdolago and soto.

Table 2-9. Mean Interest in Importing LKS by Industry Sector

	Industry sector	n	Mean	SD
S,F,D	Sawnwood, flooring and decking	5	3.8	1.3
Misc	Exclusively plywood (and paneling)	9	3.8	1.2
F	Exclusively flooring	6	3.5	2.0
2^{nd}	Secondary wood products (millwork, doors, furniture, etc.)	8	3.4	1.6
S,F,D,2^{nd}	Sawnwood, flooring, decking and secondary wood products	5	3.2	0.8
S	Exclusively sawnwood	18	3.1	1.1
S,F	Sawnwood and flooring	8	3.0	1.3
P	Plywood	15	2.8	1.2
V	Exclusively veneer	9	2.8	1.2

Note. Other sectors were excluded because of their small sample size

Marketing Issues

Several questions sought to get information about the preferred business and marketing practices in the forest products industry and Bolivia. The questions also addressed pricing, promotion and distribution channels; as well as the Bolivian situation.

No general preferred distribution channel was identified in the survey. Companies generally prefer to deal directly with producers in the country of origin and they do not want to deal with governmental organizations or international agents (intermediares).

Table 2-10 shows the preferred method by type of business. Distributors and retailers, following the distribution supply chain, prefer to deal with U.S. importers or brokers. Manufacturers have not a preferred method. They usually deal with US importers, brokers, agents of their own company, and producers in the country of origin. Wholesalers and importers preferred to deal with producers in the country of origin and agents of their company.

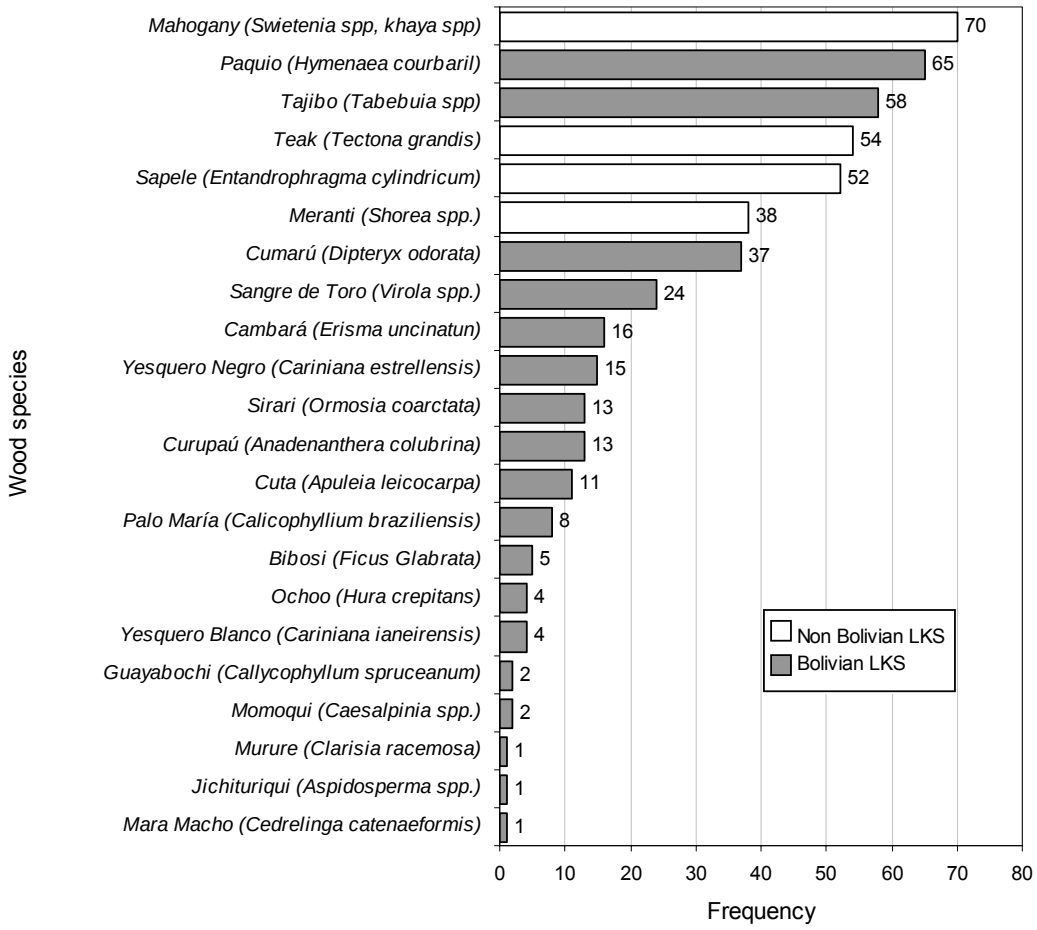


Figure 2-15. Bolivian LKS Imported by Respondent Companies (n=111)

Table 2-10. Respondents' Preferred Distribution Channels for Imported New Species

Preferred channel		Distributor	Importer	Manufacturer	Retailer	Wholesaler	Overall
US importer or broker	N	17	32	12	11	15	87
	mean	4.0	1.9	3.8	4.2	3.3	3.1
International agents	N	17	34	11	11	13	86
	mean	1.9	2.5	2.1	1.8	2.5	2.2
Agents of their own Company	N	18	33	12	10	11	84
	mean	3.1	3.8	3.9	2.8	3.0	3.4
Producers in country origin	N	20	40	15	11	15	101
	mean	3.6	4.6	3.9	2.2	4.2	4.0
Governmental organizations	N	17	33	10	11	13	84
	mean	1.4	1.8	1.2	1.4	1.8	1.8

Note. Based on a 5-point Likert scale (1=least preferred, 5= most preferred)

Pricing

Respondent companies are not willing to pay more for a Bolivian lesser-known wood species that could substitute their currently purchased species. Figure 2-16 shows the percentage that respondent companies would pay for a Bolivian substitute. Ninety-three percent of these companies would pay the same price or less for that substitute. Only 7 companies (7%) would pay a maximum of 10% more for that substitute. Forty percent of companies would pay the same price. Companies that would pay less for a Bolivian substitute on average would pay 11-15% less for that substitute, moreover 9% of companies would pay 20% less or less.

On average importers, wholesalers and distributors would pay between 6% and 10% less for a good Bolivian substitute wood species, manufacturers would pay 1% to 5% less for that substitute, and retailers would pay the same price. Likely importers, wholesalers, distributors and manufacturers have to face extra financial costs of trying the new species, while retailers do not have to charge that cost.

These results suggest that Bolivian exporters that are seeking U.S. markets should not expect premium prices for Bolivian LKS and therefore they should incorporate other desired characteristics to wood products made from LKS such as shorter delivery times, environmental certified labels and consitent supply of wood.

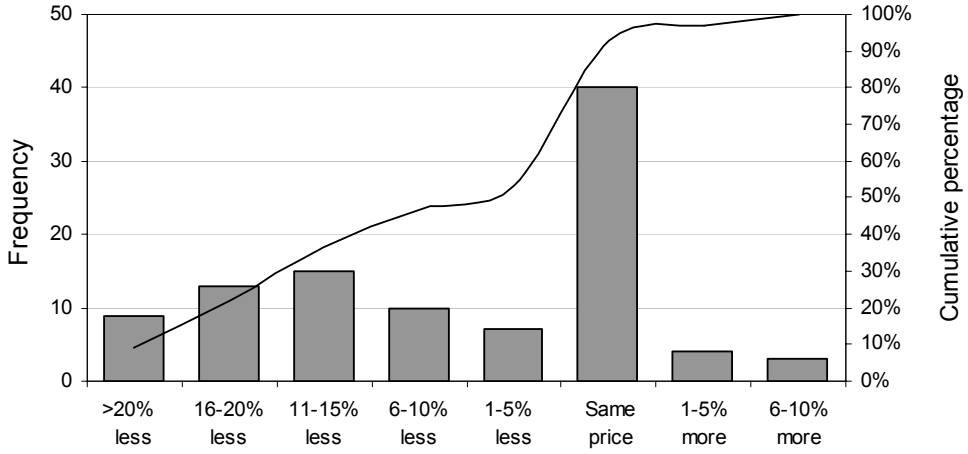


Figure 2-16. Willingness to Pay for a Bolivian Substitute Wood Species (n=101)

Respondent companies usually would not pay premium prices for an imported environmentally certified wood product. Figure 2-17 shows the willingness to pay for an

imported environmentally certified wood product. Forty-eight percent of respondents would not pay more for certified products. Thirty percent of respondents would pay premium prices between 1% and 5% for imported environmentally certified wood products; 15% would pay a premium between 6% and 10%. Only 7% of respondent would pay a premium between 11% and 20%, and no company would pay a premium more than 20%. On average distributors would pay between 1% and 10% more for environmentally certified wood products. Importers, manufacturers and retailers would pay between 1% and 5% more, and wholesalers are less willing to pay more for environmentally certified wood products. States that show an average willingness to pay between 1% and 10% for environmentally certified wood products were: Texas, Pennsylvania, North Carolina and New York. Oregon, California and Wisconsin have somewhat willingness to pay more, but tend to pay less than 1% more.

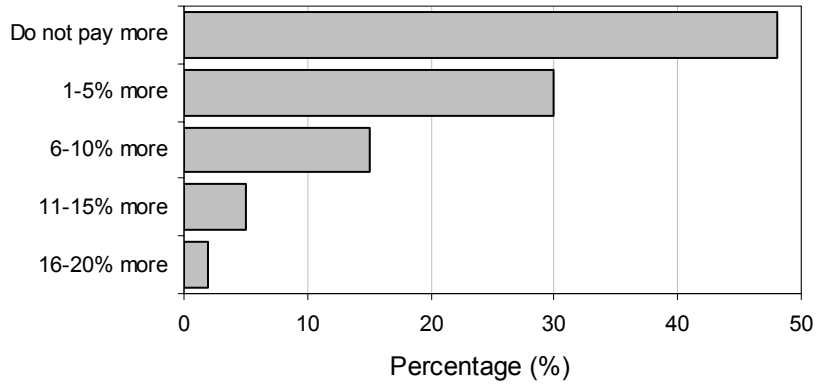


Figure 2-17. Willingness to Pay for Environmentally Certified Wood Products (n=100)

Promotion

Respondents were asked to provide the preferred source of information that they consult when they are looking for new imported wood species. Seventy percent of the companies that responded usually prefer to contact producers in the country of origin. "Word of mouth" is the second preferred source of information (52%), web sites is the third (29%), followed by trade associations (26%) and trade shows in the U.S. (19%). The least consulted source of information were catalogs (2%), newsletters (6%) and trade magazine advertisements (9%).

One question sought to identify possible brand names for Bolivian LKS (substitute species). For ochoo (*Hura crepitans*), respondents were asked to select the most acceptable brand name in the U.S. market. It was used the Bolivian LKS. This species is quite similar to North American white ash. Respondents' suggestions were (n=77):

Bolivian ash	43	(56% of respondents)
South American ash	27	(35% of respondent)
Ochoo (Bolivian common name)	3	(4% of respondent)
Others	4	(5% of respondents)

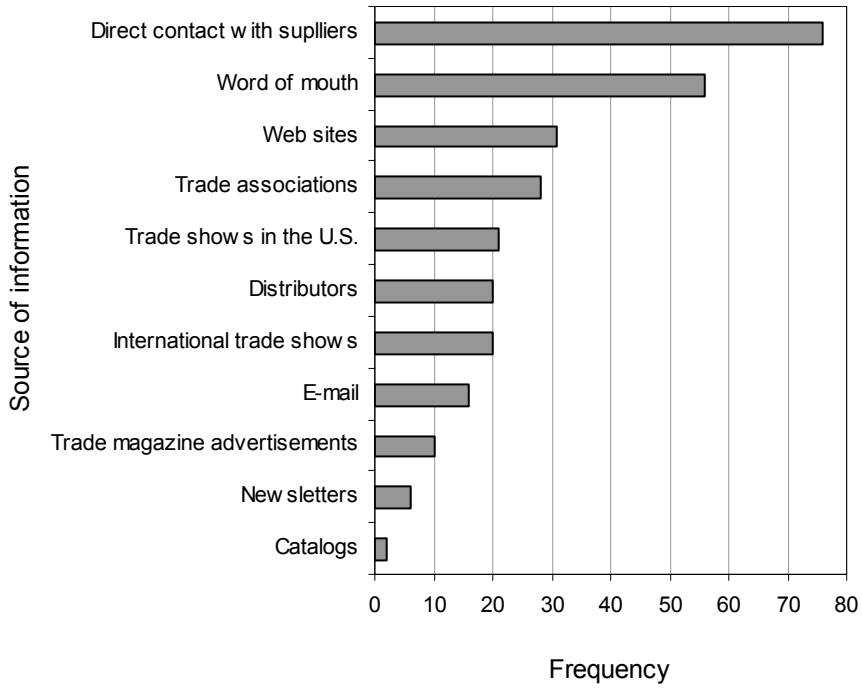


Figure 2-18. Preferred Source of Information to Find New Imported Wood Species (n=108)

Names suggested under the category "others" were: Hura, Amazon ash, koto and pearlwood. This question had two-fold objectives: 1) to determine if the brand Bolivian would be better or not against the brand South American and 2) to find out if US companies think that their customers would accept Bolivian common names. Results suggest that customers would accept brand names that include currently marketed U.S. domestic wood species. However there are several brand names that already have a good acceptance in the U.S. market such as *ipe* or *jatoba*.

Bolivian Wood Products

Three questions sought to disern the point of view of U.S. companies about Bolivian wood products and gather recommendations to increase the imports of Bolivian LKS in the U.S. In the first question respondents were asked to rate in a five-point Likert scale the potential barriers that would difficult the importation of Bolivian LKS in the U.S. Figure 2-19 shows the

results. Respondent companies find a barrier in *punctual delivery*, *Bolivian production capacity*, *Bolivian governmental policies*, and *knowledge of Bolivian wood products*. Another barrier mentioned frequently, but is not shown in Figure 2-19, was the *lack of demand* in the U.S. market.

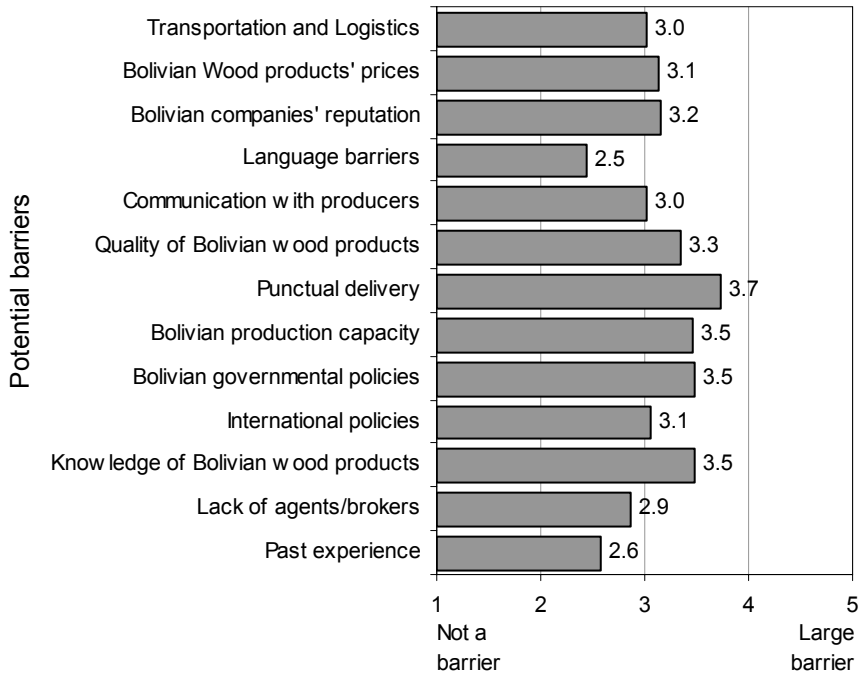


Figure 2-19. Potential Barriers that U.S. Companies Found to Import Wood Products from Bolivia

The second question aimed to find out the image of Bolivian wood companies in the U.S. wood market. Fifty-nine percent of respondent companies did not import Bolivian wood products in the past, thus 46 respondent companies (41%) rated their past experience importing Bolivian wood products in a five point scale from very bad to very good. They also were asked to give the reason of that score. Figure 2-20 shows the frequency of each scale. In general Bolivian companies are rated in a mediocre position of "neither good nor bad". Some reasons of bad experience mentioned were: *late delivery*, *quality and grading problems*, *high price* and *non-reliable supply*.

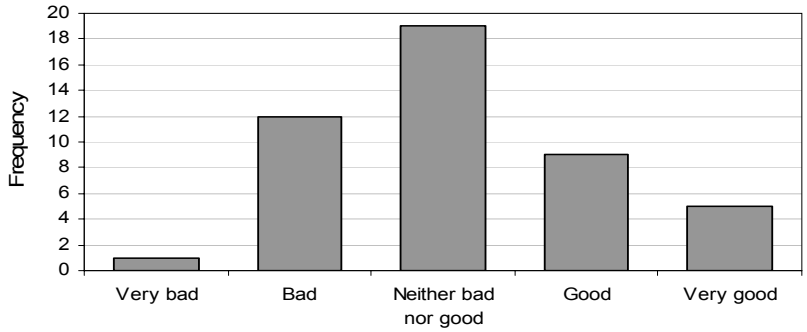


Figure 2-20. Rate of Respondents' Past Experiences Importing Bolivian Wood Products

The third question (open-ended) aimed to obtain some recommendations to increase the imports of Bolivian LKS in the U.S. An affinity diagram was used to group the general recommendations that respondents stated. Primarily the recommendations were centered on the "increase of marketing efforts in promotion and advertisement", and "to provide samples of wood species to potential buyers". We found that companies want to see and feel the alternative wood, test it and assess the price advantage. Other recommendations include create marketing centers (offices) in key states with the ability to fill small samples, organize conventions, increase knowledge of species, comparison with U.S. species, technical information and availability of species.

Segmentation of the U.S. Market for Bolivian LKS

Two statistical tools were used in an attempt of segmenting the U.S. market for Bolivian lesser-known wood species: Chi-squared Automatic Interaction Detection (CHAID) (Magidson and Vermunt 2005, Villarroel 2003), and Cluster Analysis (Hair et al. 1992, Villarroel 2003). Both are techniques of multivariate analysis, and are used frequently to identify meaningful segments. CHAID is useful for ordinal or nominal data, while Cluster Analysis is used with metric (ratio) data. These techniques were used to identify segments that are willing to pay more for Bolivian substitute wood species, and to identify the most important factors that US market sectors, which import tropical hardwoods, look for in a new imported wood species.

Willingness to Pay for Bolivian Substitute Wood Species

Nine predictor variables (factors) were tested using CHAID (Magidson and Vermunt 2005, Villarroel 2003). The dependent variable was associated to the *willingness to pay for*

Bolivian substitute species (question 18 of the survey questionnaire). Independent variables incorporated in the analysis were:

Interest in importing lesser-known wood species (question 6)

States where companies are located.

Importers and non-importers. Wholesalers, distributors, retailers and manufacturers were considered non-importers.

Gross sales.

Number of employees.

Number of 20-foot containers of wood products imported.

Certified vs. non-certified wood products. Companies have been categorized in two groups: those companies that buy certified wood products (at least 5%) and those do not.

Increase the imports of tropical hardwoods. Companies were categorized in two groups: those companies that are planning to import tropical hardwoods and those do not.

Several trial and error rotations were performed using SPSS® and its module AnswerTree® (SPSS Inc. 2002). Figure 2-21 shows the best result obtained after testing different combination of factors. The parameters of the technique were: a) growing method used was *exhaustive CHAID*, b) automatic maximum tree depth, c) minimum number of cases for parent node was set to 10, d) the minimum number of cases for child node was set to 5, and e) significance values were adjusted using Bonferroni's method.

According to Figure 2-21 the size of the company (*gross sales*) influences significantly in the willingness to pay for a substitute Bolivian wood species ($p < 0.01$). The same can be concluded about the *state* where the company is located ($p < 0.01$). The market segments found for Bolivian LKS substitutes were (n=101):

S1. Companies with gross sales between $20MM and $30MM, or less than $1MM: 41.2% of respondent companies would pay the same price, 11.8% of respondents would pay between 1% and 5% more, 17.6% of respondents would pay between 6% and 10% more for a Bolivian substitute, and 23.5% of respondents would pay between 6% and 20% less.

S2. Companies with gross sales between $30MM and $40MM; 57% of those companies would pay the same price for a Bolivian substitute species, 28.6% would pay 1% to 5% less, and 14.3% of respondents would pay 1 to 5% more for the substitute.

S3. Companies with gross sales between $1MM and $10MM, or greater than $50MM; 45% of respondents would pay the same price; only 2% would pay between 1% and 5% more for a Bolivian substitute; 15.7% (11-15% less), 15.7% (16-20% less) and 13.7% would pay more than 20% less for the substitute.

S4. Companies with gross sales between $10MM and $20MM. Maybe the worst market for Bolivian LKS. 23.1% of those companies would pay the same price, 27% would pay between 6%-10% less, 27% would pay between 11%-15% less, 11.5% would pay between 1%-5% less; none of the companies in this segment would pay more for a Bolivian substitute species.

S5. Companies with gross sales between $1MM and $10MM, or greater than $50MM; and located mostly in Florida, Wisconsin, New Jersey and Oregon; 73% of those companies would pay the same price for a Bolivian substitute species; 15.4% would pay more than 20% less for the substitute.

Other markets segments can be identified (Figure 2-21); nevertheless the most attractive market for Bolivian LKS would be the last segment (S5). S1 also can be an interesting market. On the other hand the market segment S4 and the states of North Carolina, Texas, or Pennsylvania would not be a good target market for Bolivian LKS under this analysis.

U.S. Wood Industry Sectors

Factor Analysis was used to assess the most important factors that respondent companies rated when they try new imported wood species. An exploratory study of Figure 2-14 and Table 2-6 revealed that some factors are more important than others in the decision process. Thus different rotations were tried with all factors to reduce them to less meaningful and representative factors. The nineteen variables (Figure 2-14) were reduced to 8 factors (components) that represent 77% of the total variance explained of overall 19 variables. The criterion to extract the variables was to have a total variance explained close to 80% and the absolute regression factor of individual rotated components over 0.8 (high communality). Table

2-11 summarizes the results obtained after running the Factor Analysis in SPSS®, the table includes the variables that each component represents.

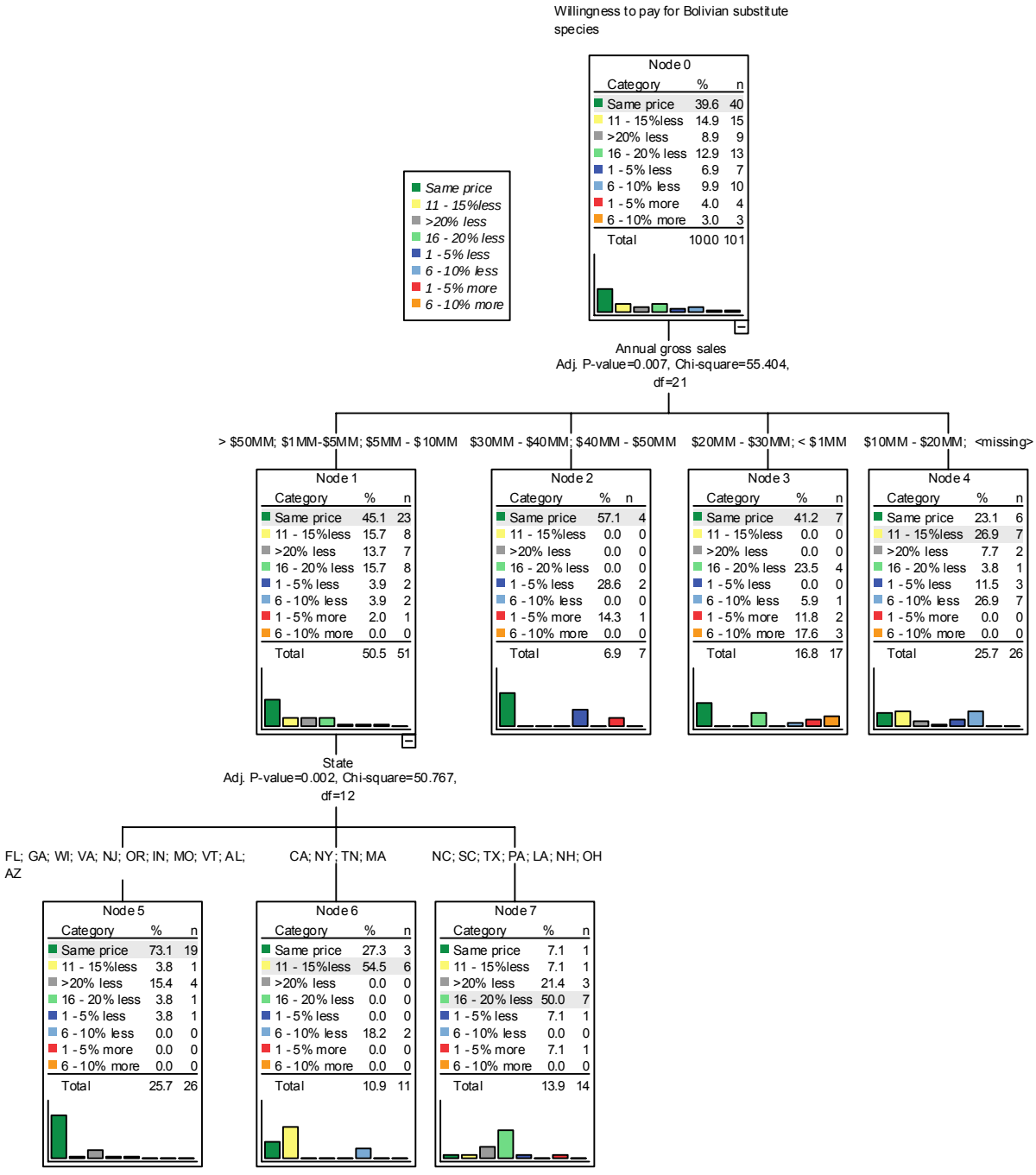


Figure 2-21. CHAID Tree, Willingness to Pay for a Bolivian Substitute Species

Hierarchical Cluster Analysis was performed with the reduced factors (components), and dependable results were obtained using Ward's clustering method and 4 groups (segments). Pair-wise comparisons between components and groups were carried out to identify differences and similarities between those segments. The segments found were:

Table 2-11. Summary of Factor Analysis

Component	Variables associated	Eigenvalues	Cumulative variance
1	Natural durability, strength	4.727	12.8%
2	Price, long-run availability	2.231	24.6
3	Known supplier	1.825	35.3
4	Easy to machine, easy to finish	1.476	44.6
5	Color, texture	1.374	53.0
6	Straightness, (stability)	1.161	61.5
7	Kiln-dried, (grade under U.S. standards)	0.959	69.8
8	Surface hardness	0.876	77.0

Note. Extraction Method: Principal Component Analysis. ¬ Rotation Method: Varimax with Kaiser Normalization.

S6. Companies that import miscellaneous wood products (i.e. sawnwood, flooring, plywood, veneer, secondary wood products, etc.). This segment also includes companies that import flooring and decking. This segment gives less importance to component 4 (easy to machine and easy to finish). Also this segment gives less importance to color and texture

S7. The only segment that has companies dedicated exclusively to import secondary wood products made from tropical wood species. This segment also has a high proportion of companies that import exclusively tropical plywood and sawnwood, and low proportion of companies that import tropical flooring. This segment gives high importance to the ease of machining and finishing. This segment gives less importance to surface hardness

S8. This segment imports mostly plywood followed by veneer, and sawnwood. This segment gives more importance to price and long run availability (component 2), gives high importance to color and texture. On the other hand, this segment gives less importance to kiln-dried products.

S9. This segment imports mostly flooring; also imports veneer and sawnwood, but in less extent. This segment does not give importance to component 4 (easy to machine and easy to finish); this segment also gives low importance to straightness.

Figure 2-22 shows an example of the pairwise comparison performed between factors (components) 4 and 5. Founded segments also are highlighted in the chart. The analysis was not able to provide conclusive results because of the small sample frame. However, it was possible to obtain useful insight about important factors that U.S. wood industry sectors (that use tropical species) consider when they look for new wood species.

These clusters were contrasted using demographic variables. Importers were found mostly in S6, S7 and S8 almost in the same proportion; and practically inexistent in S9. Wholesalers, distributors and manufacturers were found mostly in S7. No manufacturer was found in S8, and no retailer was found in S6. Surprisingly, S6 has a great proportion of companies that buy environmentally certified wood products (12 companies purchase and 1 do not); while the rest of the segments have almost the same proportion. No significant differences were found between geographic regions.

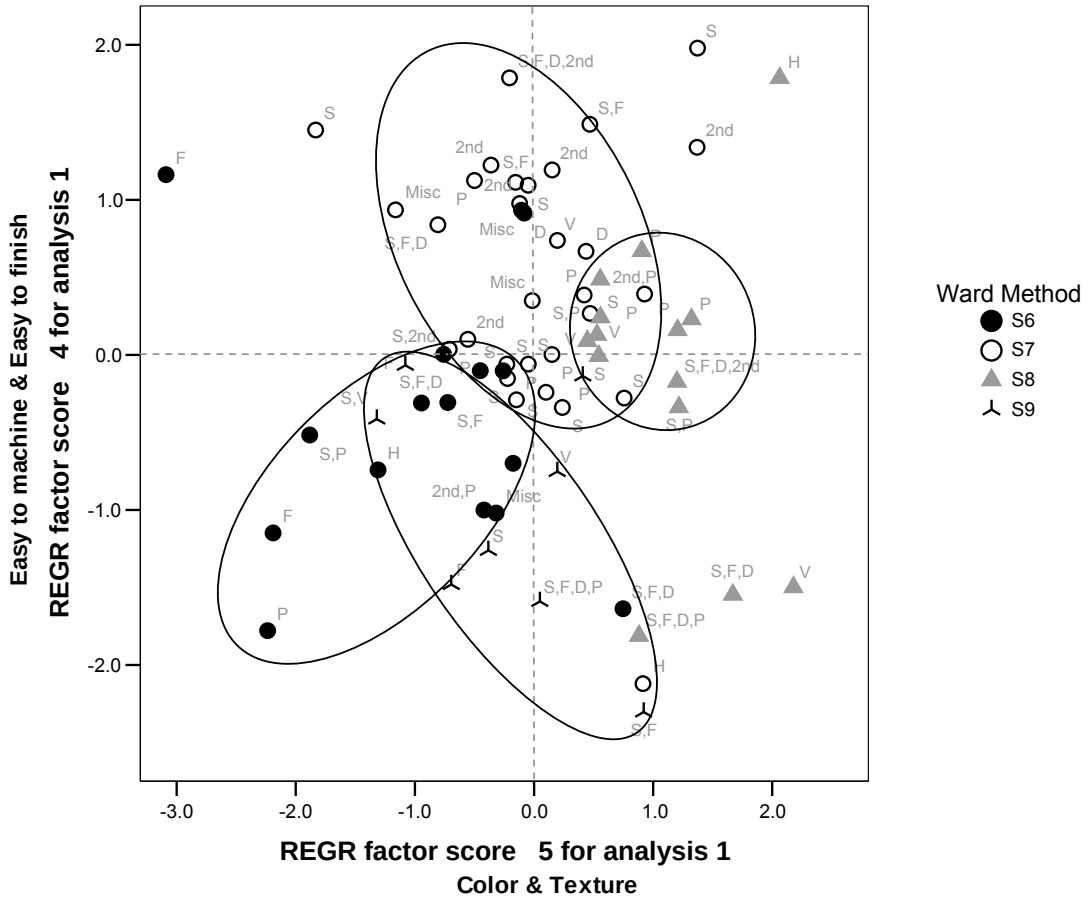


Figure 2-22. Cluster Analysis, Easy to Machine & Easy to Finish vs. Color & Texture

These multivariate statistical techniques have demonstrated to be useful tools for segmenting the U.S. for tropical hardwoods. The results of this analysis can serve the Bolivian forest products sector in different ways, such as differentiated promotional campaigns, identification of physical distribution channels or targeting specific Bolivian lesser-known wood species. For instance Bolivian companies in the flooring industry that want to sell LKS can: 1) find good customers in U.S. medium size importers in Florida; 2) promote only species with high surface hardness; and 3) should have good acceptance if it promotes environmentally certified wood products. Another example, Bolivian companies in the plywood industry can target companies in California or New York if they offer 15% less than the market price. However, certified wood products will not have acceptance at premium prices.

Personal Interviews

Five importing companies were interviewed personally: two importers of tropical veneer, one importer of tropical wooden doors and two importers of tropical lumber. The criteria of selection of those companies were as follows:

Only importers (importer and wholesalers, importers and distributors) were considered,

Due to the lack of resources available, only companies close to the Virginia Polytechnic Institute and State University campus were considered,

Companies with experience in the importing of Bolivian wood products, and

During the mail survey it was found that companies in the state of North Carolina showed low interest for LKS and low willingness to pay for a Bolivian substitute wood species; even though they had good response rate. Thus this state was preferred.

The most important findings are summarized in the following paragraphs:

Assumption: The image of the Bolivian forest products sector is in bad shape.

Finding: During the mail survey many companies rated a bad experience importing Bolivian wood products in the past (Figure 2-20). One purpose of the personal interview was to see if individual experience can be generalized to overall sector. Three of five importers had bad experience importing from Bolivia –one of them stated that has changed of supplier in Bolivia and currently that company does not have problems at all, and the other two had to leave the business due to freight costs and lack of availability of mills in Bolivia. The other two importers have good business relationships with their Bolivian partners. It seems that the image of overall

Bolivian forest sector is not in poor shape. However, there are exogenous factors that are limiting its success such as politics (current government was rated frequently as barrier), infrastructure (lack of mills that can process value-added wood products), and geopolitics (higher transportation costs).

Assumption: The quest of LKS is related to the lack of mahogany (*Swietenia macrophylla)*.

Finding: Only one company had itself commitment of promoting LKS as a substitute of domestic hardwoods in the value-added sector. This company had no other reason, just the competitive price of LKS and good acceptance in the market. The other four companies stated that the main reason to try LKS is due to the regulations to the trade of mahogany (consequently, its high price). These companies see a threat in organizations such as IBAMA (Instituto Brasileiro do Medio Ambiente) or CITES (Convention on International Trade in Endangered Species), rather than an opportunity in importing new wood species. Findings suggest that as far as the regulation on mahogany continues, the demand of LKS might increase. In addition importers of lumber showed lesser willingness to import new species than importers of value-added wood products.

Assumption: Environmental certification does not give a competitive advantage.

Finding: Interviewees mentioned, in all cases, that they are not willing to pay more for environmentally certified wood products. The only reason why interviewees buy certified products is because of the corporate image. However, certified LKS themselves were found competitive, in price, against domestic value-added wood products.

At the end, interviewees suggested some strategies to introduce certified Bolivian LKS in the U.S. All of interviewees agreed that "customer-driven" is the most important factor and the best approach should be to try to "pull" the market through value-added wood products, rather than introduce them as only lumber ("push" the market). The reasons mentioned to this approach included: 1) "Retailers such as Lowe's or Home Depot demand certified wood products"; 2) "Once the value-added market is captured, then the importing would be easier" (e.g. the success of ipe); 3) "Once one segment is captured, then would be easier to capture other segments" (e.g. once flooring is captures then customers would want to match it with doors, frames, rails, mouldings, etc.).

Conclusion

The results indicate that tropical hardwoods typically represent 33% of the product mix of the company that purchases wood products made from tropical species. Companies surveyed usually imported less than 100 MBF in 2006. The sawnwood industry is the sector that import tropical species the most, followed by plywood, secondary wood products, veneer and flooring. South America is the major region of origin of imported wood species into the U.S., and 23% of overall respondents import from Brazil, 4.4% import from Bolivia.

Six Bolivian LKS are within the list of new wood species purchased by respondent companies in 2006 and 3 Bolivian LKS are part of the top 12 common tropical wood species imported in the U.S. Sixty-seven percent of overall respondents stated that they have plans to increase the imports of tropical hardwoods in 2007. Typically, members of the supply chain tried 1 to 2 new wood species in 2006, retailers is the sector that tried the most, on average 5 new species. Price and availability were the major reasons to try new wood species.

Significant differences were found between industry sectors, regarding important factors considered to try new wood species. Factors that rated with high importance include quality, trustworthy on suppliers, long run availability, price, wood straightness and wood stability. Color and finishability were rated high in the veneer and secondary processing (doors, furniture and millwork) industries. Surface hardness was rated with high importance in the flooring industry. The industry sectors that likely will try new wood species include sawnwood lumber, plywood, decking and flooring. Significant differences also were found between geographic regions. Thus, states in the western U.S. showed more interest for importing lesser-known wood species. The state of Oregon showed more interest than the rest of states and the state of North Carolina showed the lowest interest.

It is possible to identify differentiable characteristics in the U.S. market for tropical hardwoods, and it is possible to identify some potential market segments where Bolivian lesser-known wood species can be introduced successfully. Companies still will continue to try new wood species looking for competitive prices, consistent supply and new sensory appeal characteristics that would give them competitive advantage. Particularly, species from Brazil or any country of South America are desired, likely due to the closer proximity and availability to the U.S. market.

This research demonstrated that the U.S. market offers potential opportunities for Bolivian LKS. However, marketing efforts need to provide technical specifications and samples of specific species. Differentiated promotional campaigns can be conducted to reduce promotional costs and reach the adequate market segment.

Respondents are mostly small firms, consequently with few people working in sales and marketing and very likely without interest of allocating resources for finding new wood species. Those companies have little knowledge about Bolivian LKS. Therefore, Bolivian exporters of lesser-known wood species should provide samples and technical information of Bolivian LKS to these companies. Another point in consideration is that these companies handle small volumes of imported tropical hardwood products. Hence it can benefit medium size Bolivian companies.

States in the western of the U.S. such as California and Oregon offer good market opportunities for Bolivian exporters of wood products made from Bolivain LKS. Particularly, California might the best market. Besides that companies in California are interested in imported LKS and are more concerned about environmental certification, California is a state with high personal income, high total housing units and higher population growth (U.S. Census Bureau 2002).

Even though premium prices are not expected for lesser-known species in the U.S. market, Bolivian exporters can attain competitive advantages offering a bundle of desired characteristics such as short lead times, environmental certified products and consitent supply. Since U.S. importers are willing to pay the same price for Bolivian LKS that can substitute currently marketed species the addition of these distinctivenesses can give the opportunity to Bolivian exporters for premium prices.

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CHAPTER 3. CHARACTERIZATION OF BOLIVIAN LKS

Introduction

The major domestic species used in the secondary industry in the U.S. include red oak, white oak, hard maple, cherry, ponderosa pine and yellow poplar (i.e., "traditional species"). "Non-traditional species", i.e. those that are not part of the six species mentioned above, account for less than 30% of the species mix (McDaniel 2003). The increasing trend in the importation of tropical wood species into the U.S. makes possible the introduction of new wood species into the U.S. marketplace. There are at least 217 trade names for tropical woods imported into the U.S.. Ninety-nine are from Latin America, 65 from Asia and 53 from Africa (Metafore 2004).

It is estimated that the U.S. imported $1.6 billion of wood products (not including furniture) in 2006. Imported wooden furniture products accounted for $15.6 billion for the same year (approximately 20% from ITTO members, and 48% from China and Singapore) (Goetzl and Ekström 2007, ITTO 2006). It appears that the increasing trend observed in the import of tropical wood products (excluding furniture) will remain constant at a 9% growth rate in value. Factors that will impact the utilization of tropical hardwood products in the U.S. are: a) the anticipated decline of the construction industry should not impact negatively the imports of tropical hardwood, since tropical wood market operates mainly in finished products such as flooring, decking, stock moulding and furniture; b) green policies against the emission of formaldehydes in the plywood industry or the utilization of endangered wood species; c) markets are shifting to more engineered wood products (particularly in flooring industry), and d) the Free Trade Agreements (FTA) that the U.S. government is negotiating with potential exporters of forest products to the U.S.(Goetzl and Ekström 2007).

In order to introduce Bolivian LKS in the U.S. market place successfully, one must first understand the degree of substitutability between Bolivian LKS and those wood species currently accepted in the U.S. Hence, the objective of this portion of the research is to identify U.S. domestic hardwood species and imported tropical hardwoods in the U.S. marketplace that Bolivian lesser-known wood species potentially could substitute. Even though there are different ways to characterize wood species, the marketing orientation of this research aimed to take into account those factors that are considered important in the marketplace and could influence consumer's purchase-decisions. Thus this study was limited to consider those factors.

Literature Review

Exploratory research conducted by Eastin and Wright (1998) revealed that the decision to evaluate a lesser-used species is related to the availability of technical information describing appropriate end-use applications and its substitutability for a traditional species. Although there exists several digital, non-digital or online databases of wood species, none of them provides extensive information about all species or include Bolivian LKS. The Prospect® database (Oxford Forestry Institute 2004) maybe is one of the most complete source of timber information. The system records information of 1,550 species, 92 timber properties, 175 end-uses, and 1,800 literature based references. It is important to note that this database is not updated regularly due to the lack of funds. Another remarkable electronic database is The Wood Explorer® (2006), which provides information of about 1,600 timber species. Both systems are quite similar and both have its advantages and disadvantages. For instance The Wood Explorer® provides information about mechanical properties in both system units English and International, while Prospect ® provides better timber-search capabilities.

There are also available extensive online databases of timber species. The Center of Wood Anatomy Research (2006) provides wood properties and wood identification of North American hardwoods, North American softwoods, tropical woods, and lesser-known woods. Ritcher and Dallwitz (2000 onwards) developed a comprehensive hardwood taxonomy, physical and anatomical characteristics of more than 350 commercial timbers. Several books and journal articles provide general or specific information regarding utilization of species, mechanical properties, performance or sensory appeal attributes.

The only computer database focused exclusively on lesser-known wood species found in the literature was MoreLKS®, which was developed within the framework of the Tropenbos-Cameroon project of the International Tropical Timber Organization (ITTO) (Zijp et al. 1999). The computer program was developed for MS-DOS® and provides information of 20 Cameroonian lesser-known wood species and end-uses in the Cameroonian local market. The program also allows comparing those Cameroonian LKS with selected timber species. The objective of such a program was to provide to the Cameroonian timber sector a tool to promote timbers which are currently difficult to sell, under the assumption that if the promotion of the

computer program is successful, the sector can broaden the range of species harvested. Thus contributing to sustainable forest management (Zijp et al. 1999).

Bolivian Lesser-known Wood Species

Bolivian lesser-known wood species (LKS) considered in this study are the twenty potentially marketable species identified by BOLFOR II (2005). Those species were selected because of their relative abundance (large volume of trees in the forest). They are widely used in domestic markets, and they are found in environmental certified forests in Bolivia. To properly manage the FSC certified forest in Bolivia, these species must be harvested. Bolivian LKSs' properties (mechanical, physical, anatomical and sensory appeal) were obtained mainly from the work of Gutierrez and Silva (2002). Since this reference does not provide all characteristics, other sources were consulted to complement wood species information.

Miller, Williams and others (2003, 2001) characterized the natural durability, weathering characteristics, and dimensional change of ten tropical hardwoods from Bolivia. The wood species included were: roble (*Amburana cearensis*), curupaú (*Anadenanthera macrocarpa*), jichituriqui (*Aspidosperma cylindrocarpon*), cuchi (*Astronium urundeuva*), momoqui (*Caesalpinia cf. pluviosa*), sucupira (*Diplotropis purpurea*), sirari (*Guibourtia chodatiana*), cuta (*Phyllostylon rhamnoides*), soto (*Schinopsis cf. quebracho-colorado*), and ipe (*Tabebuia spp*). Jarrah (*Eucalyptus marginata*) from Australia and teak (*Tectona grandis*) were used for comparison. Their conclusions include: 1) none of the Bolivian wood species was as resistant to checks and warping as teak; 2) all Bolivian wood species studied seem to have excellent properties for manufacturing products for outdoor use; and 3) only one species (*Phyllostylon rhamnoide)* was classified as moderately resistant to decay, while the remaining species were classified as resistant or highly resistant.

Barany and others (2003) highlighted the importance of research and wood property information of lesser used species. The authors also listed under-exploited Bolivian timber species that need further wood property information. Their recommendations included to provide wood property information to manufacturers and marketing efforts are required to help buyers and manufacturers to become familiar with these species. Mater Engineering, Ltd (1998) conducted a market research in the U.S. and found substitutive characteristics in North American

species and market strategies for four Bolivian LKS: yesquero negro (*Cariniana estrellensis*), ochoo (*Hura crepitans*), cambará (*Erisma uncinatum*) and murure (*Claricia racemosa*).

U.S. Wood Species

McDaniel (2003) assessed specie utilization in the U.S. wood secondary industry within the following market segments: cabinets, millwork, flooring, office furniture, dimension & components, windows and doors and house hold furniture. The author determined that more than 50% of surveyed companies used oaks – 43.5% red oak and 10.2% white oak. Traditional species identified for the secondary industry were red oak, white oak, hard maple, cherry, soft maple and yellow poplar. Some "non-traditional" wood species identified include: aspen, white birch, yellow birch, hickory, Douglas fir, gum and alder. But the final distinction between "traditional" and "non-traditional" depends of the market segment. McDaniel (2003) recommended that the secondary wood industry may be more adept to change their species selection if the consumer could be educated on the properties of other species.

Typically, tropical hardwoods aim to substitute U.S. hardwoods rather than U.S. softwoods. Thus, it was decided to include ten "traditional" and "non-traditional" U.S. domestic hardwood species. The species considered include: red oak, white oak, hard maple, black walnut, black cherry, American beech, hickory/pecan, white ash, white birch, and red alder. The information of these species is well documented. The Wood Handbook (Forest Products Laboratory 1999) was used as primary source of information, followed by PROSPECT® (Oxford Forestry Institute 2004) and The Wood Explorer® (2006).

Non-Bolivian Wood Species Imported into the U.S.

Flynn and Holder have compiled characteristics of 279 U.S domestic and imported timber species in the U.S. (Flynn and Holder 2001). The authors provided useful information regarding workability, origin of timbers, potential end uses and toxicity for the majority of timber species. However they barely include mechanical properties. The Wood Handbook (Forest Products Laboratory 1999) compiles information about mechanical properties of several temperate and tropical wood species.

The survey conducted in a previous stage of this project allowed to identify major wood species currently imported into the U.S. At the same time it was possible to identify some desired

characteristics in imported wood species. According to Metafore (2004b). the U.S. imports 1.7 million cubic meters of tropical wood (80% goes to the plywood market). Metafore assessed the relative amounts of different woods traded by U.S. importers, and consequently identified top wood species marketed in the U.S. The top species included: big-leaf mahogany, jatoba, ipe and purpleheart and they are used in the lumber market. Only five of the top 20 tropical woods are used in the plywood market and the most commonly traded plywood products are made from meranti, virola and keruing. The majority of companies import between one and 20 trade names at a time (Metafore 2004b).

Non-Bolivian imported tropical species considered in this research included: aniegre, balsa, cocobolo, faveira, keruing, khaya, mahogany, marupa, massaranduba, dark red meranti, morado, okoume, purpleheart, rubberwood, santos mahogany, sapele, Spanish cedar, teak, virola and wenge (Appendix C lists the scientific names of theses species). Several sources of information about these species' characteristics were consulted (CIRAD 2003, Forest Products Laboratory 1999, Oxford Forestry Institute 2004, The Wood Explorer 2.0$^{(R)}$ 2006).

Methods

Characterization of Wood Species

This research is based on extensive literature review and the results obtained from the survey of U.S. companies performed in a previous stage of the research project. The codification, classification and ranking of attributes were based on diverse sources such as database software, online documentation and publications (Erfurth and Rusche 1976b, Oxford Forestry Institute 2004, The Wood Explorer 2.0$^{(R)}$ 2006).

Some characteristics commonly found in the literature and were not considered in this study include anatomical and botanical attributes, tree characteristics and forest of origin. These characteristics would be more important for scientific purposes. Another characteristic that was not included because was ranked as "low important" is the kiln-dried (kyln schedule, kiln dry rate). Hence, it was decided not to include those irrelevant characteristics to the objective of this study. According to the literature, and from the point of view of the final consumer, the most relevant attributes to classify wood species are mechanical properties, workability, appearance, uses, and durability.

Simple descriptions of commercial, scientific, common or alternative names are used to avoid misinterpretations or possible ambiguities. It was decided to maintain common names as well as for Bolivian LKS and "non-Bolivian LKS". For instance *tajibo* (Bolivian LKS) is known as *ipe* in the U.S. market place, therefore such species will be referred as *tajibo* along this study. In order to avoid unnecessary repetition of scientific names, Appendix C lists common and scientific names of all species mentioned in this research.

Mechanical properties and workability were collected from the literature based on air dried wood conditions (12-15% M.C.). In cases where discrepancies existed between sources, the most reliable source was used. Sensory appeal an end uses characteristics were collected scrutinizing different source such as electronic databases, companies' web pages on the Internet, and published articles and books.

Although the task of identification of properties and similarities between species could be performed manually, it was decided to develop a general-purpose software program that can be used to append more species and at the same time can facilitate the identification of similarities. Also, it was decided to develop such program in a commonly database software used in desktop applications, thus it can be easily accessible to any person interested in using it.

Mechanical and Physical Properties

Density, and consequently *specific gravity (SG)*, is the single most important indicator of strength in wood and predicts many characteristics such as hardness and ease of machining. (Hoadley 2000). Therefore this was the first characteristic considered in this study. Many static and bending properties (modulus of rupture, modulus of elasticity and work at maximum load), impact strength, stiffness, compression parallel and perpendicular to the grain, shearing strength, and tensile strength can be summarized under the strength of wood. Due to the correlation among these properties and between the specific gravity, the modulus of rupture is the parameter that frequently is used to determine the strength of wood (Erfurth and Rusche 1976a, Oxford Forestry Institute 2004).

In order to summarize tangential, radial and volumetric shrinkages, a compound value for shrinkage was calculated multiplying the volumetric shrinkage and tangential/radial shrinkage ratio (Erfurth and Rusche 1976a). The last characteristic considered in this attribute was the *lateral hardness*, which is rank important factor in some market segments such as flooring and

decking, which is based on the janka hardness test. Table 3-1 shows the mechanical and physical properties considered in this study. It includes the range of values for reference, but any calculation in the database is based on its own value (since it is numeric).

Table 3-1. Mechanical and Physical Properties Considered for Wood Species Characterization

Characteristic	Range of values	Value in the database and remarks
Specific gravity	low = up to 0.5 medium = 0.5–0.65 upper = 0.65–0.8 high = 0.8 and up	Numeric, no rank (Erfurth and Rusche 1976a)
Shrinkage	low = up to 14% medium = 14–27% high = 27% and up	Numeric, no rank (multiplyvolumetric shrinkage and tangential/radial shrinkage ratio) (Erfurth and Rusche 1976a)
Strength	very low = up to 7,250 psi low = 7,250–12,400 psi medium = 12,401–17,500 psi high = 17,501–25,400 psi very high = 25,400 and up	Numeric, no rank (Oxford Forestry Institute 2004)
Lateral hardness	very soft = up to 674 lbf soft = 675–1,349 lbf medium = 1,350–2,023 lbf hard = 2,025–2,698 lbf very hard = 2,700 lbf and up	Numeric, no rank (Oxford Forestry Institute 2004)

Sensory appeal

Undoubtedly sensory appeal properties are one of the most important attributes for the final consumer. Attributes such as color, texture, character, grain, odor or even taste are important to select the appropriate wood. Table 3-2 shows the sensory appeal characteristics considered in this study and the rank of values for each characteristic. Table 3-2 also includes the corresponding numerical value for each rank in the database developed, in a scale from 0 to 1. It was decided to consider light color species close to 0 and darker species close to 1, fine texture close to 0 and coarse texture close to 1. It was decided that straight grain patterns will be ranked close to 0, and interlocked grain pattern ranked 1. Even though this ranking is subjective, it follows a simple logic of ranking of the characteristics considered, and frequently found in the literature.

Table 3-2. Sensory Appeal Characteristics Considered for Wood Species Characterization

Characteristic	Range of values	Value in the database	Range of values	Value in the database
Color of heartwood	white / cream	0.08	Red	0.62
	yellow / golden-	0.15	dark red	0.69
	yellow / orange	0.23	reddish brown	0.77
	pale brown	0.31	greenish / grayish	0.85
	brown	0.38	purple	0.92
	dark brown	0.46	black	1.00
	pale red / pink	0.54		
Texture	Fine	0.2	medium / coarse	0.8
	fine / medium	0.4	coarse	1.00
	medium	0.6		
Grain	Straight	0.25	spiral	0.75
	wavy	0.5	interlocked	1.00

Workability and Performance

The common work properties that are sub-classified under this characteristic include sawing, peeling, slicing, planing, drilling, nailing, nail holding, screwing, gluing, moulding, mortising and sanding (Erfurth and Rusche 1976b); or (The Wood Explorer 2.0$^{(R)}$ 2006). In order to simplify these characteristics, a lonely characteristic was used that summarizes the aforementioned properties was used: *workability*. The second characteristic used within this classification was *natural durability*, since it is considered important in market segments such as decking, garden furniture or any other outdoor application (Barany et al. 2003). Another characteristic considered was *toxicity* of wood.

Potential End Uses

This attribute was included because some species have been used extensively in specific market segments (domestically or traded internationally), and have provide its suitability for certain value added wood products. The comparison of species can be facilitated if the selection is based on this attribute, especially when the user is not versed in wood properties. Basically each species is ranked in a three-level scale (*suitable*, *can be used* and *non-suitable*) for the following market sectors: flooring, veneer (and paneling), decking, cabinet, handles, outdoor furniture and indoor furniture. For example if a species is exported for the flooring segment, or if

it is used extensively domestically, then it is classified as “suitable for flooring” (if the species is used experimentally with somewhat success then it is classified as “can be used in flooring”). A more experienced user should not use this characteristic for comparing, sine this characteristic is a consequence of last three set of attributes considered.

Table 3-3. Workability & Performance Attributes Considered for Wood Species Characterization

Characteristic	Range of values	Value in the database
Natural durability	very durable	0.25
	durable	0.5
	moderately durable	0.75
	non-durable	1.00
Workability	Easy	0.33
	moderate	0.66
	Difficult	1.00
Toxicity	non-toxic	0.33
	dermatic/respiratory effects	0.66
	Poisonous	1.00

Degree of Similarity

The classification and sub-classification of important characteristics considered, and range of permissible values shown in Table 3-1 were introduced and handled in MS-Access®. The code and the interface were developed in Visual Basic for applications (VBA) in order to give more interactivity to the user. The mathematical representation for the calculation of the degree of similarity is shown in Equation 3-1, and is a modified version of the Gower’s similarity index (Lim and Khoo 1985). This formula allows obtaining a value (DS) between 0 and 1, and it is based on a weighted average of absolute errors between species.

$$DS_{AB} = 1 - \sum_{j=1}^{4} \left(w_j * \frac{1}{n_j} \sum_{i=1}^{n_j} \frac{\left| x_i^A - x_i^B \right|}{R\{x_i\}} \right) \qquad \text{(Eq 3-1)}$$

Where: DS_{AB} = Degree of similarity between species A and B; $DS \in [0,1]$

w_j = User's weight to the set of attributes j (j = 1,2,3,4; mechanical and physical properties, sensory appeal, performance and end-uses); $w_j \in [0,1]$

n_j = Number of characteristics considered in the set of attributes j

$R\{x_i\}$ = Range, difference between the maximum value and the minimum value of the characteristic i of all species

x_i^k = Value of the characteristic i of the species k;

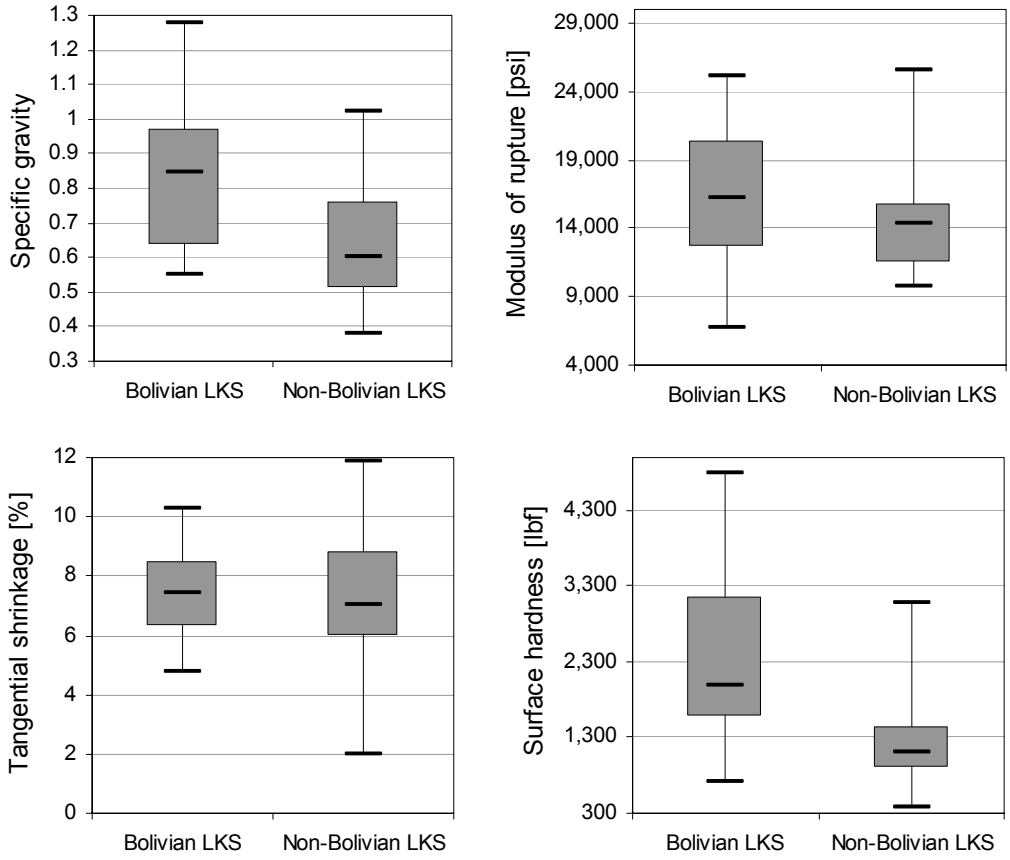
The database developed calculates the value of this formula, and stores othe calculations in specific tables.within the database.

Results and Discussion

The following sections describe the results obtained with the database and are complemented with statistical analysis. A preliminary analysis of mechanical properties revealed some differences between Bolivian LKS and "non-Bolivian LKS" (common U.S. domestic hardwoods and commonly imported tropical hardwoods into the U.S.). The boxplots of Figure 3-1 show a global comparison of four important mechanical and physical properties between Bolivian LKS and non-Bolivian LKS. Typically Bolivian LKS specific gravity (SG) ranges from 0.65 to 0.95 (upper to high according to Table 3-1), while the specific gravity of "non-Bolivian LKS" usually ranges from 0.50 to 0.75 (medium to upper, Table 3-1). Given that SG influences other mechanical properties, there exist other differences as well. The strength can be estimated through the modulus of rupture (MOR); Bolivian LKS are slightly stronger than "non-Bolivian LKS", its MOR ranges typically from 12,500 psi to 20,000 psi (high, Table 3-1), while MOR of "non-Bolivian LKS" ranges from 11,500 to 15,800 psi (low to medium, Table 3-1).

According to Figure 3-1, Bolivian LKS have outstanding *surface hardness* properties, comparing with "non-Bolivian LKS". The surface hardness of Bolivia LKS typically ranges from 1,575 lbf to 3,150 lbf (very hard, Table 3-1), while the surface hardness of "non-Bolivian LKS" typically ranges from 900 lbf to 1,450 lbf (soft to medium, Table 3-1), lower than Bolivian LKS. Shrinkage of Bolivian LKS are quite similar than "non-Bolivian LKS". Bolivian LKS that have large shrinkage include cambará and soto.

These results suggest that Bolivian LKS can have good acceptance in those market segments that *surface hardness* and *high strength* properties are desired. It appears that *stability* (shrinkage/swell) of Bolivian LKS does not impact the marketability in the U.S. marketplace, since Bolivian LKS *shrinkages* are within the range of those wood species already market accepted in the U.S.



Note. excluding balsa, since this species has special properties

Figure 3-1. Comparison of Mechanical Properties, Bolivian LKS vs. non-Bolivian LKS

Database system

As a result of this study, a MS-Access database was developed that allows one to compare (comparator) the 20 potentially marketed Bolivian LKS with 10 North American hardwood species and with 20 common non-Bolivian imported wood species into the U.S. MS-Access was chosen because it is available within Microsoft Office. Figure 3-2 shows the first window that appears when the system starts. The user can access to the database, compare

species or see the help. Figure 3-3 shows the interface of the database module. This is divided in sections according to the grouped characteristics. The database also includes other useful attributes that are not incorporated in the calculation of the degree of similarity. Figure 3-4 shows the interface of the windows that allows the comparison of species and calculation of the degree of similarity. Through this interface the user can select one Bolivian LKS and compare it with another non-Bolivian LKS. The user also can weight his criteria of selection (see Figure 3-4). For example the user might prefer to compare only mechanical properties, only sensory appeal attributes, or give the same weight to all attributes.

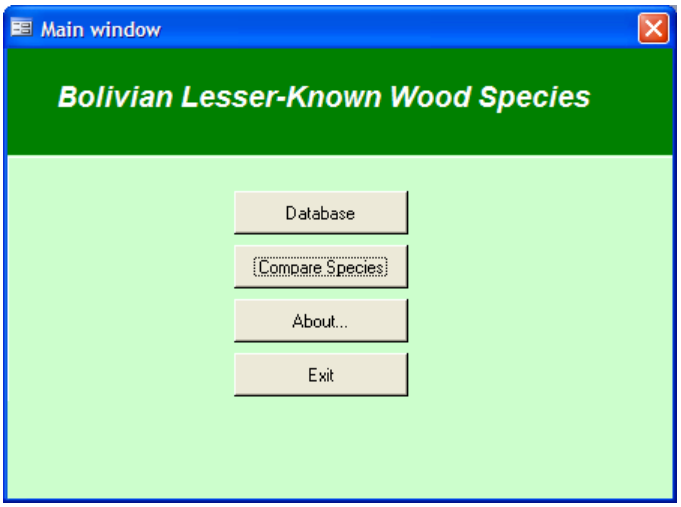


Figure 3-2. Main Window Wood Species Comparator

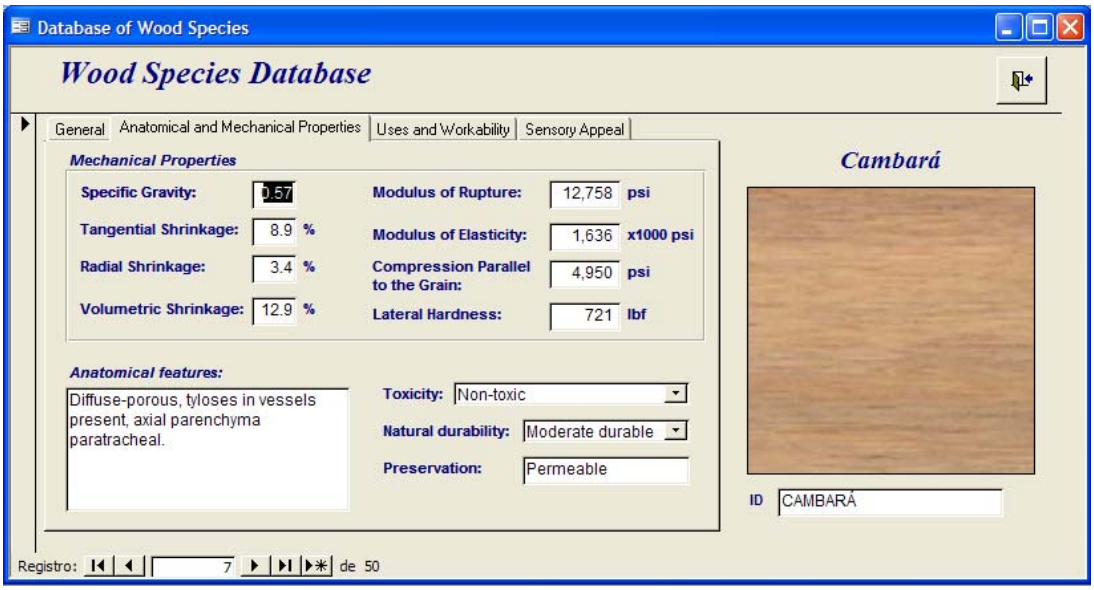


Figure 3-3. Wood Species Database Window

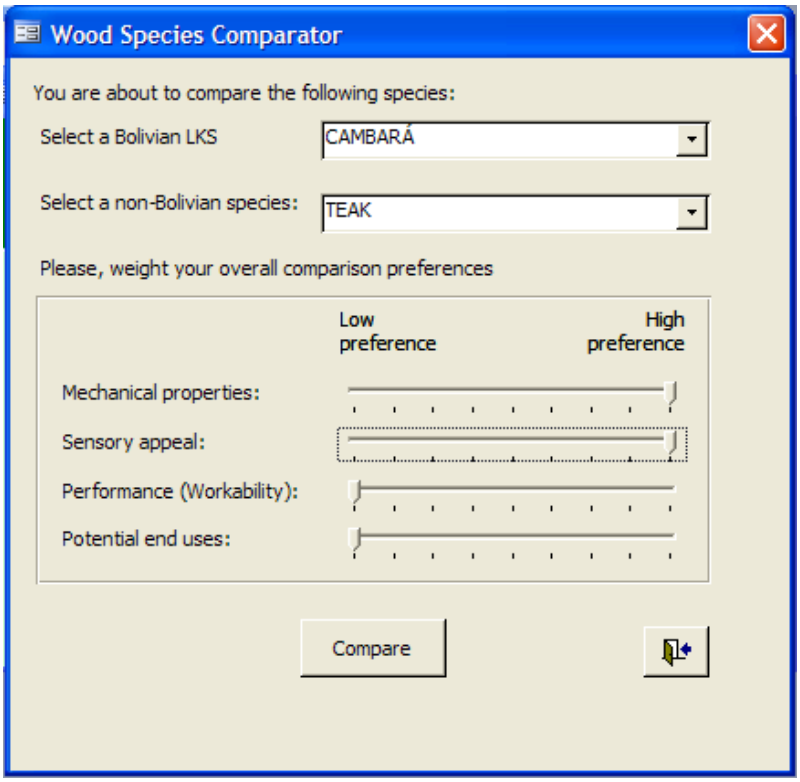


Figure 3-4. Selector of Species and Wood Species Comparator Window

Once the species are selected and the weights are given, the press of the "compare" button will generate a printable comparison sheet (Figure 3-5) that includes a summary of the characteristics of both species, and a chart with the results of the calculation of the degree of similarity. For example, here is the data for comparing ochoo and white ash:

ochoo: SG = 0.5; compound shrinkage = 14.18; strength = 9,743; surface hardness = 1,768; color = 0.15, grain = 0.25; texture = 0.4.

white ash: SG = 0.66; compound shrinkage = 20.7; strength = 15,000; surface hardness = 1,264; color = 0.38; grain = 0.25; texture = 0.4.

Ranges (constants): SG = 1.16; compound shrinkage = 24.8; strength = 20,098; surface hardness = 4,559; color = 0.92; grain=0.75; texture=0.8.

Here is the data inserted into the equation 3-1, and the results are presented in Figure 3-5.

$$DS_{ochoo-ash} = 1 - 0.5\left\{\frac{1}{4}\left(\frac{|0.55-0.6|}{1.13} + \frac{|14.18-20.7|}{24.8} + \frac{|9,743-15,000|}{20,098} + \frac{|1,768-1,264|}{4,559}\right)\right\} - 0.5\left\{\frac{1}{3}\left(\frac{|0.15-0.38|}{0.92} + \frac{|0.25-0.25|}{0.75} + \frac{|0.4-0.4|}{0.8}\right)\right\} = 0.873 \quad \text{(Eq. 3-2)}$$

Comparison Sheet

Ochoo *Hura crepitans*

Mechanical and physical propertie

Specific Gravity: 0.55
Tangential shrinkage (%): 5.7
Radial shrinkage (%): 3.9
Volumetric shrinkage (%): 9.7
Comp. parallel to grain (psi): 6,329
Modulus of Rupture (psi): 9,743
Modulus of Elasticity (psi): 1,408
Hardness (lbf): 1,768

Sensory Appeal

Color: Yellow/Golden
Grain: Straight
Texture Fine/medium

Performance

Workability Easy
Toxicity Poissonous
Durability Non-durable

Potential end uses

Flooring: Non-suitable
Outdoor furniture: Non-suitable
Indoor furniture: Suitable
Door/window: Suitable
Decking: Non-suitable
Cabinets: Suitable
Plywood/veneer: Suitable
Hand Tools: Non-suitable

White ash *Fraxinus americana*

Mechanical and physical propertie

Specific Gravity: 0.6
Tangential shrinkage (%): 7.8
Radial shrinkage (%): 4.9
Volumetric shrinkage (%): 13
Comp. parallel to grain (psi): 7,410
Modulus of Rupture (psi): 15,000
Modulus of Elasticity (psi): 1,770
Hardness (lbf): 1,264

Sensory Appeal

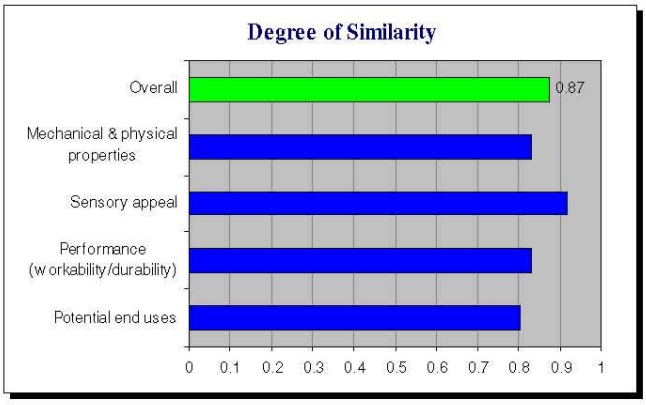
Color: Brown
Grain: Straight
Texture Fine/medium

Performance

Workability Easy
Toxicity Dermatic/Respiratory effects
Durability Non-durable

Potential end uses

Flooring: Non-suitable
Outdoor furniture: Non-suitable
Indoor furniture: Suitable
Door/window: Can be used
Decking: Non-suitable
Cabinets: Suitable
Plywood/veneer: Suitable
Hand Tools: Suitable



The degree of similarity is a coefficient with a value between 0 and 1. Values close to 1 suggest high similarity between species. "Overall" similarity is the weighted preferences of the user.

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Figure 3-5. Sample Comparison Sheet, Ochoo vs. White ash

Comparison and Substitution

The database developed allows comparing the selected 20 Bolivian LKS with the other 30 wood species under different criteria. For instance one can compare only mechanical and physical properties, or give different weights to two or more characteristics such as end uses or workability. The results from previous studies suggest that the most important characteristics are mechanical properties and sensory appeal attributes.

The degree of similarity (DS) should be interpreted like a correlation factor, with a value between 0 and 1, thus "the higher the value, the higher the similarity". It was found that comparing Bolivian LKS and non-Bolivian LKS on the basis of mechanical and sensory appeal properties the degree of similarity (DS) follows a normal distribution with mean 0.7 and variance 0.015. The criteria used here is to consider "not similar" those species that have a DS below the mean value (0.7). Thus, ranges were classified as follows:

- Wood species that are very similar (●, DS ≥ 0.90)
- Wood species that are similar (⦿, 0.80 ≤ DS < 0.90)
- Wood species that have somewhat similarity (○, 0.70 ≤ DS < 0.80), and.
- Wood species that seem to be different (blank, DS < 0.70)

Figure 3-6 exemplifies the comparison of Bolivian LKS and commonly marketed hardwood species in the U.S. (U.S. domestic and imported). The comparison is based on mechanical properties and sensory appeal attributes and the degree of similarity is classified according to the above mentioned criteria.

When reviewing the results in Figure 3-6 it is possible to cluster Bolivian LKS that are similar to U.S. domestic hardwoods and to cluster those Bolivian LKS that are more similar to tropical hardwoods imported from other countries. Thus, species such as *cambará*, *mara macho*, *ochoo*, *sirari*, *yesquero blanco* and *yesquero negro* seem to be potential substitutes for some U.S. domestic hardwoods. On the other hand, species like *bibosi*, *cuta*, *murure*, *palo maria*, *paquio* and *verdolago* seem to be potential substitutes for imported tropical hardwoods. In addition, there are some Bolivian LKS that have unique characteristics such as *ipe*, *momoqui*, *soto*, *guayabochi* and *jichituriqui*. It is important to note that some common imported tropical hardwoods in the U.S., and were not considered as Bolivian LKS, exist in Bolivian rainforest as well such as *mahogany*, *Spanish cedar*, *massaranduba* and *morado*.

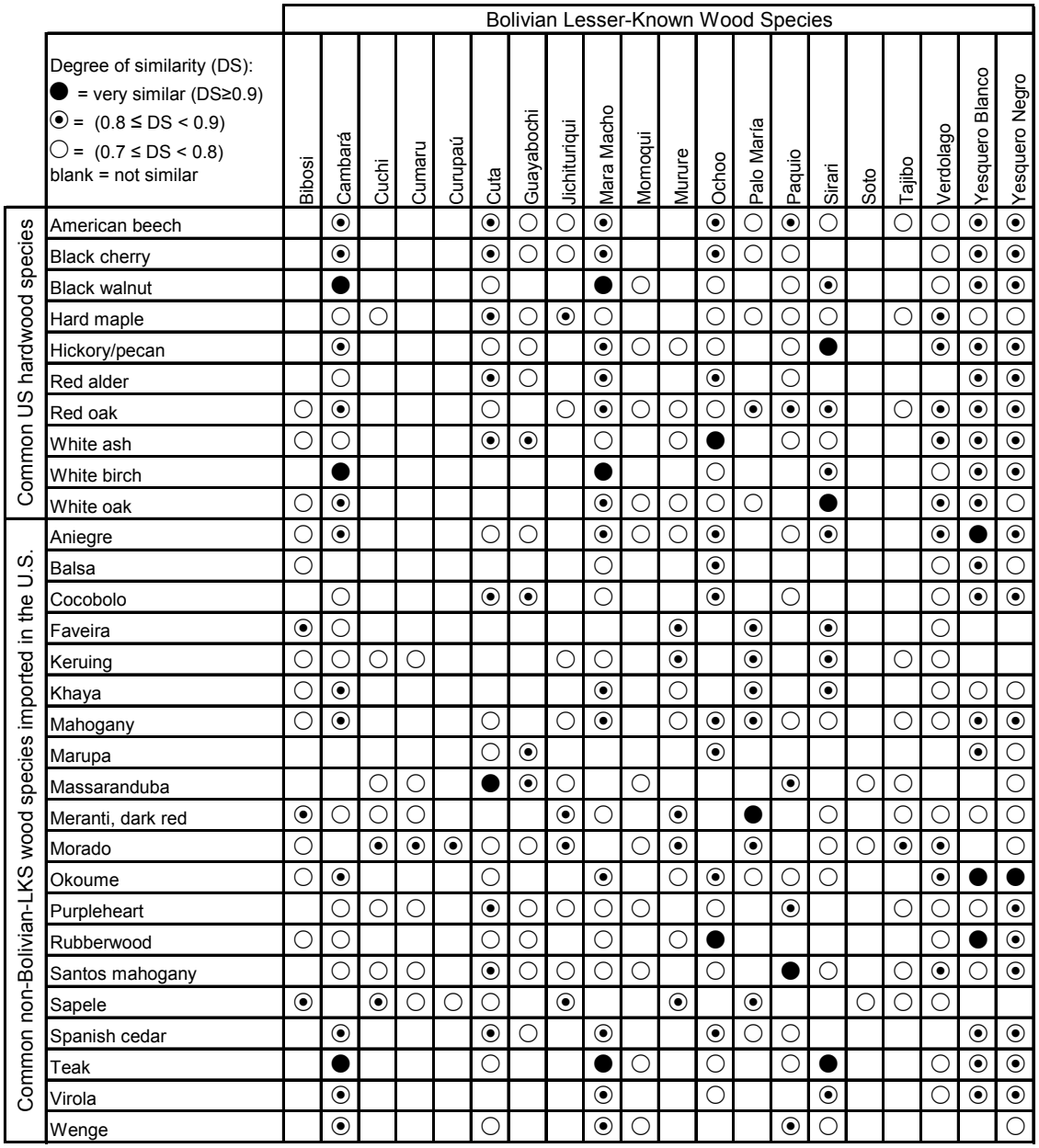

Figure 3-6. Comparison of Bolivian LKS and Common Species Traded in the U.S., Based on Mechanical Properties and Sensory Appeal Attributes

The main objective of the developed database system was to find Bolivian LKS substitutive for currently marketed wood species in the U.S. Thus, Table 3-4 (based on the comparison matrix of Figure 3-6) shows possible wood species marketed in the U.S. that Bolivian LKS can substitute, based on mechanical properties and sensory appeal attributes.

Table 3-4. Bolivian LKS that Can Substitute Hardwood Species Commonly Marketed in the U.S.

Bolivian LKS	Wood species that can substitute
Bibosi (*Ficus Glabrata*)	dark red meranti, faveira, khaya, sapele, red oak, white oak
Cambará (*Erisma uncinatun*)	deak*, black walnut*, white birch*, virola, hickory/pecan, khaya, aniegre, okoume
Cuchi (*Astronium urundeuva*)	massaranduba, sapele, morado, hard maple†
Cumarú (*Dipteryx odorata*)	Morado, massaranduba, dark red meranti, sapele, keruing
Curupaú (*Anadenanthera colubrina*)	sapele, morado, massaranduba†, dark red meranti†, faveira†
Cuta (*Apuleia leicocarpa*)	massaranduba*, cocobolo*, purpleheart*, santos mahogany*, black cherry, hard maple, American beech
Guayabochi (*Callycophyllum spruceanum*)	cocobolo, purpleheart, santos mahogany, massaranduba, marupa, white ash, black cherry
Jichituriqui (*Aspidosperma spp.*)	sapele, morado, hard maple, dark red meranti, massaranduba, keruing, mahogany†
Mara Macho (*Cedrelinga catenaeformis*)	teak*, black walnut*, white birch*, virola*, khaya, hickory/pecan, aniegre, okoume
Momoqui (*Caesalpinia spp.*)	santos mahogany, white oak, red oak, hickory/pecan, teak, black walnut, wenge
Murure (*Clarisia racemosa*)	faveira*, morado*, dark red meranti, keruing, sapele, red oak, khaya, white ash, hickory/pecan†
Ochoo (*Hura crepitans*)	rubberwood**, white ash*, aniegre, American beech, marupa*
Palo María (*Calicophyllium braziliensis*)	Dark red meranti**, red oak, keruing, khaya, morado, sapele, faveira, mahogany
Paquio (*Hymenaea courbaril*)	santos mahogany**, purpleheart*, massaranduba*, wenge, American beech, red oak, okoume
Sirari (*Ormosia coarctata*)	white oak**, hickory/pecan*, teak*, black walnut*, white birch, keruing, virola, faveira, red oak, khaya
Soto (*Schinopsis spp.*)	massaranduba, sapele, morado, hard maple†
Tajibo (*Tabebuia spp*)	morado, purpleheart, santos mahogany, dark red meranti, sapele, keruing
Verdolago (*Terminalia amazonica*)	White oak, white ash, red oak, santos mahogany, aniegre, morado, hickory/pecan
Yesquero Blanco (*Cariniana ianeirensis*)	Aniegre**, rubberwood**, okoume*, white ash, white birch, virola
Yesquero Negro (*Cariniana estrellensis*)	okoume*, white ash, aniegre, American beech, teak, rubberwood, hickory/pecan, red oak

Note. [a]Based on mechanical properties and sensory appeal attributes, *potential substitution, †lesser substitution

Conclusions

Mater Engineering (1998) recommended possible Bolivian LKS substitutes for U.S. domestic wood species such as *murure*, *cambará*, *ochoo*, and *yesquero blanco*. Only *yesquero blanco* and *cambará* showed similar conclusion than those found in this research. It is important to note that Mater Engineering suggested substitute species from a visual perspective.

The quest of wood species currently marketed in the U.S. that Bolivian LKS can substitute is one of the most important factors for the successful marketing of Bolivian LKS. Table 3-4 can be used to anticipate those U.S. market sectors in which Bolivian LKS can be accepted. For instance in the U.S. the common imported species for exterior wood doors include: *mahogany*, *khaya*, *Spanish cedar*, *teak* and *meranti*; and common U.S. hardwoods include: *oaks*, *cherry*, *maple* and *walnut*. Table 3-4 suggests that Bolivian LKS that can be accepted in the U.S. exterior wood door market are (in order): *cambará*, *mara macho*, *palo maria*, *sirari* and *bibosi*. Table 3-4 also can explain the success of some Bolivian LKS in the U.S. market. For instance, *paquio* (*jatoba*) is a good substitute for: *santos mahogany*, *purppleheart*, *massaranduba*, *wenge* and *red oak*; which are widely used in the flooring market sector.

The calculation of the degree of similarity has some disadvantages. One disadvantage of the Gower's index was highlighted by Kim and Khoo (1985), the authors found that the index tends to over estimate low similarity and to underestimate high similarity. Especially, like in this case, when few characteristics are considered. Likely a more sophisticated mathematical formulation could provide more accurate results. However the results obtained through this approach were proved to be fairly good. Another disadvantage is that such calculation is based on few characteristics and likely the subjective characteristics, such as *color* or *texture,* are not well ranked.

There exists, unavoidably, an error associated to the determination of the values of wood species' characteristics. There exist differences throughout the literature as well. The best approach to select a substitute species would be to consider all factors independently and combined. For instance an importer that would like to find a substitute for *teak* quickly finds that *murure* (Bolivian LKS) can be a good substitute, but based only on mechanical properties –this is what Mater Co. found (Mater Engineering Ltd. 1998). The database developed is intended as a

decision-support tool for buyers of tropical hardwood products and it is not the "last word" in the selection of a substitute species.

The database-program developed provides useful insights of the substitutability of Bolivian LKS in the U.S. market. However it has limitations and some of recommendations are necessary. There are more Bolivian LKS in the rainforest that can be included in the database thus to spread out the range of options. Even though values of mechanical properties were obtained from the most reliable sources, some values need to be updated with new research. The database can be upgraded incorporating new characteristics that are relevant to U.S. importers or consumers. For instances information on prices and availability of species can be incorporated. Modified versions of the database-software developed can be used as promotional material in websites, CD-ROMs. Incorporating a metric unit system can facilitate the use in other regions such as Europe, South America or Asia.

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CHAPTER 4. STRATEGIC MARKETING RECOMMENDATIONS

Introduction

Before undertaking any marketing endeavor it is important to define the appropriate strategies and marketing plans. Following the marketing management process, important insights regarding the "situation analysis" of Bolivian LKS in the U.S. were obtained through secondary and primary research. The next step would imply the formulation of marketing objectives and marketing strategies (Peter and Donnelly 2005).

During previous phases in this research several conclusion were highlighted regarding possible market segments where Bolivian LKS can be introduced successfully. In addition the study of the Bolivian forest products sector and the characterization of potentially marketed Bolivian LKS allow a better knowledge of the U.S. market for tropical hardwoods, and particularly for lesser-known wood species.

This chapter aims to summarize all the information gathered in previous phases and complement it with secondary research. As a result, some strategic marketing recommendations are stated to promote Bolivian lesser-known wood species in the U.S. market. First, an overview of previous studies is described. Later, it is analyzed the *strengths* and *weaknesses* of the Bolivian forest products sector (regarding lesser-known species), and *opportunities* and *threats* that Bolivian LKS can find in the U.S. market place.

Marketing recommendations were formulated around three principles of marketing: *promotion*, *price* and *distribution*. It is important to note that during the mail survey (and personal interviews) conducted in previous stages of this research, respondents (interviewees) recommended some strategies to increase the imports of Bolivian LKS into the U.S. Since these strategies are an important input for the marketing management process, they were considered in this chapter. Finally, general conclusions and recommendations are stated.

Literature Review

A study conducted by the Food and Agriculture Organization (2001) regarding the use of tropical timbers in Europe for sawnwood, plywood and veneer revealed that the major factors for the acceptance of tropical timbers were (in order): quality consistency, supply regularity and dependability, promotional support, and price competitiveness and stability. This research found that these factors are also important for the acceptance of lesser-known wood species in the U.S. However, in order of importance they were price, availability, appearance, quality consistency and marketing support.

Vlosky and Aguirre (2001) depicted some strategies for introducing lesser known species from forest of Central America. Marketing strategies of Central American companies include: lower price than traditional species, offer species substitute to mahogany (*Swietenia macrophylla*), meet quality standards of the U.S., low inventory at wholesale and retail level, participation in trade fairs and internet information. Eastin and Wright (1998) developed a thorough study regarding the effectiveness of different marketing factors in promoting the acceptance of lesser used species among producing and consumer countries. Firms in Ghana, Phillipines, UK and Ireland and in the U.S. were surveyed. They recommended marketing strategies (among others): 1) determine the technical characteristics of each LKS; 2) identify appropriate end-uses for each LKS; 3) identified established species for which each LKS can be substituted; 4) develop a reliable source and product supply; 5) identify and target appropriate niche markets, including domestic and regional markets; and 6) develop effective promotional material and marketing strategies for each LKS.

Best and others (2002) surveyed woodworkers in the Southeast of the U.S. to determine their lumber usage, buying preferences, preferred delivery method, and most effective methods of communication in order to increase the effectiveness of marketing plans of lumber producers and lumber sellers. They found that respondents on average bought 1,275 BF/year of green lumber, an 11,713 BF/year of dry-kiln lumber. Seventy-five percent preferred to deal with saw mill operator/owner rather than wholesalers. Sixty-eight percent currently do not use the Internet to search lumber but 35% of them indicated that they would purchase lumber through internet if they could purchase what they need. They found also found that respondents' strategies to compete with larger firms, at cost advantage, in order include: the use of lesser-known wood

species, thin stock (drawers and specialties), turning squares and wood from certified forests (FSC guidelines).

Roos and others (2005) conducted a study in the Pacific Northwest of the U.S. to identify differences between appearance-based and word-based evaluation of wood species in the cabinet industry. They suggest that certain species names should be emphasized in cabinet door making, while others should be avoided. Berger and others (2006) conducted a research among consumers of wood flooring in Austria. They found that the majority of respondents were able to distinguish between different types of flooring (i.e. oiled parquet, lacquered parquet, and laminate), and they preferred were oiled flooring types. These studies give important understandings of target markets for Bolivian LKS, and Bolivian exporters can take into account in promotional campaigns, sales tactics, and presentation at the point of sale.

Gutierrez and others (2002) characterized the Bolivian forest products sector and its competitiveness. The authors found that adequate transport infrastructure is crucial for the competitiveness of Bolivian wood manufacturers in international markets. They quoted the experience of one exporter in La Paz, Bolivia that reduced its transport costs in 50% because the road between La Paz (Bolivia) and Chile (Arica) was asphalted. Gutierrez also found that the Bolivian forest products sector lacks of adequate training, technological development and innovation and recommended the creation of a coordinated national program of research and development of forest products along the chain from logging to exports.

According to Sacre (2002) the market for pulp, plywood, particleboard, and sawn lumber for construction and packaging are not viable options for exporters of Bolivian forest products, "..Bolivia should lead its production to the furniture industry; and sectors of the secondary processing (doors, floors, etc.)…". The author emphasized that lesser-known wood species will not be viable for exporting only as sawn lumber, and argue that the final consumer is willing to accept a combination of wood species with similar characteristics.

Results and Discussion

SWOT Analysis

Strengths

The Bolivian forest products sector has a strong commitment with the environmental certification of its rainforests. This initiative brought about that Bolivia is recognized as leader in the forest management of natural tropical forests. After the promulgation of the Bolivian forestry law the Bolivian forest products sector has gain substantial experience in controlling illegal logging and control of wood species harvested.

Bolivia has a variety of wood species for diverse applications. More than 400 wood species are used in Bolivia and with a lot of potential (Antelo 2007). With the increasing trend in the exports of Bolivian wood products, Bolivian manufacturers have gained experience utilizing those species. Bolivia counts with 28.8 million hectares of forest lands for a sustainable production (Gutierrez et al. 2002).

Weaknesses

Bolivia is a landlocked country, consequently with high transportation costs. "..domestic transport infrastructure in terms of road access and pluvial ports is still precarious.." (Antsiferova et al. 2005). In addition there are long distances to main ports of export. It is estimated that the transport cost from logging to the ports of export represents on average 21% of the final price of exported wood product (Gutierrez et al. 2002).

Currently Bolivia is experiencing a transition period characterized by a high political instability, and consequently is ranked low in major economic indicators such as government effectiveness, control of corruption or rule of law (Figure 4-1). This fact influences negatively in the attraction of U.S. investors (importers). This was highlighted frequently by respondents and interviewees along this research.

Low marketing efforts in promoting Bolivian LKS *per se*. Current Bolivian LKS that are well-accepted in the U.S. are a consequence of Brazilian marketing efforts. Bolivian forest products exporters took advantage of that. However, there are several Bolivian LKS that are not the priority in Brazilian marketing strategies.

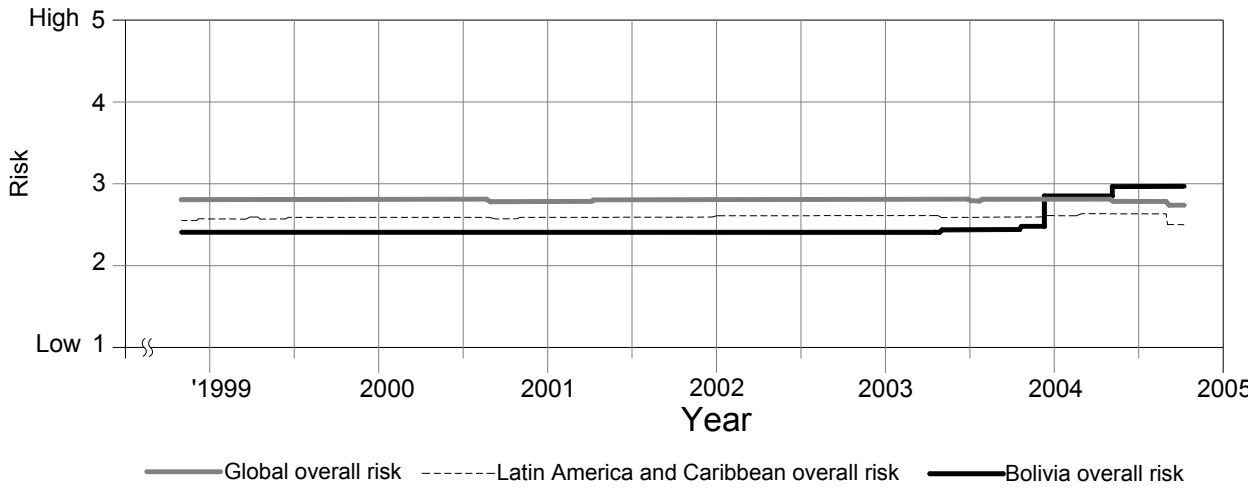

Figure 4-1. Trend of Bolivian Overall Risk Due to Political Instability (Antsiferova et al. 2005)

Sawmills technology are inadequate to provide sawn lumber suitable for exporting. That is, common cutting defects can be observed such as variations in thicknesses, marks, handling damage, stains and sun damage.

Limited capacity of Bolivian companies to offer value added wood products. There are few companies (mostly in the East of Bolivia) that represent the majority of the Bolivian production. The Bolivian forest products sector needs to encourage the diversification and creation of manufacturing centers. For instance one interviewee during this research quoted " …I like the quality of Bolivian wood products, they have considerable volumes of logs and their prices are competitive, but simply there are not veneer mills there…" In addition the low capacity of kiln-dried lumber hampers the production of value-added wood products suitable for exporting.

Opportunities

The incorporation of "traditional" tropical timbers imported in the U.S. in the list of controlled species under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) such as big leaf mahogany, Spanish cedar or Brazilian rosewood will open new opportunities for lesser-known wood species.

The increasing demand for certified wood products will benefit the consumption of Bolivian certified lesser-known wood species. It is expected that the global demand will increase at a rate of 9 to10% per year in the mid-term (Antsiferova et al. 2005),

Many Bolivian wood species (including lesser-known) exist in the Brazilian rainforest as well. Brazil has undertaken important marketing efforts to promote these species in the U.S. market and currently they are well-accepted in such market. The Bolivian forest products sector can take advantage to learn of Brazilian experiences exporting lesser-known wood species to the U.S. In addition Brazilian companies had acquired better reputation than African or Asian companies in the U.S. market as stated during the personal interviews conducted during this research.

Advances in new technologies and information systems give good opportunities to Bolivian exporters of lesser-known wood species to expand their markets. Integration of Global Position Systems (GPS) and Internet can provide accessibility, control and promptly communication between Bolivian exporters and U.S. importers.

Threats

The emergence of new composite materials that are becoming good substitutes for solid wood products in the secondary wood industry is an important threat for tropical wood species. Demand for products such as plastic mouldings, wood-plastic deckings, MDF-based floorings or paneling doors are expected to growth in the U.S.; and consequently affect the importation of tropical hardwoods. European countries such as Poland, Slovenia or Croatia are taking advantage of new technologies to introduce new products in the E.U. that are close substitute to tropical timber, and eventually could reach the U.S. market (Antsiferova et al. 2005).

Marketing initiatives of competitors undoubtedly will affect the exports of Bolivian tropical wood species to the U.S. For example, Brazil, with its aggressive campaign to promoting it exports of furniture to the U.S., and its control to illegal logging of big leaf mahogany (*Swietenia macrophylla*) would bring about the increase of the exploitation of Brazilian lesser-known wood species. China is a constant threat that already has put in conflicts the U.S. furniture industry, and surely impacts the importation of tropical timbers. In addition, companies from Central America and the Caribbean are increasing their marketing efforts and technical research on lesser used species (Forster et al. 2003, Vlosky and Aguirre 2001).

Currently, the Bolivian political situation is in transition, and many changes are expected. One is the uncertainty of the continuation of the tax and duty exemption to the exportation of Bolivian wood products to the U.S. It is estimated that such exemption represents approximately

20% of the operational costs of Bolivian exporters (Antsiferova et al. 2005). Without this advantage Bolivian manufacturers should do great efforts to remain exporting wood products to the U.S. In addition, the movement of environmental NGOs impacts the utilization of tropical timbers coming from the rainforest. Large campaigns against the utilization of forest products has a negative impact on the overall global demand of tropical timber (Antsiferova et al. 2005).

Marketing Recommendations

The following paragraphs outline some marketing strategies that the Bolivian forest products sector can take into account when considering introducing Bolivian lesser-known wood species to the U.S. Some target markets are suggested and the recommendations are based on marketing principles (Peter and Donnelly 2005).

Promotion

During the mail survey respondents recommended that marketing efforts are required to provide useful information to customers. In addition, the preferred sources of information about new wood species were: “direct contact with suppliers”, “word of mouth” and “web sites”. In the case of the first two sources of information, the success of promoting will depend on the performance of each Bolivian company in particular. However the Internet can be exploited to provide useful information to U.S. importers. As an example, Bolivian companies can take advantage of Rich Internet Applications (RIA, developed by Macromedia®) that provide outstanding capabilities, and at the same time the customer can be informed faster and visually. This technology allows incorporating such information in CD promotional multimedia material, or in business presentations. Figure 4-2 shows an example of how this technology can be applied to promote Bolivian lesser-known wood species.

Regarding the brand names of Bolivian species, the survey conducted revealed that some common names are well-established in the U.S. market place. Thus, Bolivian species should be marketed according to these known-names. For example *tajibo* (Bolivian LKS) should be marketed as *ipe* (established name in the U.S. marketplace). Bolivian LKS that are not well-known in the U.S. market should be marketed incorporating any U.S. domestic wood species, or any well-known imported species.

Figure 4-2. Example of the Use of Rich Internet Applications to Promote Bolivian LKS

For example *mururé* (Bolivian LKS) can be marketed as *Bolivian teak*. Table 4-1shows possible brand names (or tags) for Bolivian LKS. It is important to note that those brand names are only examples and variations may exist. They are based on common names found during the literature review and similar characteristics with other species. However, it is important that any brand name should be accepted, in consensus, by overall Bolivian forest products sector in Bolivian domestic markets. Other considerations for adopting brand names include: 1) some Bolivian names can be difficult to pronounce such as *guayabochi* or *jichituriqui* for English speakers, so small names that are easy to pronounce and easy to remember should be adopted; and 2) take advantage of similar species that are becoming difficult to find in the U.S. market, e.g. *sapele*.

Table 4-1. Examples of Brand Names for Bolivian LKS in the U.S. market

Bolivian LKS	Brand names (or tag)	Bolivian LKS	Brand names (or tag)
Bibosi	*bibosi, Bolivian alder*	Murure	*Bolivian teak*
Cambará	*jaboty, cambará*	Ochoo	*Bolivian ash, white mahogany*
Cuchi	*tigerwood, goncalo alves*	Palo María	*Bolivian meranti, santa maria*
Cumarú	*cumaru, Brazilian teak*	Paquio	*jatobá, Brazilian cherry*
Curupaú	*curupay*	Sirari	*Bolivian oak*
Cuta	*garapa*	Soto	*soto*
Guayabochi	*palo blanco, Bolivian maple*	Tajibo	*ipe*
Jichituriqui	*Bolivian sapele*	Verdolago	*Bolivian pecan (hickory)*
Mara Macho	*tornillo, Bolivian mahogany*	Yesquero Blanco	*Bolivian birch*
Momoqui	*Bolivian walnut, dark ipe*	Yesquero Negro	*jequitiba, Bolivian okoume*

Some Bolivian LKS are well-known in the U.S. market, thus different promotional efforts should be performed. For instance, Bolivian exporters should develop market penetration strategies for some species, i.e. "to persuade" U.S. importers to buy commonly imported species from Bolivia such as *ipe*, *garapa*, *cumaru*, *jaboty* and *jatobá*. On the other hand, they should formulate market development strategies for other species, i.e. "to inform" U.S. importers, wholesalers and retailers about the characteristics, price and availability of the rest of Bolivian LKS.

Environmental certification can be used as a good marketing tool. Bolivian exporters should promote environmentally certified wood species through architects, designers, constructors and retailers, rather than importers, wholesalers, manufacturers or distributors. That is, a "pull marketing" strategy. During any promotional campaign focused on the final consumer is important to emphasize that certified Bolivian LKS are associated with environmental issues and not with a measure of quality and excellence, since final consumer of hardwood lumber in the U.S. generally misunderstand the term "certification" (Smith and Gomon 2003). It is important to emphasize that the purchasing of environmentally certified Bolivian LKS will not go with detriment of the quality of the product (Gomon 2002).

Pricing

Generally, U.S. importers would pay the same price for a Bolivian LKS that substitutes currently imported species in the U.S. Bolivian companies should not expect premium prices by

selling environmentally certified Bolivian LKS in the U.S. marketplace. Small and medium size companies should be targeted. The western region of the U.S. seems to be the best target market, since companies in California and Oregon would pay more for environmentally certified wood products and Bolivian LKS substitutes. In the eastern U.S., New York and North Carolina should be good target markets.

The Bolivian forest products sector should work in a "price structure" that allows U.S. companies to obtain updated information on prices, historical trend of price stability, and advantages of price/volume purchases for all Bolivian LKS marketed in the U.S. Species such as ipe, garapa or jatoba already have market-prices in the U.S. and Bolivian companies should work to compete with those prices. However, it is advisable that other Bolivian LKS such as soto, guayabochi or jichituriqui should be marketed at lower prices, i.e. from 5% to 20% less than traditional species.

Distribution

U.S. importers are reluctant to the use of intermediaries. Thus, conventions, fairs and trip tours are still the best approach to find new customers (importers). However, the use of agents and centralized promotion centers in the U.S. is advisable. The following quote from one respondent to the mail questionnaire summarizes the craving of the majority of respondents: "An agent in the US with samples of the lumber, the ability to fill small sample orders and advertisement budget."

The landlocked geographic location of Bolivia hampers any physical distribution of wooden products. As stated by Zarzoso and Burguet (2005), "… being landlocked significantly deters trade…". In addition, the inaccessibility to log supply centers delay the logistics and increase costs. Hence, the Bolivian forest products sector should work in speeding up the supply of raw material to the major manufacturing plants through the improvement or construction of key transport networks. The use of mathematical programming techniques can help a lot in this venture (Biongiorno and Gilless 2003, pp. 203-220).

One way for reducing delivery times is to take advantage of the Internet and e-business. Technologies such as order-tracking or dynamic database are affordable now for Bolivian exporters and Bolivian organizations linked to forest products. The Internet is becoming a major important logistical tool for importers, exporters and transport companies (Albaum et al. 2005)

Conclusions

Bolivian wood manufacturers have gain substantial experience exporting value-added wood products. This trend should continue and Bolivian policies should encourage the exportation of secondary wood products. This study has shown that a good strategy to promote Bolivian LKS is through value-added wood products. But it is important to "test" the economical and technical feasibility of lesser-known wood species in domestic markets before going internationally. That is, several Bolivian LKS are used in lesser extent in domestic markets of value-added wood products. Marketing efforts domestically will provide useful insights regarding the acceptance of lesser-known wood species in the U.S.

Another considerations is to narrow the cultural dissimilarities between Bolivian exporters and U.S. importers from the point of view of business relationships. As stated by Zarsoso and Burguet (2005), "…cultural similarities, as sharing a language, foster trade." Maybe this recommendation is more valid for exporting to other markets such as China or Japan. However, initiatives like the consulting firm Asia Marketing and Management™ can be followed to explain U.S. importers how to make businesses with Bolivian companies (moreover with indigenous communities) (Chan 2006). This study demonstrated that U.S. importers give the highest importance to trustworthy on suppliers and quality of wood species. In addition they prefer to locate supplier through "word of mouth". Therefore, high emphasis should be done to increase the image and reputation of Bolivian companies.

The strategies formulated here were based on literature review, personal interviews and personal experience. Further research is necessary within the Bolivian environment to formulate appropriate marketing objectives and strategies. However these strategies can serve as input for Bolivian marketing endeavors in the U.S.

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CHAPTER 5. GENERAL CONCLUSIONS

Summary

The rise of prices of domestic hardwood lumber in the U.S. during last years and quality decline due to the utilization of small diameter logs are some factors that bring about the utilization of non-traditional U.S. wood species, and the importation of tropical timbers. On the other hand regulations to the trade of traditionally imported tropical species in the U.S. brings about that importers and manufacturers look for alternative species, commonly known as lesser-known or lesser-used wood species. Consequently the import of tropical hardwood lumber into the U.S. has risen during last five years.

The first objective of this study was to assess the U.S. market for the importation of certified Bolivian lesser-known wood species. Analysis showed that many Bolivian wood species that were considered lesser-known in this study, in fact, are traded in significant volumes, and even surpassing the traditional wood species imported into the U.S. Bolivian species such as tajibo, paquio, cuta and cumarú that few years ago were unknown currently are well-accepted in the U.S. It is important to note that these species exist in Brazilian or Peruvian regions. Thus, this not necessarily means that these species are imported exclusively from Bolivia. Remarkably, three of these species (ipe, paqui and cuta) are at the top of the last new imported species in the U.S. Other species, even though in lesser extent, include yesquero negro, palo maria and cuchi. Overall members of the supply chain (importers throughout retailers) typically try 1 or 2 new species per year. However, importers and retailers tend to try more new species (commonly ranged from 1 to 7). Retailers are the type of business that tries more new species (on average five in 2006). These results suggest that seven Bolivian LKS (tajibo, cuchi, yesquero negro, palo maria, cuta, paquio and cumarú) have good and growing market opportunities in the U.S. The rest of Bolivian LKS would need more marketing efforts.

U.S. importers of tropical hardwoods in general are planning to increase their imports from 6 to 20% by 2007. In general U.S. companies import less than 100 MBF per year of tropical hardwoods. This research indicated that there are not significant differences between types of businesses regarding their interest on lesser-known species or willingness to pay more for a Bolivian wood species substitute. Thus the overall supply chain (importers, distributors, wholesalers and retailers) can be considered as a whole. In general they are interested in trying

lesser-known wood species. Almost half of the companies (i.e. 48%) import environmentally certified wood products. There are several companies that their entire imports are environmentally certified (10%). Typically the volume of imported environmentally certified wood products represents 10% of importers' overall imports. These results suggest that U.S. importers likely are using tropical wood products in specialty applications and demand them in low quantities.

The second objective was to identify Bolivian lesser-known wood species that can substitute commonly hardwood species marketed in the U.S. (domestic and imported). Analysis showed that there are several Bolivian LKS that can substitute currently common U.S. domestic hardwoods and other Bolivian LKS are better substitutes to other tropical hardwoods imported in the U.S. In the first case species like cambará, mara macho, palo maria, sirari, yesquero blanco, and yesquero negro may have good acceptance in the U.S. domestic hardwood market. On the other hand, species like bibosi, cuta, murure, paquio and verdolago could be potential substitutes for other tropical hardwoods imported into the U.S. In addition there are some Bolivian LKS that have unique characteristics such as tajibo, momoqui, soto, guayabochi and jichituriqui. This analysis suggests that different Bolivian lesser-known wood species require different target markets, and consequently different marketing efforts.

Finally the research sought to recommend some marketing strategies for introducing Bolivian LKS in the U.S. There is a potential for Bolivian lesser-known wood species in several industry sectors. The flooring, decking and sawnwood lumber segments show the most potential. However if we incorporate the environmentally certification factor, the segments of flooring and secondary processing (doors and millwork) have the most potential. In the case of the paneling segment, decorative veneer shows most potential because of the uniqueness and distinctiveness in colors and textures of Bolivian tropical timbers. However the paneling segment is more volume and price sensitive, which would not be considered a good target market for Bolivian exporters considering current Bolivian capacity.

A general conclusion of this research can be summarized in the following statements:

There are potential niche markets for Bolivian lesser-known wood species. They can be segmented according to gross sales of U.S. companies, states where companies'

headquarters are located, industry sectors and purchase of environmentally certified wood products.

Even though U.S. companies are not willing to pay premium prices for environmentally certified wood products, there are companies (within certain states) that are willing to pay little more for environmentally certified tropical hardwoods.

In general, U.S. importers are planning to increase their imports of tropical hardwood species. They frequently are looking for new species. Commonly, U.S. importers, wholesalers, manufacturers and retailers are willing to try lesser-known wood species.

Results suggest that environmental certification can be a good indicator for segmenting the U.S. market for lesser-known wood species. Premium prices can not be expected for substitute species; however the incorporation of environmental certification can encourage premium-prices. Respondent companies are small firms and likely with little knowledge about Bolivan LKS, thus marketing efforts are necessary to promote Bolivian LKS with these firms.

Implications of this Research

Marketing is a process. This research can be the beginning of an integrated marketing management process for Bolivian LKS in the U.S. Important steps have been concluded, but a lot of work there is ahead. Bolivian manufacturers of wood products, exporters and institutions linked to the forest products sector in Bolivia can be benefited of the methodology and results obtained in this research. Multivariate and descriptive statistics are demonstrated to be useful tools for segmenting and understanding the U.S. market for Bolivian lesser-known wood species.

This research can help U.S. importers to gain a better understanding of Bolivian lesser-known wood species and the importation of tropical hardwoods. While the trend of the importation of tropical timbers continues, U.S. trade organizations will have to rearrange or re-classify the current international trade codes in order to track the “new species” marketed.

Opportunities for Future Research

This study has shown that Bolivian LKS have good market opportunities in the U.S. Some Bolivian LKS are well-accepted in the U.S. market, thus only promotion is needed. However, other species require reliable technical information on mechanical properties, machinability and finishability. Therefore, such studies should be conducted according to the

ASTM standards on the following Bolivian LKS: sirari, bibosi, ochoo, soto, guayabochi, jichituriqui, murure and momoqui. In addition, this study considered only those Bolivian wood species promoted by BOLFOR II. However, there are other Bolivian LKS that should be incorporated in future studies.

This research was focused on importers of tropical hardwood products in the wood industry in the U.S. More research will need to be done on the side of architects, designers and builders & constructors, which would include their perceptions on Bolivian LKS and the implications of the regulations in the use of environmentally certified tropical hardwood products in constructions (e.g. LEED). Furthermore, since this study implies Bolivian wood products, it will be needed further research on the Bolivian forest products sector to establish an integrated marketing strategy for introducing Bolivian LKS in the U.S. Such research would include a study of prices and availability of Bolivian LKS, and potentially marketed Bolivian secondary wood products made from LKS.

Limitations of this Study

Statistical results should be view cautiously, since it is based on small sample frame. Volumes and percentages of species imported also should be viewed cautiously, since they represent various types of companies and an overlapping might occur, i.e. retailers may state values that already were included by importers or wholesalers. This research study did not include architects and constructors in the survey, which could influence some statistics such as the overall acceptance of Bolivian LKS in the U.S. and willingness to pay for Bolivian wood species substitutes.

The characterization of Bolivian LKS is based on literature review and some species lack of reliable sources of information. Even though the database program developed can provide good results comparing species, those results should be view cautiously as well. This research was centered on common tropical hardwoods and U.S. common hardwoods. It is recommended to compare Bolivian LKS with U.S. softwoods, U.S. “non-tradition” species and imported temperate hardwoods.

APPENDIX A
QUESTIONNAIRE, COVER LETTER AND POSTCARD

Survey of U.S. Companies
Use of Bolivian Certified Lesser-Known Wood Species

The purpose of this questionnaire is to identify incentives and barriers to the importation of Bolivian lesser-known wood species. We define "lesser-known" as any wood species that is relatively unknown by your company or traded in very low quantities. We define "environmentally certified" as coming from forests that are sustainably harvested and managed, and certified by an independent third party organization. Please take a few minutes to answer the following questions. Your participation is very important and greatly appreciated. Your answers will be held in strict confidence and no individual or company names will be used anywhere in the research results. Please do not hesitate to call me at (540) 231-7107 or e-mail me at vhcossio@vt.edu with any questions or concerns you may have. *Thank you*

1. Which type of business best describes your company? (check one)

☐ Wholesaler ☐ Importer ☐ Distributor
☐ Retailer ☐ Broker ☐ Other_____
☐ Agent ☐ Manufacturer _____

2. What wood products do you import made from tropical species? (check all that apply)

☐ Sawnwood ☐ Cabinets ☐ Outdoor furniture
☐ Flooring ☐ Doors ☐ Paneling
☐ Furniture ☐ Windows ☐ Plywood
☐ Millwork ☐ Decking ☐ Other _____

3. Is your company member of a trade association?

☐ No
☐ Yes – Please name the association(s) here

_____

4. How many new imported wood species did your company try in 2006?

_____

5. Name the last NEW species that you purchased?

_____

6. Would you be interested In importing wood products made from "lesser-known" species?

Not interested	Little interested	Fairly interested	Interested	Very interested
☐	☐	☐	☐	☐

7. Please list any species from your current product mix for which you need to find a substitute species.

_____

_____

Why do you need this substitute?

_____

8. Have you identified any wood species that you would like to incorporate in your product mix?

☐ Yes ☐ No

If YES, which is that? _____

and, why you haven't incorporate it yet? _____

_____

9. Please list the 5 most common wood species that your company imports, and estimate its percentage of your total imports (use commercial or scientific names).

		% of total imports
1st		%
2nd		%
3rd		%
4th		%
5th		%

10. What is important for you to try a new imported species? (Please circle one number for each)

	Least important		Somewhat important		Very important
Easy to machine	1	2	3	4	5
Easy to finish	1	2	3	4	5
Mechanical properties	1	2	3	4	5
Natural durability	1	2	3	4	5
Color	1	2	3	4	5
Strength	1	2	3	4	5
Texture	1	2	3	4	5
Density (specific gravity)	1	2	3	4	5
Surface hardness	1	2	3	4	5
Stability (shrinkage/swell)	1	2	3	4	5
Straightness	1	2	3	4	5
Environmentally certified	1	2	3	4	5
Price	1	2	3	4	5
Long-run availability	1	2	3	4	5
Trustworthy (supplier)	1	2	3	4	5
Kiln-dried	1	2	3	4	5
Graded under U.S. standards	1	2	3	4	5
Quality	1	2	3	4	5
Known supplier	1	2	3	4	5

Questionnaire: page 1

11. From the following list of products how likely are you to try a new wood species in 2007? (Please circle one number for each)

	Definitely will not try		Maybe to try		Very likely to try
Doors	1	2	3	4	5
Windows	1	2	3	4	5
Moulding	1	2	3	4	5
Flooring	1	2	3	4	5
Decking	1	2	3	4	5
Kitchen cabinets	1	2	3	4	5
Outdoor furniture	1	2	3	4	5
Office furniture	1	2	3	4	5
Parquetry	1	2	3	4	5
Plywood or veneer	1	2	3	4	5
Dimension and components	1	2	3	4	5
Other, specify _____	1	2	3	4	5

12. Please indicate if your company imports the following wood species: (circle for each)

Palo Maria (Santa María)	Yes	No
Curupay (Curupaú)	Yes	No
Garapa (Cuta)	Yes	No
Momoqui	Yes	No
Meranti	Yes	No
Jaboty (Cambara)	Yes	No
Jatoba, Courbaril (Paquio)	Yes	No
Jequitiba (Yesquero negro)	Yes	No
Patagonian Cherry (Sirari)	Yes	No
Mahogany	Yes	No
Tornillo, (Mara Macho)	Yes	No
Virola (Sangre de Toro)	Yes	No
Bibosi	Yes	No
Sapele	Yes	No
Jichituriqui	Yes	No
Cuchi	Yes	No
Murure	Yes	No
Teak	Yes	No
Cumarú (Almendrillo)	Yes	No
Verdolago	Yes	No
Yesquero	Yes	No
Ipé (Tajibo)	Yes	No
Guayabochi	Yes	No
Ochoo	Yes	No
Quebracho (Soto)	Yes	No

13. Are you planning to increase imports of tropical hardwood species in 2007?

☐ Yes ☐ No

If YES, approximately how much more would you expect to increase your imports? (check one)

☐ 1 – 5% ☐ 16 – 20%
☐ 6 – 10% ☐ 21 – 25%
☐ 11 – 15% ☐ > 25%

14. If you were considering to import new wood species, would you rather deal with: (circle one number for each)

	Least preferred				Most preferred
U.S. importers/brokers	1	2	3	4	5
International agents (freelance)	1	2	3	4	5
Agents of your company	1	2	3	4	5
Producers in the country of origin	1	2	3	4	5
Governmental organizations	1	2	3	4	5

Other that you prefer: _____

15. Please list the top 4 countries of origin for the wood products that your company imports. (estimate the percentage of your total imports for each country)

	% of total imports
1st _____	☐ %
2nd _____	☐ %
3rd _____	☐ %
4th _____	☐ %
All other countries	☐ %
	100 %

16. Please estimate the number of 20-foot containers of wood products that your company imported during 2006. (check one)

☐ 0 (Did not import in 2006) ☐ 16 - 25
☐ 1 - 5 ☐ 26 - 50
☐ 6 - 10 ☐ 51 - 75
☐ 11 - 15 ☐ More than 75
Give number ____

17. How much of your imports are "environmentally certified"?

Environmentally certified	☐	%
Non-certified	☐	%
Total imports	100	%

☐ Don't know

18. If an imported species from Bolivia were available that was a good substitute for a species you currently purchase, what would you be willing to pay for that species? (check one)

☐ 0% (same price)

☐ 1 – 5% less ☐ 1 – 5% more
☐ 6 – 10% less ☐ 6 – 10% more
☐ 11 – 15% less ☐ 11 – 15% more
☐ 16 – 20% less ☐ 16 – 20% more
☐ > 20% less ☐ > 20% more

19. What are the major reasons for you to try a new imported wood species?

_____
_____

Questionnaire: page 2

20. Where do you usually get information on new imported wood species? (check up to 3)

☐ Trade associations ☐ Newsletters
☐ Web sites ☐ Catalogs
☐ International trade shows ☐ Word of mouth
☐ Trade shows in the U.S. ☐ Distributors
☐ Direct contact with suppliers ☐ E-mail
☐ Trade magazine advertisements ☐ Other _____

21. How much more would you expect to pay for imported "environmental certified" wood products? (check one)

☐ 0% (do not pay more) ☐ 11 – 15%
☐ 1 – 5% ☐ 16 – 20%
☐ 6 – 10% ☐ > 20%

22. Which of the following brand names would be most acceptable in the U.S. market for a Bolivian species that is a good substitute for North American ash? (check one)

☐ South American ash
☐ Bolivian ash
☐ Ochoo
☐ Hura
☐ Other, please suggest: _____

23. What are the potential barriers to importing Bolivian products made from lesser-known wood species? (circle one for each)

	Not a barrier		Maybe a barrier		Large Barrier
Transportation and logistics	1	2	3	4	5
Bolivian wood products' prices	1	2	3	4	5
Bolivian companies' reputation	1	2	3	4	5
Language barriers	1	2	3	4	5
Communication with producers	1	2	3	4	5
Quality of Bolivian products	1	2	3	4	5
Punctual delivery	1	2	3	4	5
Bolivian production capacity	1	2	3	4	5
Bolivian governmental policies	1	2	3	4	5
International policies	1	2	3	4	5
Knowledge of Bolivian wood products	1	2	3	4	5
Lack of agents/brokers	1	2	3	4	5
Past experience	1	2	3	4	5

Others that you consider important, and we didn't address?

24. How do you rate your past experience importing Bolivian wood products?

Very bad	Bad	Neither bad nor good	Good	Very good
☐	☐	☐	☐	☐

Why?

☐ We never imported Bolivian wood products

25. What would you recommend to increase the imports of lesser-known wood species from Bolivia?

_____

_____

These questions are for classification purposes only:

26. Please estimate the percentage of total wood products purchased by your company in 2006.

U.S. domestic hardwoods		%
Imported temperate hardwoods		%
Imported tropical hardwoods		%
Softwoods		%
Total purchased	100	%

27. Please estimate the volume of HARDWOOD products your company imported in 2006 (thousand board feet).

MBF

28. Please give the approximate gross sales of your company in 2006 (check one).

☐ Less than $1,000,000 ☐ $20,000,001 - $30,000,000
☐ $1,000,000 - $5,000,000 ☐ $30,000,001 - $40,000,000
☐ $5,000,001 - $10,000,000 ☐ $40,000,001 - $50,000,000
☐ $10,000,001 - $20,000,000 ☐ Greater than $50,000,000

29. On average how many full-time employees did you have in 2006?; include all company locations (check one).

☐ Fewer than 25 ☐ 101 - 150
☐ 25 - 50 ☐ 151 - 200
☐ 51 - 75 ☐ 201 - 300
☐ 76 - 100 ☐ Greater than 400

30. Is there anything else you wish to share with us concerning the use of "lesser-known" wood species in your company?

_____

_____

_____

☐ Yes, I would like to receive an electronic version of the results of the study, my e-mail is:

_____

Thank you for your help! This information will be kept confidential. Please fold, tape, and return the questionnaire. The postage is prepaid.

Questionnaire: page 3

VirginiaTech
College of **Natural Resources**

Department of Wood Science and Forest Products
Center for Forest Products Marketing and Management
1650 Ramble Road (0503), Blacksburg, VA 24061
(540) 231-7107 Fax: (540) 231-8868
http://www.cfpmm.vt.edu

February 14, 2007

Jameson French
Northland Forest Products, Inc.
16 Church Street
P.O. Box 369
Kingston, NH 3848

Dear Mr. French,

With the increasing demand for imported wood products many companies are looking for alternatives to currently imported species. The Center for Forest Products and Management at Virginia Tech is conducting research among executives and managers in the wood industry. The purpose of this research is to find out the opinions of yourself and other experts on the import of Bolivian lesser-known wood species (LKS). For this study "lesser-known wood specie" is defined as any specie that is not commonly used within the wood market or is used in very low quantities.

Your company was selected among others because of its experience with the importing of wood products. Your answers are very important to the accuracy of our research, whether or not your company is involved in importing Bolivian wood products.

It will take only a short time to answer the simple questions on the enclosed questionnaire, fold, tape, and return it. Of course all answers are confidential and will be used only in combination with those of other executive and managers of all over the U.S.

If you are interested in receiving a free electronic version on the findings of this research, just check the request at the end of the questionnaire and write-in your e-mail. We will be glad to send you a complimentary report when ready.

Please return the completed questionnaire at your earliest convenience. If you should have any questions, please contact me by phone at (540) 231-4525 or (540)-231-7107, or by e-mail at vhcossio@vt.edu.

Thank you for your help.

Victor H. Cossio
Graduate Research Assistant

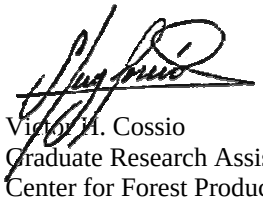
Cover letter

Dear Sir/Madam,

We need your help! Recently I mailed you a copy of a questionnaire dealing with the use of Bolivian wood species within your company. I am contacting you to ask you for help by completing and returning the questionnaire. If you have already returned it, please accept my sincere appreciation. The questionnaire is designed to gather information on the use of certified lesser-known Bolivian wood species. If you have not completed the questionnaire, please take a few minutes now to fill it out and return it.

Your participation is critical for the success of the study. The information you provide will be kept **strictly confidential**. The number on the questionnaire allows us to remove your name from future mailings. If you have any questions, please contact me at (540)-231-4525 or (540)-231-7107, or by e-mail at vhcossio@vt.edu. Our fax number is (540)-231-8868. Thank you in advance for your participation.

Sincerely,



Victor H. Cossio
Graduate Research Assistant
Center for Forest Products Marketing and Management
Virginia Tech

Postcard

APPENDIX B
QUESTIONNAIRE FOR PERSONAL INTERVIEWS

QUESTIONNAIRE FOR PERSONAL INTERVIEWS

The objective of the interview is to obtain in-depth information of key importers regarding the importation of tropical hardwood products; mainly lesser-known wood species (LKS) from Bolivia.

Date: _____ **Time of the meeting:** _____

Contact information of the company:

Interviewee
Name: _____ **Position:** _____

1. What are the product lines of your company?
2. How long have you been importing tropical hardwoods?
3. Have you approached to use any LKS? Why/Why not?
4. Do you import any LKS (or have shifted to an alternative species)? What caused it?
5. What would it take for you to use more LKS?
6. What do you think are the largest barriers to introduce LKS (challenges) in the U.S.?
7. What was the key strategy to introduce new species in your market segment?
8. Do you recall any example of success introducing LKS in the U.S.?
9. Price and availability were mentioned frequently as the major reason to try new wood species. Do you agree? Why/Why not?
10. Is it harder to obtain mahogany, cedar or Amazonia oak (traditional imported wood species)?
11. Which country do you prefer to deal with (benchmark)? Why?
12. Do you have suppliers in Bolivia? Did you try to contact them?
13. What are your feelings of working with companies from Bolivia? Your assessment of Bolivian wood sector?
14. Which would be the biggest challenge to increase the imports of LKS?
15. What strategies would you recommend to import LKS from Bolivia into the U.S.?
16. Do you consider that "environmental certification" impact or will impact your wood species selection?
17. Your market assessment of any new species coming in – What/Where?
18. What do your customers use their products for, what do they look for in your product?
19. Do you see any shift in your customers' preferences for wood species? Most important attributes?
20. Additional comments

Notes

APPENDIX C
LIST OF COMMON AND SCIENTIFC NAMES OF WOOD SPECIES

American beech (*Fagus grandifolia*)
aniegre (*Aningeria spp.*)
balsa (*Ochroma pyramidale*)
bibosi (*Ficus glabrata*)
black cherry (*Prunus serotina*)
black walnut (*Juglans nigra*)
cachimbo rojo (*Cariniana domesticata*)
cambará (*Erisma uncinatun*)
caobilla (*Carapa guianensis*)
cocobolo (*Dalbergia retusa*)
cuchi, tigerwood (*Astronium urundeuva*)
cumarú (*Dipteryx odorata*)
curupaú (*Anadenanthera colubrina*)
cuta, garapa (*Apuleia leicocarpa*)
faveira (*Vatairea spp.*)
guayabochi (*Callycophyllum spruceanum*)
hard maple (*Acer saccharum*)
hickory/pecan (*Carya spp.*)
jichituriqui (*Aspidosperma spp.*)
keruing (*Dipterocarpus spp.*)
khaya, African mahogany (*Khaya spp.*)
mahogany (*Swietenia macrophylla*)
mapajo (Ceiba pentandra)
mara macho (*Cedrelinga catanaeformis*)
marupa (*Simarouba amara*)
massaranduba, quinilla tree, Peruvian cherry (*Manilkara bidentata*)
meranti, dark red (*Shorea negrosensis*)
momoqui (*Caesalpinia spp.*)
morado (*Machaerium spp.*)
murure (*Clarisia racemosa*)
ochoo, hura (*Hura crepitans*)
okoume (*Aucoumea klaineana*)
palo maría, santa maria (*Calicophyllium braziliensis*)
paquio, jatoba, Brazilian cherry (*Hymenaea courbaril*)
purpleheart (*Peltogyne spp.*)
red alder (*Alnus rubra*)
red oak (*Quercus rubra*)
rubberwood (*Hevea brasiliensis*)
santos mahogany (*Myroxylon balsamum*)
sapele (*Entandrophragma cylindricum*)
sirari (*Ormosia coarctata*)
soto (*Schinopsis spp.*)
spanish cedar (*Cedrela spp.*)
tajibo, ipe (*Tabebuia spp*)
teak (*Tectona grandis*)
verdolago (*Terminalia amazonica*)
virola (*Virola spp.*)
wenge (*Millettia spp.*)
white ash (*Fraxinus americana*)
white birch (*Betula papyrifera*)
white oak (*Quercus alba*)
yesquero blanco (*Cariniana ianeirensis*)
yesquero negro, jequitiba (*Cariniana estrellensis*)

VITA

Victor H. Cossio Antezana was born in Cochabamba, Bolivia on July 12, 1973. He received his B.S. in Industrial Engineering from the Universidad Mayor de San Simon, Bolivia in 1998. In the fall of 2005 he started a Masters program in the Department of Wood Science and Forest Products at Virginia Tech after working some years in the secondary processing wood industry in Bolivia. He defended his Master's thesis in the Summer of 2007.