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Forests and Society: The Role of Research

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SECOND PROCEEDINGS OF IUFRO DIVISION 5 RESEARCH GROUP 5.12 SUSTAINABLE PRODUCTION OF FOREST PRODUCTS 2000

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Abstract

The concept of sustainability in the context of forest management holds a different meaning to almost every group that espouses it. Many of these differences arise because of the varying goals and objectives of those who promote the idea of sustainable forest management. When discussing this topic, the question of "sustainability of what" must be answered before reaching a common understanding of goals and objectives. In general, a sustainable approach to forest management uses innovative strategies to conserve biodiversity, improve the balance among alternative forest values, and maintain healthy ecosystems. It is often also expected to retain the aesthetic, historical, spiritual, and other qualities of the land. Various silvicultural techniques may be used to alter the developmental trajectory of existing forests to provide this range of values. In some cases, management strategies include removing wood as a primary goal. In other cases, wood is removed as a secondary objective during treatments to improve forest health, restore wildlife habitat, create recreational opportunities, mitigate impacts of forest insects and diseases, or alter the vegetative mix for increased biodiversity. Forest management strategies that aim to produce wood on a sustainable basis take many different approaches. A common model is one where tenets of conservation biology are implemented on parts of the managed landscape, often employing networks of reserves, or near reserves, on the areas considered most biologically sensitive, and management for wood occurs on adjacent, less sensitive, and often less productive lands. Another less common approach is to attempt to mix production of wood and other resource values on the same piece of ground in an attempt to manage ecosystem processes. In these cases, forest managers must either have the trust and confidence of members of the public who advocate sustainable forest management or have sufficient autonomy to work counter to public opinion. These, and two types of sustainable forest management strategies are usually planned for large landscapes and judged by using broad indicators of success. They are; however, implemented using a series of small projects, often at the stand or watershed level. It is important to be able to link activities at varying scales and through time in order to understand the implications of how activities at each scale affect outcomes at other scales, and ultimately how such practices collectively influence sustainable wood production.

The Sustainable Production of Forest Products Research Group (5.12) of IUFRO Division 5 was chartered in response to interest demonstrated by delegates at the 1997 all Division 5 Congress in Pullman Washington, USA. The group's charter emphasizes research on local, regional, and global issues regarding sustainably produced forest products. The purpose of the Research Group is to provide a forum for researchers who study the sustainable production of wood and other forest products. The group is intended to increase the awareness of Division 5 members in issues concerning sustainable forestry and to foster interactions between Division 5 members and other IUFRO Divisions or other organizations with an interest in sustainable forestry. The scope of topics addressed by this group will include but not be limited to questions regarding certification of production, life cycle analysis, characteristics and quality of wood products from sustainably managed forests and the economic contribution of wood products to sustainable forestry.

Keywords: Sustainable Forest Management, Wood Products, Forest Certification, Ecosystem Management.

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Sustainable Forestry and Wood Production: Common Ground and Conflicts--the Mission of IUFRO Research Group 5.12

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Abstract
The International Union of Forest Research Organizations (IUFRO) Division 5 Research Group 5.12 Sustainable Production of Forest Products was created in 1998 to (1) promote research on the sustainable production of wood products and (2) encourage communication between IUFRO Division 5, other IUFRO divisions, and other organizations and individuals interested in sustainable forestry. This paper describes the history and objectives of this research group, provides some thoughts on future directions, and summarizes the technical and poster sessions held at the IUFRO 2000 congress in Kuala Lumpur, Malaysia.
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Keywords: sustainable forestry, forest products, silviculture, wood

The Charter
"The Research Group on Sustainable Production of Forest Products focuses on local, regional, and global issues regarding sustainably produced forest products. It provides a forum for researchers who study the production of wood and other forest products in a sustainable manner. Among other things, it examines questions regarding certification of production, life cycle analysis, characteristics and quality of wood products from sustainably managed forests and the economic contribution of wood products to sustainable forestry."

Objectives
1. Promote research on sustainable production of wood products.
2. Encourage communication among IUFRO Division 5, other IUFRO divisions, and other organizations or individuals interested in sustainable forestry.

Current Activities
This proceedings reports on the second symposium of the research group, featuring papers and extended summaries of the 5 invited oral presentations and 12 offered posters. An additional paper by Appanah, Krishnapillay, and Dahlan is included because it was originally part of the 5.12 program but was selected by the IUFRO 2000 Conference Scientific Committee for inclusion in a subplenary session. The authors of these papers come from various parts of the world and cover issues related to sustainable forestry in many of the world's major forest types. They address contentious and technically complex issues facing those interested in managing forests in ways that maintain or restore ecological function while providing the goods and services people desire from the forest. These goods and services include wood products, the research group's primary area of work, but also other things society expects and in many cases is beginning to demand. Some of these things are: sources of safe fresh water and clean air; biological reservoirs to conserve biodiversity of plants, animals, insects, fungi, and other living things; a sense of place, solitude, and spiritual renewal; opportunities for recreation; A source of food; etc.

The Future
Our desire is that the Research Group on Sustainable Production of Forest Products will provide a forum for those interested in examining the role of forest products in sustainable forestry. We are interested in fostering the early stages of the research cycle where creativity is at its height. We want to provide a platform where new ideas are presented in an atmosphere of discovery, a place where researchers, young and old, established and fledgling, feel free to air their views.

We want the research group to be accessible to researchers from all countries. We intend to provide opportunities for scientists from countries with limited research budgets, and toward this end we have opened this proceedings to scientists who were unable to attend the IUFRO World Congress but had a relevant message to present. We want to foster the sharing of ideas among researchers, policymakers, resource managers, wood products manufacturers, and others interested in ways to sustainably produce forest products. We have in the past and will continue into the future to address this goal by inviting representatives of those groups to make presentations at our symposia, and where possible, to develop a format that encourages interaction among individuals with different interests, backgrounds, opinions, and expertise.

Some of the topics that we hope members of the research group will address in this and other upcoming symposia include:

1. Definitions of sustainable forest management and how wood and other forest products fit into these definitions.
2. Effects of third party certification on forest management and products such as:
    a. Ways in which certification will alter the characteristics and availability of forest products.
    b. Importance of certification in maintaining and expanding markets for forest products.
3. Ways that adoption of criteria and indicators of sustainability (such as those agreed to in the Montreal Accords [USDA 1998]) influence the types and quantity of forest products at the national, regional, and global scale.
4. Life cycle (or similar) analysis:
    a. To compare wood with alternative materials.
    b. To compare different forest management strategies.
5. Role of carbon credits in sustainable forestry and its implications for production of forest products.
6. The role of wood preservation and other wood-processing activities as a forest resource management strategy.
7. Substitution of species in the manufacture of similar products.

These are all important topics of today. Over time, we expect this list to change, and we hope that the Research Group on Sustainable Production of Forest Products will become one of the places where those "hot" topics are initially recognized and discussed.

Overview of This Proceedings

The papers and summaries presented in this proceedings provide a cross section of some of the major issues currently being addressed in the area of sustainable production of forest resources. They cover topics ranging from how governments use scientific findings to develop forest management policies to how local populations are finding ways to support themselves by processing wood or nonwood products from forests managed for sustainability.

Oral Presentations

Appanah,Kishnapillay, and Dahlan:

Present a review of the state of forest management in Southeast Asia, particularly Indonesia and Malaysia. They describe the balance that these countries are trying to find among the timber revenues, the forest resource, and the biological diversity these forests provide.

Awang and Bhumibhamon:

Examine the conflicts between human needs and the conservation of biodiversity in forested and previously forested lands in Southeast Asia. They discuss the roles of mining, agriculture, and the forest products industry in altering the forested landscape, as well as the needs of rural populations to secure basic necessities such as energy, shelter, food, medicines, and water from forests. These uses have altered many of the natural forests in Southeast Asia, and attempts are being made to manage the remaining natural forests on a sustainable basis. Plantation forestry plays a role in this strategy, but biodiversity in plantations is much lower than in natural forests. Improvements in technology and better utilization of the wood that is harvested, community forestry, agroforestry, and use of alternative cellulosic materials are providing renewable alternatives to solid wood products.

Ozanne, Bigsby, and Gan:

Examine consumer preferences for wood from certified forests used to make outdoor furniture in New Zealand. They used conjoint analysis to evaluate several factors that consumers might find important including price, warranty, environmental certification, forest type, and country of origin. Their results suggest that New Zealand consumers are most concerned with environmental certification but also prefer materials that come from New Zealand plantations over foreign sources or wood from New Zealand's natural forests.

Chen:
Presents information on the production of wood in various parts of the world and trends in manufacturing technology. The relation of these to the current Chinese wood supply and technical capabilities of the Chinese forest products industry is used to identify fruitful areas for future research is reported.

Johnson, Salwasser, and Bollenbacher:
Provide an overview of the potential role of Federal lands in the United States in achieving sustainable forest management goals. They discuss U.S. population trends and wood use history, and then conclude that at today's use rates, the United States currently has the potential to supply its own annual consumption but will lose this capability by 2050. They describe three major forest types found on U.S. National Forests: low-elevation warm and dry forest types, mid-elevation warm and moist forest types, and upper elevation cool and moist forest types. They discuss management systems that could provide some wood while improving ecosystem health, conserving biodiversity, and meeting other societal goals for each of these forest types.

Kanowski:
Discusses the history of forest management in Australia and the progression of forest management techniques over the past 50,000 years. He highlights how changing perceptions of forest management over the past century have altered management practices and perceptions of the contributions forestry should make to Australian society. This evolution of public attitude has led to a more complex understanding of the concept of sustainability embodied in the principles stated in the Montreal Process of Criteria and Indicators.

Posters

Garcia and de Lima:
Describe a procedure to evaluate and monitor the sustainability of lumber production. This system uses empirical methods to develop relations between tree volume and lumber yield. This is an important step in developing a sustainable management program for *Eucalyptus grandis* W. Hill ex Maid. plantations in Brazil.

Hon:
Summarizes research to develop wood-plastic composite materials that will extend the supply of wood fiber while providing advanced composite materials. These materials have both the high strength and stiffness needed in engineering applications. By combining wood and plastics in composite products, new materials are developed with properties that have the best properties of both materials and reduce demands on natural resources.

Kim:
Describes the adoption of sustainable forestry practices in Korea. Korea has actively participated in the Montreal Process and others including Intergovernmental Panel on Forests under the United Nations Commission On Sustainable Development (UNCSD), which is leading to a greater understanding and acceptance of sustainable forestry practices.

Li:
Evaluates the possibility of using trees from rubber plantations to partially supply China's wood needs. China has the 4th largest rubberwood resource in the world, and developing uses for trees from these plantations is important in the strategy to find domestic sources of timber for the Chinese market.

Magnusson and Hånell:
Tested a new method for spraying municipal sludge pellets on forests stands as a fertilizer. The method was effective and the production of commercially valuable mushrooms increased. Two years after treatments, the heavy metal concentrations in edible fruits and mushrooms were no different than those on the control plots, thereby suggesting that this is an effective method for disposing of municipal sludge that may have beneficial effects on commercially valuable forest vegetation.

McClellan and Deal:
Report on the progress of a large manipulative study in southeastern Alaska in the United States. This study examines alternatives to clearcutting in one of the world's largest old-growth temperate rain forests. Even and uneven-age silvicultural systems are being assessed for

their effects on forest health, stand dynamics, understory plant communities, wildlife habitat, stream ecology, slope stability, hydrology, economics, visual quality, and social acceptability**.**

Middleton, Munro, Dai, Morris, Lum, Watson, Gee, Johal, Reath, Yeun, and Hussein:

Present information on a large cooperative study that examines the wood properties of second-growth western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) from British Columbia, Canada. In this study, trees from fast-grown stands were examined to determine their basic wood properties, and to evaluate their suitability for a wide range of wood products including mechanically graded lumber, veneer, machined wood products, preservative treated wood products, and kraft and theromechanical pulp. The authors concluded that the growth rate of young trees was the best predictor of solid wood properties and that maintenance of relatively high initial stand densities on the best sites may be needed to produce trees with characteristics required for certain product applications, but pulp characteristics were generally similar to those from older stands.

Muga, Githiomi, and Chikamai:

Reported on the use of Neem (*Azadirachta indica* Adr. Juss.) to substitute for species that have become overexploited as raw materials for the woodcarving industry in Kenya. Woodcarving is an important source of income in rural areas, and without adequate supplies of acceptable substitute wood, rural economies will suffer. To a tourist, the macroscopic properties of Neem are indistinguishable from the traditional wood materials used for woodcarvings. The authors suggest product labeling and certification to promote use of this alternative species and inform purchasers of the environmental benefits of its use.

Pascutti:

Outlines a process for manufacturing edible products from the wood of *Jacaratiá spinosa*. This is a unique process that provides the potential for development of a new industry in an area of Argentina with limited employment opportunities, and where ecological concerns about traditional forestry are growing.

Ravindran and Swaminath:

Present information on the Western Ghats forestry project in India. They explore the link between nontimber forest products and rural livelihoods. This study is being conducted collaboratively with others who explore biodiversity and its relation to sustainable forest management.

Sauter, Gonzales, Gordon, Schmidt, and Jaquish:

Discuss the wood properties of western larch (*Larix occindentalis* Nutt.) trees from stands that developed after wildfires and had received precommercial thinning treatments. They found that despite large differences in diameter growth, no significant differences in average wood density occurred among the various spacings, and that branch size in the lower stem did not exceed 20 mm.

Strakhov:

Reports on the progress of establishing the Manditory Certification System by the Russian Ministry of Natural Resources. This certification system will work at the local level to improve the ecological management of forests.

Zhu, Lei, Zang, Zhang, Zhang, and Wang:

Discuss the development of criteria and indicators for sustainable forest management at scales below the national level in China. They describe a case study with the objective of evaluating criteria and indicators at the national, provincial, and forest management unit.

Summary

The mission of the IUFRO Research Group S5.12 is to facilitate active participation and to provide a forum where the role of forest resources in sustainable forest management can be debated. The research group also will recognize that common ground and conflicts prevail in attempts to harmonize the relation between sustainable forestry and wood production.

References

Barbour, R.J. and Skog, K.E. Role of wood production in ecosystem management. Proceedings of the Sustainable Forestry Working Group at the IUFRO all Division 5 Conference, Pullman, Washington, July 1997. Gen. Tech. Rep. FPL-GTR-100. Madison, WI, USA, United

States Department of Agriculture, Forest Service, Forest Products Laboratory. 98p.

USDA Forest Service. 1998. Montreal process criteria and indicators. USDA Forest Service Report to Facilitate Discussion of Indicators of Sustainable Forest Management. http://www.fs.fed.us/land/sustain_dev/sd/welcome.htm.

Sustainable Production of Forest Products in Southeast Asia: What Products and Production Systems?

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Abstract

Forest lands and their associated resources have played significant roles in the socio-economic development of most of the Southeast Asian countries. Much of these forests have either been converted into other land-uses such as agriculture, mining and settlement or disturbed due to harvesting of wood and various other products in support of the forest product industries. Apart from these industries, large proportions of the rural populations of these countries are dependent on the forest resources for their livelihood. The forests supply the basic needs in terms of energy, shelter, food, medicines and water of these rural dwellers.

There are varying degrees of advances in technologies, utilization and market development in these different countries. Sustainable management of these resources will therefore have to take into consideration these different stages of development, and the ecological, economic and social dimensions of the production and other uses. It must adopt a holistic approach and research must be strategic in nature.

Past supplies of forest products have come mainly from the harvesting of the natural forests. Today much of these forests have been exploited or converted into other uses. They are fast diminishing or degraded. However, attempts are being made to put the remaining forests under an appropriate management system with sustainable objectives. Other strategies are also being adopted to meet the expected shortage of supplies due to increased demand following population increases.

The increasing reliance on other production systems is emerging in many of these countries. For example interest in plantations, both on a small or industrial scale, has grown in recent years. However, the number of species used is limited to a few, mainly those with fast growth rates. Likewise, increasingly more products are being produced from community forests or on small farms of individual farmers. Various models of agroforestry practices are in use. Other nontraditional sources of cellulosic materials such as oil palm fibers, bagasse and *Hevea* wood are also fast becoming important particularly in composite industries.

Similarly, the utilization pattern has evolved from the selective harvesting of a few limited species of only large dimension to a wide range of species including those of small dimension. Improvements in processing technologies and market development have produced new products and opened more opportunities. Solid wood utilization is giving way to composite products. More uses are finding their way for each species. Besides wood, other parts of trees are being more intensively researched for complete utilization. Multipurpose species are becoming increasing popular. The products obtained can be used for subsistence or cash income, hence growing trees on farm is becoming more attractive.

Keywords: Sustainable production; Forest products; Production systems; Southeast Asia

A Conjoint Analysis of New Zealand Consumer Preference for Environmentally Certified Forest Products

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Abstract

The study examines the relative importance to New Zealand consumers of environmental certification compared to other wood product attributes using conjoint analysis. A survey of preferences for product attributes for wooden outdoor furniture using different product bundles based on price and warranty for the furniture, and environmental certification, type of forest, and country of origin of the wood. Conjoint results indicate that environmental certification is just one of a number of important attributes. Other important attributes include the country of origin, with New Zealand sources being preferred, and forest type, with plantation grown preferred over wood from natural forests. Cluster analysis of the data indicates that six market segments with unique furniture attribute preferences exist in New Zealand, although the standard demographic variables, such as age, sex, and education, collected in the survey did not provide a basis for profiling these segments.

Keywords: Environmental certification, conjoint analysis, cluster analysis, forest products, marketing

Introduction

Environmental certification of forest management and harvesting practices is a global issue, impacting forest landowners, wood product manufacturers, distribution intermediaries and consumers. Environmental certification is a market-based approach, or works through market incentives to improve forest management. It is also a voluntary approach. The inherent aim of environmental certification is to promote sustainable forest management. The approach is based on the assumption that consumer interest in the forestry dilemma is strong, and this interest may cause consumers to discriminate in favor of environmentally certified forest products (Upton and Bass 1996). Certification programs assume that consumers want to be assured by a neutral third party that a forest products company is employing sound practices that will ensure a sustainable timber output, and sustain other benefits from the forest, such as erosion control, biodiversity, and watershed protection. It is believed that those companies who can prove themselves environmentally responsible by being certified will benefit by differentiating their products and thus increasing their share of the marketplace.

Currently in New Zealand, there are no environmentally certified wood products offered in the market. However, there are many claims by manufacturers and perceptions by consumers of the environmental friendliness of the wood products sold in New Zealand. In addition, a number of companies have seen the benefits of certification and have had their operations certified under either the ISO 14000 system or the Forest Stewardship Council (FSC) approach (McLean 1998). For instance, since Craigpine Timber Ltd. secured FSC certification, they have been able to supply markets in Europe that were previously not accessible to them (McLean 1998). In addition, the New Zealand Forest Industries Council (NZFIC) and the Forest Owners Association (NZFOA) are developing a New Zealand based forest product certification system, the Verification of Environmental Performance (VEP). The NZFIC says that the system is being designed to provide a cost effective, credible environmental performance verification and communication tool for use by New Zealand forest industry companies (Griffiths 1999).

Thus, although Western European consumers are widely held to be the most sophisticated in their demands for green and environmentally certified products, New Zealand has been active in promoting environmental aspects of its production. What has been overlooked though are specific forestry issues which may be of concern to New Zealand consumers, and which would influence purchases of domestic timber. One key issue is to determine whether environmental considerations influence the timber choices of consumers, and which particular environmental issues will be considered as being important. One prevalent assumption of the forest sector is that current plantation practices are sustainable and that this is widely understood by consumers. This assumption is extended to a belief that consumers consider plantation-grown trees to be environmentally superior to other timbers and likely a preferred choice. This belief is not substantiated, and there is little understanding of which factors consumers would include as part of an environmentally friendly timber product. Questions about environmental certification would also include indigenous forestry. It is important to know whether environmental certification would convince consumers that there is sustainable management of indigenous forests, or whether this would influence preferences between 'recycled' and 'new' indigenous timber.

There has been some research into New Zealand consumers' attitudes towards environmental certification. This research has shown that New Zealand consumers are predisposed to environmentally friendly and certified products, would be most trusting of environmental groups as certifiers, and would pay a premium for environmentally certified wood products (Ozanne, Bigsby and Vlosky 1999). However, it has not been determined what the relative importance of environmental certification is compared to other important wood product attributes, such as price, quality level, New Zealand sourced, or plantation grown. Thus, the objective of this research is to determine the relative importance to New Zealand consumers of environmental certification as compared to other important wood product attributes.

The purpose of this paper is to present and discuss the results of a survey of New Zealand consumers, which used a conjoint analysis (CJA) research methodology. CJA was selected because it allows a measurement of the relative importance of attributes considered by respondents conjointly. In addition, CJA can determine the contribution of each attribute level to a respondent's overall preference.

Research Methodology

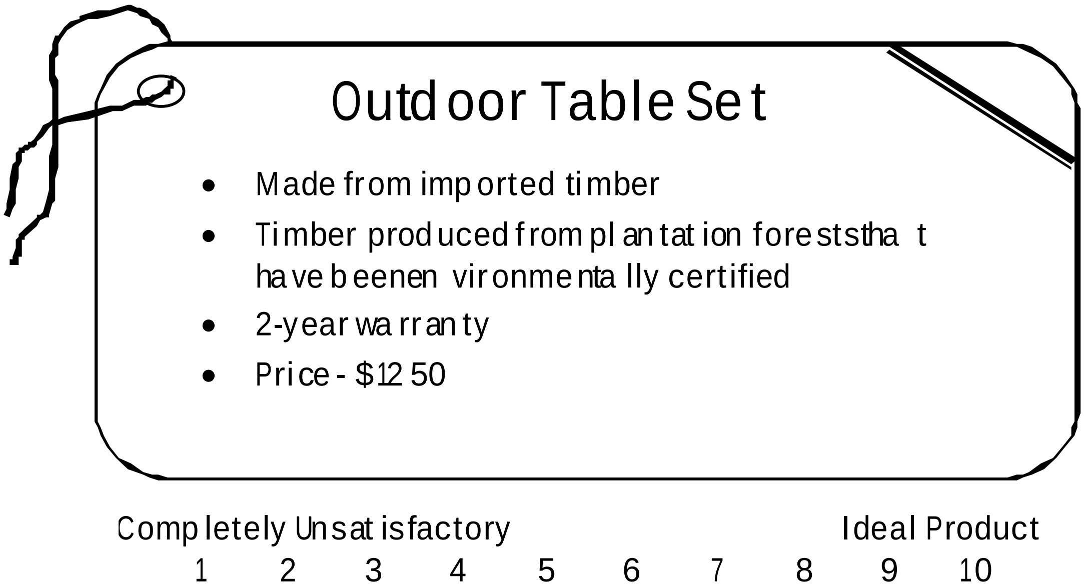
Data on the importance of wood product attributes was collected using a mail survey sent to New Zealand consumers. Survey development and implementation for this study was based on methods recommend by Dillman and described as the Total Design Method (TDM) (Dillman 1978). Data were collected in late 1998 and early 1999. In adherence to the TDM survey guidelines, an initial survey mailing, post-survey reminder and a second mailing were conducted in order to maximize response rates.

The survey instrument contained a number of sections. First, respondents were asked to indicate whether they had shopped for or purchased household furniture within the past 12 months. In this section, they were also asked to indicate whether they had seen products displaying environmental information on packaging or products that had been environmentally certified. These questions were asked to determine the relevance of the conjoint purchase scenario to the respondents.

The second section of the questionnaire contained the conjoint procedure. Respondents were asked to approach this section as if they were intending to buy a wooden outdoor table and four chairs, with a drawing of the furniture being provided for them, along with 12 product labels. Furniture was selected because it was assumed that most consumers would have shopped for furniture at some point in the past, and outdoor furniture was appropriate because data were collected during the summer months. Next, respondents were asked to treat the 12 labels as if they were the labels they would find attached to furniture in a shop (See Figure 1).

Respondents were asked to rate each of the twelve labels by circling the most appropriate number, where one equals a completely unsatisfactory product and ten equals an ideal product. Each label contained a combination of product attributes including, price and extent of warranty for the furniture, and country of origin, forest type, and environmental certification of the wood used (See Table 1). One of two possible attribute levels was provided on each label (Refer to Figure 1). Price and warranty were selected as attributes because in a review of retailer.

Figure 1-Product Label



advertisements and point of purchase information relating to outdoor furniture, these were consistently discussed. Country of origin, forest type and environmental certification were selected because they are attributes that may be of particular relevance to New Zealand consumers.

Table 1-Product Attributes and Levels

Attributes	Level 1	Level 2
Price	$1000	$1250
Warranty	2-year	5-year
Origin	Imported	New Zealand
Forest Type	Natural	Plantation
Certification	None	Certified

Respondents were also asked to read all the labels before answering the section and were advised that they could assign the same rating to more than one label. To help clarify a somewhat complicated task, respondents were given definitions for, natural forests, plantation forests, and environmental certification.

The final section of the questionnaire contained a series of demographic and socioeconomic questions. The research instrument was pretested twice to check for biased, misleading or confusing questions, to verify the quality and comprehensiveness of information received, and to test the effectiveness of the conjoint procedure.

Sample Design

A mailing list for consumers was generated by randomly selecting names from the 1998 New Zealand Electoral Roll. Selecting the sample from the Electoral Roll ensured that respondents would be over the age of 18 and thus more likely to be in the potential target market for outdoor furniture. A total of 500 surveys were mailed. After adjusting the sample size for non-deliverable surveys and incomplete or otherwise unusable surveys, the adjusted response rate was 238 or 52.3%.

Nonresponse Bias

Nonresponse bias is a common concern in survey research. Bias due to nonresponse can be evaluated by comparing those who respond to the initial mailing to those who respond as a result of subsequent mailings and other follow-up efforts (Armstrong and Overton 1977). From this procedure, nonresponse bias was found to be statistically insignificant ($\alpha = .05$).

Data Analysis

Simple frequencies and mean responses were used to report the data on the demographic profile of the sample, furniture purchases, and purchases of environmentally marketed products. Conjoint analysis (CJA) and cluster analysis techniques were used to determine the importance of environmental certification as compared to other forest product attributes, and to segment the respondents. Analysis of variance techniques were used to look for demographic differences in the clusters.

Conjoint analysis is a recent development in mathematical psychology that has been applied extensively in the marketing field. It has been recognised in marketing that consumer decision processes are inherently multidimensional. The basic idea in CJA is that by providing consumer with a range of stimuli from which to choose, we can make inferences about their value systems based upon their behaviour. The word "conjoint" has to do with the fact that researchers can measure relative values of things considered jointly which might be unmeasurable taken one at a time. CJA is therefore concerned with measuring the joint effect of two or more independent variables on the ordering of a dependent variable. In the area of market analysis, it relates the buyer's preferences to a set of pre-specified brand attributes. In addition, CJA determines the contribution of each attribute level to a buyer's preferences.

In this study, CJA allows an examination of respondents' decision-making processes for outdoor furniture purchases by presenting them with a number of combinations of product attributes. Through this analysis, it is possible to discern the relative importance of price, warranty, timber source, forest type and certification, and the relative importance of each of the levels for each attribute. This makes it possible to determine the relative importance of environmental certification compared to the other furniture attributes presented to respondents.

Cluster analysis is a term applied to a group of empirical techniques used for classification of objects without prior assumptions about the population (Punj and Stewart 1983). Cluster analysis attempts to identify and classify objects or variables so that each object is very similar to others in the cluster and very different from those outside the cluster (Hair, Anderson, Tatham and Black 1992). In this study, cluster analysis is used to group respondents based on the importance they assigned to the different product attributes. In other words, cluster analysis can indicate whether all respondents value furniture attributes in a similar fashion or whether there were segments of respondents with different preferences. Cluster analysis is also able to determine the size of any segment and assists in providing a demographic profile of each segments.

Unlike theoretical statistics, cluster analysis does not provide precise rules for choosing a cluster solution (Dess and Davis 1984). Hair et al. (1992) suggest that it is probably best to compute solutions for several different numbers of clusters and then to decide among the alternative solutions based upon a priori criteria, practical judgment, common sense, or theoretical foundations. In this study, utility values were clustered or classified using the cluster analysis technique, and three, four, five, six and seven cluster solutions were all consider. A 6-cluster solution was chosen because this number of clusters was the smallest that adequately differentiated the utility values.

Results

Respondents represented a broad cross-section of New Zealand society. There was a higher number of female respondents (61.4%) than male respondents (38.6%), and the majority of respondents were aged between 26 and 65 years old (72.3%). In terms of income, 28.8% of respondents had an annual income under $20,000, 58.5% between $20,000 and $59,999, and the remaining 12.7% had incomes over $60,000. Only 9.1% of respondents indicated they were a member of an organisation whose primary mission was to protect the environment. Finally, 21.8% of respondents indicated having a primary or secondary education level, 25.5% had finished high school, 33.2% completed some form of non-university tertiary education, and 19.5% had a university degree.

Along with profiling respondents on demographic characteristics, respondents were profiled on two additional characteristics. In terms of determining how relevant this purchase scenario was to respondents, they were asked to indicate whether they had been or would be in the market for furniture. Figure 2 presents the average response for furniture purchases. 44% of respondents indicated they had bought household furniture in the last 12 months. Approximately, 34% indicated that they intended to purchase household furniture in the next 12 months, and 24.8% indicated that they intended to purchase outdoor furniture during that same time period.

In addition to furniture purchases, respondents were asked whether they had been exposed to environmental information on packaging and whether they had purchased such products. Figure 3 presents respondents purchases of environmentally marketed products. Approximately, 55% of respondents indicated they had seen some type of product (e.g. detergents, organic foods, and paper products) that had environmental information on the packaging. Almost 50% of respondents indicated that they had purchased such products in the last 12 months. However, a much smaller proportion of the respondents indicated they had seen any type of environmentally certified product (34.9%) or had actually purchased environmentally certified products (35.4%).

Figure 4 presents the averaged importance values of the various furniture attributes provided by the conjoint analysis. Overall, country of origin (importance score of 23.82) and environmental certification (23.53) are rated as the most important furniture attributes, closely followed in importance by forest type (22.10). Warranty (15.57) and price (14.98) are rated as less important furniture attributes. The Pearson's R (.98, .000) and Kendall's tau (.94, .000) statistics indicate how well the model fit the data. These statistics are correlations between the observed and estimated utilities and, as such, these coefficients should always be very high. The correlations between the observed and estimated scores for the holdout profiles (Kendall's tau = 1.00, .059) give a better indication of the fit of the model since these profiles were not used to estimate the scores. This statistic indicates that the model provides a good fit.

Although useful, these aggregate results provide an incomplete picture. CJA used in conjunction with cluster analysis can indicate whether all respondents value product attributes in a similar fashion. Table 2 provides the results for the six-cluster solution from the cluster analysis procedure. Included are the relative utility values for each of the six clusters on each attribute, the most valued level of that attribute and the sample size for each cluster. The relative utility value of an attribute is computed by taking the attribute utility value divided by the sum of the utility values for all the attributes.

Cluster 1 (14.8% of the sample), rates price as the most important attribute, and would prefer the lower price of $1000. Cluster 2 (3.3% of the sample) rates certification as the most important attribute, preferring environmentally certified over uncertified outdoor furniture. Cluster 2 is also somewhat price sensitive and shows a preference for plantation-grown wood. Cluster 3 (16.3% of the sample) rates country of origin as the most important attribute and preferring wood sourced from New Zealand over imported wood. Cluster 4 (18.2% of the sample) also rates certification as the most important attribute, preferring certified over uncertified products, but unlike Cluster 2 shows no other clear preferences. Cluster 5 (12.4%) rates forest type as the most important attribute, preferring wood from a plantation. Cluster 6 (34.9% of the sample) also rates certification as the most important furniture attribute, but in addition, also prefers the wood to be sourced from New Zealand and a longer warranty. A Scheffe one-way analysis of variance technique was used to test the hypothesis of no difference between the utility values across the six clusters. All of the attributes proved to be statistically significant (at $\alpha = .05$) across the six clusters. In order to develop a demographic profile of the six clusters, they were compared using a Scheffe one-way analysis of variance technique. Table 3 presents the mean value of each cluster for a number of demographic variables, along with the F-statistic of the Scheffe test. None of the demographic variables were statistically significant, and it was not possible to draw a profile of the segments using these demographic variables.

Figure 2-Furniture Purchases

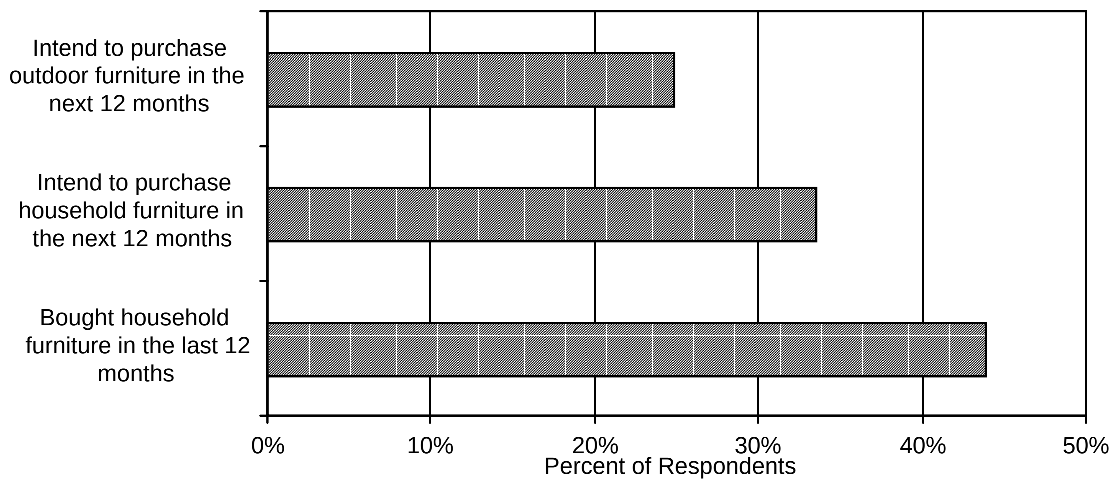


Figure 3-Purchases of Environmentally Marketed Products

In the past 12 months have you...

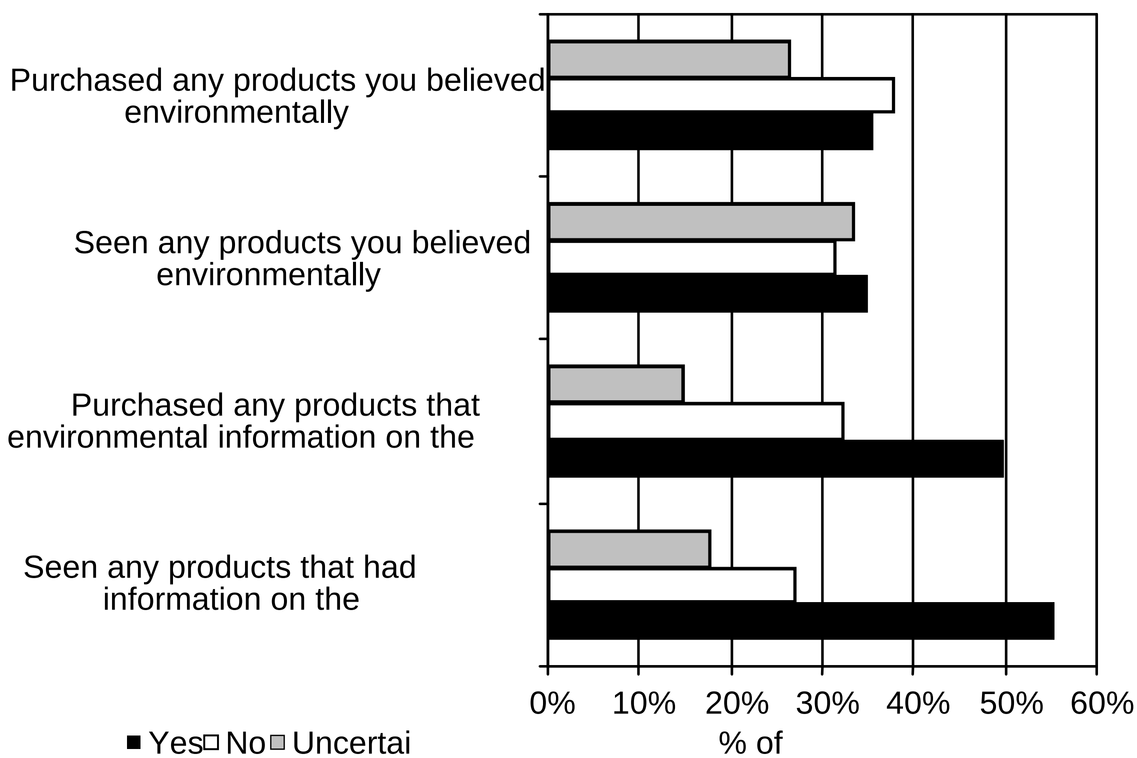


Figure 4-Importance of Furniture Attributes

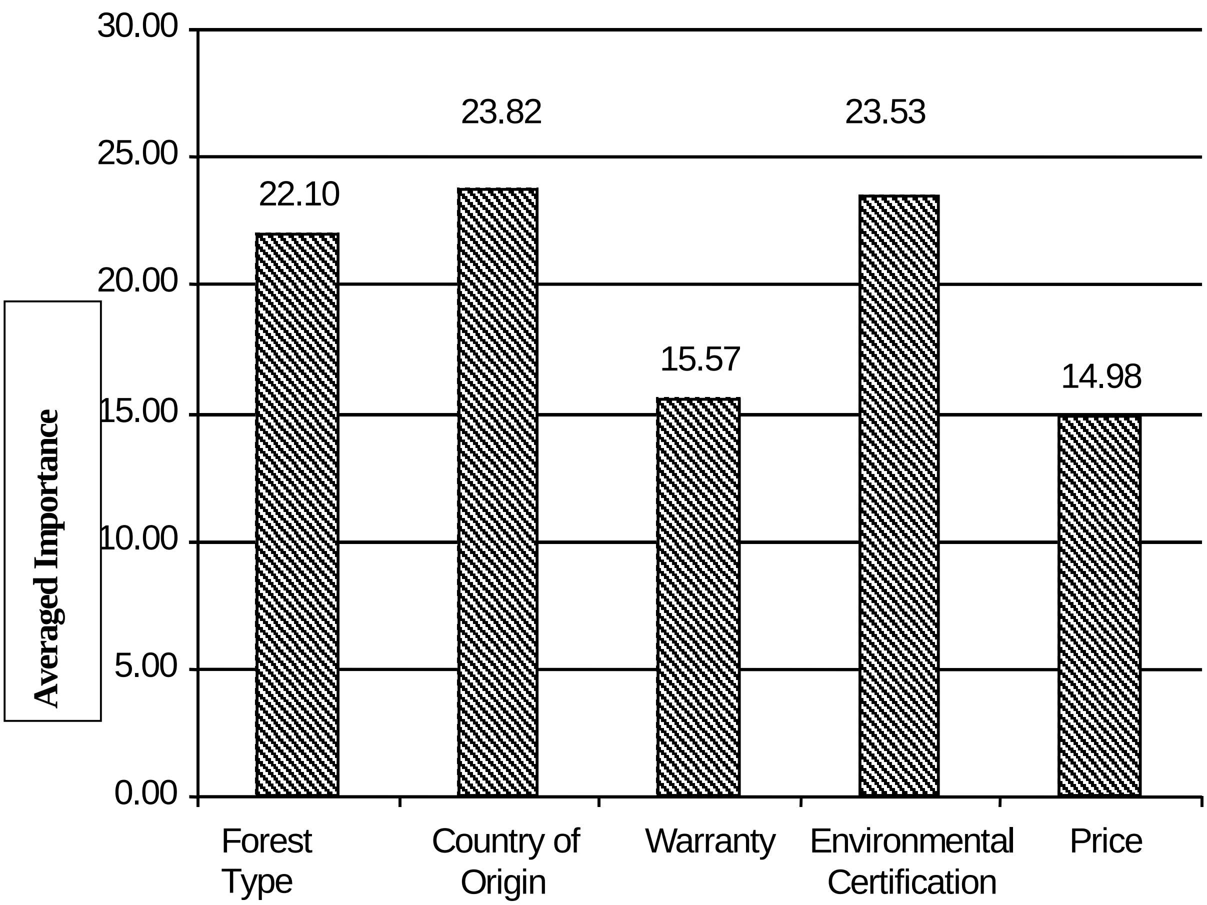


Table 2-Relative Utility Values for the 6 Clusters

Attribute	Cluster 1 n=31	Cluster 2 n= 7	Cluster 3 n=34	Cluster 4 n=38	Cluster 5 n=26	Cluster 6 n=73
Forest Type	6.1%	23.8%	2.9%	16.5%	**58.2%** Plantation	2.5%
Country of Origin	18.6%	2.5%	**65.7%** New Zealand	13.7%	14.3%	24.5%
Warranty	12.2%	10.5%	7.3%	9.9%	6.9%	22.2%
Environmental Certification	5.1%	**35.6%** Certified	11.2%	**43.5%** Certified	6.0%	**44.6%** Certified

Price	**57.9**% $1000	27.5%	12.9%	16.5%	14.5	6.2%

Table 3-Clusters Compared on Demographic Characteristics

Characteristic	Cluster 1 n=31	Cluster 2 n= 7	Cluster 3 n=34	Cluster 4 n=38	Cluster 5 n=26	Cluster 6 n=73	F Statistic
Age Group	2.33	2.57	2.67	2.51	2.27	2.39	.93
Gender (% female)	48.3%	71.4%	67.7%	66.7%	80.0%	50.7%	2.10
Education Level	2.66	2.00	2.28	2.72	2.48	2.63	1.13
Env. Group Membership	12.5%	11.4%	14.8%	5.2%	4.8%	11.8%	2.07
Income Level	1.92	2.00	1.67	1.91	1.74	1.88	.81
Area of Residence	1.83	1.71	1.59	1.62	1.85	1.68	1.64

Conclusions

The objective of this research was to determine the relative importance of environmental certification compared to other furniture attributes. Given that the results indicate that a large percentage of respondents have purchased both household furniture (44%) and outdoor furniture (25%), and intend to purchase furniture in the next 12 months (34%), assessing the importance of various furniture attributes is potentially important to outdoor wooden furniture manufacturers. In addition, results indicate that respondents are being exposed to environmental information on packaging (55%) and are also purchasing environmentally marketed products (50%), indicating that this hypothetical purchase scenario containing and environmentally certifies products is not irrelevant to them.

For wooden outdoor furniture in New Zealand, conjoint results indicate that there are several important attributes. Respondents are interested in the country of origin of the wood, whether the wood has been environmentally certified, and in the type of forest the wood has been grown in. The extent of the warranty and the price of the furniture are generally less important attributes.

Cluster analysis indicates that there are six unique market segments for outdoor furniture in New Zealand. Three segments, comprising 56.4% of the sample, view environmental certification as the most important attribute and would prefer certified over uncertified furniture. One segment, comprising 16.3% of the sample, indicated that they were most concerned with the country from where the wood was sourced, preferring wood sourced from New Zealand. Another segment, comprising 14.8% of the sample, was price sensitive. The last segment, comprising 12.4% of the sample, indicated that forest type is the most important furniture attribute, preferring wood harvested from plantation forests over natural forests.

In terms of profiling these segments, results indicate that demographic variables do not provide a basis of identification or description. This finding confirms earlier research (Ozanne, Bigsby and Vlosky 1999), that found that environmental awareness and concern is very broad based in New Zealand. In addition, this finding suggests the need for additional research to more clearly define these groups of consumers.

References

Armstrong, J.S. and T.S. Overton. 1977. Estimating nonresponse bias in mail surveys. Journal of Marketing Research. 14(3):396-402.

Dess, G.G. and P.S. Davis. 1984. Porter's generic strategies as determinants of strategic group membership and organizational performance. Academy of Management Journal. 27(3): 467-487.

Dillman, D. 1978. Mail and Telephone Surveys: The Total Design Method. New York, NY: John Wiley & Sons.

Griffiths, J.V. 1999. Personal Communication to NZ Stakeholders. New Zealand Forest Industries Council. September 24.

Hair, J.F., R.E. Anderson, R.L. Tatham, and W.C. Black. 1992. Multivariate Data Analysis. 3rd Edition. New York, NY: MacMillian Publishing Co.

McLean, V. 1998. Certified green. New Zealand Forest Industries Magazine. February: 64-67.

Ozanne, L.K., H. Bigsby, and R.P. Vlosky. 1999. Certification of forest management practices: the New Zealand customer perspective. NZ Journal of Forestry. 43(4): 17-23.

Punj. F. and D.W. Stewart. 1983. Cluster analysis in marketing research: review and suggestions for application. Journal of Marketing Research. 29(5):131-148.

Upton, C. and S. Bass. 1996 The Forest Certification Handbook. Delray Beach, FL: St. Lucie Press.

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Wood Products Research for the 21st Century in China

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Abstract
Wood is versatile and, perhaps like water, represents one of the most widely used raw material in the world. It is renewable, environmentally friendly, aesthetic, of high strength-weight ratio, and consumes low energy in wood processing. Furthermore, studies show that wood production and utilization serves the purpose of decreasing CO_2 emissions. With sustained economic and population growth, the world demand for wood and wood products in the future will certainly increase. The future of China's wood industry largely depends on the stable supply of wood resources from managed forests, with considerable opportunities to supply these sustainable wood resources because of its favourable climate conditions in parts of the country, vast areas and abundant manpower. Further research is therefore required in the proposed wood research priority areas to help support sustainable development of wood industry in China in the 21st century.

Keywords**:** wood products research, wood utilization, China, sustainable wood production.

Introduction
Wood is a wonderful, perhaps the most important and widely used raw material except water. It is renewable, environmental friendly, nice looking, of high strength-weight ratio, and easy to process with low energy consumption. As economic and population growth increases, the demand for wood and wood products in the future will likewise continue to increase. Indeed wood plays an important role in economic and social development, and relied upon by humans as a fundamental material for our sustenance.

The annual consumption of timber in China reaches 250 million m^3 , equaling to the sum of that of steel, aluminum and plastic. In the United States the consumption of timber reaches 200million tons, equaling the sum of that of steel, cement, plastic and aluminum. The annual turnover of the forest industry in Sweden and Finland accounts for 14% of their GDP, and the export value of the wood industry in Indonesia has reached USD$5 billion in recent years, which is 25% of its total export value. Furthermore, it has been found that the system of wood production and wood utilization serves the purpose of decreasing CO_2 emissions.

Trends in Wood Product Consumption and Production
The world demand for forest products increases with economic development and population growth. The world annual consumption of timber increased by 36% between 1970-1994 to 3.4 billion m^3. The major change in the past 20 years is the decreased consumption of sawn timber while the consumption of wood based panels increased. The consumption of wood based panels only accounted for 17% of that of sawn timber, and this ratio increased to 30% in 1994. The annual consumption of wood based panels in the world in 1994 was 126 million m^3 and that in 2000 will reach 154 million m^3. The annual consumption of plywood in 1994 was 50 million m^3, accounting for 40% of the total consumption of panel products (a decrease of 8% compared to that in 1970's), and is expected to decrease to 31% in the year 2000.

The particleboard consumption is 46million m^3 in 1999, and is expected to account for 37% of total wood based panels consumption in 2000 as a dominant form of panel product. The annual consumption of oriented strand board (OSB) in 1999 is about 10 million m^3, and will expectedly account for 12% of the total panel products in the year 2000.

According to FAO sources, the world wood based panel production in 1997 reached 155,634,000 m^3, up 5% from the previous year. Such has indeed been continuously upward trend for the past five years. Particularly noteworthy was China's continuing surge with additional production capacity in many product categories. The US led with 38,502,000 m^3 trailed by China, Canada, Germany and Indonesia (Table 1). The US was the largest panel consumer with 44,121,000 m^3. However, Singapore, with its building boom, was the biggest per capital panel user, with 232 m^3 per 1,000 inhabitants.

MDF has been growing very fast, the annual growth rate reaching 13% in the past 15 years and the world production capacity in 1999 peaked at 25.7 million m^3/year. It is expected that by the year 2000, the world consumption of MDF will account for 14% of wood based panels produced.

Table 1. World panel production by country 1997 (, 000m^3)

No	Total production		Hardboard		MDF		Particleboard		Plywood	
	USA	38502	China	1597	USA	2402	USA	16263	USA	15897
	China	14540	USA	1328	China	1060	Germany	9190	Indonesia	9600
	Canada	11339	Brazil	637	Korea R.	728	Canada	7954	China	8094
	Germany	10874	Russian Fed.	617	Germany	710	China	3683	Malaysia	4100
	Indonesia	10163	Japan	528	Malaysia	600	France	3289	Japan	3830
	Malaysia	7000	Canada	342	Italy	600	Bel/Lux	3087	Brazil	1900
	Japan	6435	Poland	306	Turkey	530	Italy	2750	Canada	1828
	France	4588	Germany	140	Spain	490	UK	2175	Korea R.	1014
	Italy	4364	Estonia	134	UK	460	Poland	2041	Finland	987
	Brazil	3558	France	126	Australia	434	Spain	1970	Russian Fed.	968

Challenges and Opportunities for the Development of Wood Industry in the World

The total world forest area in 1995 was 3.45 billion ha. The forest area decreased 56.3million ha in 1980-1990, especially tropical forests in Asia, Africa and Central South America. The quantity and quality of conifer timbers from former USSR and North America are declining.

More public concerns are given to ecological & environmental effects of natural forests since the1980's. Environmental pressure to the industry concerns:

- Protection of natural forests;
- Pollution control;
- Timber (product) certification, e.g. tropical timber products should be from sustainably managed forests; and eco-labeling.

Sustainable forest management has gradually become a common principle of forestry development in the world in recent years. The major objective of forestry has shifted from traditionally supplying timber products to offering multiple uses including ecological, environmental, social benefits and supplying timber and timber products in a sustainable way.

Establishment of industrial plantations has been the emphasis to satisfy the needs for timbers and timber products, while wood resources for industrial purposes are shifting from the natural forests to timber plantations.

Table 2. Functions of timber plantations

Country	% of total forest area in the country	% of total industrial timber production
Argentina	2.2	60
Brazil	1.2	60
Chile	17.1	95
New Zealand	16.1	93

Establishing of timber plantations

New Zealand has a success story of timber plantations, being managed for 140 years. Today 95% of timber supplied in the country comes from plantations. Each year it increases 70,000~100,000ha of timber plantations, and the forestry sector has become the 3rd industry in NZ after wool and meat.

Major trends in the development of the world wood industry:

- Establishing of timber plantations;
- Developing of environmental friendly technologies and products;
- Restructuring for value added processing.
- Developing of environmental friendly technology and products.

This includes:

- Improving efficiency and diversification of raw materials, including using non-wood raw materials, agricultural residues such as bagasse, flax, cotton stalk, wheat stalk and bamboo for panel products;
- Developing technology for processing small size logs from plantations, including non-veneer structural panels, composite lumber products, including Laminated Veneer Lumber (LVL), OSB, etc.;
- Pollution control technologies.

Restructuring for value- added processing

Much timber producing countries have restricted or decreased their exports of logs or sawn timber, and developed down stream value-added wood processing. Malaysia is a good example of a highly effective use of wood based resources. Being enrich in forest resources, Malaysia has natural forests of 19million ha and plantations of 4 million ha. This represents natural forest coverage of 60%, and plantation coverage of 12%, while the planned plantation coverage by government will reach 68% in future. With government policy of restructuring for down stream value-added processing, the export value of logs decreased from 50% of total timber exported in 1990 to 15% in 1997, while export value of down stream processed products including furniture, joinery increased to 25% from 8% in the same period.

It can be concluded that the future of wood industry largely depends on the stable supply of wood resources from sustainable managed forests. Under the guidance of the sustainable development principle, developments in the cultivation and utilization of industrial plantations, environmentally compatible technologies and products that meet the needs of the markets and to improve the competitive capabilities, are the development strategies of forestry and wood industry in the 21st Century.

When nearing the end of 20th century, we should also re-consider our present life style, which depends heavily upon fossil fuels and metal resources, and the accompanying environmental degradation and resource depletion, which are occurring at an alarming rate. In considering aspects of energy conservation and pollution abatement in resource processing and utilization, and the sustenance of resource for biological diversity, we must propagate the benefits of biological resources, especially wood, to maintaining the quality of human life in the next century. Studies have shown that the system of wood production and wood utilization serves the purpose of decreasing CO_2 emissions and that wood provides a comfortable living environment. We bear these issues in mind as we confront the new millennium, with expected emphasis on production of wood-based materials and wood industrial developments.

Challenges and opportunities for wood industry in China

The present annual consumption of wood in China reaches 250 million m^3 including annual import of timber products valued USD$3 billion. To prevent further environmental degradation from wood production, the Chinese government has decided from 1998 to set 60% of the state owned forests for eco-forests with a ban on logging, and cutting of logs in state owned forests be reduced to 13 million m^3 in the year 2000 from 23 million m^3 in 1999. Under the constraints of a large population and limited forest resources, against the implementation of natural forest protection program since 1998, the dilemma between demand and supply of wood products in China will become more serious. It is estimated that the shortfall in timber supply may reach 60 million m^3 in the year 2000-2010. Particularly, shortage of those high quality timbers of valuable species and traditional industrial species such as Korea pine, Chinese Northeast ash, basswood, Yunnan Pine, and larch may be severe.

To meet growing demands for wood products in China, remarkable progress has been made in recent years especially in the field of wood based panels industry in the country. In 1997, the production of wood based panels reached 16.48 million m^3, comprising 7.58million m^3 of plywood, 2.76million m^3 of fiberboard (including 1.06 million m^3 of MDF), and 3.6million m^3 of particleboard. The capacity of MDF production reached 2.95 million m^3, ranking 2nd in the world. The quality and variety of wood based panels products and production efficiency have greatly improved. The total turnover of the Chinese furniture industry in 1998 was 87 billion yuan RMB with an export value of USD$1.5 billion.

China has a big possibility to supply the sustainable wood resources because of her favourable growth climate in parts of the country, vast areas and the abundance of manpower. Great efforts have been made to extend the forest areas. The area of timber plantations established between 1980 and 1987 was 28.92 million ha accounting for 33.5% of the total plantation area established since 1949. From this, 3.83 million ha were fast growing and high yield timber plantations accounting for 13.2% of the total area of timber plantation between 1980 and 1987. Between 1988 and 1992, 16.17 million ha of timber plantations were established of which 2.5 million hectares were fast growing and high yield timber plantations making up 15% of the total timber plantations in this period. In recent years, the area of fast growing and high yield timber plantations in China has increased by 0.5 million ha per year. In 1994 the actual area of established timber plantations was 34.5 million ha with a growing stock of 45.819 million m^3 and an annual growth of 10.17 million m^3. Among the wood species, conifers dominate China's fast growing and high yield timber plantations accounting for 76%, of which *Cunninghamia lanceolata* makes up 46% and pine species 30% (Table 3). Further efforts are neededto improve cultivation practice to raise the productivity, quality and variety of industrial plantations.

Table 3. Major species being used for timber plantations in China

Region	Climate zone	Average temperature C º	Annual rain fall (mm)	Major species
Northeast (Heilongjiang, Jilin and Liaoning)	Temperate/cool temperate	North -4 -6 South 4 6	400-600	*Larix , Pinus sylvestris var mongolica, P. Koraiensis, Populus and Fraxinus mandshurica;*
Central North (Shandong , Hebei and Henan)	Warm temperate	10-15	500-950	*Populus, Paulownia , Ulmus Pumila L*
South (Guangdong , Guangxi, Hainan, Fujian, Jiangxi, Hunan, Hubei, Guizhou, Yunnan and Sichuan)	Subtropical Tropical	14-21 20-26	800-2000 1200-2000	*Cunninghamia lanceolata, Pinus massoniana, P. elliottii , P. Taeda, Acacia and Eucalyptus*

Wood Research Priorities

As the wood resources in China for industrial purposes shift from the natural forests to timber plantations, the industry needs technical support from research institutions in developing technologies for establishing and utilizing fast growing and high quality timber plantations, and to provide effective and value-added processing of environmental friendly products. Therefore further R&D will be needed in China with the proposed priorities as follows:

Wood Properties

Effect of various silvicultural treatments on wood quality; Suitability of wood for various utilization purposes; Use of enzymes for biologically based pulping and bleaching; Use of wood chemicals in the development of new wood adhesives.

Wood Drying

Modeling the wood drying process, including stress development, relaxation and fracture; Emission of volatile organic compounds during wood drying; New drying process, including radio-frequency/vacuum, and super–heated steam/vacuum.

Wood and Environment

Methods of cultivating forests and use of wood products with better environmental effects, including mitigating effects on the build-up of greenhouse gases in the atmosphere;
Sustainable development and conservation of forest resources;
Methods of recycling wood-based products and paper;
Methods of life cycle analysis to develop an objective process that can track the environmental burdens associated with a product ,process, or activity;
Biological methods of wood preservation and use of less toxic preservative chemicals to allow easier disposal with positive impact to the environment;
Improved processing of wood to conserve and extend the timber supply;
Harvesting and processing methods for short-rotation of wood of superior quality.

Wood Preservation

Waterborne copper systems for pressure treatment;
Safe and environmentally sound anti-sapstain systems as alternatives to pentachlorophenates.

Wood Composite

Durable and value-added wood-plastic composites for special uses;
Use of agricultural fibers, recycled wood, and an incredible variety of fibers from post-consumer wastes;
Emissions of volatile organic compounds from panel products;
Accelerated curing of PF resins.

Pulp and Paper

Silvicultural techniques for hardwood plantations to produce wood with short and soft fibers.

Economics and Policy

Cost and price effect of changes in forest management practices and forest sector policies;
Analyzing factors affecting middle and long term outlook for timber demand and supply;
Analyzing trends in trade and investment and their effects on wood industry.

Conclusion

From the viewpoint of energy conservation and low pollution generation in resources utilization and sustenance of biological production, we must elevate the roles of wood to maintain the level of human life in the next century. We are facing a new age of wood-based materials, and development of wood industry is strongly expected.

Under the sustainable development principle, the wood products research effort in China should stress the cultivation and utilization of industrial plantations, and environmentally compatible technologies and products that meet the needs of the markets and to improve the competitive capabilities of the forestry and wood industry. These are among the strategies for the wood industry in China to make useful contributions to society in the 21st Century.

References

Chen Xuhe.1999. The sustainable development of wood industry for the 21st century, China Forest Products Industry. 26(1): 6-8, 13(2) 3-5, 9.

Norm Kutscha. 1999. Trends in wood research and utilization. Forest Products Journal. 49(7/8)12-17.

Motoaki Okuma.1998.Evaluation of the system of wood utilization from the standpoint of carbon stock and CO2 balance.Forestry towards the 21st century—Proceedings of the Workshop for the 40th Anniversary of Chinese Academy of Forestry: 536-539.

Zhang Shougong, Chen Xuhe, Li Weichang. 1999. Outlook of Plantations in China. Chinese Academy of Forestry. 30 p.

Bill Keil.1999. On a continuous upward curve. Wood Based Panels International. 19(3) 60-61,63.

Sustainable production of forest products in Australia

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Abstract

The sustainability of production from Australia's forests – especially but not exclusively its native forests – has been a strongly contested issue for the past three decades. Australia's first National Forest Policy Statement in 1992 committed Australia to the goal of sustainable forest management in the context of a broader commitment to ecologically sustainable development. It is being translated from policy to practice by – for the first time in Australia's history – a suite of nationally-coordinated processes consistent with international initiatives. Although progress towards sustainability in forest management far exceeds that in other Australian natural resource sectors, the sustainability of production from Australia's forests remains both contested and challenging.

Keywords: Sustainable Forestry, Australia, Montreal Process, Regional Forest Agreement

Introduction

Over the perhaps 50000 years of their settlement, the land management practices of Australia's aboriginal people - principally their extensive use of fire - altered the distribution of Australia's forests, ecosystem structure, and the forest fauna. The European settlers' displacement of aboriginal people, and their conversion and use of forests, both had profound impacts. The fragmentation and conversion of forests to other uses, and European farming practices have adversely affected for the sustainability of Australian agriculture and its rural landscapes, including their forest and woodland remnants. These impacts have generally been most severe in the widespread broad-acre cropping and grazing regions; it is not yet clear whether production from these ecologically-degraded landscapes can be sustained.

The historical focus, and continuing emphasis, of Australian native forest management has been on the closed forests; their discontinuous continental distribution coincides with the distribution of the majority of Australia's population near the southern and eastern coasts. With the exception of forest-rich Tasmania, the majority of these forests are in public ownership; their principal products and services are biodiversity, recreation, a diversity of wood and non-wood products, and water. Whilst the economic importance of wood production from these forests remains significant, the relative value accorded it by the majority of the Australian population has been progressively diminishing. Continuing community conflict over the management of these forests led, in 1995, the Australian governments to institute a Regional Forest Agreement process, first mooted in the National Forest Policy Statement.

Australia's Regional Forest Agreement process is the first nationally-coordinated attempt to assess the diversity of Australian forest values – economic, environmental and social – and agree forest allocation and management based on this information. Regional Forest Agreements are being negotiated between the Commonwealth and respective State governments for each commercially-important native forest region. The goals of the process are expressed in terms of greater certainty: for biodiversity conservation, based around establishment of a national reserve system with a target of incorporating 15% of the pre-European extent of each forest ecosystem, and around the development of ecologically sustainable forest management regimes in forests outside reserves; for the forest-based industries, based around secure access to resources outside the reserve system; and for indigenous and European heritage, based on explicit recognition of those values in forest allocation and management decisions. Concomitantly, Australia's wood production has been shifting progressively from native to plantation forests. Most existing plantations were established on sites converted from forest; almost all new planting is established on farmland, much in partnership with farmers. This expansion poses both challenges and opportunities for enhancing the sustainability of production.

The Montreal Process is providing the framework for the development of criteria and indicators of sustainable forest management for all Australian forests. The formulation and testing of criteria and indicators are paralleled by the development of Codes of Forest Practice and by institutional reform in which State regulatory and management roles are separated. These measures are relatively well-developed for State forests, but are – with the exception of Tasmania – as yet poorly developed for the increasingly important private forest sector, including its extensive woodlands.

Substantial research and implementation challenges remain in improving, monitoring and communicating the sustainability of production from all Australia's forests.

Australia's forests and forest products[1]

Australia's forests[2] are extensive, diverse and globally unique. These forests presently cover some 157 million ha: the majority, some 112 million ha, are defined as woodland[3], and there are about 1 million ha of plantation forest; however, in total, Australia's forests occupy only 20% of the land area of the world's driest continent. The Australian biota have high levels of endemism, and the country is ranked among the top dozen globally in terms of the significance of its biological diversity. The genera *Eucalyptus* dominate Australia's forest ecosytems; rainforests and mangroves, and forests dominated by the genera *Acacia, Callitris, Casuarina* and *Melaleuca*, are also significant. Plantation forests are principally (80%) of exotic taxa, mostly *Pinus radiata* (65% of total); *Pinus elliottii*, *Pinus caribaea* and their hybrid comprise around 10%; 75% of the native species plantations are of a few eucalypt species, and 25% are of *Araucaria cunninghamii.*

Nationally, around 70% of native forests are publicly owned, but around 40% of this area is held and managed under lease by the private sector, principally for grazing. Conservation reserves, forests managed for production and other values, and public forests held under other tenures[4] each represent around 10% of the native forest area. Around 70% of plantation forests are publicly owned. The distribution of these tenures varies widely geographically and across ecosystems.

The majority of the forests managed for production in continental Australia lie within a few hundred kilometres of the east and south-east coasts, and of the south-west corner; those in Tasmania are principally in the east and north. Wood is the major commercial product, and apiary the principal commercial non-wood product. Many important products, such as water and biological diversity, are not currently valued commercially. The wood-based forest industries account for around 1% of national Gross Domestic Product. The majority of wood is now harvested from plantation forests. Almost all local production of sawnwood, panels and paper is consumed domestically; most (66% by volume, 48% by value) exports are of unprocessed eucalypt woodchips, principally harvested from native forests. Australia is a net importer of forest products, in both volume and value terms.

A brief history of Australia's forests and forest production

Over the perhaps 50000 years of their presence, Australia's aboriginal people managed the forests principally through their extensive use of fire, largely to facilitate access and hunting. Their impact on Australia's now-extinct megafauna remains a matter of debate, but it is widely accepted that their practices alterered the distribution of Australia's forests – particularly the rainforest/ eucalypt forest boundary – and the structure of many forested ecosystems. The impact of European settlers over the past 210 years has been much greater, with more than a third of forests converted to agriculture across the nation; in the south-eastern states of New South Wales, Victoria and South Australia, the loss has been over 50% (NFI 1998). Forest ecosystems in some parts of Australia, notably in the state of Queensland, are still being converted to agriculture at a rate of some hundreds of thousands of hectares annually.

Many of the most productive forests were largely cleared in these successive waves of European settlement; many lowland coastal forest ecosystems, and those on the inland slopes of the coastal watersheds, now exist only as remnant fragments. Strong public reaction against the apparently wanton destruction of forest resources in the late 1800s led, after many political battles, to the establishment of forestry agencies and the reservation of forests for wood production and for catchment and landscape values (Carron 1985, Dargavel 1995). The focus of these agencies, through to the 1980s, was principally on managing the state forests for wood production without prejudicing other values. For most of this period, they were also at the forefront of forest conservation and reservation from production. However, state governments, which retained responsibility for resource management after federation in 1901, saw and used forest resources primarily as the basis for regional economic development, and established resource allocation and industry regulation regimes to foster this development. The forest agencies also began to develop Australia's softwood plantations, recognising the relative lack of native softwoods and the evidently poor performance of most eucalypts in plantation culture. Rates of production from native forests peaked in the 1960s, and the rates of conversion of native forest to plantation peaked in the 1970s. Subsequently, wood production has come increasingly from plantation forests, and plantation forests have been established increasingly – now almost exclusively - on previously-cleared farmland. It is also increasingly shifting from the public to the private sector, although

[1] this section draws extensively on BRS (1998).
[2] used here to also include woodlands, unless where otherwise stated. The definition of forest used by Australia's National Forest Inventory is for "an area … dominated by trees … [with a] mature stand height exceeding 2m and … crown cover of overstorey strata about equal to or greater than 20%" (BRS 1998).
[3] between 20-50% crown cover (BRS 1988).
[4] these tenures commonly preclude industrial wood production.

the former remains dominant, albeit in a corporatised form (see Ferguson 1998).

Although the forest agencies and their staff had been, and were seen to be, at the forefront of forest conservation until the 1960s, public perceptions and expectations had changed by the 1970s. The overharvesting of native forests to support the post-second war economic expansion, the subsequent conversion of hundreds of thousand of hectares of native forest for higher yielding pine plantations, and the large-scale intensive harvesting of native forests for woodchips, all reflected contemporary interpretations of the contributions forestry should make to Australian society. As Australian society changed, and its perception of sustainability evolved, these earlier interpretations of sustainable production came to be seen as too narrow, notwithstanding their foundations in the concepts of sustained yield and multiple use. Australian society is now having to confront similar - and generally more challenging - issues of sustainability in agricultural production (PMSEIC 1999)

These broader societal and professional views of sustainable production are now reflected in Australia's explicit focus on sustainability in the wider terms exemplified by the Principles, Criteria and Indicators of the Montreal Process, with their recognition of sustianability's economic, environmental and social dimensions (Commonwealth of Australia 1998). Sustainability in the broad sense was the focus of Australia's recent Regional Forest Agreement process (Box 1). It is similarly mirrored in the expansion of tree planting on farms - in its various manifestations for production, conservation and restoration - and in the beginnings of debate about how we might harness the emerging markets for environmental services to support reforestation and forest management. These opportunities and constraints, and the associated financial and environmental imperatives, set the context for the more sustainable production of forest products and services in Australia.

Australia's Regional Forest Agreement process

Australia's Regional Forest Agreement process (Commonwealth of Australia 2000) is one of the principal mechanisms for implementing the goals agreed in Australia's National Forest Policy Statement of 1992. The process is the first nationally-coordinated attempt to assess the diversity of Australian forest values and agree forest allocation and management based on this information. Regional Forest Agreements are to be negotiated between the Commonwealth and respective State governments for each commercially-important native forest region. Although each of the Agreements is negotiated under a common framework, the processes vary markedly between States, reflecting their different characteristics.

The basis for negotiation of each Regional Forest Agreement is a Comprehensive Regional Assessment of each of the environment, heritage, economic and social values of forests. Data from the assessments are used as the basis of negotiation of each Agreement, which has a life of 20 years. The principal goals of each Agreement are:

- a protected area system which seeks to incorporate 15% of the distribution of each forest ecosystem that existed prior to Europeans arriving in Australia, at least 60% of existing old growth forest, and at least 90% of high quality wilderness;
- the protection of indigenous and European heritage, based on explicit recognition of those values in forest allocation and management;
- certainty of resource supply for forest industries and regional communities, enabling the development of internationally competitive and ecologically sustainable industries;
- sustainable management of the whole forest estate, both on and off reserves.

The Regional Forest Agreement process has relied heavily on the use of bioregional conservation planning processes and tools (Kanowski *et al* 1999). The process has demanded a substantial commitment of resources from governments, and revealed many gaps in data. It has involved a variety of forms of community consultation and stakeholder involvement, and demonstrated both their potential and limitations (Dargavel *et al* 1999).

More sustainable forestry[5]

As the preceding discussion illustrates for the case of Australia, and has been much more explicitly argued in discussions of the role of forestry internationally (*eg* Westoby 1987), the purpose of forestry has long been to contribute to economic and social development without prejudicing environmental values, *ie* to promote sustainable development. The means by which this complex, challenging and dynamic goal might be translated into practice in particular Australian contexts has recently been explored by a number of leaders in Australian forestry, *eg* in the Tasmanian and West Australian cases (Rolley 1999, Shea 1999). These proposals are set in the broader context of the environmental, economic and social challenges facing rural and regional Australia, and of those generated by the expectations of urban Australians.

It is widely accepted (*eg* Regional Australia Summit 1999) that rural and regional Australia are struggling to

[5] this section draws on Kanowski (2000).

adapt to a suite of disparate but powerful economic, social and environmental forces: for example, the globalisation of markets, increased exposure to market forces and market-based policy, declining farm and regional community incomes and public services, the rising environmental and economic costs associated with many traditional farming systems, and the increasing urbanisation of Australia's population. It is also clear that many rural and regional communities are finding ways to respond to these challenges, and that – in regions where there is a critical mass of forest resource – the forest industries are a key part of that response (Stayner 1999). Forestry has also to judge how it can best address urban Australians' expectations of sustainability, a task which poses some different challenges. These contexts suggest some key themes which more sustainable forestry should address in Australia, in native, plantation and farm forests:

Economic contributions at the national, regional and farm levels.
The aggregate national contributions of forestry to the Australian economy are well documented (BRS 1998), and further enhancing them is an explicit national policy goal (Commonwealth of Australia 1992, 1995). However, it is at the regional and local levels that the economic contributions of forestry are most directly felt. Awareness of the significance of forestry and the forest-based industries to regional economies has been greatly enhanced by the Regional Forest Agreement process, which has focused on industries based on native forests (Commonwealth of Australia 2000), and by other region-specific studies such as that for plantation-based industries of NSW's Oberon region (Dywer-Leslie and Powell 1995).

It is clear that, whatever the forest resource base, regional economic contributions are maximised when value-adding takes place within a region. Stayner (1999) points out that - whilst there are exceptions to this generality (*eg* the case of fresh food marketing), and whilst the benefits of value adding generally accrue to processors rather than producers – "clustering" of enterprises can generate significant added-value regionally, and cites a number of forest industry examples in support of his case. He notes some of the complications associated with sustaining value-adding – *eg* the possibility of concentrating rather than diversifying a region's economic base – but his and associated analyses suggest a number of policy directions to encourage sustainable value-adding.

The most appropriate contributions at the farm enterprise level will be as diverse as farmers and farm businesses themselves, and include both direct and indirect benefits. All research suggests that farm forestry solutions need to be tailored to individual farmers' needs, reflecting their various economic circumstances and personal preferences (*eg* Guijt and Race 1998).

Environmental contributions at different scales and in different places.
There is now a broad awareness of the most pressing environmental imperatives in the Australian agricultural landscape: principally, water and land salinisation, soil and ecosystem degradation, and biodiversity loss (eg Commonwealth of Australia 1996, PMSIEC 1999). Reforestation, and the improved management of remnant forests and woodlands in the agricultural landscape, are two of the central responses – transforming islands of remnant vegetation into networks, and enhancing the sustainability of our land use systems at landscape and farm scales (eg Williams 1999). Such landscape-scale transformations, which can only be built through some level of coordination of actions at the individual farm level, are necessary not only to arrest the degradation we are currently witnessing, but to sustain the new forest-rich agricultural production systems we shall have to create.

In the forests managed for conservation and for production, management regimes which recognise the complex dimensions of sustainability will be necessary to sustain Australian society's expectations of our forests. Whilst elements remain contested, the progress that has been made towards the goal of ecologically sustainable forest management under the RFA and Montreal Processes offers a good foundation for the adaptive management regimes (*eg* Kanowski 1997, Margules and Lindenmayer 1996) that will be necessary - on all tenures - to deliver outcomes acceptable to the (primarily urban) Australian community, and which will therefore be sustainable in social terms. The development of Codes of Forest Practice, and of progressive systems for their implementation across all forest types and tenures (*eg* Wilkinson 1999), provides the means for translating these higher-level commitments into operational practice.

Social contributions to Australian communities.
Some of the social contributions to Australian rural, regional and urban communities have been outlined above. One that has not yet been addressed adequately in government and industry policy, notwithstanding some notable exceptions in practice (*eg* Robins *et al* 1996), has been that of the integration of reforestation with other agricultural activity. Instead, we are still seeing more of a transfer, at a property scale, from agriculture to plantation forestry, and the resurgence of a backlash against that transformation and its landscape and social consequences (*eg* ABC 1999). It is clear that, in some cases at least, different policy settings and partnership incentive mechanisms could better promote commercial farm forestry, and attendant environmental benefits, as part of – rather than instead of – the farm enterprise. Finding appropriate incentive and resourcing mechanisms are a critical part of generating options for more integrated, and sustainable, approaches; the emergence of carbon and salinity

credits, and novel proposals for community-wide environmental levies (Community Salinity Summit 2000), suggest the beginnings of such mechanisms.

Conclusions

As elsewhere, concepts and expectation of sustainable forestry have evolved in Australia, from a focus on sustained yield to recognition of the broader dimensions of sustainability. The high standard of living enjoyed by most Australians reflects the transformation of much of Australian natural capital, including Australia's forests, into the social and financial capital. However, Australians are now appreciating that much of that transformation of natural capital has been unsustainable, and that forestry has – as well as its part in that history - a substantial role as part of the re-creation of sustainable environments and economies. The sustainability of Australian society depends on how we conceive and manage this re-creation.

References

ABC (Australian Broadcasting Commission). 1999. Plantation forestry. Report on *Country Breakfast*, 3 April 1999. http://www.abc.net.au/rural/breakfast/stories/s21033.htm.

BRS (Bureau of Rural Sciences). 1998. *Australia's state of the forests report 1998*. BRS, Canberra. 189 p.

Commonwealth of Australia. 1992. *National Forest Policy Statement.* AGPS. 51 p.

Commonwealth of Australia. 1995. *Wood and Paper Industry Strategy*. http://www.isr.gov.au/industry/forestproducts/html/initiatives.html

Commonwealth of Australia. 1996. *State of the environment. Australia 1996*. Environment Australia, Canberra. http://www.environment.gov.au/soe/index.html

Commonwealth of Australia. 1998. *A framework of regional (sub-national) level criteria and indicators of sustainable forest management in Australia*. http://www.affa.gov.au/ffid/sir/criteria/index.html

Commonwealth of Australia. 2000. *Regional Forest Agreements*. http://www.rfa.gov.au/

Community Salinity Summit. Press report on meeting, Wagga Wagga, 4 February 2000. *The Weekend Australian*, 5-6 February 2000. 10.

Dargavel, J, I Guijt, P Kanowski, D Race and W Proctor. 1999. *Australia: settlements, conflicts and agreements*. Paper for IIED, London, *Policy that works* series. 35 p.

Dwyer-Leslie Pty Ltd and Powell, RA. 1995. *Oberon: rural community development study*. Final Report. State Forests NSW, Sydney.

Ferguson, IS. 1996. Australian forest services: institutions of change or changing institutions? *Commonwealth Forestry Review* **75**: 136-141.

Guijt, I and D Race. 1998. *Growing successfully*. Greening Australia and DPIE. 42 p.

Kanowski, PJ. 1997. Regional Forest Agreements and future forest management. In: *Outlook 1997*. ABARE, Canberra. 225-235.

Kanowski, PJ. 2000. Forestry's role in a sustainable Australian society. Paper to *Austimber 2000*, Albury NSW, 15 March 2000. 5p.

Kanowski, PJ, DA Gilmour, CR Margules and S 1999. *International forest conservation: protected areas and beyond*. Discussion Paper for IFF. Environment Australia. 52 p. http://www.environment.gov.au/library/pubs/pdf/forests.pdf

Margules, CR and DB Lindenmayer. 1996. Landscape level concepts and indicators for the conservation of forest biodiversity and sustainable forest management. In Proc. UBC-UPM Conference *Ecological, Social and Political Issues of the Certification of Forest Management*. May 1996. Putrajaya, Selangor, Malaysia. Faculty of Forestry, University of British Columbia, Vancouver. 65-83.

PMSEIC (Prime Minister's Science, Engineering and Innovation Council). 1999. *Dryland salinity and its impacts on rural industries and the landscape*. http;//www.dist.gov.au/science/pmseic/

Regional Australia Summit 1999. http://www.dotrs.gov.au/regional/summit/

Robins, L, McIntyre, K and Woodhill, J. 1996. *Farm forestry in Australia*. Greening Australia. 54p.

Rolley, E. 1999. Max Jacobs Oration, 18th Biennial Conference, Institute of Foresters of Australia. Hobart, 3-8 October 1999. IFA, Canberra.

Shea, S. 1999. The potential of tree crops to contribute to the restoration of the ecological and economic balance of agricultural land. Paper to Fenner Conference, *Visions of future landscapes*. Canberra, 2-5 May 1999.

Stayner, R. 1999. *Value-adding to regional communities and farming industries*. Background paper for Regional Australia Summit, 27-29 October 1999. http://www.dotrs.gov.au/regional/summit/background/index.htm

Westoby, J. 1987. *The purpose of forests*. Blackwell. 343 p.

Wilkinson, G. 1999. Codes of forest practice as regulatory tools for sustainable forest management. In: RC Ellis and PJ Smethurst (eds). *Practising forestry today*. Proc. 18th Biennial Conference, Institute of Foresters of Australia. Hobart, 3-8 October 1999. 43-60.

Williams, J. 1999. *Farming without harming: can we do it?* Background paper for Regional Australia Summit, 27-29 October 1999.

Procedure for evaluating and monitoring the sustainability of a lumber production forest[*]

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A reliable estimate of the standing volume of sawn wood enables a strategy to be formulated for the sustainable management of production forests. This study proposes a method for estimating the sawn-wood volume stocked in any standing plantations. Only a few variables are required to make such prediction and each of them is very easy to be obtained for a particular forest, either planted or natural one.

The accuracy of the proposed theory was verified in an *Eucalyptus grandis* experimental plantation which was being grown and managed according to the Correlated Curve Trend (CCT) method.

The paper shows that stem shape and round wood volume can be predicted very well by a studied function which is based on the DBH and the height of the tree only. This function permits to obtain the diameters of all logs that are intended to be obtained from that stem.

Another function was obtained from logs processing in an industrial sawmill for predicting the recovery rate which is expressed by the relationship between sawn wood volume and its early round wood volume. This function is based on the smaller diameter of the log only.

The combination of those functions permits to obtain the sawn wood volume stocked in each DBH class of a standing population. Also provides a good estimate of the total round wood volume and sawn wood volume available in the entire forest.

It was important to note that round and sawn wood prediction curves get closer each other as DBH becomes larger. This means that at some extent smaller trees do not contribute effectively with an optimized lumber production. In the case of natural forest, smaller trees can be saved for contributing with the regeneration process, without introducing great impact on lumber productivity of the whole forest.

It is important for the sustainable management of forests that companies obtain an accurate assessment of end-product volume. They must know how large their forests have to be in order not to have either problems concerning to raw material supply or to explore above of the forest capacity.

It is possible from this study to calculate either the exact area needed to supply a specific sawmill or the exact size of a sawmill that will operate, at optimum, based on a specific forest area.

The proposed methodology estimates the potential of a forest lumber production and arrives to an indicator that brings together all people who work consciously exploring and protecting the environment. It may be considered as an interesting tool, which increases the capability for monitoring the maintenance of the lumber productivity.

Introduction

Long term businesses have been understanding the strong concept of sustainable management of production forests. Most of the time the forest sustainability has been meaning the profit continuity. So it will not be difficult to find industries that act for preserving both the forest and the profit. In this particular case they have been looking for the best tools for understanding the interaction between forest and industry.

The objective of this work is to evaluate a method for the estimation of the sawn-wood volume stocked in a *Eucalyptus grandis* Hill ex-Maiden plantation. It also proposes the use of this method in natural forests as useful tool for monitoring the maintenance of the lumber production.

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Materials and Methods

Equation (1) adapted from (Ormerod,1973) was used to predict the stem shape of *Eucalyptus grandis* of a Correlated Curve Trend (C.C.T.) experiment which was set up according to the methodology described by Hyley (1959). Three trees were sampled from a plot which had approximately 17% of standing trees only which means 360 stems per hectare from an initial stocking of 2220 stems per hectare.

$$d = DBH \cdot \left[\frac{H-h}{H-1.3}\right]^{0.6057} \qquad (R^2 = 0.85; F = 29478^{**}) \qquad (1)$$

Where: d = diameter at the specified height h; DBH = diameter at breast height; and H = total height of the tree.

Three logs of each tree were taken and processed in an industrial sawmill for measuring the current recovery rate that will be useful to predict the sawn wood volume stocked in standing forests. The sawn wood recovery rate (SWR) was quite well explained by equation (2) which was obtained from that industrial procedure.

$$SWR = e^{5.18764 - \frac{37.0257}{d}} \qquad (R^2 = 0.72 \quad F = 18.44^{**}) \qquad (2)$$

Where: d = minimum log diameter obtained by equation (1) which depends of the log length.

The total volume of sawn wood was then estimated from the DBH distribution of the stand using equation (3).

$$SWV/ha = \frac{\pi}{8}\sum_{ji=1}^{n}\sum_{ij=1}^{k}\left(d_{ij}^2 + D_{ij}^2\right)\cdot SWR \cdot \left[\frac{d^2 + D_L^2}{d^2 + D^2}\right]\cdot f\left(DBH_j\right) \qquad (3)$$

Where:

D_L = log diameter measured at a distance of 2.5 m from the top of the log; *f((DBH)i)* = frequency of DBH belonging to the class i; *k* = number of logs available in a tree; and *n* = number of classes in the *E. grandis* population.

d and D = minimum and maximum log diameters both estimated by equation (1); $\left[\frac{d^2 + D_L^2}{d^2 + D^2}\right]$ is the factor which corrects the SWR when the new logs are longer or shorter than those used to build up the equation (2) which were 2.5 m long.

Results and Discussion

Fig. 1 shows that stem volume can be predicted very well from equation (1) output diameters. The prediction do not lose accuracy even for great changing in the marketable height of the tree. This is very important because it provides a good estimate of the exact logs they have. Afterwards we may know the solid wood volume of any individual log.

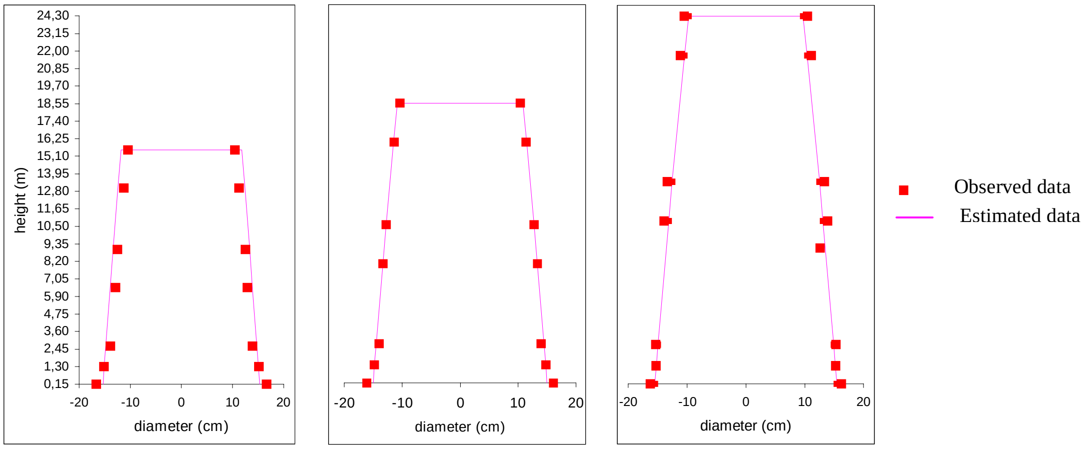

Fig. 1. Trees seen as a combination of component logs.

Fig. 2 shows the observed and estimated sawn wood volume of three logs obtained of the sampled trees. Log 1 is related to the tree basis. Log 3 was taken from the highest marketable height. Log 2 came from the middle height of the tree. The sawn wood volume (SWV) was calculated by equation (2) which provided very good prediction and can be considered as having quite good accuracy.

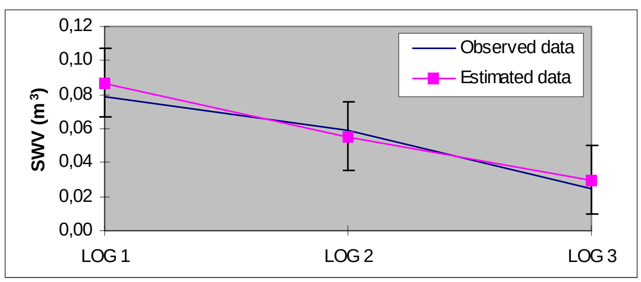

Fig. 2. Sawn wood volume (SWV) obtained from the tree bottom (LOG 1), middle height (LOG 2) and top (LOG 3).

Fig. 3 shows the round wood volume and sawn wood volume that were estimated for each class of the standing population using the equation (3). The total volumes calculated were 532 m^3/ha for round wood and 218 m^3/ha for sawn wood.

It's important to note that round and sawn wood volumes go getting closer as DBH goes becoming larger. This means that smaller trees of a natural forest, for example, can be saved without introduce great impact on the whole productivity.

Afterwards it is possible to calculate either the exact area needed to supply a specific sawmill or the exact size of a sawmill which will operate based on a specified forest area.

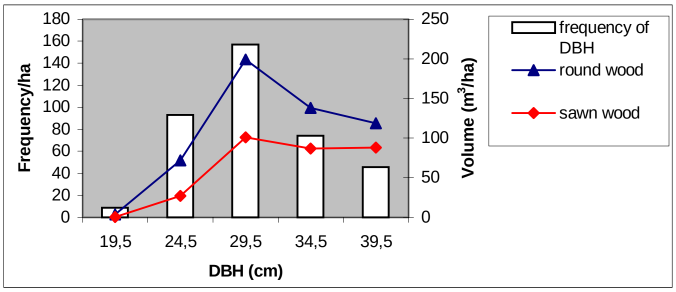

Fig. 3. Forest productivity related to its DBH distribution.

Conclusions

It is important for the sustainable management of forest that companies obtain an accurate assessment of the wood volumes.

The company must know how large its forest has to be in order not to have problems concerning to raw material supply. The proposed methodology estimates potential lumber productivity in standing forests giving to the forester the necessary basis for making the proper management. Further studies are needed in order to increase the accuracy on the productivity maintenance. Some researches have been carried out on the Amazonian Rain Forest in which it was possible to see the usefulness of an indicator that brings together all people who work consciously exploring and protecting the environment. It was concluded that 50% of the harvested tree will be saved if the minimum DBH required for harvesting increases from 40 to 50 cm. The impact on the whole productivity will be less than 20% of the current sawn wood volume produced. However this percentage can be by far compensated by an increasing of the recovery rate during the wood processing inside the sawmill.

References:

HILEY, W. E. 1959. Conifers: African Methods of Cultivation. London, Faber and Faber. 123 p.

ORMEROD, D.W. 1973. A simple bole model. **Forestry chronicle**, Quebec, 41:136-8.

Made to Compete: A Hybrid Product for Forest Products Industry

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Abstract
Wood has long been considered as an engineering material. Recent survey showed that many builders do not consider wood as a suitable material for construction use. They see wood as the least *durable* material. In order to improve wood's competitive position, forest products industry is facing many challenges. One of the attractive and practical approaches is to produce a hybrid product from wood and plastic materials. The potential of producing a high wood fiber, low plastic characteristic wood fiber-thermoplastic composite is discussed. Current upward trend in cooperation between the forest products and plastics industries is exhilarating.

Keywords: Reliability, durability, strength, material shift, forest products industry, plastics industry, composite materials.

Introduction
We are living in a dynamic world. Science and technology are changing with it. Three megatechnologies will dominate in the early years of new millennium: information technology, biotechnology, and new materials. In terms of new materials, they must be functional, high performance engineering materials. Even though metal and non-metal materials have their places in the science and technology world, only those products with high reliability and durability will prevail. Wood is a versatile material. Can it be compete with other engineering materials as we stride into the new millennium?

Is Wood a Durable Engineering Material?
The development of civilization over the past 10,000 years, and especially the expansion and intensification of human activities over the past two centuries, has brought great changes in materials utilization. Wood has been ingrained in human culture since the beginning of history. It is the working substance of our civilization. It has been used as fuel, in domestic utensils, tools, weapons, as a building material, and in transportation. In the past three decades, wood has encountered growing competition from nonrenewable raw materials such as steel, reinforced concrete, prepressed concrete, aluminum and plastics. In order to make wood more competitive with these non-wood materials, new wood products, namely, plywood, particleboard, waferboard, oriented strand board, fiber board, and glued laminated timber, have been developed. There is little doubt that wood is easily worked, has great strength in relation to weight and beauty, and has great ability to absorb shocks from impact-type loads. In addition, wood does not corrode, is comparatively light in weight, and is adaptable to a countless variety of uses. The production of wood and the manufacture of wood products contribute about US$400 billion to the world market economy (about 2% of GDP). Recent projections of future consumption of industrial wood to the year 2050 suggest an increase from the current level of about 1.7 billion cubit meters per year to somewhere between 2 and 3 billion cubit meters per year. Nonetheless, wood is an organic, biological material which is more susceptible to deterioration than other inorganic materials such as steel or concrete or even organic materials such as plastics. In comparison to other engineering materials, wood suffers the following disadvantages: biodegradation, dimensional instable, flammable, sensitive to chemicals, moisture and sunlight. In order to improve the serviceability of wood, it is necessary to overcome these disadvantages.

In many industrial applications, including building and repairing of infrastructure, wood products industry should play an important role in this activity. Unfortunately, people who decide which materials to use in infrastructure projects often don't see wood as their best choice. In terms of performance, wood was rated lowest among the engineering materials. When choosing materials for infrastructure projects, officials use six factors. In order of importance, they are durability, maintenance, cost, environmental impact, ease of design and innovation. Their perception of wood was not very high. Among the materials in question, they see wood as the least durable, yet durability is their most important criterion. Thus, wood products industry is facing many challenges. Simply put, as we enter the new millennium, the challenges to wood industry have never been greater.

Materials Shift
At the beginning of the 20th century, the United States obtained about 75% of its material from renewable resources. The remaining 25% was met by minerals. This pattern of use held relatively constant until the Second World War when the oil and plastics industry started to emerge.

Wood products industry is a mature industry and wood is an old engineering material. More than 5,000 items can be produced from wood. Wood technologists are still making new engineering products out of old ones. On the other hand, plastics industry is a young industry. It produces more than 10,000 different materials for use in products as diverse as the mind can imagine. In little more than 60 years, plastics have become a primary engine of economic growth. We surely today live in the Plastic Age. Plastics have become important materials in our society because they exhibit a variety of physical properties. Scientists have also developed plastic materials cheaper and stronger. Engineering plastics exhibit high degrees of mechanical strength, thermal stability, chemical stability, and dielectric properties. It has been recognized that plastics have been and will continue to displace traditional materials, like wood and metal in building and construction applications. They grow at a compound annual rate of 5 to 6% worldwide. In the construction field, in some instances, replacing previously used wood products by plastics has been particularly strong and is continuing to increase. The use of plastics or non-wood materials is stimulated by the escalating prices of wood construction products which have roughly doubled in the past four years after remaining essentially constant since the late 1970s. The expansive use of plastics, however, creates a serious disposal problem. A high quantity of this durable material ends up in the landfill and is non-biodegradable. The plastics industry searches desperately for ways to solve the disposal problems with aggressive involvement in recycling business.

Under these circumstances, it is imperative that durable wood products be developed in order for them to be competitive. One of the attractive and practical areas is to produce a hybrid product from wood and plastic materials. Durable wood fiber-thermoset composites, using phenol-formaldehyde as the binder, have been successfully demonstrated in the 1950s. However, the use of wood fiber with thermoplastics is a more recent innovation. Even though the wood products industry has been involved in innovative wood composite production for a long time, the development of wood fiber- thermoplastic composites can be described as the introduction of a new product to the industry.

Engineering Composite Materials

The properties of simple homogeneous polymers are sufficient for many applications. On the other hand, materials scientists are noting with increasing frequency and urgency that heterogeneous dispersion of a second phase in the polymer, on a submicroscopic or microscopic scale, can often produce tremendous improvement in properties and versatility for a greater variety of more demanding applications. Thus, they have been creating new composite materials by blending and alloying. Composites represent one of the fastest growing commodities in the world market. Perhaps one of the most important concepts that composite materials are useful is because of their complexity. Blends and composites are toughened because many modes of resistance to failure are available.

One of the biggest new areas of research in this fields is in combining wood fiber with thermoplastics. As a matter of fact, wood fiber - thermoplastic composites have been prepared in the 1950's. The difficulty of quickly processing them into solid composite materials because of their inherently high melt temperature has limited interest in commercializing them until recently. Success in utilizing wood fibers as a reinforcing agent for plastic composites, coupled with the realization that huge volumes of a valuable resource, namely plastics and lignocellulosic materials in the municipal solid waste are being wasted prompted renewed interest. Since 1990, enormous commercial and scientific attention has been focused on developing composites from recycled wood and plastics. A considerable amount of work has revolved around improving the interfacial bond between the hydrophobic thermoplastic and the hydrophilic lignocellulose. The beneficial effect on mechanical properties of wood fiber-plastic composites treated with coupling agents or oxidizing agents has been demonstrated.

In general, two types of wood fiber- thermoplastic composites can be prepared. Namely, composites with high and low thermoplastic contents. In the former, wood fiber serves as a reinforcing agent or filler in a continuous thermoplastic matrix. On the contrary, in the latter, thermoplastic serves as a binder to wood fiber. The composites with high thermoplastic content appear and perform like thermoplastics with the exception that they have better strength properties due to the stiffness of wood fiber. On the other hand, the composites with low thermoplastic content appear like wood composites with the exception that the surface looks like having laminated or coated with thermoplastics. Regardless of the thermoplastic content in the composites, the well-prepared composites exhibit good dimensional stability, insect resistance and water-repellent property, and provide good strength properties. Currently, most of the research and commercial products are based on high thermoplastic content. This class of products probably serves well for the plastics industry. For the purpose of effective utilization of wood fiber, the preparation of composites with high wood fiber content and low thermoplastic components suits well for the forest products industry.

Composites with low thermoplastic content can be made in different ways. In principle, the plastic acts like a binder or adhesive to the wood fiber. Hence, wood fiber can be dry-blended with thermoplastic granules, flakes or films at ambient temperature and put into a hot press; or hot air is injected through the mixture to melt the plastic. The fiber with molten plastic is then pressed into a mat. The mat is transferred to a cold press to consolidate and cool the mat. In this process, it is very similar to the conventional wood fiber composites; no extrusion equipment is needed. And in the process, more than seventy percent of wood fiber may be used.

The composites of high wood fiber, low thermoplastic content are a new field for forest products industry. In order to produce such composites with excellent chemical, physical and mechanical properties, there is much work to be done. In addition to understanding wood properties, including species, density, geometry of fiber or chip, it also requires understanding plastic properties, including density, viscosity, melting and softening temperatures and glass transition points. Moreover, blending techniques and mat-forming parameters have to be studied thoroughly. Since it is a relatively new field to the forest products industry, there are inevitably many obstacles to overcome before these materials become common in mass-market products, but these problems are mostly engineering rather than chemistry problems, and solutions will be found. The high wood fiber and low plastic composites are here to stay. Interestingly, cooperation between the forest products and plastics industries is showing an upward trend. More and more wood fiber-plastic composites are expected to appear in the marketplace in the very near future..

Concluding Remarks

As we enter the 21st century, advanced composites will be the fastest growing materials of all. The world of advanced composites is a highly competitive commercial arena. *Natural* wood products are used and *synthetic* plastics are made mainly because of their outstanding mechanical properties. All their industrial importance as construction and engineering materials is ultimately based on strength, stiffness and high modulus. Both of these unique materials have their strengths and weaknesses. In view of the important relationships between the traditional wood products and plastics industries, it is quite certain that cooperation and competition between the two industries will be intensified in the years to come, and that more companies will be engaged in activities involving both industries. Naturally, the combination of both materials can augment their strengths and meliorate their weaknesses.

Wood fiber-plastic composite is emerging as a coherent doctrine or technical field with deep intellectual roots, which promises new contributions, on a practical time scale, to the nation's prosperity, security, and quality of life. The coming years should be a heady time for the wood products industry, but clouds are on the horizon. To meet the growth projections, wood products manufacturers must work cooperatively with plastics manufacturers; they will have to increase the amount of applied research they conduct and provide better performance, durability for their consumers. The challenge of meeting these increased demands will help foster a high level of versatility and innovation with wood products industry aggressively exploring new and more efficient way of doing business.

General References

Youngquist, J. A. 1999. Wood-Based Composites and Panel Products. In: Wood Handbook. .FPL-GTR-113. Madison, WI: USDA Forest Service, Forest Products Laboratory.

Youngquist, J. A.;Myers, G. E.; Muehl, J. M. 1993. Composites from recycled wood and plastics. Final Rep., U.S. Environmental Protection Agency, Project IAG DWI12934608-2. Madison, WI: USDA Forest Service, Forest Products Laboratory.

English, B.; Chow, P.; Bajwa, D. S. 1997. Processing into composites. In: Rowell, R. M.; Young, R. A.; Rowell, J. K., eds. Paper and Composites from Agro-Based Resources. Boca Raton: CRC Lewis Publishers Co.: 269-299.

Implementation of Sustainable Forest Management : Application of Criteria and Indicators in Korea

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Abstract

Since the UNCED in 1992, sustainable forest management has been the major theme of conservation, management, and development of forest resources around the world. While addressing the promotion of efficient utilization and assessment to recover the full valuation of the goods and services provided by forests, forest lands and woodlands at UNCED, governments agreed to pursue, in cooperation with special interest groups and international organizations, the formulation of scientifically sound criteria and guidelines for the management, conservation and sustainable development of all types of forests (Chapter 11 of Agenda 21, Programme Area C, Section 11.23[b]). Also governments recognized that sustainable management and use should be carried out in accordance with national development policies and priorities and on the basis of environmentally sound management guidelines; and that, in the formulation of such guidelines, account should be taken, as appropriate and if applicable, of relevant internationally agreed methodologies and criteria(paragraph 8(d) of the Forest Principles).

To promote sustainable forest management in Korea, many actions have been taken in close cooperation with international and regional initiatives about forest resources. In particular, Korea has actively participated in the Montreal Process and others including Intergovernmental Panel on Forests under the UNCSD. Based on the major criteria and indicators for sustainable forest management, the current forest management conditions were evaluated in Korea. The average applicability of criteria and indicators for sustainable forest management in Korea was estimated at about 70% among major criteria, except for legal, economic, and institutional framework. In each criterion, the current status were discussed and future activities were suggested to achieve the sustainable forest management in Korea. In particular, the general conditions of forest management based on criteria in Korea was briefly described and major programmes towards sustainable forest management were explained in context with the long-term Forest Plan, started in 1998.

Sustainable Development of Rubberwood in China

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Abstract

The situation of rubberwood resource and supply , as well as the timber demand and timber supply shift in China is discussed. For the sustainable development of rubberwood industry and rubber plantation, more research on rubber wood utilization including regeneration, management, processing, marketing, are proposed.

Key Words: rubberwood, sustainable development, research

Introduction

As the 4th largest rubberwood resource in the world, rubberwood plantation area in China occupy 618,500 hectares of which 374,000 hectares are on Hainan Island, 156,500 hectares are in Yannan Province and 88,000 hectares are in Guangdong Province.

China has had an active rubberwood research program since 1980's when the rubberwood industry was established. Research has included

sawing, prevention of attack by mould and blue stain fungal or insect, preservative treatment, drying etc., but the main focus is on primary processing. This research provided the basic technical information needed by rubberwood industry at that time.

With the emergence of environmental protection as a critical issue in industry development, and the consideration sustainable management of forest in national development, many new problems has arisen in the rubberwood industry which needs to be resolved.

Resource and Supply

The rubberwood industry on Hainan Island is more developed than in other areas of China. The General Bureau of Hainan State Farms (GBHSF) owns 66.5% of the 374,000 hectares of rubberwood plantation on Hainan Island. The regeneration data of rubber tree implemented by GBHSF is listed in Table 1［1］.

Table 1. Regeneration Area of Rubberwood Tree Plantations in Hainan State Farms

YEAR	AREA (hectare)
1981	917.5
1982	804.9
1983	1,781.9
1984	2,326.1
1985	2,391.5
1986	1,830.3
1987	2,512.9
1988	2,741.4
1989	2,926.8
1990	2,885.9
1991	3,558.5
1992	4,547.0
1993	4,522.2
1994	3,823.6
1995	3,268.0
1996	2,473.2
1997	2,560.5

Industrial utlilization of rubberwood began around 1985-1987. The annual wood production capacity was 400,000 m^3 of sawn timber, 20,000 m^3 of plywood, and 39,000 m3 of MDF as at 1998. Other rubberwood products were flooring, blockboard, moulding board, laminate, and handicrafts. The average annual output of rubberwood products was around 350,000m^3 from 1988 to 1997. The production volume of the main rubberwood the production volume of rubberwood sawn timber and furniture products is listed in Table 2［1］. It can be seen that has dramatically increased over the past 10 years, whereas the volume of plywood has heavily decreased since 1995 due to the depleting supply of quality veneer.

Table 2. Production Volume of the Main Rubberwood Products

	1991	1992	1993	1994	1995	1996	1997
Sawn Timber (m^3)	33,856	45,970	55,740	62,185	87,575	75,197	69,820
Plywood (m^3)	8,111	19,304	22,104	23,151	9,598	4,887	4,547
Particleboard (m^3)	9,843	30,312	25,174	28,003	26,197	26,305	27,759
Furniture (1,000 Set)	214.4	714.4	836.0	1,081.0	890.0	940.0	970.0
(1,000 RMB)	11,260	--	59,530	--	111,070	144,550	162,700

Timber Supply Shift

The severe deforestation of natural forest was one of the most important causes for the heavy flooding in both the southern and northern regions of China in 1998. This was one of the reasons that led China to implement the Natural Forest Protection Program. By executing of the logging ban on natural forests, China faces a big problem in supplying raw materials to the forest industry as over 50% of timber supply in China were once from these natural forests.

The reduced timber production in connection with the logging ban would have a severe impact on the local forest industry. Therefore, China should find appropriate ways to overcome this situation. The importation would ease the timber shortage, but it can not meet the demand, as the shortage is too big—59.9 million m^3 in 2000, and increasing after 2000. If the supply relies only upon the importation, it would also cause a severe impact on the world timber market.

It was predicted that the total timber demand in 2000 would be 101.9 million m^3 (excluding fuelwood), and the supply would be only 63.9 million m^3 without the logging ban. As 21.9 million cubic meters of the timber reduction (logging ban) was planned for 2000 in the Natural Forest Protection Program, the timber shortage would be 59.9 million cubic meters in 2000 ［2］.

One of the ways to resolve the shortage of raw materials in the forest industry is to facilitate the utilization of plantation timber or fast growing species. In order to fulfil the need for the conservation of natural forest and the sustainable management of plantation forest, appropriate fast growing tree species should be selected that thrive under the climatic and growing conditions in China while still producing timber with satisfactory characteristics. Rubberwood is such a species. It fits the sub-tropical climate region of China and has acceptable wood properties. This can provide a considerable potential to provide raw materials to forest industry by substituting a large number of currently used species in China.

Future R & D Activities

The timber supply shift would provide oportunities for the development of rubberwood as a viable plantation timber resource.

Regeneration of 2.5-3.0% rubber s each year is planned in Hainan. This means that the annual supply of rubberwood would be 418,000 m^3 of log and 188,000 m^3 of branches. Due to the s at the local economic level, there are still 33,000 hectares of old (over 30 years) standing rubber trees which form part of the supply potential once regeneration activities commence.

For promoting the sustainable use of rubberwood, research and development work on rubberwood products should emphasize improvements in efficiency and competitiveness of the Chinese rubberwood industry. Some important topics to address in this R & D effort include:

Plantation for both Latex and Timber

All rubberwood supplies now come from rubber plantations originally established for latex in China. The rubberwood timber is a secondary or by-product of rubber plantations. Therefore the quality of rubberwood timber/log is not very good for making wood products.

The regeneration of existing rubber areas with vigorous clones which can provide high wood volume with good quality at harvest and the sustainable management of rubber forest plantation are ways to enhance rubberwood production. Planting rubber tree for both latex and timber would benefit both the latex industry and rubberwood processing industry in China. In view of the attractive returns that can be obtained from both latex and rubberwood, the owner of rubber farm should be encouraged to adopt rubber tree planting for latex and eventually timber..

Development of Processing Control

The time lapse between the felling of rubberwood trees and the kiln drying is very critical as this is the time when most fungal and insect attack will take place, no matter what sort of chemical and treatment process is used. The shorter the time, the less the risk of fungal and insect attack.

The long time lapse between log cutting and kiln drying was one of the main reasons that prompted the use of sodium pentachlorophenate (NaPCP) to protect rubberwood from stain, mold and insect attack. In fact, if the sawing, treatment and drying can be done without delay, it would not be necessary to use NaPCP. So the key factor for the management of rubberwood processing is "no delay": freshly felled rubberwood should quickly be sawn, treated, and kiln-dried. Synchronizing capacities of sawing, treatment and kiln drying is important, and would reduce delay. Specifications for input of raw materials at each stage of production right to the end products are also needed.

Treatment with Environmentally-Friendly Chemicals

Rubberwood is susceptible to fungal and insect attack. Hence it must be properly treated to prevent the deterioration of wood which would result in wastage of useful material and financial loss. The preservative used for treating rubberwood in China was a mixture of borax, boric acid and NaPCP. The mixture is called BBP. In which NaPCP contains contaminants of dioxins and is highly toxic to both human being and environment. As dioxins in NaPCP can cause a number of hazard, it has been strictly restricted or prohibited in many countries, such as Sweden, Germany, Spain, Chile, Denmark, Switzerland, Italy, Greece, Malaysia, Indonesia, Japan, New Zealand, Australia and USA (restricted used). BBP is highly corrosive to the inner surface of the impregnating tank as well as the components of seasoning kilns. Furthermore, BBP also discolors the wood, thus lowering the acceptability and value of treated rubberwood.

To reach the international quality of rubberwood products, not only the effectiveness of the preservative but also the environmental impact of the preservative, have to be considered. Therefore it is necessary to replace NaPCP with environmental-friendly chemicals. Pentachlorophenol-free preservative for rubberwood will minimize many of the problems encountered at present.

More Applications of Rubberwood

Rubberwood sawn timber can be used for manufacturing many timber products such as furniture, flooring, doors, doorframe, and laminate. In view of the huge population and fast economic growth, China has a very large market for timber products. Hainan Island and Yunnan Province are rich in rubberwood timber resources and have great potential to further develop and expand the rubberwood industry in China.

Rubberwood as a source of raw material for the wood-based industry in Malaysia and Thailand has indeed determined and accelerated the development of the downstream timber industry in these countries with respect to furniture manufacturing and panel production, especially MDF. Here rubberwood is also used for the production of other products such as laminated veneers lumber (LVL) and laminated boards. The growth in this kind of panel products not only improves the application of rubberwood for furniture manufacturing, parquet flooring and craft production etc., but also opens a new market for rubberwood residues. This new kind of rubberwood board products and more added-value high quality products increase the competitiveness of the rubberwood industry in China.

Market Research and Marketing

Rubberwood products are well accepted in the international market, especially in the United States of America, Japan and Europe. During the last decade, the market for rubberwood products has been growing very fast and is probably in excess of US$500 million, but its potential as a utility timber is immense and still largely untapped in China.

The demand for rubberwood was not considerable in the domestic market although China has long been short of local timber. The reasons for the low demand included:
The advantages of rubberwood as one of the plantation timbers which can be sustainablly used has not been appreciated;
The production of durable rubberwood through suitable treatment has not been accepted;
The quality of local rubberwood did not meet the requirement of specification, color, and durability;
Insufficient marketing knowledge and measures in the rubberwood industry.

Despite having a large area of rubber tree plantations, the annual output value of rubberwood products in China is relatiavely minor in proportion. Current status of rubberwood utilization is still at very low level because of low market acceptance and lack of marketing expertise.

With the shift from planning economy to market economy in China, market forces would prevail to influence the direction of the wood industry. The market and marketing research is becoming increasingly important, and should be strengthen, to help promote the development of a sustainable rubberwood industry in China.

Conclusions

Timber research has yielded the basic technology of rubberwood processing and utilization for the establishment of rubberwood industry in China. To promote the sustainable development of the rubberwood industry and the rubber plantation in China, both technological and marketing research are needed. This would also support the strategic timber shift from natural forest to plantation forestry in China.

References

1, Lin, Zechuan. 1998. The development, utilization and future of rubberwood in Hainan Island. Pp5-10 in Proceedings of the rubberwood processing and utilization seminar. 2-3 December 1998. Haikou, China.

2, Shi, Feng, Yang, Zhen and Tian, Zhiwei. 1997. Some considerations on the implementation of the protection of natural forest resource and the development of wood industry in China. In proceedings of Chinese Society of Wood Industry. October 1997. Zhengding, Hebei Province, China.

Pelleted Municipal Sludge - A Key Element in Future Resource Cycling and Sustainable Forest Management.

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Introduction

Field experiments have been established in northern and southern Sweden on the basis of the vision that forests may become important links in the cycling of waste by-products, such as e.g. municipal sludge and wood ash, and that cycling of environmentally safe sludge pellets could be an important element in sustainable forest management.

New technology, including spraying of newly formed sludge pellets with lime or wood ash, which prevents these from sticking together, allows for producing dry and hygienic (non-infectious) pellets that are easily stored and transported. This method eliminates severe problems that are associated with the handling of wet or moist sludge, i.e. high water content, pathogenic bacteria and bad smell (Hånell et al., 1996). Partly due to these problems and credibility gaps between the general public and public agencies regarding the fate of waste water products, amendments of municipal sludge to agricultural or forest soils have not been generally accepted and become common practise - in spite of the fact that the quality of sludge has constantly improved with respect to e.g. the content of toxic trace metals. Our study was restricted to testing a method of spreading sludge pellets in forest stands, the pellet fertilization effects on the rate of nitrification and nitrogen turnover, the heavy metal content in berries, mushrooms and field vegetation in fertilized and unfertilized plots, and number of mushroom species and changes in their relative abundance following various amounts of pellet amendments.

Materials and methods

In order to test the value of a forest application program with respect to environmental and ecological effects, including single tree and stand growth, dried and hygienic sludge pellets were amended in dozes of 0, 4, 8, and 16 tonnes ha^{-1} in Scots pine and Norway spruce dominated forest stands. The pellets contained approximately 32 % C, 2.9 % N, 1.8 % P, 0.2 % K, 0.3 % Mg, 7.2 % Ca and 0.4 % S. Each treatment were replicated three times. Nitrate reductase activity (NRA) in vegetation was measured according to Högberg et al. (1986).

Results

The results show that

(i) an ordinary farm tractor equipped with the most common type of centrifugal spreader designed for commercial fertilizers, can be used for spreading sludge pellets as well. These were evenly distributed after spreading in perpendicular direction from strip roads 10-12 m apart.

(ii) the nitrate reductase (NR) activity in leaves of *Deschampsia flexuosa* (L.) Trin. was moderately (but statistically significant) increased 6-8 weeks after pellet amendments of 4-16 tonnes ha^{-1} (fig. 1). In another set of experimental plots NR activity was still somewhat raised two years after application of 4 tonnes ha^{-1}.

(iii) two years after treatment, the heavy metal concentrations in edible lingonberries (*Vaccinium vitis idaea* L.), blueberries (*Vaccinium myrtillus* L.) and fruitbodies of mycorrhizal fungi, did not differ between untreated control plots and plots recieving 4 tonnes ha^{-1} (Table 1).

(iv) inventories of fungal fruitbodies 6-8 weeks after pellet amendments of 4-16 tonnes ha^{-1}, showed that the number of species remained unchaged, while species composition changed significantly. The very large and important genus of *Cortinari*ed in relation to other groups (Fig. 2).

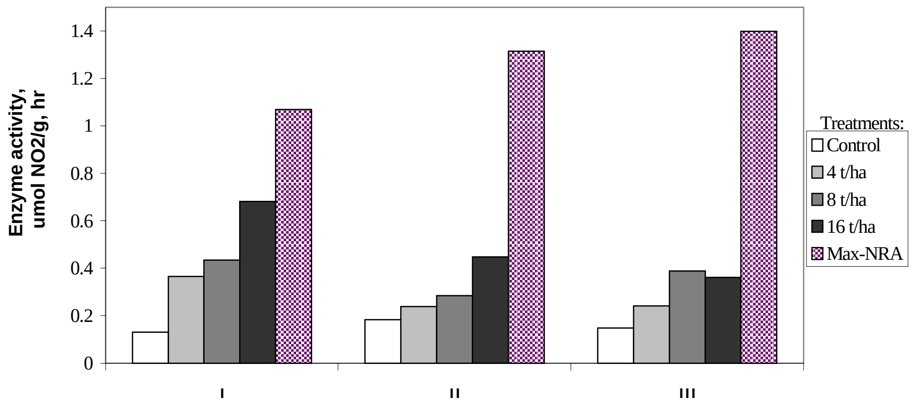

Figure 1. Nitrate reductase activity (NRA) in *Deschampsia flexuosa* leaves 6-8 weeks after sludge pellet amendments in a three block (I-III) experiment.

	Cd		Cu		Ni		Pb		Zn	
	C	SP	C	SP	C	SP	C	SP	C	SP
Blueberry/Lingonberry (n = 12)	0.04	0.05	6	6	2	2	0.2	0.2	32	43
Blueberry leaves (n = 6)	0.07	0.06	11	7	7	3	0.6	0.5	62	30
Cortinarius leucophanes (n = 3)	5.00	5.67	18	19	1	1	0.3	0.6	136	121
Mixed mycorrhizal fungi (n = 16)	1.94	1.87	18	18	1	1	0.4	0.5	90	89

Table 1. Heavy metals (mg/kg d.w.) in plants/fungal fruitbodies two years after addition of 4 tonnes of sludge pellets per hectare. (C = Control; SP = Sludge pellets)

Figure 2. Example of changes in species composition of fungi after sludge pellet amendments (decrease of the *Cortinarius* genus).

Discussion

Despite constantly improved quality of municipal sludge in Sweden since the 1970´s, pellet concentrations of most heavy metals are higher than in the organic matter of surface soils in the Swedish forests. Possible biological enrichment in microbes, plants and further up in food chains have to be checked. In this investigation no such enrichments were indicated.

The results encourage further efforts to find out whether or not cycling of pellets from municipal sludge into silvicultural systems for intensive and extensive production rates can be justified. Provided environmentally sound, relatively large amendments
of pellets could be made in areas selected for intensive forest production (pulpwood, fuel) whereas smaller pellet dozes could favour timber assortments in forest stands which are reaching the end of the rotation period.

References

Hånell, B., Magnusson, T. & Modig, T. 1996. Pelleting of sludge - innovation strengthens the role of forests in cycling. Swedish Univ. Agr. Sciences. Fakta Skog, nr 11. 4 pp. (In Swedish).

Högberg, P., Granström. A., Johansson, T, Lundmark-Thelin, A. & Näsholm, T. 1986. Plant nitrate reductase activity as an indicator of availability of nitrate in forest soils. Can. J. For. Res. 16:1165-1169.

Högbom, L. & Högberg, P. 1991. Nitrate nutrition of *Deschampsia flexuosa* (L.) Trin. In relation to nitrogen deposition in Sweden. Oecologia 87, 488-494.

Alternatives to Clearcutting in the Old-Growth Forests of Southeast Alaska.

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Abstract

Clearcut logging of old-growth temperate rain forests is one of the most visible and contentious forest management issues in southeast Alaska. This issue touches the cornerstones of southeast Alaska's economic and social well being: the timber industry, fisheries, tourism, and subsistence. Broader concerns for biological diversity, threatened or endangered species, and the value of wild and remote places have focused national attention on this issue. Observations suggest that southeast Alaskan forests and the associated animal taxa are well adapted to the widespread small-to-medium-sized disturbances caused by wind, disease, and landslides. The use of silvicultural systems other than even-aged management with clearcutting could take advantage of this adaptation to provide a sustainable supply of timber—along with a host of other important values.

The alternatives to clearcutting (ATC) study uses experimental and retrospective approaches to evaluate several silvicultural systems for managing old-growth western hemlock-Sitka spruce (*Tsuga heterophyla-Picea sitchensis*) forests—including even and uneven-aged management—and their biological, physical, and socioeconomic effects. The ATC study integrates research on stand dynamics, forest health, understory plant communities, wildlife habitat, stream ecology, slope stability, hydrology, economics, visual quality, and social acceptability.

Three factors and their interactions are tested in the experimental study: the stand density retained after timber harvest, the spatial pattern of the retained trees (uniform vs. patchy), and the size of *patches* (gaps or uncut reserve areas). The matrix-patch design includes both 'hard' and 'soft' edges. Post-treatment stand densities range from 0 to 100% of the initial stand basal area (clearcut and uncut control, respectively), with three intermediate densities. Nine treatments are replicated in three blocks located across the Tongass National Forest, and each experimental unit is 18 ha, on average.

The purchase of two major ATC timber sales and the successful harvest of one demonstrated that ATC systems are viable in the current timber marketplace and that the treatments are feasible from technical and safety points of view. In general, residual trees at the first harvested block showed higher levels of harvest related damage in 25% retention prescriptions (top breakage in 5.2-10.2%, bole wounds in 4.0 to 26.8%) than in 75% retention prescriptions (top breakage in 3.4-4.5%, bole wounds in 3.4-6.4%). Group selection employing gaps with diameters of 200-300 feet was operationally efficient, but 100-foot gaps created severe difficulties during falling and yarding operations.

Keywords: sustainable forestry, clearcut, landscape ecology.

Second-Growth Western Hemlock Product Yields and Attributes Related to Stand Density

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Abstract
The effect of stand density on 90-year old western hemlock tree and wood characteristics was determined to assist foresters with stand density management. Trees were selected from three Vancouver Island stands. Stand densities were 580 and 930 stems per hectare (sph) at two northern locations, and 930 sph at a stand 500 km south. Mean breast-height wood densities were .42, .45 and .47 respectively. The 580 sph stand trees had fastest early growth rate, were taller, larger in diameter, had largest branches, and highest taper. The southern 930 sph stand had the slowest early rate-of growth. Tested in bending, lumber mean modulus-of-elasticity (MOE) and mean modulus-of-rupture (MOR) differed significantly by stand density, and average early growth rate. The 580 sph stand had the lowest proportions of high grade structural lumber and the lowest MOE and MOR values. Structural properties of veneer, LVL, and small clears were consistent by stand with those of lumber. Lumber machined as well, and treated more easily than old growth hemlock. Kraft and TMP pulp properties did not differ significantly by stand. Kraft pulp yields were 1 to 3 percent higher than those published for western hemlock.

Keywords: Second-growth, western hemlock, Tsuga heterophylla, stand density, growth rate, juvenile wood, lumber, veneer, LVL, pulp, machining, treated wood, mechanical properties.

Introduction
In British Columbia second-growth western hemlock (*Tsuga heterophylla* (Raf.) Sarg) remains a small proportion of harvested volume, but represents an increasing area of young stands that are subject to silvicultural treatment. Foresters need information quantifying the effect of stand density management on important tree characteristics and wood attributes.

Methods
Two hundred 90-year-old western hemlock trees were selected from three natural stands on western Vancouver Island. Two stands (PH580 and PH930) located near Port Hardy at latitude 50° 36′; longitude 127° 30′ had stand densities of 580 and 930 stems per hectare (sph) and site index at 50 years of 39 and 32 respectively. The third (PR930) located at Port Renfrew, at latitude 48° 35′; longitude 124° 21′ had stand density of 930 sph and site index 30.
Tree samples were selected systematically by diameter-at-breast height (d.b.h.). Tree dimensions, quality and pathological indicators were recorded. Sample trees were felled, stems were scaled and graded, and knots and knot indicators were measured and recorded. Stems were cut to 4 m lengths and the first 15 and 30 annual rings from the pith were marked on log ends to represent two measures of juvenile wood.

Logs equal to or greater than 25 cm small-end diameter were sawn to Japanese lumber sizes, primarily 105x105 mm squares. The lumber was kiln dried, planed and graded to both Japanese

(JAS) and North American (NLGA) rules for structural lumber. Lumber was also graded to both rules based on consideration of knots only.

All structural grade lumber was tested in bending to determine modulus of rupture (MOR) and modulus of elasticity (MOE). Depending on dimension, bending tests were done in accordance with ASTM D4761 or ASTM D198. Data were related to individual trees for analysis of stand and tree growth effects.

Sub samples of lumber were selected from the PH580 and PH930 stands by juvenile wood content and tested for treatability with a water-borne preservative, chromated copper arsenate (CCA) and a solvent-borne preservative, acypetacs copper (Cuprinol). Additional lumber samples were selected by stand and juvenile wood proportion and tested for machining (planing, sanding, shaping, boring and mortising) and fastener (nail and screw) withdrawal properties.

Three additional trees (small, medium and large) from each stand were obtained to test properties and yields of kraft and TMP pulps, veneer yields and Laminated Veneer Lumber (LVL) potential, and mechanical properties of small clears.

Results and Discussion

For PH580, PH930 and PR930 respectively, mean breast-height diameters were 42.7, 32.8 and 32.5 cm. Mean heights were 43.8, 37.3, and 34.9 m. Mean percent basal areas of first 30 years growth were 46.4, 44.9 and 25.7%. Mean breast-height wood densities were .42, .45 and .47 respectively, equal to, or higher than the species average of .42. Measured on logs, mean knot diameters were 1.50, 1.16 and 1.20 cm. The PH580 trees had the fastest early growth rate, were taller, larger in diameter, had the largest branches, and the highest taper. PH930 was distinguished from PR930 by faster early rate-of-growth. Figure 1 shows average ring widths by cambial age compared by stand.

Log and Lumber Grades

Relatively higher proportions of PH580 log volume were assigned to high value log grades on the basis of larger log diameter. Lumber recovery was higher from PH580 larger diameter logs, but the proportion of premium NLGA and JAS grades obtained declined significantly as tree d.b.h. increased. Lumber from the PH580 stand yielded the lowest proportions of JAS No. 1 and NLGA Select Structural grades.

Lumber Structural Properties

Lumber from the PH580 stand had significantly lower mean MOE and MOR values compared to lumber from the two more dense stands, and fell below code values. Mean MOE and MOR values for lumber from the two 930 sph stands were also significantly different.

Figure 2 shows that mean MOE values for Select Structural 105 x 105 mm lumber obtained from the two 930 sph stands essentially met or exceeded existing code values for Hem-Fir. It also shows that mean MOE values for the slow grown PR930 stand exceeded a value published for old growth hemlock (Littleford and Rovner, 1968) to MOE for Select Structural Old-Growth Western Hemlock

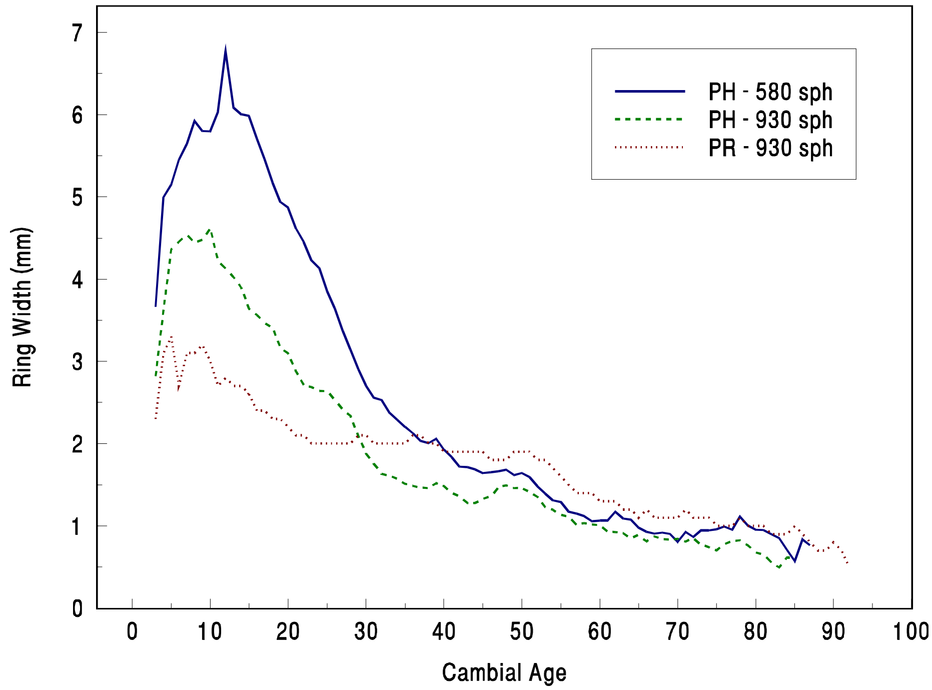

Figure 1—Comparison of Average Annual Ring
Width by Cambial Age

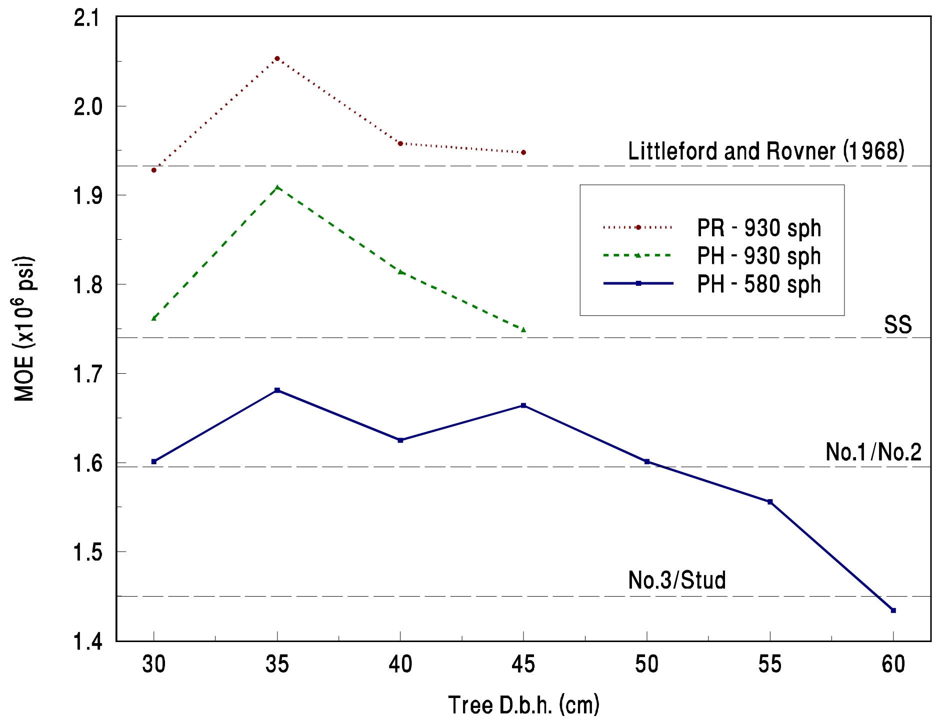

Figure 2—MOE for Select Structural 105 mm
Squares Compared to Hem-Fir Code Values and

Mechanical Properties of Small Clears

Strength and stiffness values for small clears were consistent with those for tests of full sized lumber, but differences between material from the two 930 sph stands were not significant

Juvenile Wood And Branches

Juvenile wood zones 15 and 30 annual rings from the pith provided poor predictions of lumber strength and stiffness, but there were significant differences in mean MOE and MOR values between discrete 20 percent classes of juvenile wood. Increased proportions of juvenile wood were associated with significant reductions in MOE and MOR.

Various measures of knot size (measured on the logs) provided relatively poor estimates of percentage yields of premium NLGA and JAS lumber grades. Average knot size was generally the best measure of knot effects on lumber grade but easier to obtain knot indices proved to be nearly as effective. Predictions of mean MOE and MOR based on tree d.b.h. and breast-height wood density were improved only slightly by the inclusion of knot size.

Treatability

In terms of retention, fast grown western hemlock from PH580 was more treatable than hemlock from PH930. Juvenile wood, defined as the first 15 annual rings, was less treatable than 16-to-30 ring juvenile wood with both CCA and Acypetacs Copper. Full cell treatment of 16-to-30 ring juvenile wood with CCA achieved the requirement for decking lumber in CSA 080.32. There was no significant difference in treatability with Acypetacs Copper between PH580 and PH930. Double vacuum treatment of second-growth hemlock with Acypetacs Copper achieved the target penetration for protection of joinery grade lumber. Second-growth western hemlock was much more treatable with CCA than old growth.

Machining Properties

Machining tests showed no significant differences by stand. Second-growth western hemlock machined as well as old growth.

Veneer and LVL

Structural properties of veneer and LVL were consistent by stand with those of lumber. Logs from PH930 and PR930 produced high yields of structural veneer suitable for LVL. For all bolts tested, 82.5 percent of the veneer obtained was suitable for making structural LVL. The larger, lower density logs from PH580 had higher recovery suitable for the production of plywood.

Pulp Properties and Yields

There were no significant differences in pulp properties between the stands, but in thermomechanical pulping, mature wood obtained from PH580 exhibited poorer tensile strength compared to that from the other two stands. Second-growth western hemlock kraft pulp yields at kappa 30 exceeded published values by 1 to 3 percent.

Conclusions

Consistent results were obtained for solid wood properties. Trees from the lower stand density and higher site index stand, PH580, were characterized by comparatively rapid early growth rate, lower average wood density and larger branch size. These characteristics in turn resulted in lower structural properties observed for lumber, veneer and small clear wood specimens. Early rate-of-growth proved to be a more effective measure than stand density at 90 years for discriminating stands on the basis of wood attributes. Early growth rate at PH930 exceeded that at PR930, and was associated with significantly lower breast-height average wood density and, for the most prevalent lumber dimension, significantly lower lumber strength and stiffness properties.

Second-growth western hemlock in general treated more readily than old-growth western hemlock and could find value in markets for treated wood products. It machines as well as old growth. Kraft pulp yields from second-growth western hemlock exceeded published values which should significantly improve digester productivity.

Foresters responsible for stand density management can expect that second-growth western hemlock from stands similar to PH930 and PR930 will have structural properties that meet or exceed code standards for Hem-Fir. However, given the lower structural properties of lumber from PH580, they must consider maintaining relatively high initial stand densities on high sites if they wish to produce trees with structural attributes comparable to old growth western hemlock.

References

ASTM. 1999. Standard test methods of static tests of lumber in structural sizes, D 198-98. In: 1999 Annual Book of ASTM Standards, Vol. 04.10 Philadelphia, PA. 676p.

ASTM. 1999. Standard test methods for mechanical properties of lumber and wood-base structural material, D 4761-96. In: 1999 Annual Book of ASTM Standards, Vol. 04.10 Philadelphia, PA. 676p.

Canadian Standards Association. 080.32-97. Preservative treatment of decking lumber with waterborne preservatives. CSA, Rexdale, ON 2p.

Littleford, T.W. and B. Rovner, 1968. Modulus of elasticity of western hemlock, white spruce and lodgepole pine dimension lumber. Inf. Rep. VP-X-32. For. Prod. Lab. Vancouver, BC. 16p.

Saving the Wooden Rhino in Kenya through Responsible Sourcing and Sustainable Use.

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Abstract

Wood carving industry in Kenya is a rural development success facing uncertain future due to its dependence on declining stocks of over exploited, slow-growing hardwoods. The four major and overexploited species are *Dalbergia melanoxylon* (Mpingo), *Brachylaena huillensis* (Muhugu), Olea europaea (Mutamaiyu) and *Combretum schumanii* (Mugurure). To sustain the supply of raw materials for this industry, there is need to promote utilization of fast growing alternative species. The most viable alternative species is *Azadirachta indica* (Neem). This paper compares Neem with the four traditionally used wood carving species in terms of wood properties. A comparison with Muhugu on cost of wood and quality of carved products is done. *Azadirachta indica* wood has lower density, hardness and durability than the four. It has interlocked (as compared to straight) grains, coarser wood texture and thinner fibre walls. However, the salient macrcroscopic features are similar. In terms of cost of logs, carvers pay as much or a higher price for Neem wood as compared to Muhugu, producing carvings indistinguishable to tourists. Neem has properties that make it a suitable alternative for the major species. To promote conservation of the overexploited species, product labelling and certification are recommended.

Keywords: Kenya, Wood carving, Wood properties, Responsible sourcing, Sustainable use, *Azadirachta indica* (Neem).

Introduction

This paper is based on a study undertaken by KEFRI in collaboration with WWF/UNESCO/Kew People and Plants Initiative on anatomical and related properties of wood carving species from Kenya.

Wood carving industry in Kenya provides a means of livelihood to over 350,000 people and generates about US$ 4.4 million in terms of foreign exchange (Economic Survey, 1998). Like any other wood based industry in Kenya, it relies on raw materials from fast diminishing forests and woodlands.

Most of the woodcarving materials are sourced from some pockets of indigenous upland dry forests of Central Kenya, lowland dry forests of Coast and woodland and hills of Eastern Province.

Currently, there is wide spread awareness and concern amongst wood carvers, conservation organisations and some wood carving exporters that the two major sources of wood *Dalbergia melanoxylon* (Mpingo) and Brachylaena huillensis (Muhugu) have been overexploited. Large trees of the two other popular species Olea europaea subspecies africana (Mutamaiyu) and c*ombretum schumanii* (Mugurure) are increasingly difficult to obtain (Cunningham, 1997). The preferential demand for these few popular species coupled with a high rate of expansion on wood carving industry, inefficient and wasteful techniques, declining forest land, low regeneration capacities and slow growth rates has resulted in acute scarcity of wood carving materials. Wood carvers have resorted to use immature wood from these species or substitutes (Obunga, 1995). Most of the substitutes are indigenous hardwood species, currently available in small quantities. The carvers have also been experimenting with some exotic species e.g. *Azadiracht indica (*Neem), G*revillea robusta* (Grevillea), *Jacaranda mimosifolia* (Jacaranda) and *Mangifera indica* (Mango). Among the alternative species *Azadirachta indica is* the most viable substitute (Cunningham, 1997). It has reached a considerable market share, particularly at the coast. This paper compares *Azadirachta indica* with the traditionally used wood carving species in terms of wood properties, cost of logs and quality of carved products and recommends strategies for sustainable supply and responsible sourcing of wood for carving.

Materials and Methods

Wood samples were obtained from Coast, Eastern and Nairobi Provinces of Kenya. A total of 52 species were sampled from the field. The samples were prepared and analysed at KEFRI Forest Products Laboratories using standard procedures. The macroscopic and physical features used in the description of the wood specimen were mainly density, hardness, durability, colour of heartwood and sapwood, odour, pore size, ray size, growth rings, wood grains and texture. In description of microscopic structures, IAWA list of microscopic features for hardwood identification was used (Wheeler E.A., et al., 1989).

Results and Discussion.

The 52 wood carving species were classified into 3 main categories i.e. major, minor and alternative. The major ones were: Mpingo *(Dalbergia melanoxylon),* African brown olive *(Olea europaea),* Muhugu *(Brachylaena huillensis)* and Mugurure *(Combretum schumanii).* The minor ones (those occasionally used as alternatives to the major ones) were: Mwangati *(terminalia spinosa),* Muhutu *(Terminalia brownii),* Mbambaro *(Terminalia kilimandscharica),* Mutula *(Terminalia prunoides),* Mjafari *(Zanthoxylum chalybeum),* Muthea *(Cordia sinensis),* (Mutanga) *Spirostachys africana*, and Mukau (*Melia volkensii*). The rest were classified as alternative species (those not widely used for carving but have potential). Among these Neem (*Azadirachta indica*) was considered the most ideal alternative species due to its properties, fast growth, provision of other wide range of uses and current market share.

The criteria for preferences for a particular species are based on multiple attributes including; durability, workability, aesthetic values derived from texture and colour (Obunga, 1995). These factors dictate the price of the product.

Some of the salient macroscopic and microscopic features for the four major wood carving species are: heartwood distinctively darker than sapwood, thick walled fibres, minute pores (partly solitary and partly in radial multiples of 2 or more), minute and homogenous rays (1-3 cells wide), straight grain, fine to medium wood texture, distinct growth rings, vessels with simple perforations and a few parenchyma cells (Muga et al. 1998). *Azadirachta indica* (Neem) has similar features (see Table 1) except for the interlocked grains, coarser (medium) wood texture, predominantly heterogeneous and multiseriate rays and thinner fibre walls. The medium wood texture implies a lower density.

The four major wood carving species have very high density ranging from 0.93 g/cm^3 to 1.23g/cm^3, very high Janka hardness from 10.0 KN to 19.7 KN and are very durable (Table 1). *Azadirachta indica* has a moderately high density of 0.70 g/cm^3 , moderate Janka hardness (6.2 KN) and is moderately durable. The lower density and hardness of *Azadirachta indica*, probably due to its fast growth rate, makes it easier to work on as compared to the other species.

Of all trees harvested for wood carving in Kenya, approximately 50 % are Muhugu (Cunningham et al. 1999). Currently wood carvers are paying as much for logs from faster growing Neem (3800-5800 Ksh./m^3) as compared with slower growing Muhugu (4600-7700 Ksh./m^3), producing carvings indistinguishable to tourists (Bond et al., 1997). The price of a log of Neem bought from a farmer in Malindi (Coast) is almost the same as that of Muhugu cut in Aberdare forest and transported 700 Km to Malindi (Cunningham et. al, 1999). This indicates that Neem is popular and carvings from it are of similar quality to those from Muhugu.

Table 1: Wood density, Hardness, Durability and some Macroscopic Features of 5 Wood Carving Species from Kenya.

SPECIES	FAMILY	COLOUR OF HW/SW	GRAINS	TEXTURE	HARDNESS KN	DENSITY g/cm ^{3}	DURABILITY
Brachylaena huillensis (Muhugu [Kik])	*Compositae*	Grey/ Yellowish brown	Straight	Fine	10.0	1.15	Durable
Combretum schumanii (Mgurure[Swa])	*Combretaceae*	Purplish brown/Whitish yellow	Straight	Medium	19.7	0.93	Very Durable
Dalbergia melanoxylon (Mpingo [Swa])	*Papilionaceae*	Purple to Brownish black/Yellow to White	Straight	Fine	18.0	1.23	Very Durable
Olea europaea (Mutamaiyu [Kik])	*Oleaceae*	Medium to dark brown/Pale yellow	Straight	Fine	12.3	0.99	Very Durable
Azadirachta Indica (Mwarubaini [Swa])	*Anacardiaceae*	Pinkish brown/Light yellow	Interlocked	Medium	6.2	0. 70	Moderately Durable

Key
Swa-Swahili; Kik-Kikuyu; Hw-Heartwood; Sw-Sapwood

Conclusions

Azadirachta indica wood has properties that make it a good substitute for the traditionally used wood carving species. Its use will enable recovery of wild stocks of the overexploited indigenous wood carving species, leading to environmental conservation. To ensure a sustainable supply of wood, assessment on stock levels, natural regeneration potential and growth dynamics trials of Neem and other potential alternative species should be carried out. Certification of good forest management and labelling for woodcarvings produced from sustainable sources also need to be emphasised in Kenya.

References

Bond , I., Cunningham, T., Standa-Gunda, W., & Sigu, G. 1997. The economic values of wood carving timber in Kenya. A Project proposal for a study by KEFRI funded through the WWF/UNESCO/Kew "People and Plants Initiative."

Bryce, J. M. 1967. The commercial timbers of Tanzania. Tanzania Forest Division, Utilisation Section. Tanzania Litho Printers Ltd., Moshi.

Cunningham, T. , Hoft, R., & Maingi, D. 1999. Wood carving, certification, and 'good wood' product labelling – Searching for practical systems. A report on a regional course and discussions organised by the WWF/UNESCO/Kew "People and Plants Initiative", held in Nairobi and Malindi: 15-20, March, 1999.

Cunningham,T. 1997. Kenya wood carving: Steps towards sustainable sourcing. WWF/UNESO/Kew "People and Plants Initiative" workshop report, held at the Trisan Hotel, Nairobi on December, 8, 1997.

Government of Kenya. 1998. Economic survey. Government printers, Nairobi.

Muga, M. O., Githiomi, J. K. & Chikamai, B. N. 1998. Anatomical and related properties of wood carving species in Kenya. A study undertaken for the WWF/UNESCO/Kew "People and Plants Initiative."

Obunga , R. 1995. Sustainable development of the wood carving industry in Kenya. A study undertaken for the WWF/UNESCO/Kew "People and Plants Initiative".

Wheeler, E. A., Baas, P., and Gasson, P.E. (eds). 1989. IAWA list of microscopic features for hardwood identification. IAWA bulletin n. s 10(3): 219-332.

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Biodiversity conservation, Non-Timber Forest Products management, rural livelihoods and sustainable forest management linkages - Insights from Western Ghats, India.

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Abstract

With the shrinkage of forest resources, the issues of sustainable management of forests (SFM) and conservation of bio-diversity are gaining importance. The likely positive impact of managing the forests for non-timber benefits on sustainable management of forests, is receiving increasing attention. However there is need for greater clarity on the linkages between bio-diversity conservation, NTFP management and rural livelihoods with the sustainable forest management, to develop appropriate policy initiatives for better management of forests.

The western Ghats forestry project has attempted to address the issue of SFM of the mega-bio-diversity area of Western ghats through approaches combining conservation and collaborative forest management. The present study specifically explores the linkages between the forest management, use and the livelihoods in western ghats. Through a survey of the forest use by the communities in the Western Ghats the study maps the dependencies of communities on NTFPs for their livelihoods. These studies are inter linked with the studies on the bio-diversity status of the forests to provide insights into bio-diversity conservation, livelihoods and SFM linkages.

Key words: Biodiversity, Western Ghats, Livelihoods, Sustainable Forest Management, India.

Thinning Western Larch Stands Improves Sustainablility of a Valuable Resource

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Abstract

Western larch (*Larix occindentalis* Nutt.) is one of three native *Larix* species in North America, besides subalpine larch (*Larix lyallii* Parl.) and tamarack (*Larix laricina*(Du Roi) K. Koch). Western Larch occurs mainly throughout the Upper Columbia River basin of southeastern British Columbia, northwestern Montana and northern Idaho. It easily reaches 50 m in total height. High wood density and strength usually characterize its wood. Throughout most of western larch's natural range, existing stands originated from natural regeneration following wildfires, and are often overstocked. Therefore, early reductions of stand densities by precommercial thinning became an important management tool to establish stabilized stands and to concentrate stand growth potential on fewer vigorous, well-formed trees. This process of maximizing total stand value rather than maximizing yield can be completed by later commercial thinning and artificial pruning. The intent of this study, carried out by Forintek Canada Corp., was to provide basic information on the relationship between tree spacing and the two major wood quality parameters wood density and branch size to support stand management decisions. From young western larch experimental stands in northwest Montana, 618 sample trees were chosen representing different stocking levels ranging form 270 to 4300 trees per hectare. From two pith-to-bark cores, taken at breast height for each tree, density profiles were obtained using Forintek's x-ray densitometer. We also measured the largest branch diameters below 4 m stem height. The sample trees showed a strong relationship between width of spacing and tree height and diameter breast height. As expected, trees in the widest spaced plots grew the fastest. Despite large differences in diameter growth, no significant differences in average wood density occurred between spacings. A second moderate thinning on the best sites clearly showed that enhancing the wood density of western larch is possible. For the most valuable part of the tree, the branch sizes do not exceed 20 mm even when a wide spacing as 4.6 by 4.6 m is applied. High wood density levels and reasonable knot size confirm that western larch from sustained managed stands remains a valuable tree species in future markets.

Keywords: western larch, *Larix occindentalis*, specific gravity, stand density, x-ray densitometry

Ecosystem management of forests in Russia: Place of the forest certification

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Abstract

In contradistinction to international systems, the Russian Mandatory certification system (MFC) provides for a mandatory certification of stumpage sale timber and secondary forest resources on conformity to the existing Forest legislation, the executive acts of which, with their ecological requirements, have been widely discussed and are agreed with the Russian Ministry of natural resources and the State Committee on environment protection.

The MFC system includes a Central board of forest certification (CBFC) and accredited MFC centres. Such centres would be organisations independent from forest management units, forest users and consumers, and possessing experience in the forest management running and use (scientific, inventory and planning establishments). Thus, the created MFC system allows to estimate conformity of the forest management and use to the clauses of legal acts, and thus to provide the local level of forest management with an effective tool of ecosystem-minded forest management.

Historical background

The National System of Mandatory Forest Certification of standing sale timber and secondary forest resources is being developed in Russia since 1997. Its legal basis is: the Law of the Russian Federation “On certification of goods and services” from June 10, 1993, No. 5151-1, as amended and completed by the Federal Laws from December 27, 1995 No. 211, March 02, 1998 No. 30, from July 31, 1998 No. 211, as well as the Forest Code of Russian Federation issued on January 29, 1997 (No.22) with its Article 71 “Mandatory Certification of Forest Resources”. The formulation of this Article shows the principal features of the forest certification in Russia: “Standing sale timber and secondary forest resources are subject to mandatory certification. Mandatory certification of the aforesaid forest resources shall be organised and carried out by the Federal body of forest administration in accordance with the order established by the Government of the Russian Federation” [Forest Code 1997].

The appropriate Ordinance of the Government of the Russian Federation from February 02, 1998, No.131 "On mandatory certification of standing sale timber and secondary forest resources" has ruled that the Federal Forest Service of Russia performs organisation and carrying out of such work in accordance with the order determined in the Law “On certification of goods and services”, with participation of the State Committee of the Russian Federation for Standards, Metrology and Certification, the Ministry of Economics of the Russian Federation and other interested Federal bodies of the executive power. The aforesaid Ordinance entrusts the Federal Forest Service of Russia: to create a system of the mandatory certification of standing sale timber and secondary forest resources (hereinafter referred to as *forest certification*) enforcing the Article 71 of the Forest Code of the Russian Federation; to develop and approve by duly procedure the legal norms needed for forest certification, including the list of items subject to mandatory certification [Ordinance 1998].

The legal act worked out by end-1998 has the working title “Temporary Regulations of carrying out mandatory certification of standing sale timber and secondary forest resources in forests of the Russian Federation”. It was developed in accordance with the Procedures of carrying out certification of products in the Russian Federation approved by the order of the State Committee for Standards of Russia from February 16, 1994, No. 3, and registered in the Ministry of Justice on March 21, 1994, No. 521 [Certification 1997]. All the interested ministries and agencies, as well as ecological NGOs have positive replies of the draft document, except the Ministry of Economics. Nevertheless, the draft was examined and approved at a joint session of the Council for Science and Technology of the Federal Forest Service of Russia and the Section of timber, pulp and paper and woodworking industry of the Council for Science and Technology of the Ministry of Economics. The opinion in dissent of the Ministry of Economics was exposed in the letter of Mr. B.P. Masliy, vice-minister, to Mr. V.A. Shubin, Chief of the Council for Science and Technology of the Federal Forest Service.

In 1999 in order to proceed to an enforcement of this basic document and to create a legal norms' basis of the forest certification system, a package of legal instruments was developed, allowing a real application of mandatory forest certification in Russia. This package includes: Statute of the Sign of conformity to the System of mandatory certification of standing sale timber and secondary forest resources; Tariffs and Procedure of payment for the certification work; Requirements to be met by experts in the mandatory certification of standing sale timber and secondary forest resources and Procedure of their attestation; Guidelines and Procedure of accreditation of the Centres of mandatory certification of standing sale timber and secondary forest resources; and a number of other documents.

At present one proceeds to test the above Rules with the purpose of a practical assess of their acceptability, as well as omissions and weak points. The mandatory forest certification in Russia is based on reaffirming the compliance with the forest legislation's provisions aimed at ensuring a sound and non-exhaustive forest use, protection, preservation and regeneration, following the principles of sustainable forest management and forest ecosystems' biodiversity conservation. The testing is performed in several members of the Russian Federation, on the free will of their administrations and supported by timber industry enterprises and local communities. First and foremost regions include: Arkhangelsk, Novgorod and Leningrad Regions, Republic of Karelia and Primorye Territory.

In the said regions were created the Regional Centres of mandatory forest certification attached to State inventory and planning enterprises (Sevzaplesproyekt, Karellesproyekt, Sevlesproyekt, Dallesproyekt). The Chief of the Federal Forest Service of Russia has signed the Order appointing the Central State inventory and planning enterprise (in Moscow) the Central body of forest certification.

In view of the Ministry of Economics dissent, the final approval of the Temporary Regulations of carrying out mandatory certification of standing sale timber and secondary forest resources in forests of the Russian Federation is postponed up to the finishing of the period of its testing. In accordance with the Federal legislation, the System of forest certification can be deemed established only after its State registration duly in line with "Procedures of carrying out the State registration of certification systems and signs of conformity in force in the Russian Federation" in the State Committee for Standards and the Ministry of Justice. The above Temporary Regulations are the basic document of the System of mandatory forest certification.

Why mandatory forest certification in Russia?

In accordance with the Article 7 of the Russian Federation's Law "On certification of goods and services", the mandatory certification shall be carried out in cases stipulated by the legislative acts of the Russian Federation" [Certification 1997]. The said Article entrusts the State Committee for Standards to organise and carry out the necessary work in general, but - in cases stipulated by Russian Federation's legislative acts for separate kinds of goods – these functions may be entrusted to other State power bodies. The mandatory certification of standing sale timber and secondary forest resources is prescribed by the Article 71 of the Forest Code of the Russian Federation. All these clauses of Laws were fully taken into consideration when issuing the Governmental Ordinance "On mandatory certification of standing sale timber and secondary forest resources".

The dissent of the Ministry of Economics that has braked the realisation of the Article 71 of the Forest Code and the fulfilment of the above Governmental Ordinance is explained by a different interpretation of the forest certification object. The position of the Ministry is based on their experts' assumption that the 'standing sale timber" is merely growing trees (alive wood) to be certified by quality parameters.

The Federal Forest Service of Russia proceeded from other reasons when drafting the System. First, there is a principal difference of professional terms "timber" or "wood" and "standing sale timber". The Law states: is subject of certification not merely "timber" or "wood", but "standing sale timber". The standing sale timber, as well as secondary forest resources may be certified only for the compliance of their delivery with the requirements of legal acts regulating the forest management and forest use in the forests of the Russian Federation. It was just the reason to include appropriate Article in the Forest Code. Such treatment of the Article does not contradict to the Law "On certification of goods and services" the preamble of which explains: this Law "establishes the legal norms of mandatory and voluntary certification of goods, services and other items (hereinafter "goods") in the Russian Federation". It means that "goods" in this Law has a broad interpretation and, in particular, in other legal tools exposed as goods, work, services.

Certification of compliance with requirements of forest legislation is on the meeting-point of certification of goods and of quality systems, but cannot be considered as a quality system. The international standards of quality systems, series ISO 9000, are complementary, but not alternative as regards technical requirements to be met by goods, and intended to provide for a certification control of production quality in the enterprise that markets its goods, to provide for compliance of such goods to established requirements. The contents of the standards ISO 9000 indicates that the goods' certification systems may include selected elements of Quality Systems' standards [ISO 1995].

The main legal act (with further executive governmental act) for creating the System of mandatory certification of standing sale timber and secondary forest resources is the Federal Law "On certification of goods and services". The Temporary Regulations of carrying out mandatory certification of standing sale timber and secondary forest resources in forests of the Russian Federation were developed to follow up this Law. It is to note that, in accordance with the Article 15 of the said Law, the State Committee of Standards, other specially authorised State administrative bodies - within their jurisdictional limits - should carry out the State control and surveillance of respecting rules of mandatory certification and goods to be certified under the procedures and conditions established by the Law of the Russian Federation "On standardisation". The Russian legislation has a legal tool more: the Annex to the Instructions of the State Tax Service from June 3, 1993, No. 4-04/84 contains "Procedures of delivering orders and imposing fines by the bodies of the State Committee for Standards of Russia in the events of breaching requirements relative to security and rules of certification of goods (work, services)" developed and approved by the Order of this State Committee from February 24, 1993, No. 50 [Certification 1997]. Breaches entailing a fine under the item 3.2.2 of the above Procedures are: selling goods, doing work and services subject to mandatory certification without certificate. This document lists a number of possible finable infringements against rules of certification of goods (work, services) subject to mandatory certification.

Objects of mandatory forest certification

All the legal instruments that have served to create the System of mandatory forest certification name objects to be certified the standing sale timber and secondary forest resources. Regulations of timber sale consider the procedure of "timber sale" as a sequence of actions that takes a certain time.

The term "standing sale timber" is of exclusively Russian origin and used only in the Russian forestry practice. For an adequate understanding of the text of the Article 71 of the Forest Code of the Russian Federation it is necessary to give a special explanation of this term from the standpoints of its historical provenance and contents.

Historically, as the Common Law, Civil and Forest legislation developed, forests were classified as a real estate, as land plots and everything inseparable from them. So, all the legal rights and norms established for the real estate covered forests and other features closely related to the land. Being linked to land where it grows, forest became integral part of the land plot, as well as of property and other economic relations when using forests. When the land owner changed, the forest growing on this land (as the unique natural feature) passed to a new owner. The forests were measured by hectares (desyatinas) equally as land plots. The running of the forest management was directed not only to care the trees, but also to treat land (soil) allowing a successful forest restoration after felling.

The timber (wood) was considered as movable property only after cutting that produced a commercial good - wood that was apprised by other parameters and qualities. The handling of this product does not enter the sphere of forest relations covered by the Russian forest legislation. The Russian forest law system before the Revolution was based just on such clauses. And it was just the reason why the word "forest" in the Russian forest deal was always used for its main product - timber, or wood. As timber is purchased in forests, the everyday wording employs forest purchasing, hauling, floating, removal, working. It was reflected in explanatory dictionaries of the Russian language.

Since the beginning of the 19th century some limitations of forest use were introduced, and this has engendered the notion of "forest (timber) sale" [Century 1898]. At that time the timber sale was already operated following special regulation rules. For the first time the procedure of timber sale and the immediate link of this procedure with the principle of a continuous and non-exhaustive forest use were clearly and in details presented in the work of the eminent Russian scientist Prof. M.M. Orloff "Forest governing as implementation of forest inventory and planning" [Orloff 1930]. In this monograph the author subdivides the procedure on two main elements: "allotment for sale" and "implementation of timber sale". He has indicated that the Forest Code of 1923 and the Instruction of the RSFSR People's Commissariat for Agriculture for the sale of timber from the State forests from

May 6, 1926, put as the initial (reference) point of annual timber sale regulation the calculated amount of timber (AAC in today's wording) that should not exceed the annual increment. This position confirms that the Law recognises the obligatory respecting of the principle of a continuous and non-exhaustive forest use for our forest management practice. The amount of annual remove and logging parcels were determined for every forest district (lesnichestvo). The amount of timber sale was accounted by cutover area and stumps. Later on, one year before cutting, one proceeded to allot on-ground the parcel to cut, to nick trees, to evaluate the stand, etc. One performed a stumpage appraisal of the parcel to cut. Lists of timber designated for cutting as a summary report of forest districts' data, information on area size and evaluation were sent to the forest management administrative bodies. The issue of implementation of timber sale was the addressed. M.M. Orloff suggested that "at any form of annual timber removal from forest districts, it needs to work out normal conditions of using the parcels to cut, getting agreement of harvesting requirements with those of forest regeneration and conservation. The crucial clauses of such conditions should be the terms of operation and methods of slash removal".

In 1929 the major timber purchasers were exempted from payments for standing timber sale, the payments were remained only for local people and kolkhozes (collective farms) [Orloff 1930]. The time of industrialisation and large-scale clearcutting, that came soon after these decisions, marked a transition to a quite different type of management and refusal of the principle of a continuous forest use at the forest management. Instead of scientific substantiation of management, methods of administrative orders became prevailing, based on the priority of political directives instead of economic calculations.

In 1949 new stumpage fees were developed and enforced: "Fees for wood of major forest-forming tree species to sale", price-list No. 07-01 [Bugayev 1982]. Important remark: in this document the notion of "standing sale timber" was substituted by "timber outturn". This substitution has both positive, and negative consequences. The positive was a closer (at a certain extent) definition of forest use object as opposed to a more broad understanding of forest (as an aggregate of forest vegetation, soils and other components of the natural environment). The negative - in that the natural resource and ecosystem essence of the object to sale was hidden at some extent. For majority of people the term "timber outturn" was now associated, first of all, with economic and market characteristics (stumpage price, auction unit, receipts, payment assignments, advance deposits, etc.). Though in its essence the "timber outturn", timber to sale is growing trees - a main component of forest (forest ecosystem) that is assigned to cut. From the economic standpoint, it is a certain amount of forest resources on a parcel of the Forest Fund assigned for felling by forest user. It is just the reason why the trees assigned for felling are measured not only in volume units (m^3), but also in land area units (hectares).

The timber purchasing was and remains the main kind of forest use, carried out at final harvesting, intermediate felling and other cuts. Regardless of felling kinds, the sale of standing timber on parcels of the Forest Fund to cut is proceeded following the established procedure. The procedure of parcel allotment for forest use was established by the Russian forest legislation. In accordance with Article 116 of the Forest Code of the Russian Federation "Organisation and Order of Wood Harvesting in the Course of Felling", the order of making cutting areas available, their allocation to forest users, wood harvesting in the course of cutting, as well as the amount of penalties for violating the forest management requirements are established by the "Rules for selling standing timber in the forests of the Russian Federation". Under the norms of this document (approved by the Ordinance of the Government of the Russian Federation from June 1, 1998, No. 551) and in full compliance with the principle of a continuous, non-exhaustive and sound forest use the timber removal on the parcel of Forest Fund should be done providing for further forest restoration on this parcel. Thus, the notion of "standing sale timber" is a very capacious one, reflecting the key feature of the forest use - removal of the main forest product that is standing timber.

According to "Rules for selling standing timber in the forests of the Russian Federation" the legal procedure of this operation lasts up to two years and imposes a determined sequence of actions, bearing in mind felling kind, forest category, and respective rules of cutting. Participants of this operation are both leskhoz (forest management unit) that offers a part of forest area for wood purchasing and duly prepares it for forest user, and the forest user who - according to the above Rules - obtains rights to purchase the timber and uses these rights respecting all existent rules and procedures established by the Russian Federation.

Why to use norms in the mandatory forest certification?

Under the Article 9 of the Law "On certification of goods and services" the State Committee for Standards and other State administrative bodies -

within their jurisdictional limits - should choose how to confirm if the products meet the requirements of legal norm documents. “Procedures of carrying out certification of products in the Russian Federation” approved by the Order of the State Committee for Standards on February 16, 1994, indicate that legal documents concerning the mandatory certification are: Laws of the Russian Federation, State standards (including interstate and international standards approved in the Russian Federation), sanitary norms and rules, safety norms, as well as other documents that - under the Russian Federation’s legislation - impose the compulsory requirements to be met by products. Following the clauses of norms established by the State Committee for Standards, the requirements to be met by objects of forest certification in the “Temporary Regulations of carrying out mandatory certification of standing sale timber and secondary forest resources in forests of the Russian Federation” were developed in accordance with the norms established by forest legislation.

In the said Temporary Regulations the mandatory certification is an activity towards confirming that the standing sale timber meets the requirements established in legal norms’ acts concerning the forest management and use: Rules for selling standing timber, regional rules (guidelines) of cutting, forest restoration, sanitary rules, fire prevention, and other acts of the Russian Federation and Federation’s members in the field of forest management. The certificate delivered for standing sale timber confirms the compliance with the requirements established in the System of mandatory certification of forest resources.

The para 2.4. of the “Procedures of carrying out certification of products in the Russian Federation” indicates that “In order to provide for recognising abroad the certificates and signs of conformity, these procedures and recommendations for certification are built in conformity with existing international norms and procedures described in the guidebooks of the International Organisation for Standardisation (ISO) and International Electrotechnical Commission (IEC), international standards of ISO 9000 and 10000, European standards series 45000 and 29000, in documents of other international and regional organisations working in the field of certification”. The para 2.5 of these Procedures states that “The recognition of the accreditation of foreign bodies for certification and testing laboratories, as well as certificate and signs of conformity in Russia (and respectively of Russian ones abroad) is to be carried out according to multilateral and bilateral agreements of which the Russian Federation is the Party”. Thus, the recognition of mandatory certification of goods made in Russia (including the standing sale timber and secondary forest resources) by foreign countries may be achieved using legal instruments in accordance with existing international norms for recognition of certificates and signs of conformity.

Conclusion

The challenge of sustainable forest management is not only the UNCED decision. The importance of sustainable forest management for all countries, but especially for those who has an amount of forests, has an independent roots, but, of course, the acceleration of new approach is closely related to UNCED and follow up international negotiations about future of National and Global Forests. In this context the SFM can be achieved only involving the interests of various population groups, industries, forest management bodies and ecological NGO.

As the SFM should be related to the conservation and exploitation of forest resources within a specific territory, the goals of SFM should be understandable at the local level. So, the SFM means not only management of the wood and non-wood forest resources, but their processing and creation of appropriate economical structures, by ensuring employment for all population groups, and without any damage to ecological features or forest biodiversity. In this context the maintenance of biodiversity probably is the main goals of the SFM. The maintenance of biodiversity infers the conservation and protection in the forest area of the historically formed landscapes, habitats and ecological niches that together determine the organisation of living organisms at the genetic, population, species and ecosystem levels. The mosaic of habitats formed in the course of evolution and history determines the biodiversity of the forest ecosystems, populations and genetic diversity of the species.

For achieving the goals of the SFM at the national, sub-national and local levels it is necessary to clarify new tools and decision-making mechanisms for the policy of accommodating land use, as well as for the evaluation, amendment and establishment of a structure of private ownership of land and settlement rights, including the traditional ties of the aboriginal human populations with the forests. Between new tools for SFM we recognise for national and sub-national levels of Russia the Criteria and Indicators (C&I). And at the local level – the mandatory forest certification system.

Therefore, now it needs to develop in different groups of peoples a common understanding of new tools and mechanisms relevant to SFM at the local level (Forest Management Unit - FMU). We suggest that Mandatory Forest Certification system could be continuously linked with the Criteria and Indicators (C&I) of the SFM at the FMU level, but we understand that C&I and Forest certification have a different methodological approaches.

The mandatory forest certification system will comprise the assigned Central Forest Certification Body (CFCB) and accredited forest certification centres. CFCB will establish the Certification System's Council and the Committee of Appeal. The Certification System's Council should employ experts in forestry and forest industries, scientists engaged in environment protection problems, and representatives of non-governmental ecological organisations. The CFCB should accredit the regional Centres on mandatory certification of standing sale timber and secondary forest resources (Centre of forest certification - CFC), they are constituting integral part of the System of forest certification. Accredited CFC will be independent from forest management units, forest users and customers, and having a good knowledge of how to exercise controls of forest management and forest use.

Functions of CFCs may be performed by various institutions irrespective of the pattern of ownership, if they are not forest users, wood consumers, and State bodies of forest management and if they are experienced in the work of controlling the running of forest management and use. Affiliated to the CBFC are Council of the System and Appeal Commission, the statute of which is to be approved by the CBFC. The practical work on forest certification should include some steps that give an opportunity for collaboration of the governmental and non-governmental bodies and independent experts:

1. Forest user submits to the Centre of forest certification an application accompanied by copies of documents confirming his right of using parcels of the Forest Fund for standing sale timber or secondary forest resources: the protocol of forest auction and felling permit or lease agreement registered in due procedure.
2. The Centre on forest certification proceeds to consider the application not later then 15 days after its submission.
3. One selects a scheme of certification, determines the appropriate legal acts for the certification, procedure of a direct inspection. The applicant has a right to participate in choosing the scheme by the CFC.
4. Decision making as concerns the application.
5. Drafting and signing the contract between the applicant and the CFC.
6. The CFC establishes its Committee for forest certification. The order of establishing the Committee is issued by the chief of the CFC. The commission includes employees of the CFC, (possibly) representatives of research institutions, public and other organisations. The forest management unit where the forest certification work is to be carried out presents for acquainting by the Committee necessary technical documents on forest use and management

The programme of activity is to be worked out and includes:

1. Documentary analysis of all materials confirming lawful forest use and meeting requirements of the normative legal acts;
2. Selective inspection on the ground of parcels of the Forest Fund planned to cut, or parcels where timber or secondary forest resources were allotted, the estimation of their conformity to the fixed requirements;
3. Analysis of productive facilities of forest user (if it is stipulated by the certification scheme) to identify his ability ensure a stable (sustainable) forest use. In such a way one states available legal support, technical and material means, qualified man-power and managing staff.

The programme should be approved by the chief of the CFC. Implementation of the work according to the programme and drawing up protocols on the documentary analysis and inspection on the ground should be done with participation of an ecological NGO. At forest certification a direct inspection is performed by the Centre of forest certification during all the validity term of the certificate and the licence for using the Sign of conformity. Such inspection could be operated together with ecological NGO in the form of periodic and off-schedule check-up, including documentary check-up and selective inspection on the ground of parcels of the Forest Fund where timber was cut or secondary forest resources purchased.

References (Literature cited)

Bugayev V.A. 1982. Fundamentals of inventory and planning. Manual. - Voronezh: Publishing House of the University82. - 232 p.

Century of the Forest Department (1798-1898) 1898. - St. Petersbourg. - 252 p.

Certification of goods and services in the Russian Federation. 1997. 2nd Edition - Moscow: Osi-89. - 160 p.

Forest Code of the Russian Federation. 1997 (English text published by ARICFR in 1997) International Standard ISO 9000-1. 1995.

Guidelines for quality management and quality standards. - Moscow: VNIIS. - 50 p.

Ordinance of the Government of the Russian Federation “On mandatory certification of standing sale timber and secondary forest resources” from February 2, 1998, No. 131. - In: “Forest legislation of the Russian Federation. Collection of norms and legal acts. - Moscow: PAIMS, 1998. - 576 p.

Orloff M.M. 1930. “Forest governing as implementation of forest inventory and planning” - Leningrad. - 491 p.

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