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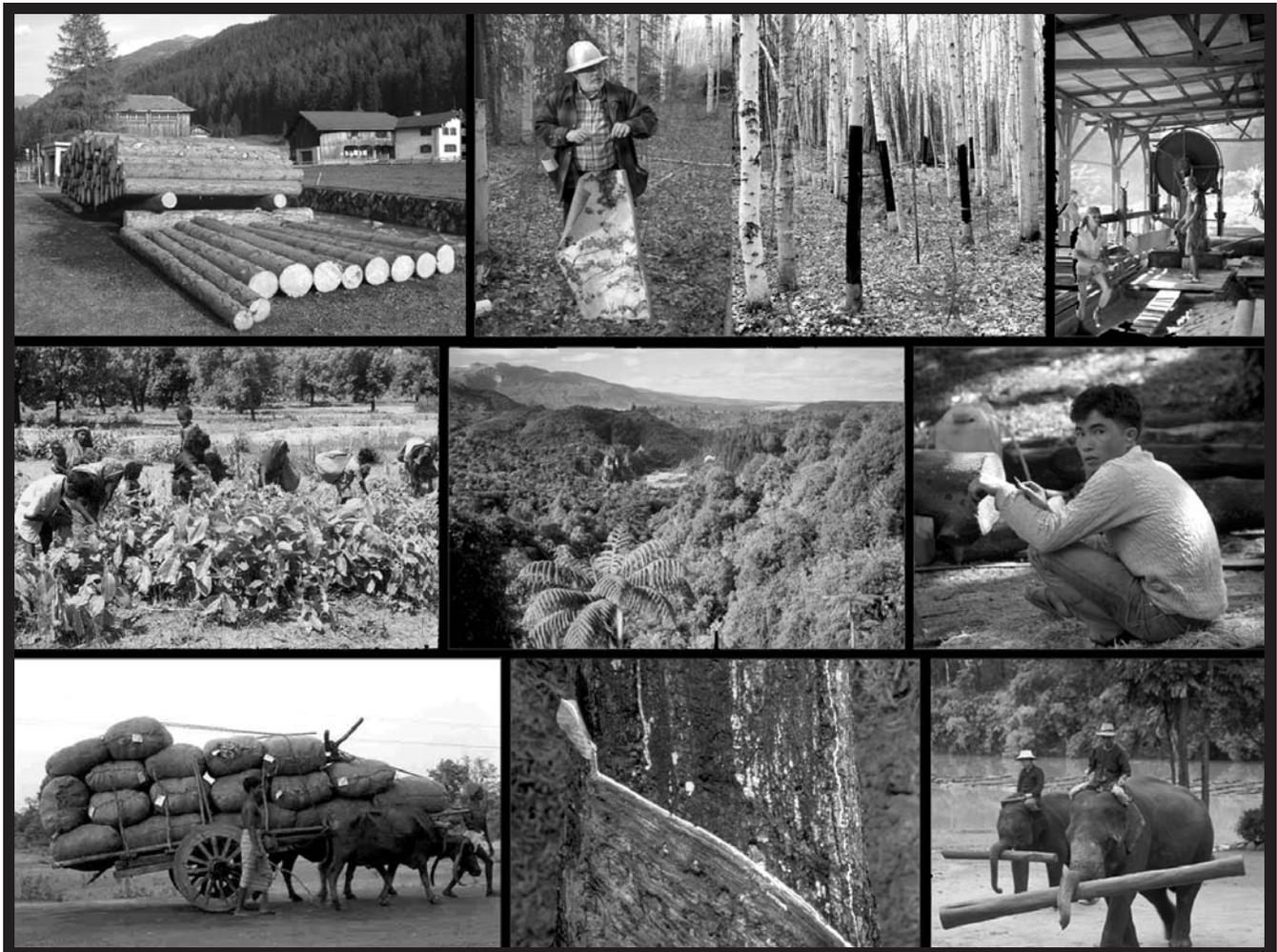
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February 2004



SUSTAINABLE PRODUCTION OF WOOD AND NON-WOOD FOREST PRODUCTS

Proceedings of the IUFRO Division 5 Research Groups 5.11 and 5.12, Rotorua, New Zealand, March 11–15, 2003



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On the cover: Central photo taken in area of Rotorua, New Zealand, site of the 2003 IUFRO Conference. Surrounding photos depict global examples of wood and non-wood forest products and activities related to these products. Products and activities (clockwise from upper left corner) include: Alaskan log products, birch-bark peeling; wood milling, preparation and transport, rubber tree tapping; and Tendu leaf transport and picking.

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ABSTRACT

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This proceedings is a collection of 18 papers and extended abstracts based on talks presented at the International Union of Forest Research Organizations (IUFRO) All Division 5 Conference, held in Rotorua, New Zealand, March 11–15, 2003. This conference emphasized the many ways that forest products research can contribute to sustainable choices in forest management. The two IUFRO Research Groups represented in this proceedings are the Sustainable Production of Forest Products Research Group (5.12) and the Non-wood Forest Products Research Group (5.11). The papers address many aspects of wood and non-wood forest products including: forest management; product development; economic development implications; local, national, and international protocols; assessments; and research strategies.

KEY WORDS: Forest products, non-timber forest products, non-wood products, sustainable forest management, wood products.

ENGLISH/METRIC EQUIVALENTS

When you know:	Multiply by:	To find:
Centimeters (cm)	0.394	Inches (in)
Cubic feet (cf)	5	Board feet (bf)
Cubic meters (m ³)	35.3	Cubic feet (ft ³)
Grams (g)	0.0352	Ounces
Grams (g)	0.0022	Pounds
Hectares (ha)	2.47	Acres (ac)
Kilograms (kg)	2.205	Pounds (lbs)
Kilometers (km)	0.62	Miles (mi)
Meters (m)	3.28	Feet (ft)
Milliliters (ml)	0.03378	Ounces (fluid)
Square kilometers (km ²)	0.386	Square miles (mi ²)
Trees per hectare (t/ha)	0.405	Trees per acre (t/ac)
When you know:	Multiply by:	To find:
Acres (ac)	0.405	Hectares (ha)
Inches (in)	2.54	Centimeters

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INTRODUCTION

Ellen M. Donoghue¹, Gary L. Benson², and James L. Chamberlain³, Technical Coordinators

The International Union of Forest Research Organizations (IUFRO) All Division 5 Conference in Rotorua, New Zealand, March 11–15, 2003, focused on issues surrounding sustainable forest management and forest products research. As the conference title “Forest Products Research: Providing for Sustainable Choices” suggests, the purpose of the conference was to consider scientific progress towards meeting the rapidly increasing demands for forest products in the context of social, economic, and environmental considerations associated with sustainable forest management. Conference attendees addressed challenges and opportunities of sustainable forest management through exchanges of knowledge and experience from presentations, field trips, and formal and informal discussions about forest products research at national and international levels.

This publication is the 3rd proceedings of the IUFRO Division 5 Sustainable Production of Forest Products Research Group 5.12. Two prior proceedings were from the 1997 All Division 5 conference in Pullman, Washington, USA (Barbour and Skog 1997) and the 2000 IUFRO World Congress in Kuala Lumpur, Malaysia (Barbour and Wong 2001). New to this proceedings, however, is the inclusion of papers from the Non-Wood Forest Products Research Group 5.11. Many similarities emerge when both wood and non-wood research is set in the context of social, economic, and ecological dimensions of sustainable forest management. This suggested a natural combining of the papers from the two Research Groups for this publication. Both Research Groups focus on the development, evaluation, and application of forest products. Both address complex issues of ecological integrity and economic development. Also, both grapple with the ways that research is providing for sustainable choices for forest-based societies around the world.

Although all research groups of Division 5 participated in the conference, this proceedings includes only those papers from the 5.11 and 5.12 Research Groups.

The Sustainable Production of Forest Products Research Group 5.12 focuses on 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, the group members examine questions regarding green certification, life cycle analysis, wood products from sustainable managed forestry, and the economic contribution of wood products to sustainable forestry.

The Non-Wood Forest Products Research Group 5.11 focuses on the discovery, development, and wise use of non-wood products found in forests around the world. This Group conducts research on medicinal and aromatic plants, edible plant products and forest fungi, resins and gums, and many other non-wood products that have long been important for rural and native people for cultural, subsistence, and economic reasons. The research focuses on a variety of topics including harvesting techniques and effects on ecological integrity, techniques for extracting and synthesizing compounds, traditional and non-traditional uses of non-wood products, and commercial development opportunities.

The papers on sustainable wood forest products discuss the history of forest disturbance and wood removal in temperate and tropical regions, especially Indonesia, and the cultural and silvicultural practices needed to sustain forest wood production and stable forest ecosystems. Effects of timber harvesting on a non-sustainable basis are discussed, as well as the effects of government and forest management policies striving to achieve sustainable wood production.

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Regional assessments and future projections (based on modeling) are discussed as potential aids to achieve sustainable wood production. The identification of barriers to achieving sustainability is also discussed. The role of social science is linked with the ecological, economic and social aspects of forest management to indicate its importance to sustainability. The relationships between integrated research and sustainable forest management and production are also discussed.

The papers on non-wood forest products address research, management, and economic development challenges, as well as opportunities, associated with increased demand for non-wood products and increased pressure on forest ecosystems. Specific non-wood products discussed in the papers include medicinal plants in Nepal, and barks, leaves, and resins in India. Harvesting methods intended to increase ecological integrity and sustainable economic development opportunities are discussed. The design of inventory protocols and the development of production and trade statistics are discussed as ways to contribute to resource management, national and international policymaking, and economic development strategies. The role of non-wood products in employment and income generation for rural people is addressed in a number of papers. Research strategies for non-market and market non-wood products and the role of research institutions in the economic development of forest-based communities are discussed. Several papers talk about the ways that assessments of non-wood products contribute to sustainable development and resource management at national and international levels. The terms non-wood forest products and non-timber forest products are used in a number of papers and can be considered synonymous, unless otherwise stated.

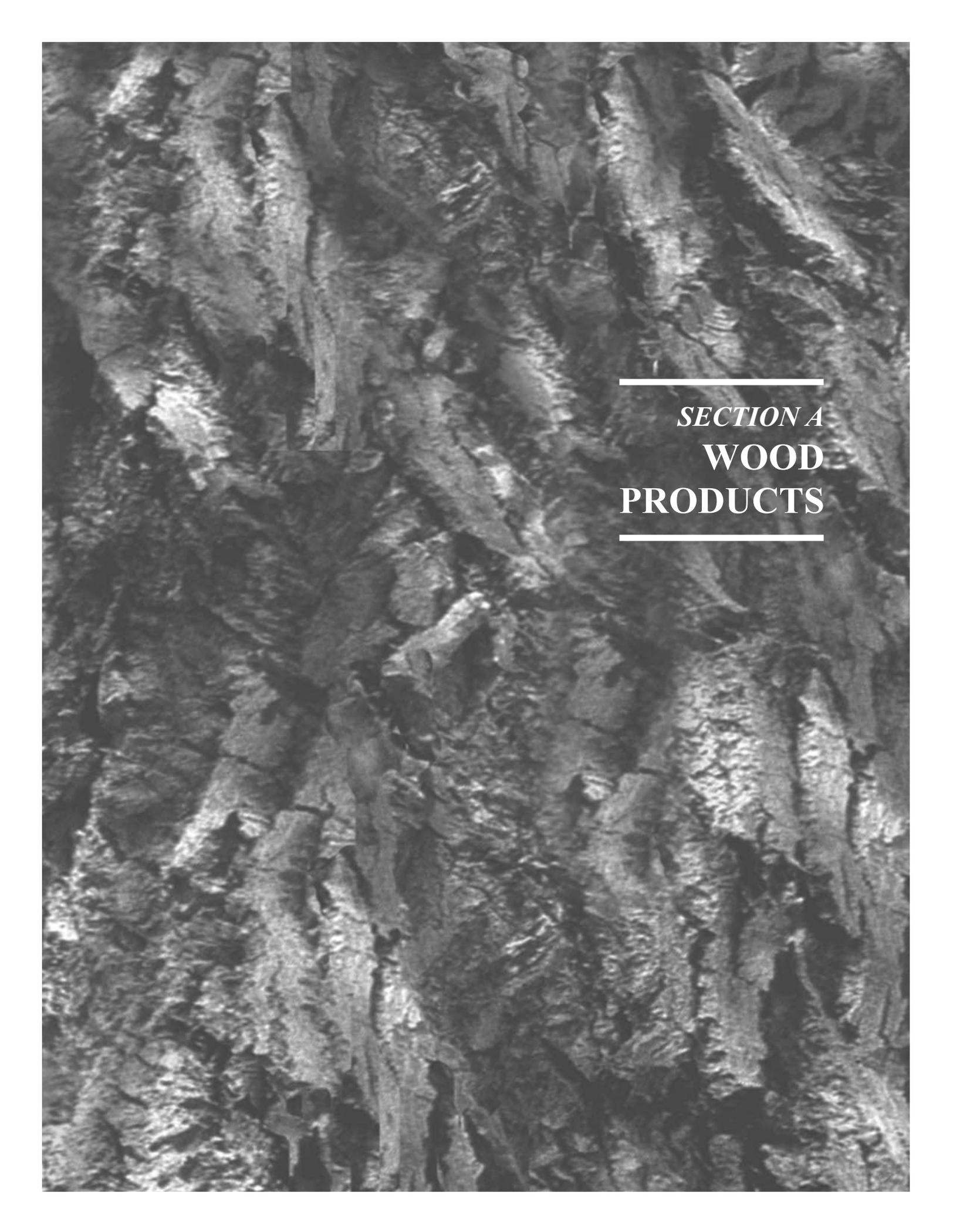
Full papers or extended abstracts are included for the majority of conference sessions of the 5.11 and 5.12 Research Groups. Papers were provided for printing by the authors, who are therefore responsible for the content and accuracy. Opinions expressed may not necessarily reflect the position of the U.S. Department of Agriculture. The use of trade names is for information only, and does not imply endorsement by the U.S. Department of Agriculture of any produce or service.

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SECTION A
**WOOD
PRODUCTS**

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THE FUTURE OF PLANTATION FORESTS AND FOREST-BASED INDUSTRY IN INDONESIA

Aulia L.P. Aruan¹

ABSTRACT

The development of forest-based sawmilling and ply milling industries (1980s-1990s) and pulp and paper industries (mid 1990s) plays an important role in forest resource management. Wood supply from plantation forests will have to provide an increasingly larger share of the supply in the near future, particularly of pulp logs. Technology and marketing problems are emerging in processing logs from those plantations. The development of industrial forest plantations is focused on meeting the need of pulp and paper industries' raw material, and therefore tree species are dominated by fast growing species such as *Acacia* spp. and *Eucalyptus* spp.

Government policy established more forest-based industries to promote forest based and timber processing industries in the country. Indonesia's forest-based industry comprises a mix of non-panel forest-based industry of 81 pulp and paper mills (12 integrated pulp and paper mills; 66 paper mills; 3 pulp mills), and panel-based industry of 4,400 sawmills, 120 plywood mills, 39 block board mills, 13 chip mills, 2 Medium Density Fibre mills. The rapidly expanded Indonesian forest-based industries were not well supported by the long-term sustainable supply of raw materials. The forest-base has been supplied by an abundance of quality raw material with relatively low production costs. There were minor efforts to increase efficiency and competitiveness. There is an imbalance between log supply and demand. The technological aspects of the forest-based industry are also neglected. Observations are that most of industries were built in the 1980s and the technology is now inefficient and thus competitiveness in the global market is low. Machinery is out of date and can process higher grades and larger log sizes, but not wood wastage and smaller diameter logs.

The sustainability of Indonesian pulp and non-pulp plantation forests and processing industries should be clearly planned and implemented. This paper provides a national review of Indonesian plantation forests, their processing industries' restructuring and potential markets.

KEY WORDS: Plantation, industry, conservation, restructuring.

INTRODUCTION

Indonesia is a diverse tropical country of approximately 220 million people. Forest areas are about 60 per cent of the land area. The forestry sector is important, and it provides a significant contribution to the Indonesian economies. Its contribution to the GNP is approximately 6 per cent. It is estimated that the forestry sector provides employment for approximately 3.7 million employees. The forest is home to some 40 million people.

Since early 1970s, Indonesia's growth-oriented development over the last three decades has led to unsustainable forest management. Pressures on natural forests for timber production have been expanding steadily. The development of forest-based industry especially sawmilling and plymilling industries (1980s–1990s) and pulp and paper industry (since mid 1990s) plays an important role in forest resource management. In addition, further pressures such as forest fires, forest conversion to non-forestland uses, and illegal logging activities have been involved.

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Indonesian forestry is changing. In 1999, the Government announced a new forestry law reflecting the forest reform. The focus is to empower communities. Environmental concerns, social and industrial demand pressures and the diminishing forest resource still constrain the sustainable wood supply from natural forest.

The Ministry of Forestry has launched five priority programmes for forestry development during the period of 2001–2004, namely (a) combating illegal logging, (b) controlling forest fire, (c) restructuring the forestry sector, (d) rehabilitation and reforestation, and (e) the decentralisation of forestry issues.

To avoid repeating growth before considering environmental aspects, the Government of Indonesia is adopting policies for sustainable forest management by striking a better balance between economic, social and environmental aspects. The economic aspect (e.g., economic growth) has previously been the priority. Recently, greater emphasis has been focused on the social aspect (e.g., social forestry) and environmental aspect (e.g. rehabilitation of degraded forest areas and combating illegal logging activities). The economic aspect (e.g., economic growth) has been a major role. More recently, the environmental aspect of forestry is also important for soil and water conservation.

The purpose of this paper is to briefly assess the role of policies followed by the government on the development of Indonesian plantation forests. The paper will also review the future of Indonesian plantation forests.

THE ROLE OF POLICY ON THE DEVELOPMENT OF PLANTATION FORESTS

Guizol and Aruan (2002) analyzed the historical review of policies followed by the Government on the development of plantation forests in Indonesia. Those policies and development during the 1990s to early 2000s has contributed to the current situation where more than 2 million hectares (ha) of commercial plantation forest has been created. Figure 1 shows the historical development of plantation forests. There are three major distinctive periods, i.e. the initial development (1980–1989), major development (1990–1997) and consolidation/transitional development (1998 onwards).

Prior to 1981—Surplus Log Supply from Natural Forests

Prior to 1981 the main earnings from the export of oil and from forests was Dipterocarps (hardwood) logs for export and domestic consumption. Major plantation forest establishment prior to 1981 was mainly in Java when *Tectona grandis* was first planted in 1880, and several trial plots

and pilot projects in outside Java were planted with a combination of fast and slow growing species such as *Shorea*, *Swietenia*, *Agathis*, *Albizia*, *Eucalypts* and *Acacias*. Large Teak plantation forest has been managed by a state-owned forest company, especially in Java, which has the higher population growth nationwide. In addition, plantation forests were established not only for construction wood, but also for fuelwood demand and erosion reduction.

Initial Development of 1980-1989

Non-oil earnings from estate crops were promoted by the Government during the mid 1980s. Laws and incentives had been enacted but not the practical guidelines, consequently few plantation forests were established. After 1981, a policy banning log exports was imposed and incentives were introduced to encourage sawmilling and plymilling industries. The development of these forest-based industries has occurred so rapidly that production inefficiency and forest product quality has caused marketing problems. Indonesia became a major tropical forest product producer in Asia during this time period.

A range of government incentives was introduced in the early 1980s. A Presidential decree of 1980 introduced a bond to natural forest concessionaires. It was called the Reforestation Guaranty Fund (Dana Jaminan Reboisasi/DJR). This bond was redrawn when the natural forest concessionaires were not able to rehabilitate themselves. This was supposed to be an incentive for them to invest in plantation forests. But its result was unsatisfactory until the Government: (a) decided to extend the plantation forests nationwide in 1984 and (b) changed it into a royalty, i.e., from DJR to DR (Dana Reboisasi or Reforestation Fund/RF and this RF has been used to establish and extend the plantation forests nationwide.

In 1989, the Government anticipated that by the year 2000, the natural forests would not be in line with the installed capacity of forest-based industries. Therefore, it set up a range of introduced incentives such as easier access to the Reforestation Fund (RF) and land clearing permits.

The plantation forest area was established with seven main species, including the following commercial slow-growing species: *Acacia mangium*, *Eucalyptus deglupta*, *Gmelina arborea*, *Parthenesis falcataria* and *Pinus merkusii*, and selected fast-growing species such as *Peronema canescens* and *Shorea* spp. Private companies played a major role in the establishment of plantation forests.

Major Development of 1990–1997

Introduced and ongoing incentives such as access to the Reforestation Fund on joint ventures between private and

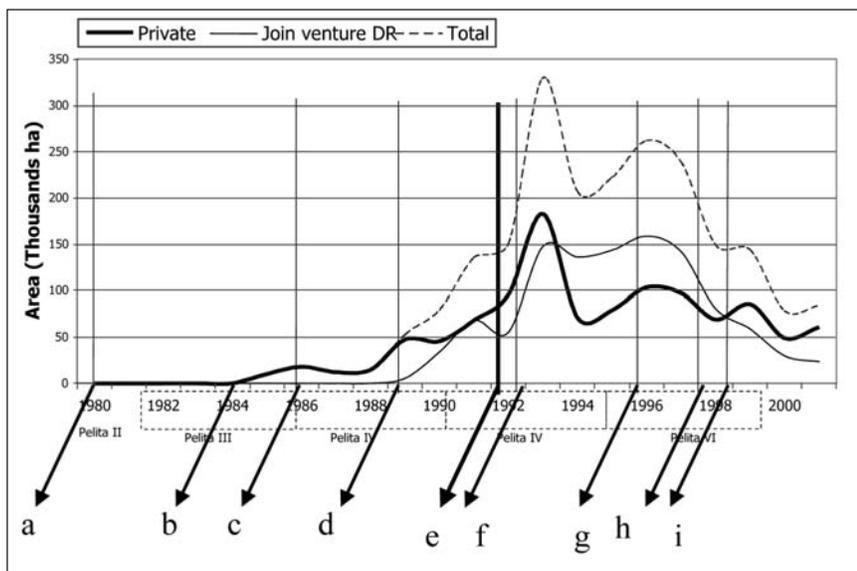


Figure 1—Progress of the Plantation Forest Establishment

Figure 1 Legend:

- a: no effect of the Presidential Decree No. 35/1980 about bond for concessionaire rehabilitation
- b: A political decision to develop industrial plantation forests
- c: Reforestation Fund has impacts on the establishment of plantation forests
- d: land access and easier access to the Reforestation Fund has positive effect on number of joint ventures
- e: tight money policy has negative impact on pure private plantation forests
- f: Transmigration Scheme launched in 1992 has initial positive impact on joint ventures
- g: Reforestation Fund regulation has initial positive impact on joint ventures
- h: 1997 Indonesian early crisis, forest fires, drop in joint ventures scheme
- i: 1998: Reforestation Fund eliminated; drastic drop in joint ventures scheme

Pelita: Five-Year Plan

Sources:

1. Davis (1989); Laurila (1989).
2. Ministry of Forestry (Forestry Statistics of Indonesia; 1989–2000).
3. Directorate of the Management of Forest Plantation (2000/2001).

state-owned forest companies boosted the level of plantation forest establishment. Another incentive was access to land. The annual rate of new plantation forest establishment slowed down by the time of the tight money policy in 1991.

Impacts of political and economic crises have affected Indonesia since early 1997. Large portions of the Reforestation Fund have been misused, and plantation forest establishment remained far behind the targets. In addition, the decrease in plantation forest establishment was also caused by: the increase of illegal logging activities, low domestic wood prices and the serious issue of deficit log supply to the existing forest-based industries.

Consolidation/Transitional Period (from 1998 to 2003)

There are two types of plantation forests based on the management regime, namely pulp and non-pulp plantation forests. In 1996, a new Reforestation Fund procedure for Government Capital Share and Reforestation Fund Loans for the development of plantation forests defined the Reforestation Fund financial schemes dedicated to joint ventures. The plantation could be financed as follows: 14 per cent from Government Capital Share, 21 per cent from Private Capital Share, 32.5 per cent from Reforestation Fund loans, and the remaining 32.5 per cent from commercial loans. Now, the Reforestation Fund disbursement has been stopped and so the former Government Capital Share portion must come from commercial loans.

Table 1 shows plantation forest progress. Non-pulp plantation forest covers about 40 per cent of the total established

Table 1—Plantation Forests by Management Regime*

No.	Management Regime	Total (ha)		Establishment (ha)	Percentage of Planting Area
		Area(Granted)	Planting Area**		
a.	Pulp	5,450,518	3,815,363	1,334,985	(25%)
b.	Non Pulp	3,715,398	2,600,779	900,235	(24%)
	Σ(a + b)	9,165,916	6,416,141	2,235,220	

Notes: * recalculated/updated.

** effective planting area is 70% of total area (based on the regulation).

Sources: Ministry of Forestry (2001); various reports.

plantation forest, whereas pulp plantation forest covers 60 per cent. Main species are *Acacia* spp, *Eucalyptus* spp, *Pinus merkusii*, *Shorea* spp, etc. Records indicate that harvest work (> 4 million cubic meters harvested annually) has occurred over more than 200 plantation units, however only 2.2 million ha of plantation forests have been planted.

The International Tropical Timber Organization (ITTO; 2001) has analysed and evaluated Indonesian plantation forest development. Some constraints for this low establishment rate are: (a) land tenurial issues and land conflicts; (b) lack of plantation performance audit; (c) lack of maintenance; (d) inappropriate species selection; (e) lack of long-term plantation plans; and (f) inadequate access to credit due to high risks and low productivity. Measures addressing the plantation problems as stated in above section are: (i) on-going activity on inventory and evaluation of various plantation programmes; (ii) research and technology development (an on-going enhancement of productivity of plantation forests, etc); (iii) on-going formulation of a clear and transparent policy on plantation forests; (iv) strengthening institutional support for plantation forest development through the promotion of stakeholder participation in line with the decentralisation issues.

Kanowski (2003) states that the challenges for plantation forests for the first part of the 21st Century are consolidation and building from past accomplishments, lessons learned from errors, then positioning the structure of plantation forests to better contribute to all dimensions of sustainable forest management. Therefore, it is necessary to re-evaluate the condition of plantation forest resources through main issues such as decentralization of forestry issues.

The current policy on rehabilitation of the degraded forests including promoting plantation forest has been determined to be the principal focus of forestry-sector related policies and actions for the next 10 – 20 years. Parallel with the determination of the five priority policies

is the reinvention of an approach for implementing the programs, termed social forestry.

Social forestry is basically any method that aims at achieving sustainable forest management and improving people's welfare simultaneously. It is an approach in which people, particularly those living in and around forests, are the main actors in forestry-related activities. In addition, the main focus is to promote greater participation of the private sector, rural cooperatives, local communities, indigenous people, and non-governmental organizations in forest-related activities.

Restructuring has started with joint venture state-owned plantation forest companies. Recognising tremendous problems of plantation forest development, the Ministry of Forestry established an internal working group on restructuring of the industrial plantation forests in early 2002. Initial steps have been taken to evaluate the state-owned forest companies.

Criteria and indicators for this restructuring process are significantly transparent and based on technical, financial, law and social aspects. There are 2 main decisions:

- a. Liquidation and RF reimbursement for companies that are:
 - i. technically infeasible and financially feasible;
 - ii. technically infeasible and financially infeasible;
 - iii. technically feasible and financially infeasible.
- b. Facilitation and supported incentives for companies that are:
 - i. technically feasible and financially feasible.

In point b., companies shall be supported in such a way that:

- The Government Capital Share (PMP) must be disbursed to the Government; and
- Rescheduling opportunities are developed for companies faced with cashflow problems and accounting reasons.

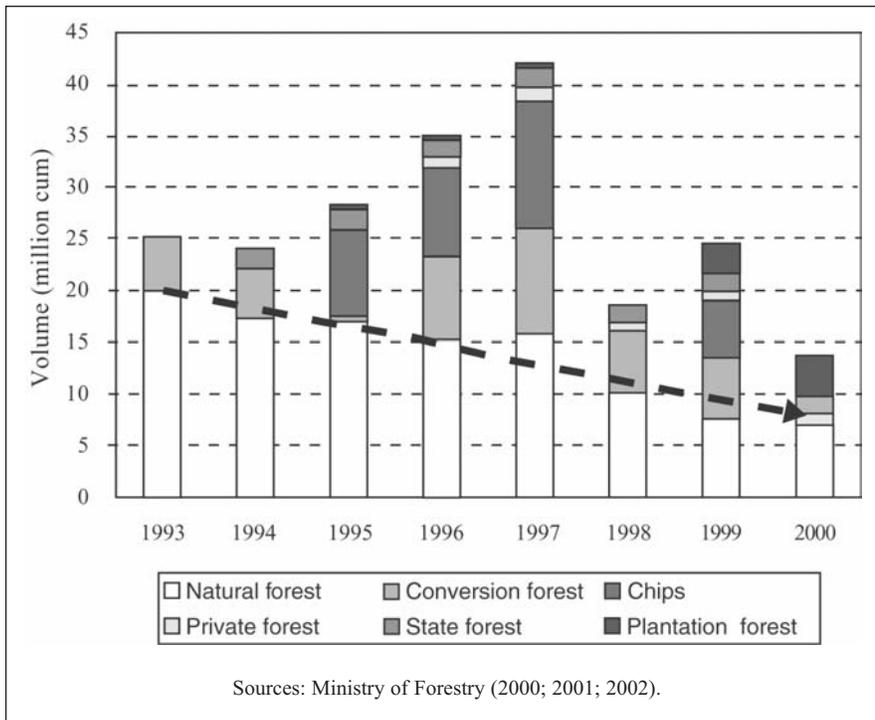


Figure 2—Indonesia's Log Supply

This restructuring activity is an on-going process in which the Ministry of Forestry has focused on these measures in order to provide a transparent and responsible sustainable plantation forest management which can contribute to sustainable development and nationwide conservation.

FOREST INDUSTRY

Government policy promoted forest-based industry to primarily utilize natural forests through added value and infrastructure (Nasendi, 1984). Indonesia's forest-based industry comprises a mix of:

- i. Non-panel forest-based industry consists of 81 pulp and paper mills (12 integrated pulp and paper mills; 66 paper mills; 3 pulp mills).
- ii. Panel-based industry consists of 4,400 sawmills, 120 plywood mills, 39 block board mills, 13 chip mills, and 2 Medium Density Fibre (MDF) mills.

The volume of logs harvested from natural forests has declined significantly over the past years as shown by Figure 2. This decline is due to unsustainable forest management practices in common with lacking appropriate techniques for silviculture, forest fires, illegal logging including encroachment, and natural forest conversion. The existing natural virgin forest is 18.8 million ha (46% of total natural forest concessions).

Current annual log supply shortage is 35 million cubic meters (cum), i.e., between log supply from natural and plantation forest (15 million cum) and the log demand (50 million cum). This log supply from natural forests may be much less if recent tentative policy is to be implemented by use of a "soft landing" or the reduction of the annual allowable cut (AAC) in order to provide a period for natural forests to renew.

Indonesia has progressively planned and developed forest plantations since mid-1980s. There are currently 3 million ha of pulp plantations that have been granted. The establishment rate is more than 40% or 1.2 million ha (excluding 1 million ha of Teak plantations). The principal species that is planted is *Acacia* spp. (comprising about 80% of the species planted for pulp plantation establishment). The pulp log production in 2000 was 4 million cum or 23% of total pulp log demand from pulp mills (Aruan, 2000; 2001). Its future pulp log production and its establishment rate are estimated to increase gradually.

Following a multi-dimensional crisis in 1997–1998, the Government has realised that forestry issues should be addressed in the background of the global forest mechanisms and sustainable forest management principles (external and internal factors).

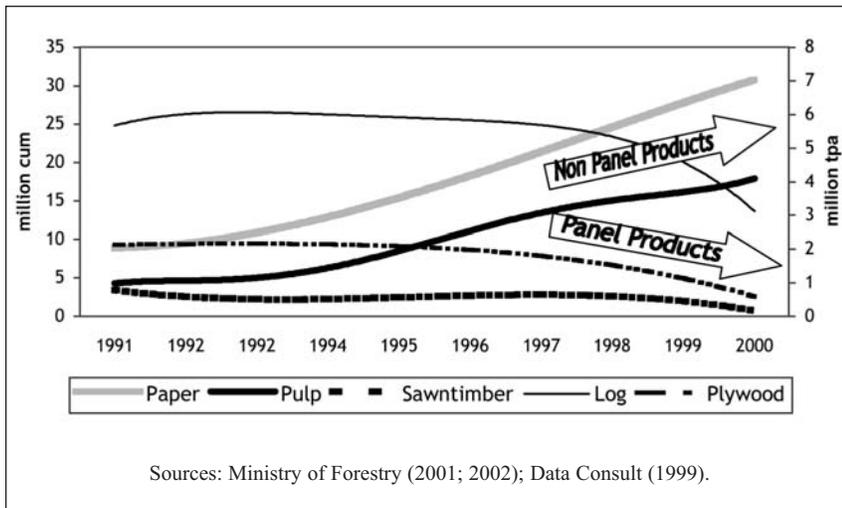


Figure 3—Indonesian Forest Product Trends

The technological aspects of the panel forest-based industry are partly neglected. Most of the forest-based industries were built in the 1980s. The technology is now inefficient. Competitiveness in the global market is low, due to the out-of-date machinery. The current machinery can only process higher grade logs and larger log sizes, but a limited amount of the industry is well-equipped.

The development of forest-based industry follows the dynamic of entrepreneurship. It has distinctive periods of growth, decline and restructuring (Le Heron, 1997). The panel forest-based industries face the restructuring period, whereas the non-panel forest-based industry is entering its growth period.

A natural follow-up to the review and evaluation is to develop and implement a master plan for restructuring the forest-based industries. This master plan should be based on strategic, transparent, and well-defined criteria (ITTO, 2001).

Growing imbalances in demand (i.e. further forest resource-base decline) and supply (i.e. population growth adding to future demand for forest lands and products) already exists nationwide. Figure 3 shows Indonesian forest product trends. Pulp and paper production is an uptrend whereas the panel forest products such as sawn-timber and plywood are in a downtrend (Aruan, 2000; 2001). Two major questions are: (a) What should be done if these trends persist? and (b) In the near future, can the pulp and paper industry develop significant exports of their products that would supplement the existing plywood and sawn-timber trade and their export values? In answering those two ques-

tions, further strategic policy analysis should be carried across industry sectors. Activities on restructuring forest-based industries and plantation forests are underway.

Increasing the harvest volumes from plantation forests will influence more plantation establishment. Increased rate of return from plantation investments—(e.g., fertilization, genetic improvement, pre-commercial thinning, and harvesting improvement)—would boost long-term pulp log supply.

The sustainability of Indonesian pulp plantation forests will clearly be enhanced. The benefits of investments should be realised, when the reasons for pulp plantation forests are well established within broader Indonesian contexts such as (a) social context, i.e., more community participation in managing the resources including plantation forests; (b) environmental context, i.e., more resource accountability locally and regionally; and (c) economic context, i.e., more employment and increased prosperity.

Figure 4 shows the figures for the dynamics of forest product exports from Indonesia.

Linking the plantation forest products with the global and domestic markets, the focus on the development of plantation forests should be aimed to rehabilitate degraded forests and lands, and to increase productivity and quality as a way to ease pressure on the natural forests. Properly managed forest plantations can make a substantial contribution to the wood supply, however they are currently very inadequate in terms of total area, are marginal in quality, and often have low stocking.

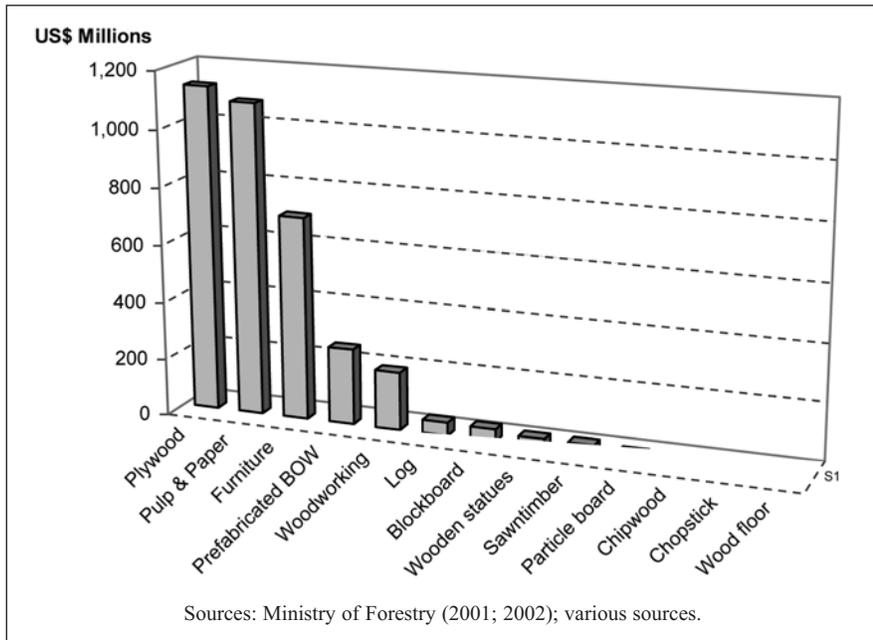


Figure 4—Indonesian Forest Product Export (2000).

DISCUSSION

The global plantation forest has increased by three times. It was nearly 12 million hectares/year in the 1990s, compared to less than 4 million hectares/year in the 1980s (FAO, 2001; ITTO, 2001). This increase of plantation forest establishment indicates steadily increased investment in forestry. Therefore, the principal current problem is not only the availability of the investment but also the ability to plan, manage, control and market the plantation forest products successfully.

The current changes in the global forestry scene are: (i) forestry policies such as national forest policy (nfp), priority forestry programmes, gradual shift from public sector to private sector in managing forests, and being proactive in global scenes such as UNCED, UNFF, etc; (ii) social and economic consequences, e.g., through partnerships for better community welfare and social forestry; and (iii) research and development/technological improvement, e.g., several fast and slow growing commercial species.

The challenge for plantation forest development will be to become better integrated into the local community. Initial steps have been conducted including sharing ownership. Other challenges are to expose and identify various possibilities in the development of plantation forests in terms of matching species, appropriate and environmentally sound technology, incentives (Guizol and Aruan, 2002), and potential domestic and global markets.

The panel forest-based industries must be concerned about their current restructuring process and their research budget. Forest-based industry can be in a better position in the future through innovative research. Small and medium scale forest-based industries can be created, for example, to process bark waste from Acacias logs in the MDF mill. This could lead to a potential linkage between social responsibility and private sector responsibility.

Non-panel forest-based industry (consisting of pulp and paper mills) will increasingly need better quality and uniformity from established plantation forests. On the other hand, the panel-based industry (consisting of sawmills, plywood mills, and block board mills) needs to be restructured in terms of their installed and production capacities, log requirements, machinery capabilities, and markets.

The recent significant forest and forestry issues and changes have implications for future dialogue, ownership/partnership, incentives, resource and market structures. These future structures need a transparent planning system. In addition, this planning system needs to contain political and other types of discretion that enables decision makers to strengthen their ideas. (Leslie, 1995; personal communication).

Based on the above discussion, the overall future plantation forest and forest-based industries can be shown by Figure 3. These trends need further in-depth analyses not only for the wood supply from natural and plantation

forests but also future demands of different forest products. Such analyses should also be cross-sectoral analyses. In addition, external and internal factors such as: criteria and indicators of sustainable forest management, policy analysis, proposed incentives, schemes, periodicity, equity share, integration, tax, performance, macro economic and other sectors determine the plantation forest plans. The output of various analyses should indicate future plantation forest and the forest-based industries. Regional plantation forest planning methodology has been proposed to support and indicate the trends of future plantation forests given various inputs and the involvement of relevant stakeholders (Aruan, 1990; Aruan, 1996; Aruan et al, 1997; Aruan, 1998; 1999). Accurate information such as numerical outputs can be indicative point of reference (or entry point) for dialogues between relevant stakeholders.

This effort is the Government's responsibility to convey such plans at the appropriate planning levels, i.e. nfp, national plans, sector plans, priority programmes. National forest policy (nfp) is the forum of dialogue with other relevant stakeholders. They are traditional communities, central and local authorities, and associations. Both master plans for plantation forest development and forest-based industries are developed simultaneously. The restructuring of plantation forests and forest-based industries can also be included in those master plans. The nfp is a both technical and political process in the sense that the identification of goals, policies, strategies and mechanisms for implementation are based on accurate information and broad participation of all parties of the society.

The existing and future plantation forests will play an increasingly important role not only for the wood production but also in non-wood production such as soil and water protection, carbon sequestration (carbon trade), and conservation.

CONCLUSIONS

First, it seems that despite initial uncertainty regarding the declining wood supply from natural forests, the future possible wood supply will be complemented by fast and slow growing plantation forests.

Second, conservation (or environmental) and social issues through small and medium business scales ("forest for people") will gradually direct the business opportunities. Forestry policies and regulations have to be in line with these trends.

Third, lessons learned from the historical development of Indonesian plantation forests indicate that consistency of government policy is a critically important factor for the initial and following stages of development.

Finally, the future role of plantation forests and forest-based industries in Indonesia will be clearly understood with the probability of a good outlook. Then, sharing and adapting the successful global experiences should be an effective adaptation in promoting successful future plantation forests.

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REDUCED IMPACT LOGGING: THE TROPICAL FOREST FOUNDATION EXPERIENCE IN INDONESIA

A.W. Klassen¹

THE TROPICAL FOREST FOUNDATION

The Tropical Forest Foundation (TFF) is a non-government, not-for-profit training institution dedicated to the promotion of sustainable forest management in the tropical forests. TFF has become widely recognized for establishing demonstration models and training schools to show the advantages and teach the principles of sustainable forest management and operational strategies such as Reduced Impact Logging (RIL).

TFF initiated its field activities with a program in Brazil in 1992. This program of training, demonstration, and research into RIL strategies, has proven so successful that preparations are now under way to create a permanent RIL training center in the Amazon with multi-stakeholder funding and participation.

In January, 2000, TFF expanded its activities into Southeast Asia with the start of a program based in Indonesia. In 2002, TFF further expanded its activities by initiating an RIL training program in Guyana. Investigations are now also underway to open a program in West Africa.

This paper provides a brief overview of the TFF activities in Indonesia.

TFF's INDONESIA PROGRAM

Program Concept

TFF responds to requests from forest companies to conduct specific training and demonstrations related to the implementation of RIL. All of TFF's training activities have been specifically tailored to the needs and requests of willing companies; hence the participation involves a strong sense of partnership and a high level of motivation.

This active "buy-in" to TFF's training and extension services makes a low-budget training program possible since the companies generally agree to cover local travel and accommodation costs.

Definition of RIL

TFF's self-appointed mandate to develop a RIL training and demonstration program came about with the recognition that the way most tropical forests were being logged was simply not sustainable. Early research into improving forest planning and harvesting resulted in dramatic, but expected reductions in all impact parameters. A surprising additional benefit, however, was the discovery that in many cases, significant financial and economic gains could be achieved through a more disciplined approach to operational planning and control.

It has become clear, at least in the Indonesian context, that RIL must be promoted pragmatically. An idealistic model of RIL, which includes activities of questionable benefit such as vine cutting, etc., will never be accepted by the forest industry if the resulting cost structure is higher than the conventional approach to harvesting. TFF, therefore, summarizes its definition of RIL as consisting of:

- Forest inventory producing contour and tree position maps at appropriate operational scale.
- Detailed planning incorporating simple and clearly defined operational and environmental standards.
- Pre-felling location and opening of skid trails.
- Clear and practical guidelines for felling, bucking and skidding.
- Tight supervision of logging activities with adequate, qualified supervisory personnel who have been empowered to effect changes as necessary.
- Physical deactivation of skid trails to minimize the risk of erosion

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- Meaningful monitoring and evaluation of harvesting activities and the maintenance of permanent records.
- Appropriate management systems and management support to ensure that improved practices are, in fact, implemented.

Content and Scope

TFF's program in Indonesia has, till now, involved four major types of activities:

- Information dissemination on RIL: newsletters, journal articles, participation in workshops, etc.
- Development and publication of technical literature and procedures manuals.
- Training in RIL methodologies using a modular approach.
- Demonstration and technical extension services.

INDONESIA: FOREST MANAGEMENT IN CRISIS

The Indonesian forest sector is still relatively young but it is already contracting. Rapid expansion of the manufacturing sector really only occurred after the Government imposed massive log export taxes in 1984 effectively halting the export of logs.

At its peak in 1992–93, Indonesia had approximately 64 million hectares (mm ha) of production forest licensed under a forest concession system. Almost 600 concession companies operated on an officially endorsed annual allowable cut of approximately 28 million cubic meters (mm m³). Since then, the forest sector has been contracting rapidly. The rate of decline has become particularly pronounced after the financial crisis in 1997 when many of the Southeast Asian currencies sharply devalued due to a crisis in the banking sector.

Synopsis of the Current Situation

The forest sector in Indonesia is facing massive problems and is on the brink of a large-scale decline. The problems facing this sector can be summarized as follows:

- General lack of authority due to confusion surrounding the decentralization process.
- Virtual absence of any law enforcement within the forest sector due to lack of jurisdictional clarity and widespread corruption.
- Large scale illegal logging. World Bank reports (2001) and Holmes (2002) estimate illegal logging of approximately 41 mm m³ in 1997. This was esti-

mated to have increased dramatically in 1998 to an estimated 57 mm m³.

- Large scale illegal log exports account for recent major increases in the output of China's woodworking industry and support much of Malaysia's and other Southeast Asian country's wood processing industries (EIA 2002).
- Massive overcapacity in the Indonesian wood processing industry is widely considered responsible for fueling much of the illegal logging.
- Rapidly shrinking resource: deforestation rate is now estimated at 2.1 to 2.4 mm ha per year. Degradation of remaining forests is considered to be even more serious.
- Endemic corruption at every level of government and direct involvement in illegal logging activities by members of the government.

In 2003, the Ministry of Forests announced a halving of the annual allowable cut to 6.89 mm m³ for legal forest concessions. Assuming that the plywood output of approximately 9.7 mm m³ at the peak of production in 1992–93 represents the legally licensed plywood sector's consumption capacity of around 20 mm m³ of logs, it is easy to see how this existing industry exerts a tremendous pressure for harvesting outside of the current annual allowable cut.

However, all is not "doom and gloom". There remains in Indonesia, a core of forest companies who are committed to sustainable management of the natural forest. TFF works with most of these companies in various training and demonstration configurations.

TRENDS AND FUTURE PROGRAMS OF THE TFF

The continuing problems in the Indonesian (and Southeast Asian) forest sector, is creating a negative impression in the markets, particularly the European and North American markets. Environmental lobby groups have been effectively capitalizing on the fact that so much of Indonesia's (and the Region's) production comes from illegal logging and illegal export to neighboring countries from where it finds its way as "laundered" finished products to international markets.

Buyers in the European and North American markets are demanding FSC certified products, but these are still in scarce supply. The dimensions of the problems facing the forest sector in Indonesia are likely to prevent a significant increase in the rate of certifications in the immediate future.

This situation is further aggravated by the increasingly strident calls for a moratorium on forest certification from uncompromising environmental NGOs.²

TFF has responded to this situation by developing two new project initiatives. These initiatives recognize the relevance of a more holistic approach to training in sustainable forest management. These initiatives also strengthen collaborative efforts and provide stronger training linkages to the promotion of sustainable forest management and forest certification.

International Tropical Timber Organization (ITTO)–Funded Partnership in Training

The first of these initiatives is a partnership in training with the Ministry of Forests, Center for Forestry Education and Training, under a two year ITTO grant. This initiative will seek to institutionalize training in RIL for the remaining forest companies as well as reaching out to District forest administrations.

Forest-Market Linking Mechanism

TFF has secured funding support from USAID as well as the private sector, represented by a major U.S. distributor of Indonesian plywood and an Indonesian forest industry, to create a mechanism linking the market with a forest management unit.

Under this mechanism, the U.S. buyer will accept plywood made only from logs originating in the collaborating forest concession's annual operating area. The principle preconditions in order for this mechanism to be activated are:

1. The establishment of legality of the wood supply from an identified source.
2. Independent, third party audit, which will track the wood from the identified source to the factory and through the manufacturing process.
3. Adoption of RIL management and harvesting strategy on an identified source area from which logs will be sourced.

Implementation of this mechanism started in January, 2003, and the first shipment of product under this mechanism is expected to reach the U.S. market by the middle of the year.

While this initiative may spark some controversy, it is by no means out of step with evolving market demand. Various other organizations operating in Indonesia are

exploring similar forest-market connections. Such mechanisms vary from individual manufacturers looking for sources of "legal logs" from "well managed forests", to the World Wildlife Fund initiative to establish buyer-producer group connections in support of sustainable forest management and forest certification.

TFF is committed to assisting the Indonesian forest sector to weather the difficult adjustments needed to achieve a sustainable forest production. The linking of forest production units with specific markets, based on clear and achievable criteria of legality and sound forest stewardship, provides an effective opportunity to encourage sustainable forest management in a truly meaningful way.

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² Ongoing lobbying for a certification moratorium in Indonesia by a coalition of Indonesian and European environmental groups, has resulted in a report "Implementation FSC's Principles No. 2 and 3 in Indonesia: Obstacles and Possibilities", January 2003.

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SUCCESSION OF FALLOWS AFTER SHIFTING CULTIVATION IN SUNGAI SARAWAK BASIN, KUCHING, SARAWAK

I.B. Ipor and C.S. Tawan¹

ABSTRACT

Shifting cultivation is the simplest and very widespread method of agriculture. It is estimated that about 3.2 million hectares (ha) of land has been cleared for shifting cultivation. It is basically developed from the traditional way of hunting and gathering by the rural people. In Sarawak, the people are mainly Iban, Bidayuh, Kayan, Kenyah, Kelabit, Murut and other indigenous communities. They traditionally plant hill padi, interplanting with tapioca (*Manihot* sp.), maize (*Zea mays*), cucumber (*Cucumis* sp.), Brassica vegetables, sorghum etc. and then these areas are abandoned for the next cycle. This practice is often considered to be one of the major causes of extensive deforestation and environmental degradation. The abandonment has normally led to the formation of various stages of fallows or secondary forests.

Forests are usually classified based on their structure (physiognomy). The secondary forests offer a distinct contrast to the primary forests, both structurally and floristically. The common successional categories in the survey area are the grassland, Temuda (3 to 8 years after shifting cultivation) and Belukar (8 to 20 years after shifting cultivation). The grassland becomes established approximately one year after shifting cultivation of hill paddy planting. Grassland is dominated by herbs, grasses and sedges. Shrubs and small trees are also present. The young Temuda I develops after approximately 3 to 4 years and is dominated by herbs, sedges, ferns and young shrubs. Trees generally grow to 3 meters (m) in height during this successional stage. Temuda II represents the successional stage following Temuda I. This successional stage develops between 5 to 8 years after shifting cultivation. Emerging shrubs and trees are still very common and characterize the vegetation of this successional stage. Trees may reach 6 m in height but the canopy is still rather open with pockets of shade from taller trees. Canopy closure takes place at the beginning of the Belukar 1 stage after about 8 to 15 years old. This stage of succession is conspicuously dominated by *Palaquium sericeum* (Importance value (Iv) = 13.33), *Helicia petiolaris* (Iv = 12.578), *Artocarpus elasticus* (Iv = 11.088), *Adinandra acuminata* (Iv = 11.075), *Anisophyllea corneri* (Iv = 9.187) and *Premna integrifolia* (Iv = 7.590). The fast-growing trees of the genera *Ficus* and *Macaranga* grow gregariously, notably *Ficus uncinata*, *Ficus grossularioides*, *Macaranga beccariana*, *Macaranga triloba*, *Macaranga pruinosa*, *Macaranga hypoleuca*, *Ficus gecharis*, *Macaranga costulata*, and *Macaranga gigantea*. Other common species are *Artocarpus nitidus*, *Artocarpus elasticus*, *Artocarpus anisophyllus*, leban (*Vitex pubescens*), *Dillenia* sp., terbulan (*Endospermum malaccense*) and *Callicarpa*. *Macaranga pruinosa*, *M. gigantea* and *M. beccariana* are occasionally established in pure stands. Light-demanding herbs, grasses and sedges of the Temuda forest have largely been shaded out, except *Blechnum orientale*, some species of ginger and *Nephrolepis biserrata*. *Licuala* is quite commonly found among the sparser ground cover. The estimated above-ground biomass of Belukar vegetation is 181.8 tons/hectare (t/ha). The highest contribution of biomass is from *Palaquium sericeum* followed by *Helicia petiolaris* and *Artocarpus elasticus*. In Belukar II (more than 20 years old), the dominance of the fast-growing pioneer trees is ending. This vegetation is a transition to mixed dipterocarp forest. Shade-tolerant species have become established and are gradually gaining dominance in the overstorey. This type of vegetation occupies a small area along the edge of the mixed dipterocarp forest.

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INTRODUCTION

Shifting cultivation is practiced by a large portion of the population in Sarawak. This cultivation is a highly complex system, with wide variations based on cropping and yield pattern. These variants (based on ecological, social and cultural variations in the tribal societies) are very insulated because of topographical and language barriers. Shifting cultivation is adopted mainly to restore soil fertility, suitability and capability of the degraded areas that results from a few years of continuous cultivation. Usually a specific amount of virgin or secondary forest is cleared and transformed into temporary cropping area (locally known as Uma). The farmers will get a good harvest during the first year and the harvest levels eventually decrease as soil degradation occurs. These areas cannot be used agronomically for planting hill paddy after 3–5 years of continuous cultivation. These lands will be left as fallow and the farmers will move to other new areas. These fallow areas may be cultivated again when soil fertility is restored as a result of secondary forest regrowth. After this cultivation, the land will again be left fallow. The fallow areas normally become capable for cultivation after a resting period of 3–20 years. The resting period greatly depends on soil type and climate factors (Young and Wright 1979).

It is estimated that about 3.2 million ha of land (25.7% of Sarawak) has been cleared for shifting cultivation (Hatch 1982). The shifting cultivation is confined mostly in the Native Area land and the interior land with slopes of 47° to > 65%. In most cases, the cultivators have farmed in the area where they have acquired Native customary Rights on the land. In some areas, the pressure already referred to has increased the tendency for shifting cultivators to move into totally unsuitable types of land, even if only to take one crop of hill paddy and never return to it again. Vegetation succession as a result of shifting cultivation, is dominated by several fast-growing tree species. The present study was conducted to determine the structure and floristic composition of various stages of succession in fallow areas following shifting cultivation.

MATERIALS AND METHODS

A survey on different stages of succession was carried out within Sungai Sarawak basin. All trees at ≥ 5 centimeters (cm) diameter breast height (DBH) were enumerated within 20 x 20m plots (10 x 10m sub-plots) to determine the total above ground biomass (TAGB) by an allometric correlation method (Kato et al. 1978, Ogawa and Kira 1977, Yamakura et al. 1986), relative frequency (Rf), relative density (Rd), relative dominance (RD) and important

value (IV) of tree species were determined by following the method described by Brower and Ende (1990). The herbaceous plants were surveyed and identified at 1m x 1m to assess their dominance status (Kim and Moody 1983). The assessment was based on the values of relative density (Rd), relative frequency (Rf), importance value (Iv) and summed dominance ratio (SDR).

RESULTS AND DISCUSSION

The destructive effects of shifting cultivation practice on these ecological components are obvious. The majority of the shifting cultivators are not educated and not fully aware of the damage they have on the environment. In the absence of any alternative employment in their ecological setting, they regard shifting cultivation as the sole method of producing food in order to survive. In this process, they destroy the valuable timber species (the main forest resource and source of tree regeneration), cause soil erosion, deplete soil fertility, and create problems of land tenure and ownership.

Since at least 20% of the land area of the state has been cut and burned for hilly paddy at some time or another, it is clear that shifting cultivation probably represents the greatest threat to the long term preservation of Sarawak's forest resource. The quantity of high quality hardwood timber that is cut and burned annually by the shifting cultivator is of more immediate impact.

The classification of forests is usually assessed based on their structure (physiognomy). The secondary forests offer a distinct contrast to the primary forests, both structurally and floristically. The common successional categories in the survey area are the grassland, Temuda (3 to 8 years after shifting cultivation) and Belukar (8 to 20 years after shifting cultivation). The grassland is established approximately one year following shifting cultivation of hill paddy planting. It is dominated by herbs, grasses and sedges. Shrubs and small trees are also present. *Paspalum conjugatum* (SDR = 4.43) is the most dominant species and then followed by *Imperata cylindrica* (SDR = 4.13), *Axonopus compressus* (SDR = 3.66), *Scleria sumatrensis* (SDR = 1.90) and *Eleusine indica* (SDR = 1.58) (table 1). Lalang (*Imperata cylindrica*) appears to dominate the degraded sites subjected to several cycles of shifting cultivation. Pure lalang stands are frequently found in abandoned farms. *Scleria sumatrensis* and *Melastoma malabathricum* are well represented on dry, exposed or compacted sites. However, this vegetation offers a wide variety of plant species. Many of these species are of some importance due to their roles as (1) potential weeds, or (2) effective and fast growing cover for exposed soils.

Table 1—The quantitative estimates of plant species found in one year fallows of shifting cultivation at Sg. Sarawak Basin (Rd = Relative density, Rf = Relative frequency, Iv = Importance value and SDR = Summed dominance ratio). (continued on next page)

Species	Family	Rd	Rf	Iv	SDR
<i>Paspalum conjugatum</i>	Poaceae	7.43	1.43	8.86	4.43
<i>Imperata cylindrica</i>	Poaceae	6.62	1.65	8.27	4.13
<i>Axonopus compressus</i>	Poaceae	5.97	1.34	7.31	3.66
<i>Scleria sumatrensis</i>	Cyperaceae	2.36	1.43	3.79	1.90
<i>Eleusine indica</i>	Poaceae	2.70	0.45	3.15	1.58
<i>Cyperus iria</i>	Cyperaceae	1.76	1.25	3.01	1.51
<i>Asystasia intrusa</i>	Acanthaceae	1.81	1.16	2.97	1.49
<i>Ischaemum muticum</i>	Poaceae	1.09	1.76	2.84	1.42
<i>Cyperus digitatus</i>	Cyperaceae	1.40	1.16	2.57	1.28
<i>Cyperus distans</i>	Cyperaceae	1.44	1.08	2.52	1.26
<i>Cyperus compressus</i>	Cyperaceae	1.16	1.34	2.50	1.25
<i>Chromolaena odorata</i>	Asteraceae	0.90	1.52	2.43	1.21
<i>Ischaemum timorensis</i>	Poaceae	1.05	1.34	2.40	1.20
<i>Fimbristylis miliacea</i>	Cyperaceae	1.05	1.34	2.40	1.20
<i>Panicum repens</i>	Poaceae	1.23	1.16	2.39	1.20
<i>Phyllanthus amarus</i>	Euphorbiaceae	0.88	1.40	2.28	1.14
<i>Ageratum conyzoides</i>	Asteraceae	0.63	1.65	2.27	1.14
<i>Cyperus difformis</i>	Cyperaceae	1.11	1.16	2.27	1.14
<i>Euphorbia hirta</i>	Euphorbiaceae	1.08	1.16	2.24	1.12
<i>Leersia hexandra</i>	Poaceae	0.78	1.40	2.18	1.09
<i>Mimosa invisa</i>	Mimosaceae	0.79	1.34	2.13	1.07
<i>Hyptis capitata</i>	Labiatae	0.90	1.22	2.11	1.06
<i>Pennisetum purpureum</i>	Poaceae	0.38	1.61	1.99	0.99
<i>Dactyloctenium aegyptium</i>	Poaceae	1.00	0.99	1.99	0.99
<i>Panicum sarmentosum</i>	Poaceae	0.60	1.34	1.94	0.97
<i>Solanum torvum</i>	Solanaceae	0.70	1.16	1.87	0.93
<i>Digitaria setigera</i>	Poaceae	0.77	1.09	1.87	0.93
<i>Digitaria ciliaris</i>	Poaceae	1.05	0.81	1.86	0.93
<i>Eragrostis atrovirens</i>	Poaceae	1.12	0.73	1.86	0.93
<i>Fimbristylis globulosa</i>	Cyperaceae	1.00	0.84	1.84	0.92
<i>Paspalum scrobiculatum</i>	Poaceae	0.44	1.40	1.84	0.92
<i>Cyperus kyllingia</i>	Cyperaceae	1.00	0.81	1.81	0.90
<i>Hedyotis corymbosa</i>	Rubiaceae	0.42	1.38	1.80	0.90
<i>Elephantopus tomentosus</i>	Asteraceae	0.81	0.95	1.76	0.88
<i>Cyperus aromaticus</i>	Cyperaceae	0.66	1.08	1.74	0.87
<i>Mikania micrantha</i>	Asteraceae	0.39	1.34	1.73	0.87
<i>Isachne globosa</i>	Poaceae	1.05	0.66	1.72	0.86
<i>Lopatherum gracile</i>	Poaceae	0.63	1.08	1.70	0.85
<i>Leptochloa chinensis</i>	Poaceae	0.53	1.16	1.70	0.85
<i>Panicum maximum</i>	Poaceae	0.89	0.81	1.70	0.85
<i>Erechthites valerianifolia</i>	Asteraceae	0.60	1.08	1.68	0.84
<i>polygonum barbatum</i>	Polygonaceae	0.46	1.22	1.68	0.84
<i>Oldenlandia dichotoma</i>	Rubiaceae	0.46	1.22	1.68	0.84
<i>Hyptis brevipes</i>	Labiatae	0.45	1.22	1.66	0.83
<i>Hedyotis verticillata</i>	Rubiaceae	0.40	1.25	1.65	0.83
<i>Cyrtococcum accrescens</i>	Poaceae	1.18	0.45	1.63	0.82

Table 1 (continued)—The quantitative estimates of plant species found in one year fallows of shifting cultivation at Sg. Sarawak Basin (Rd = Relative density, Rf = Relative frequency, Iv = Importance value and SDR = Summed dominance ratio). (continued on next page)

Species	Family	Rd	Rf	Iv	SDR
<i>Ottochloa nodosa</i>	Poaceae	0.54	1.09	1.63	0.82
<i>Euphorbia heterophylla</i>	Euphorbiaceae	0.58	1.02	1.60	0.80
<i>Brachiaria milliformis</i>	Poaceae	1.25	0.30	1.55	0.78
<i>Melastoma malabathricum</i>	Melastomataceae	0.65	0.90	1.55	0.77
<i>Cynodon dactylon</i>	Poaceae	1.11	0.41	1.52	0.76
<i>Echinochloa colona</i>	Poaceae	0.61	0.90	1.51	0.76
<i>Ludwigia adscendens</i>	Onagraceae	0.30	1.20	1.50	0.75
<i>Emilia sonchifolia</i>	Asteraceae	0.69	0.81	1.49	0.75
<i>Elephantopus scaber</i>	Asteraceae	0.74	0.72	1.46	0.73
<i>Panicum brevifolium</i>	Poaceae	0.74	0.70	1.44	0.72
<i>Chloris barbata</i>	Poaceae	0.63	0.81	1.43	0.72
<i>Costus speciosus</i>	Zingiberaceae	0.44	0.99	1.42	0.71
<i>Ischaemum indicum</i>	Poaceae	1.12	0.27	1.39	0.70
<i>Phragmites karka</i>	Poaceae	0.67	0.72	1.38	0.69
<i>Stenochlaena palustris</i>	Dennstaedtiaceae	1.25	0.13	1.38	0.69
<i>Commelina diffusa</i>	Commelinaceae	0.33	1.02	1.36	0.68
<i>Cleome rutidosperma</i>	Capparidaceae	0.35	0.99	1.34	0.67
<i>Cyperus pilosus</i>	Cyperaceae	0.70	0.63	1.33	0.66
<i>Mimosa pigra</i>	Mimosaceae	0.46	0.86	1.32	0.66
<i>Lantana camara</i>	Verbenaceae	0.53	0.79	1.32	0.66
<i>Cyperus brevifolius</i>	Cyperaceae	0.70	0.61	1.31	0.66
<i>Portulaca oleraceae</i>	Portulacaceae	0.53	0.77	1.30	0.65
<i>Aeschynomene americana</i>	Papilionaceae	0.28	0.99	1.27	0.63
<i>Coix lachryma-jobi</i>	Poaceae	0.38	0.81	1.19	0.59
<i>Coelorachis glandulosa</i>	Poaceae	0.74	0.45	1.19	0.59
<i>Monochoria vaginalis</i>	Pontederiaceae	0.46	0.72	1.18	0.59
<i>Digitaria fuscescens</i>	Poaceae	0.79	0.38	1.17	0.58
<i>Sida rhombifolio</i>	Malvaceae	0.27	0.90	1.16	0.58
<i>Scirpus grossus</i>	Cyperaceae	0.62	0.54	1.16	0.58
<i>Pennisetum polystachyon</i>	Poaceae	0.61	0.54	1.15	0.58
<i>Chrysopogon aciculatus</i>	Poaceae	0.70	0.41	1.11	0.56
<i>Urena lobata</i>	Malvaceae	0.30	0.81	1.10	0.55
<i>Sida acuta</i>	Malvaceae	0.18	0.91	1.10	0.55
<i>Cyperus rotundus</i>	Cyperaceae	0.74	0.36	1.10	0.55
<i>Phymatosorus scolopendria</i>	Polypodiaceae	0.24	0.84	1.08	0.54
<i>Erigeron sumatrensis</i>	Asteraceae	0.42	0.61	1.03	0.52
<i>Centotheca lappacea</i>	Poaceae	0.58	0.45	1.03	0.51
<i>Fagraeae racemosa</i>	Loganiaceae	0.26	0.72	0.98	0.49
<i>Globba pendula</i>	Zingiberaceae	0.44	0.54	0.98	0.49
<i>Hyptis suaveolens</i>	Labiatae	0.30	0.65	0.94	0.47
<i>Stachtarpheta indica</i>	Verbenaceae	0.35	0.57	0.92	0.46
<i>Sporobolus diander</i>	Poaceae	0.56	0.36	0.92	0.46
<i>Eichhornia crassipes</i>	Pontederiaceae	0.38	0.54	0.92	0.46
<i>Cardiospermum halicacabum</i>	Sapindaceae	0.34	0.57	0.91	0.46
<i>Rhynchelytrum repens</i>	Poaceae	0.63	0.27	0.90	0.45
<i>Brachiaria mutica</i>	Poaceae	0.76	0.14	0.90	0.45

Table 1 (continued)—The quantitative estimates of plant species found in one year fallows of shifting cultivation at Sg. Sarawak Basin (Rd = Relative density, Rf = Relative frequency, Iv = Importance value and SDR = Summed dominance ratio).

Species	Family	Rd	Rf	Iv	SDR
<i>Lipocarpha chinensis</i>	Cyperaceae	0.44	0.45	0.89	0.44
<i>Physallis minima</i>	Solanaceae	0.42	0.45	0.87	0.43
<i>Borreria latifolia</i>	Rubiaceae	0.32	0.54	0.86	0.43
<i>Ludwigia hyssopifolia</i>	Onagraceae	0.23	0.63	0.86	0.43
<i>Sacciolepis indica</i>	Poaceae	0.56	0.27	0.83	0.42
<i>Scirpus mucronatus</i>	Cyperaceae	0.38	0.45	0.82	0.41
<i>Cassia tora</i>	Leguminosae	0.28	0.54	0.82	0.41
<i>Taenitis blechnoides</i>	Adiantaceae	0.29	0.52	0.81	0.41
<i>Cordia curassavica</i>	Boraginaceae	0.27	0.54	0.80	0.40
<i>Clidemia hirta</i>	Melastomataceae	0.27	0.54	0.80	0.40
<i>Elettariopsis curtisii</i>	Zingiberaceae	0.39	0.41	0.80	0.40
<i>Cyrtococcum oxyphyllum</i>	Poaceae	0.44	0.36	0.80	0.40
<i>polygonum chinense</i>	Polygonaceae	0.33	0.45	0.78	0.39
<i>Mimosa pudica</i>	Mimosaceae	0.24	0.54	0.78	0.39
<i>Croton hirtus</i>	Euphorbiaceae	0.24	0.50	0.74	0.37
<i>Sporobolus indicus</i>	Poaceae	0.47	0.27	0.74	0.37
<i>Rubus moluccanus</i>	Rosaceae	0.28	0.45	0.73	0.36
<i>Ipomoea cairica</i>	Convulvolaceae	0.24	0.48	0.72	0.36
<i>Themeda villosa</i>	Poaceae	0.27	0.45	0.71	0.36
<i>Lygodium flexuosum</i>	Schizaeaceae	0.35	0.36	0.71	0.35
<i>Tetracera indica</i>	Dileniaceae	0.25	0.45	0.70	0.35
<i>Melothria affinis</i>	Cucurbitaceae	0.28	0.41	0.69	0.35
<i>Echinochloa crus-galli</i>	Poaceae	0.30	0.39	0.69	0.35
<i>Nephrolepis biserrata</i>	Olendroideae	0.27	0.36	0.63	0.31
<i>Setaria palmifolia</i>	Poaceae	0.35	0.27	0.62	0.31
<i>Tetracera scandrens</i>	Dileniaceae	0.25	0.36	0.60	0.30
<i>Scoparia dulcis</i>	Scrophulariaceae	0.32	0.27	0.58	0.29
<i>Themeda arguens</i>	Poaceae	0.21	0.36	0.57	0.28
<i>Rhynchospora corymbosa</i>	Cyperaceae	0.30	0.27	0.57	0.28
<i>Vitis japonica</i>	Ampelidaceae	0.27	0.27	0.54	0.27
<i>Borreria laevicaulis</i>	Rubiaceae	0.26	0.23	0.50	0.25
<i>Triumfetta rhomboidea</i>	Tiliaceae	0.22	0.27	0.49	0.25
<i>Brachiaria paspaloides</i>	Poaceae	0.35	0.13	0.48	0.24
<i>Passiflora foetida</i>	Passifloraceae	0.22	0.23	0.45	0.23
<i>Tridax procumbens</i>	Asteraceae	0.19	0.23	0.43	0.21
<i>Tripsacum laxum</i>	Poaceae	0.21	0.18	0.39	0.19
<i>Pistia stratiotes</i>	Araceae	0.25	0.13	0.37	0.19
<i>Melochia concatenata</i>	Sterculiaceae	0.19	0.18	0.37	0.18
<i>Eragrostis tenella</i>	Poaceae	0.23	0.09	0.32	0.16
<i>Dicranopteris linearis</i>	Gleicheniaceae	0.18	0.13	0.30	0.15
<i>Amaranthus spinosus</i>	Amaranthaceae	0.21	0.09	0.30	0.15
<i>Lasia spinosa</i>	Araceae	0.21	0.09	0.30	0.15
<i>Asystasia coromandeliana</i>	Acanthaceae	0.18	0.07	0.25	0.12
<i>Typha angustifolia</i>	Typhaceae	0.07	0.13	0.20	0.10
<i>Alocasia macrorrhiza</i>	Araceae	0.09	0.05	0.14	0.07
<i>Centella asiatica</i>	Apiaceae	0.05	0.07	0.12	0.06

The young Temuda I stage (at approximately 3 to 4 years) is dominated by herbs, sedges, ferns and young shrubs. Trees generally grow to 3 m in height. The characteristic species are the aggressive sun-loving ferns resam (*Dicranopteris linearis*), *Nephrolepis biserrata*, *Blechnum orientale* and bracken (*Pteridium aquilinum*). The sedges *Scleria levis* and *Scleria sumantrensis* are abundant. Other species that are widespread in this Temuda are sendudok (*Melastoma malabathricum*), rumput naga (*Lycopodium cernuum*) and wild banana (*Musa* spp.). Concurrently, numerous species of light-demanding fast-growing trees are establishing and beginning to dominate. This area is well represented by several *Macaranga* species as well as leban (*Vitex pubescens*), legai (*Adinandra dumosa*), *Callicarpa pentandra* var. *pentandra*, manyam (*Glochidion* spp.), rentap, pulai (*Alstonia* spp.), terap (*Artocarpus elasticus*) and the fig, *Ficus grossularioides*. In highly disturbed areas such as roadsides, the following are found: simpor air (*Dillenia suffruticosa*), empitap (*Nauclea peduncularis*), tembusu gajah (*Fagraea racemosa*), the giant grass (*Erianthus saccharinum*), and the ground orchid, (*Bromheadia finlaysoniana*).

Temuda II represents the successional stage following Temuda I. It represents succession that occurs between 5 to 8 years following shifting cultivation. Emerging shrubs and trees are still very common and significantly characterize this vegetation. Trees may reach 6 m in height but the canopy is still rather open with pockets of shade due to the presence of taller trees. The most dominant species in this stage of succession is *Glochidion borneense* (Iv = 45.59). Species in decreasing order of dominance are: *Dillenia beccariana* (Iv = 16.60), *Alstonia angustiloba* (Iv = 9.72), *Arthropodium diversifolium* (Iv = 8.30), *Xylopiya furruginea* (Iv = 8.29), *Gaertnera vaginans* (Iv = 7.04), *Ficus geocharis* (Iv = 6.98), *Ploiarium alternifolium* (Iv = 6.98), *Timonius flavescens* (Iv = 6.98), *Terennia cumingiana* (Iv = 4.81) and *Vitex pubescens* (Iv = 4.80) (table 2). The occurrence of figs such as *Ficus uncinata* and *Ficus grossularioides* are occasionally accompanied by different *Macaranga* sp., *Callicarpa* sp., ginger (*Achasma* sp.) and wild banana (*Musa* sp.). Also present are Selanking (*Artocarpus nitidus*), *Trema orientalis*, Simpor (*Dillenia* sp.) and legai (*Adinandra dumosa*). All of the original grasses, sedges (such as *Scleria sumantrensis*), ferns and herbs are still present although the pioneer herbs are on the decline. In addition the sun-loving climbers (such as *Vitis* sp., *Uncaria* spp., *Rubus moluccanus* and the climbing fern, *Lygodium*) become locally abundant and often strangle the slower-growing shrubs. Other species seen in this stage are *Pteridium aquilinum*, lalang (*Imperata cylindrica*), the climbers *Meremia* and *Uncaria* sp. and young trees such as *Terennia cumingiana*, *Pleiocarpidia*

sandahanica and *Pleiocarpidia enneandra*. The estimated above-ground biomass of Temuda II area is 152.36 t/ha. *Glochidion borneense* contributes the most in term of biomass.

Canopy closure takes place at the beginning of the Belukar 1 stage after about 8 to 15 years. This stage of succession is conspicuously dominated by *Palaquium sericeum* (Iv = 13.33), *Helicia petiolaris* (Iv = 12.578), *Artocarpus elasticus* (Iv = 11.088), *Adinandra acuminata* (Iv = 11.075), *Anisophyllea corneri* (Iv = 9.187) and *Premna integrifolia* (Iv = 7.590) (table 3). The fast-growing trees of the genera *Ficus* and *Macaranga* grow gregariously, notably *Ficus uncinata*, *Ficus grossularioides*, *Macaranga beccariana*, *Macaranga triloba*, *Macaranga pruinosa*, *Macaranga hypoleuca*, *Ficus geocharis*, *Macaranga costulata*, and *Macaranga gigantea*. Other common species are *Artocarpus nitidus*, *Artocarpus elasticus*, *Artocarpus anisophyllus*, leban (*Vitex pubescens*), *Dillenia* sp., terbulan (*Endospermum malaccense*) and *Callicarpa*. The following species are occasionally established in pure stands: *Macaranga pruinosa*, *M. gigantea* and *M. beccariana*. Light-demanding herbs, grasses and sedges of Temuda forest have largely been shaded out, except *Blechnum orientale*, some species of ginger and *Nephrolepis biserrata*. *Licuala* is quite common among the sparser ground cover. The estimated above-ground biomass of Belukar vegetation is 181.8 t/ha. The highest contribution is from *Palaquium sericeum*. This is followed in dominance ranking by *Helicia petiolaris* and *Artocarpus elasticus*. In Belukar II (greater than 20 years old), the dominance of the fast-growing pioneer trees is ending. This vegetation is a transition to mixed dipterocarp forest. Shade-tolerant species have established and are gradually becoming dominant. This type of vegetation occupies in a small area along the edge of the mixed dipterocarp forest.

Although logging creates jobs, brings other commercial benefits and is less wasteful of forest resources, logging can be generally destructive when compared to shifting cultivation practices, due to the following logging effects: exposure of the soil possibly resulting in severe soil erosion; long term forest destruction; stream siltation and water pollution; dramatic fluctuations in river levels; and, increased flooding in down-river settlements (King 1988). Heavy machinery used in logging operations, such as road construction and skid trails for log transportation, causes extensive destruction. However, shifting cultivation practices through slashing and burning activities has obviously led to minimal destruction or site-removal of surface soil. The results of this survey revealed that fallow areas are able to restore rapidly during the short period of abandonment. In the early stage, particularly after the first year,

Table 2—Total trees, average dbh, average height, biomass, relative density (Rd), relative frequency (Rf), relative dominance (RD) and importance value (Iv) of trees species with a DBH of > 5cm from 5 - 8 year fallows of shifting cultivation at Sg Sarawak Basin

Species	Total trees	Average dbh	Average height	Biomass	Rf	Rd	RD	Iv
		<i>cm</i>	<i>m</i>	<i>kg</i>				
<i>Endospermum diadenum</i>	39	9.8	12.5	1905.59	8.99	17.10	18.10	44.19
<i>Gaetnera vaginans</i>	41	6.7	8.9	579.88	8.99	17.98	8.26	35.23
<i>Alstonia spatulata</i>	29	8.4	10.4	941.78	7.86	12.72	10.02	30.60
<i>Macaranga becceriana</i>	15	11.8	15.6	1766.70	3.37	6.58	11.46	21.41
<i>Macaranga hosei</i>	8	15	17.3	1269.76	4.49	3.51	8.86	16.86
<i>Helicia attenuata</i>	9	14.7	18.3	1429.90	2.25	3.95	9.40	15.59
<i>Adinandra dumosa</i>	8	8	11.1	192.96	7.86	3.51	2.27	13.64
<i>Litsea varians</i>	3	18	19	721.28	3.37	1.32	4.69	9.37
<i>Cratoxylum arborescens</i>	7	10.8	13.3	389.45	2.25	3.07	3.70	9.02
<i>Glochidion borneense</i>	6	8.5	10	166.30	3.37	2.63	1.97	7.97
<i>Horsfieldia grandis</i>	5	9.1	9.4	128.90	3.37	2.19	1.85	7.41
<i>Fagraea fragrans</i>	4	6.3	7.5	47.33	4.49	1.75	0.75	7.00
<i>Helicia petiolaris</i>	3	13.9	19.7	346.86	2.25	1.32	2.50	6.07
<i>Macaranga gigantea</i>	3	9.5	9.7	101.15	3.37	1.32	1.29	5.97
<i>Sarcotheca glauca</i>	6	8.2	7.7	108.76	1.12	2.63	1.79	5.54
<i>Xylopia furruginea</i>	3	10.7	13	206.06	2.25	1.32	1.73	5.29
<i>Vernonia arborea</i>	3	10.7	13.7	164.18	2.25	1.32	1.55	5.11
<i>Cratoxylum formosum</i>	4	6.5	8.3	44.69	2.25	1.75	0.72	4.72
<i>Kostermanthus heteropetala</i>	5	6.8	10.6	78.39	1.12	2.19	1.03	4.34
<i>Timonius borneensis</i>	3	5.2	7.7	19.55	2.25	1.32	0.34	3.90
<i>Euodia latifolia</i>	2	9.5	11	61.55	2.25	0.88	0.76	3.88
<i>Ploiarium alternifolium</i>	2	8.8	9.5	48.33	2.25	0.88	0.66	3.78
<i>Elaeocarpus nitidus</i>	1	22.4	26	377.06	1.12	0.44	2.10	3.67
<i>Pithecellobium jiringa</i>	2	5.5	9	18.80	2.25	0.88	0.26	3.39
<i>Anthocephalus cadamba</i>	3	6	7.2	38.88	1.12	1.32	0.56	2.99
<i>Millettia chaperii</i>	1	15	12	80.12	1.12	0.44	0.94	2.51
<i>Macaranga pruinosa</i>	2	7.2	9.5	35.61	1.12	0.88	0.46	2.46
<i>Barringtonia sarcostachys</i>	2	6.1	7	16.29	1.12	0.88	0.31	2.31
<i>Artocarpus elasticus</i>	1	12.1	13	56.85	1.12	0.44	0.61	2.18
<i>Hevea brasiliensis</i>	1	10	12	36.17	1.12	0.44	0.42	1.98
<i>Vitex pubescens</i>	1	6.4	10	12.64	1.12	0.44	0.17	1.73
<i>Adinandra acuminata</i>	1	5.8	5	5.31	1.12	0.44	0.14	1.70
<i>Parkia javanica</i>	1	5	8	6.28	1.12	0.44	0.10	1.67
<i>Dillenia suffroticosa</i>	1	4.5	6	3.87	1.12	0.44	0.08	1.65
<i>Anisophyllus disticha</i>	1	3.5	5	1.99	1.12	0.44	0.05	1.61
<i>Garcinia havilandii</i>	1	3.5	6	2.38	1.12	0.44	0.05	1.61
<i>Lepisanthes alata</i>	1	3.5	7	2.76	1.12	0.44	0.05	1.61

152.36 t/ha

Table 3—Total trees, average dbh, average height, biomass, relative density (Rd), relative frequency (Rf), relative dominance (RD) and importance value (Iv) of trees species with a DBH of > 5cm from 8–15 year fallows of shifting cultivation, Sg Sarawak Basin. (continued on next page)

Species	Total trees	Average dbh	Average height	Biomass	Rf	Rd	RD	Iv
		<i>cm</i>	<i>m</i>	<i>kg</i>				
<i>Alstonia spatulata</i>	17	22.4	24.8	7621.93	6.56	1.15	28.34	36.05
<i>Fagraea fragrans</i>	16	9.8	12.0	781.29	6.56	2.87	5.93	15.36
<i>Adinandra dumosa</i>	5	23.6	23.7	1984.42	3.28	2.87	8.57	14.73
<i>Ploiarium alternifolium</i>	27	7.3	8.6	476.82	7.38	1.72	4.74	13.84
<i>Arthrophyllum diversifolium</i>	7	15.1	18.3	915.68	4.10	2.87	4.97	11.94
<i>Atuna excelsa</i>	2	10	10.5	63.46	1.64	9.20	0.60	11.43
<i>Ganua attenuata</i>	5	15.7	16.8	1019.04	4.10	1.15	4.62	9.87
<i>Elaeocarpus nitidus</i>	6	12.7	14.5	582.05	3.28	1.72	3.36	8.37
<i>Hevea brasiliensis</i>	6	8.9	10	283.39	4.10	1.72	1.99	7.81
<i>Vernonia arborea</i>	2	30	29.5	1634.34	1.64	0.57	5.55	7.77
<i>Helicia fuscotomentosa</i>	3	23.8	24.7	1422.62	1.64	0.57	5.34	7.55
<i>Chassalia curviflora</i>	3	10.8	11.3	180.00	1.64	3.45	1.27	6.36
<i>Cratoxylum sumatranum</i>	2	20.5	20	699.35	1.64	1.15	3.06	5.85
<i>Dillenia suffruticosa</i>	5	5.1	5.6	26.67	4.10	1.15	0.41	5.66
<i>Timonius borneense</i>	5	9.5	11	169.27	3.28	0.57	1.42	5.28
<i>Litsea varians</i>	3	6.3	8	39.76	1.64	2.87	0.41	4.92
<i>Elaeocarpus stipularis</i>	2	12.3	15	147.43	0.82	2.87	0.94	4.64
<i>Eugenia chlorantha</i>	2	9.4	10.5	68.74	1.64	1.72	0.60	3.96
<i>Litsea paludosa</i>	5	6.9	9.8	85.29	2.46	0.57	0.76	3.80
<i>Croton oblongus</i>	1	26.9	27	561.30	0.82	0.57	2.17	3.57
<i>Nephelium lappaceum</i>	1	21.4	17	226.84	0.82	1.15	1.37	3.34
<i>Endosperma diadenum</i>	1	18.9	21	211.92	1.64	0.57	1.04	3.25
<i>Glochidion borneense</i>	2	7.8	11	72.74	1.64	1.15	0.46	3.25
<i>Sarcotheca glauca</i>	3	9.2	9.3	101.50	1.64	0.57	0.86	3.07
<i>Macaranga gigantea</i>	2	5.2	6.5	15.45	1.64	1.15	0.18	2.96
<i>Endospermum diadenum</i>	2	14.6	15	255.16	0.82	0.57	1.52	2.91
<i>Ardisia macrophylla</i>	1	9.2	7	18.13	0.82	1.72	0.25	2.80
<i>Camptosperma squamata</i>	2	9.8	11.5	67.76	1.64	0.57	0.58	2.79
<i>Terminalia catappa</i>	2	9.1	8.5	41.70	1.64	0.57	0.52	2.74
<i>Elaeocarpus cupreus</i>	2	14.7	16	212.56	0.82	0.57	1.31	2.71
<i>Xylopiya furruginea</i>	2	6	7.5	20.47	1.64	0.57	0.23	2.44
<i>Xylopiya coriifolia</i>	1	17.8	23	212.56	0.82	0.57	0.95	2.35
<i>Macaranga hosei</i>	3	3.7	4	5.40	1.64	0.57	0.12	2.34
<i>Xerospermum acuminatissimum</i>	1	17.5	18	161.53	0.82	0.57	0.92	2.31
<i>Parkia javanica</i>	2	3.6	3.5	2.91	1.64	0.57	0.08	2.29
<i>Endosperma peltatum</i>	1	9	13	31.82	0.82	1.15	0.24	2.21
<i>Eugenia elliptilimba</i>	1	16	17	128.04	0.82	0.57	0.77	2.16
<i>Ficus durata</i>	1	5.2	5	4.29	0.82	1.15	0.08	2.05
<i>Terenna cumingiana</i>	1	5	4	3.20	0.82	1.15	0.08	2.04
<i>Calophyllum borneense</i>	1	3.5	4	1.60	0.82	1.15	0.04	2.01
<i>Gaertnera vaginans</i>	1	3.5	3	1.22	0.82	1.15	0.04	2.01
<i>Helicia petiolaris</i>	1	3.5	4	1.60	0.82	1.15	0.04	2.01
<i>Palaquium sericeum</i>	1	3.5	4	1.60	0.82	1.15	0.04	2.01
<i>Vitex pubescens</i>	1	14	15	87.10	0.82	0.57	0.59	1.98

Table 3 (continued)—Total trees, average dbh, average height, biomass, relative density (Rd), relative frequency (Rf), relative dominance (RD) and importance value (Iv) of trees species with a DBH of > 5cm from 8–15 year fallows of shifting cultivation, Sg Sarawak Basin.

Species	Total trees	Average dbh <i>cm</i>	Average height <i>m</i>	Biomass <i>kg</i>	Rf	Rd	RD	Iv
<i>Litsea elliptica</i>	1	13.9	22	125.11	0.82	0.57	0.58	1.97
<i>Artocarpus kemandu</i>	1	5.5	7	6.64	0.82	4.02	0.09	1.93
<i>Norrisia maior</i>	1	12	11	47.48	0.82	0.57	0.43	1.83
<i>Calophyllum obliquinervium</i>	1	12.7	11	53.06	0.82	3.45	0.48	1.75
<i>Prunus arborea</i>	1	10.5	11	36.55	0.82	0.57	0.33	1.73
<i>Adinandra acuminata</i>	1	3.5	4	1.22	0.82	9.77	0.04	1.63
<i>Randia kuchingensis</i>	1	8.5	11	24.16	0.82	0.57	0.22	1.61
<i>Timonius flavescens</i>	1	7.4	5	8.53	0.82	0.57	0.16	1.56
<i>Dehaasia firma</i>	2	4	8	7.52	0.82	0.57	0.10	1.49
<i>Eugenia castanea</i>	1	4.5	4	2.61	0.82	0.57	0.06	1.46
<i>Macaranga beccariana</i>	1	4.5	8	5.12	0.82	0.57	0.06	1.46
<i>Glochidion superbum</i>	1	3.5	5	1.99	0.82	0.57	0.04	1.43
<i>Castanopsis hypophoenicea</i>	1	3.5	4	1.60	0.82	15.52	0.04	1.37
	174			181.8 t/ha				

clearings are successfully invaded principally by grasses, sedges, broad-leaved weeds and ferns. Later in the Belukar stage, the successional pattern is dominated by resourceful tree species that have a high potential for forest restoration and rehabilitation. These species can be further selected for large-scale forest plantation since they are fast growing and would develop to the commercial size quickly.

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SUSTAINABLE WOOD PRODUCTION IN THE PACIFIC NORTHWEST

Robert Deal¹, and R. James Barbour²

ABSTRACT

The Pacific Northwest of the United States is one of the world's major timber producing regions, and the regional capacity to produce wood on a sustained yield basis is widely recognized. Issues relating to the ecological, social and economic frameworks of sustainable forestry, however, will play a major role in future wood production of the region. The Sustainable Wood Production Initiative (SWPI) was developed to identify and understand key issues relating to sustainable forestry in the Pacific Northwest. This initiative will identify key regional issues for the sustainable production of wood including barriers to sustainable forestry such as environmental regulations, markets and public perceptions of forestry, and develop an assessment of resource trends and market conditions.

KEY WORDS: Sustainable forestry, wood production, timber harvest projection models, timber supply, Pacific Northwest.

BACKGROUND

The Pacific Northwest (PNW) is widely recognized as a major timber producing region, with annual timber production averaging 50 million cubic meters for the past decade (Haynes 2003). As one of the principal timber producing regions in the United States, there has been both public interest in assuring that forests are being sustainably managed and a desire by landowners and forest managers to demonstrate their commitment to responsible stewardship. To address concerns about sustainable forest management, the United States Department of Agriculture (USDA), Pacific Northwest Research Station, is sponsoring a three year Sustainable Wood Production Initiative (SWPI) to identify and understand key issues relating to sustainable forestry in the PNW. We define sustainable forestry as "the capacity of forests ranging from stands to ecoregions, to maintain their health, productivity, diversity, and overall integrity, in the long run, in the context of human activity and use" (Helms 1998). We further define sustainable wood production as "the capacity of forests to produce various wood products, in the long run, in the context of human

activity and use." This initiative has identified six issues, based on client input thus far, that affect the ability of landowners to sustainably produce wood in the region. These key issues are as follows: (1) identify and understand the major issues relating to wood production in the PNW in the broad context of sustainable forestry, (2) identify barriers to sustainable forestry and assess the impacts of market incentives and environmental regulations on sustainable forest management, (3) develop a regional assessment of resource trends and market conditions including the long-term economic viability of forestry in the region, (4) assess opportunities for small woodland owners in the PNW and identify niche market opportunities for small landowners, (5) identify emerging technologies for wood products and summarize and synthesize new and existing information on wood technology, and (6) develop a comprehensive communication strategy for reporting findings to a broad client base of land managers, researchers and the general public. Information on these issues will be synthesized and a capstone report will be produced to address the challenges and opportunities for sustainable forestry in the PNW.

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IDENTIFY AND UNDERSTAND KEY ISSUES RELATED TO SUSTAINABLE WOOD PRODUCTION AT THE REGIONAL SCALE IN THE PNW

The PNW is a highly productive timber-growing region, and the regional capacity to produce wood on a sustained yield basis is widely recognized, however issues relating to the ecological, social and economic frameworks of sustainable forestry will play a major role in future wood production of the region. We will identify key regional issues in the PNW relating to sustainable wood production (focusing on state and private land) including barriers to sustainable forestry (such as environmental regulations, market incentives, and public perceptions of forestry), and develop an assessment of resource trends and market conditions.

Sustainable forest management often does not consider ownership or local market differences other than contributions of selected ownerships to broad-scale measures. We will evaluate different land management and ownership contributions to regional forest productivity including differences among private ownerships (industrial, small and larger non-industrial landowners), and publicly administered land (federal, state and municipal) that distinctly define the PNW.

The SWPI will provide a regional analysis of future wood industry and resource conditions using established timber supply models that project scenarios of future development of timber resources across a range of possible scenarios (Adams and Haynes 1996). The initiative will address barriers to sustainable forestry and investigate the relative cost and effectiveness of regulatory and incentive-based approaches to sustainable forest management. Potential alternative management strategies and incentives will be identified that could reduce barriers to sustainable wood production while meeting regulatory requirements and environmental expectations. The initiative will also examine how selected segments of the public perceive timber-harvesting practices and will develop conceptual models that explain public perceptions about forestry practices. We will evaluate differences among large industrial and small landowners and their relative contributions to sustainable wood production in the PNW. We will also summarize and synthesize new and emerging information on wood technologies and their potential contributions to sustainable wood production. We will explore ways in which land-use models can be used to predict how landowners respond to land-use policies and how these land-use changes might be distributed across the landscape. These land use models will also be used to explore ways to address wildlife habitat problems stemming from forest

fragmentation and examine the associated impacts on wildlife. Lastly, we will summarize and synthesize these different issues and forecast future forest resource conditions and market trends to identify opportunities and challenges for sustainable wood production in the PNW.

IDENTIFY BARRIERS TO SUSTAINABLE FORESTRY

The ability of forestland owners and managers to sustainably produce wood in the PNW is impacted by a wide range of market-based or regulatory incentives and public perceptions about forestry management practices. This issue will identify some of the major barriers to sustainable forestry and address both the impact of regulations on the ability to produce wood and the effect of market-based incentives on potentially increasing production. We will also integrate and evaluate some of the potential compatibilities of wood production with other forest resources such as wildlife, biodiversity and other forest values. The public perception of alternative harvest patterns will also be evaluated to assess implications for social, economic and ecological aspects of sustainable forestry.

This work will incorporate three different studies on barriers to sustainable forestry. One study will investigate the relative cost and effectiveness of regulatory and market-based incentives to achieve sustainable forestry objectives on private lands. This project will build onto ongoing research that models cost-effective stand level management for late successional forest structure and measures the opportunity cost of achieving regional targets for late successional forest structure on private land in western Oregon (Wimberly et al. 2000, Montgomery et al. 2003). This research will use a timber supply model to estimate production possibilities for compatible forestry objectives related to wood production and biodiversity (Adams et al. 2002). Following this work, a range of policy scenarios will be simulated and compared to the minimum cost outcomes estimated by the timber supply model. These scenarios will be used to evaluate the impact and efficiency of achieving biodiversity objectives using current and hypothetical regulatory restrictions and market-based incentives on private land including estate, yield and property taxes, subsidies, and incentive payment programs.

Another study will identify and investigate potential alternative management strategies, incentives and educational opportunities that could reduce barriers for sustainable wood production (Lippke and Fretwell 1997, Bare and Lippke 2002). This project will determine the economic and environmental impacts of recent regulations for some small-owner case studies. Similar impacts on larger owners

will be determined with consideration of intra-regional distinctions, different tree species mixtures and other environmental factors. Exploratory surveys will also be conducted to determine the problems that owners are having with permitting processes and the subsequent impacts on operations. Case studies will be used to determine the effects of harvesting, stream protection and other treatments. Also economic analyses and aesthetic metrics will be used to evaluate the success of different treatments. This research will be summarized to identify major barriers to sustainable forestry and opportunities to improve wood production while also maintaining the intended environmental objectives.

Another study will conduct work to understand public perceptions of alternative harvest patterns in young-growth forests. This study will develop preliminary conceptual models explaining how selected segments of the public perceive alternative patterns of timber harvesting. This work will explore how various visual cues affect public responses to a suite of different timber harvesting patterns as well as how personal knowledge and assumptions affect the interpretation of those cues (Kaplan 1985, Lucas 1991). Information for public participants may be particularly important for evaluating harvest patterns that include snags, logging debris and other structural material important for soil stability, wildlife habitat or other ecosystem features.

DEVELOP A REGIONAL ASSESSMENT OF RESOURCE TRENDS AND MARKET CONDITIONS

We will develop a regional assessment of forest industry and resource conditions and evaluate the long-term economic viability and sustainability of forestry in the PNW region. The goal is to inform policy makers, small and large landowners, timber processors and other stakeholders about potential future issues regarding sustainable wood production in the PNW. We will develop a set of analytical tools that project future development of the resource and the industry under a range of possible scenarios (Adams and Haynes 1996, Adams et al. 2002, Schillinger et al. 2003). We will then use these tools to develop a regional timber harvest projection model with potential applications for detailed tree condition class projections of the regional forest resource. Our information will then be used to assess resource trends and market conditions for the PNW with projections forecast across stand to regional scales.

A timber supply assessment will be used that employs both market-based and volume-flow methods. A timber supply projection model was developed in Oregon and will

be extended to Washington sub-regions (Adams et al. 2002). This model simulates market equilibrium conditions and then includes costs of different silvicultural practices. Trends in costs, interest rates, volume yields, future expected public timber harvests and potential harvests on public and private lands can be projected over a 100-year period. Extending this model to western and eastern Washington will include different sets of forest management practices, estimated log demand, harvest costs and yields for different regions of the Pacific Northwest.

The timber assessment methodology will be expanded to include timber quality characteristics. Volumes of different tree species and their size, height, and tree crown characteristics will be used to develop underlying condition classes and to assess relationships between timber characteristics and industry processing capacity. Timber assessments will be revised to link projections from the timber supply assessment model to regional scales to insure that price and harvest projections are consistent across the sub-region.

Integrating this information will allow us to project future resource conditions, harvests given various industrial capacity and processing assumptions, and responses of harvest, investment and inventory under different scenarios. We will then apply this information to assess resource trends and market conditions for the PNW region.

ASSESS MARKET OPPORTUNITIES FOR SMALL WOODLAND OWNERS

Private forestland owners are particularly interested in developing a better understanding of market demand and supply information and the opportunities of active management of forest land for timber and nontimber products. We will assess some of the special niche market opportunities for small woodland owners. In conjunction with small woodland owners associations and the Northwest Wood Products Association, we will explore ideas for improving market opportunities for small woodland owners. One project being developed is to work with the associations to gather market information from small woodland owners and identify avenues for increasing their market opportunities. We will participate in regional workshops to assess what small woodland owners know about niche markets, value-added opportunities and information regarding marketing their products through different buying and selling cooperatives. Specifically, in each regional workshop we will work with these associations to develop ideas to: (1) enhance the awareness of product management and marketing opportunities; (2) establish relationships across the

value chain for continued work together; (3) review innovations in technology and organizational relationships that have been tested elsewhere; and (4) develop a working database within each region of resource owners and their prospective suite of forest products and combine this information with current and emerging market opportunities. The SWPI will be responsible for utilizing the information from these workshops to identify and understand marketing issues of importance to woodland owners. This information also will be used to distinguish commonalities and differences in marketing opportunities among the regions.

IDENTIFY EMERGING TECHNOLOGIES FOR WOOD PRODUCTS

We will summarize and synthesize new and existing technologies for wood products and describe how the forest industry in the PNW is positioned to take advantage of new or various market opportunities. This work may include an overview of the state of knowledge for emerging technologies for wood products and the current and future status of these new industries in the PNW region.

We will focus on one or two specific studies to address this issue. One such study is the development of an outreach program for manufacturing extruded wood-plastic products for economic development in rural communities. This work will focus on case studies in the state of Washington but will have applications for the broader PNW region. The objectives of the study are to facilitate the development of business plans to stimulate the creation of a wood-plastic composite industry in the PNW. This work will also identify appropriate distribution channels to market end products. Workshops will be conducted to disseminate information to personnel involved with economic development.

DEVELOP COMMUNICATION STRATEGIES FOR REPORTING FINDINGS

We will develop a broad set of technology transfer outlets to provide information for land managers, researchers and the general public. Different user groups use different types of outlets for receiving information and we will work to design, and publish information in ways best suited to reaching the intended clients. Examples of this work include USDA Forest Service Research Station publications that provide technical information for land managers and forest practitioners. Other outlets are publications in forest research journals or symposium proceedings or books that address needs of researchers and scientists. In addition, we will

report information on the SWPI for the general public in simple to understand language that is accessible to non-forestry audiences. This work may include photographs and other visual materials that are more effective in conveying information to the general public than technical or research oriented outlets.

It is critical that we ensure that all reports are objective and based on best available science. Regardless of the medium or outlet, it is essential that all publications be written in an objective manner. To ensure that publications are technically sound and use the best available science, we will insist that all publications be peer-reviewed for quality assurance and quality control.

SUMMARY

The USDA Forest Service, Pacific Northwest Research Station is sponsoring the Sustainable Wood Production Initiative to identify and evaluate key issues relating to sustainable forestry in the PNW. The initiative will address barriers to sustainable forestry and investigate the relative cost and effectiveness of regulatory and market-based approaches to sustainable forest management. Potential alternative management strategies and incentives will be identified that could reduce barriers to sustainable wood production while meeting regulatory requirements and environmental expectations. The initiative will also examine how selected segments of the public perceive timber-harvesting practices and will develop conceptual models that explain public perceptions about forestry practices. Timber harvest on federal land in the PNW has been greatly reduced in recent years with increasing market demand from state and private forest landowners. We will evaluate differences among large industrial and small landowners and their relative contributions to sustainable wood production in the PNW. We will also summarize new and emerging information on wood technologies and their potential contributions to sustainable wood production. Lastly, we will synthesize these different issues and forecast future forest resource conditions and market trends and identify opportunities and challenges for sustainable wood production in the Pacific Northwest.

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INTEGRATING SOCIAL SCIENCE WITH FOREST PRODUCTS RESEARCH: THE BENEFITS OF ADDRESSING ALL DIMENSIONS OF SUSTAINABILITY

Ellen M. Donoghue¹

INTRODUCTION

The on-going debate about sustainable forest management reflects the need to better understand the links among ecological, economic, and social dimensions of forest management. Biophysical and social scientists are drawn into the sustainability debate, sometimes unwittingly, because they produce information that helps clarify these links. The level of complexity of issues surrounding forest management, coupled with the growing awareness that most forest management activities have ecological, economic, and social implications, all but compel scientists to engage. Science aimed at informing sustainable forest management may require interdisciplinary research across disciplines that traditionally have had little interaction. Such is the case with forest products research and social science. Some implications and opportunities for integrating social science and wood products research are discussed in this paper.

FOREST PRODUCTS AND PEOPLE

Forest products research is increasingly addressing issues of sustainable forest management, as evidenced by the 2003 International Union of Forest Research Organizations' Division 5 conference in Rotorua, New Zealand, titled "Forest Products Research Providing for Sustainable Choices." Although forest products research has a tradition of linking forest products to ecological and silvicultural dimensions of forest management, it has less experience linking forest products research with social dimensions of wood utilization. However, anything less than full consideration of the three dimensions of sustainability—ecological, economic, and social—may limit the ways that forest products research can provide for sustainable choices. This poses some challenges, as well as opportunities, for forest products research with respect to how

it can more thoroughly participate in the debate on sustainable forest management. One challenge involves identifying the relations between wood products and people. Another challenge involves overcoming methodological, theoretical, and language boundaries associated with conducting interdisciplinary research.

Although interdisciplinary research is not new to forest products research, the integration of social science may require redefining questions about forest products. Social scientists think about questions related to wood products by considering how existing and emerging forest management and wood utilization practices relate to people. They think about the people who grow, tend, harvest, process, create, manufacture, build, buy, and sell wood products. They think about how people do these things, why they do them, when they do them, and where they do them. They also think about the social, cultural, and economic factors that affect people's ability to work in the woods, and make and market products from the woods. People with unique values and knowledge about forests and wood products are involved throughout all stages of wood production. Some people have unique knowledge about processes, patterns, and interactions that they acquired through experience with wood products. Many people value forests and forest products in ways that are reflected in their lifestyle choices, occupational choices, and consumption choices. For example, a flooring or furniture manufacturer may value craftsmanship, tradition, or entrepreneurship, whereas a consumer may value a wood product for utilitarian, aesthetic, or economic reasons. Social science can expand the relevancy and implications of wood products research by increasing understanding about values, preferences, lifestyle choices, and other social and economic factors in the context of forest management.

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OPPORTUNITIES FOR INTEGRATED RESEARCH

The Ecologically Sustainable Production (ESP) of Forest Resources Team of the USDA Forest Service, Pacific Northwest Research Station (USDA 2003b) is an interdisciplinary team of scientists that researches the effects of forest management activities on forest outputs (goods and services) over time and at different geographic scales. The team consists of a wood technologist, a forester, a silviculturist, a biometrician, and two social scientists. Historically, the team focused on product recovery studies and wood quality research. However, in order to remain relevant to a broader audience of science users, particularly those concerned with issues of sustainable forest management, the team expanded the focus on wood utilization to include ecological and social sciences. The expanded focus includes research on forest product valuation and silviculture related to stand structure and wood quality. It also includes research related to the social dimensions of forest management, such as rural community development and societal values toward ecological functions and wood utilization. The ESP team researches forest management topics in more than a dozen western states of the United States where public forestlands are an important part of the social and biophysical geography. In one area of work, the team is developing an interdisciplinary research agenda that focuses on forest resource characteristics, wood quality, wood products, and rural communities associated with densely stocked forests in the western United States.

Forest Management in the Western United States

Land ownership in the western United States (U.S.) is unique among other U.S. timber producing regions. For example, almost 70% of the forestland in the West is managed by public agencies (federal and state) and much of the private timberland is held in large tracts. This differs from the eastern half of the country where approximately 83% of forestland is in private ownership and 17% is in public ownership (Haynes 2003). As in other areas of the United States, the West has experienced a conversion of forests from older to younger stands. This, coupled with over a half century of fire suppression, has led to a high proportion of densely stocked, small diameter stands. In this context, “small diameter” refers to trees of 4–12 inches dbh (diameter at breast height). These are trees that from both utilization and economic standpoints continue to pose challenges to mills.

Increased concern that densely stocked forests are at risk of uncharacteristically severe fires and insect and disease attacks has led to a new focus on forest health (USDA

Forest Service 2003a) and nontraditional forest products, particularly in the western United States. Most of the emphasis is on densely stocked stands, where the management objectives are to reduce fire hazard and improve forest health through thinning, prescribed burning, and other prescriptions. These management activities have implications for wood products, particularly those related to small diameter material. For example, some wood from older, small diameter trees has properties similar to old-growth trees, such as tighter grain and small knots. This material has applications for millwork, moulding, furniture, flooring, and other higher value products. Other small diameter material may have applications for composite wood products or bioenergy generation. Some uses of small diameter material may offer economic development opportunities for small businesses and forest-based communities, although transportation costs, upfront capital investments, and other factors may pose barriers. Many rural communities in the western United States historically have been socially and economically connected to forests and forest product industries. However, some owners of forest products companies are unclear about how to make profits from small diameter material. Other forest-based communities may have small or non-existent forest products industries but are looking for economic development opportunities related to small diameter timber.

The objectives to improve forest health, reduce fire hazard, and generate economic opportunities through small diameter timber utilization illustrate a prevailing challenge in achieving sustainable forest management. The challenge is to understand the ecological, economic, and social interactions of a complex forest management issue. The conventional approach of focusing on a single dimension of an issue through a single discipline, for example wood product utilization, may no longer be sufficient. Some level of integration may be necessary to address complex issues. Recognition, and integration, of the social and economic dimensions of the small diameter timber issue, for example, may be an important step to achieving sustainable forest management.

Social Science, Wood Products, and Small Diameter Timber

Although not traditionally integrated with wood products research, social science can contribute in a number of ways to the management and utilization of small diameter wood from densely stocked forests in the western United States. First, many densely stocked forests are in urban-wildland interfaces, where population densities are increasing at the edge of vast areas of public forestlands. The concern about uncharacteristically severe fires near populated places had led to an increased emphasis on hazardous

fuel reduction. It has also resulted in a demand for information about changing demographics and the social and physical infrastructure of communities. The proximity of people to fire hazard areas also has raised awareness about risk perception and community preparedness for wildfire. Social scientists draw on methods and theories from anthropology, sociology, geography, political science, and economics to address these types of questions and information needs.

Second, the utilization of small diameter wood may provide economic development opportunities for rural, forest-based communities. However, harvesting, loading, hauling, and handling costs of small diameter material can be high. And, the ability to meet management objectives of thinning stands may depend in part on the existence of facilities that can economically process small diameter material. The development of value-added products may offer opportunities for industries that provide employment for local residents. Social science can contribute to better understanding of such opportunities through assessments of feasibility and employment effects of locating wood processing facilities in rural areas.

Third, social science also can help clarify why some communities have the ability to take advantage of economic development opportunities associated with the wood products sector, whereas others do not. The social science literature refers to this as community capacity. This requires better understanding about community leadership, social cohesion, work force skills, and physical capital needed to support such industries. For example, an economic development organization may be interested in supporting a small mill in a rural community. However, unless the community has some level of human, physical, and social capital to lure and sustain the mill, the financial support may be for naught.

Fourth, many former timber-based communities in the western United States have been experiencing social and economic change in the past several decades. Social science can contribute to understanding the dimensions of community change. For example, this might include addressing questions about how and why some communities transition from forest products-based to recreation-based economies.

Lastly, social values of forest management and wood products are reflected in informal (i.e., norms) and formal institutions (i.e., rules and regulations). Social science can contribute to increased understanding of the institutional opportunities and constraints for harvesting small diameter material. This might include an evaluation of federal contracting authorities intended to increase collaboration with

local communities and local businesses. Also, increased understanding of social values and social acceptability of forest management practices may help forest managers to identify a range of forest management options (Donoghue 2003) for managing small diameter timber.

CONCLUSION

Researchers in wood science and wood technology are increasingly being asked to consider how forest products research provides for sustainable choices. Where resources, time, and skills at working across disciplines are present, research that integrates ecological, economic, and social dimensions of forest management may address some important issues related to sustainable forest management. The integration of social science represents a nontraditional approach to wood products research. It reflects a growing recognition that we cannot talk about issues of sustainability without talking about people. Integrated research about wood utilization that includes social science may enhance the relevancy of forest product research in contemporary debates about sustainable forest management.

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LIFE CYCLE ASSESSMENT OF WOOD FLOOR COVERINGS

B. Nebel,¹ B. Zimmer,² and G. Wegener¹

INTRODUCTION

The forest and wood industry relied in the past on their reputation of providing environmentally friendly and sustainable products. However, competition with other materials and customers has created the need to provide facts to support this traditional reputation. Life Cycle Assessment (LCA) is a tool to provide these data and shows potential for improvement during the life cycle of products.

GOAL AND SCOPE

The goal of the study is a life cycle assessment on wood floor coverings according to ISO 14040–14043 for the different kinds of wood floor coverings. The comparison of these floor coverings among each other was not the aim of the study. Rather, we provided basic data for all wood floor coverings for a possible comparison with other floor coverings in the future. The main focus was a hot spot analysis to help involved industry partners in improving their environmental performance and, on the other hand, to use the results for marketing purposes.

The study considers the whole life cycle of the floorings from cradle to grave: The first and most important stage of the life cycle is the forestry. The following stages are saw milling, production of the floorings, laying, and use. The end-of-life scenario considers the thermal utilization (fig. 1).

The functional unit is defined as 1 square meter (m²) of laid wood floor covering assuming average wear and tear in a home that is completely refurbished after 50 years. Other functions, e.g. insulation, effects on the room climate etc., are not considered in this LCA.

Allocation rules have to be considered for the co-products such as residual wood and for the provision of thermal energy, at the end-of-life stage. Since the residual wood is used for the generation of heat and/or electricity on site, it stays within the system under analysis, and no allocation is required.

However, the thermal energy at the end-of-life stage leaves the system that is under analysis and is used in a different system. With the help of system expansion, this functional problem is solved. The amount of thermal energy that is provided by thermal utilisation of 1 m² wood floor covering substitutes the same amount of thermal energy provided with fossil fuels. The emissions from burning the fossil fuels are therefore avoided and thus subtracted from the system under analysis (Jungmeier et al. 2002, Werner 2002). In order to minimize the influence of the method, the best available technology is chosen for the provision of thermal energy from fossil fuels.

INVENTORY ANALYSIS

For the saw milling and production stages, data were collected on site. A total of 15 flooring manufacturers and 4 saw mills, contributing 70% of the German wood floor covering production, were involved in the project. Data for laying, surface finishing, and refurbishment were also collected on site. Information on all transports between these stages was provided by the relevant project partners. The forestry and end-of-life stages are based on literature (Schweinle 1996, Speckels 2001). Generic data is based on the database of the GaBi-Software 3.2 (IKP 2000).

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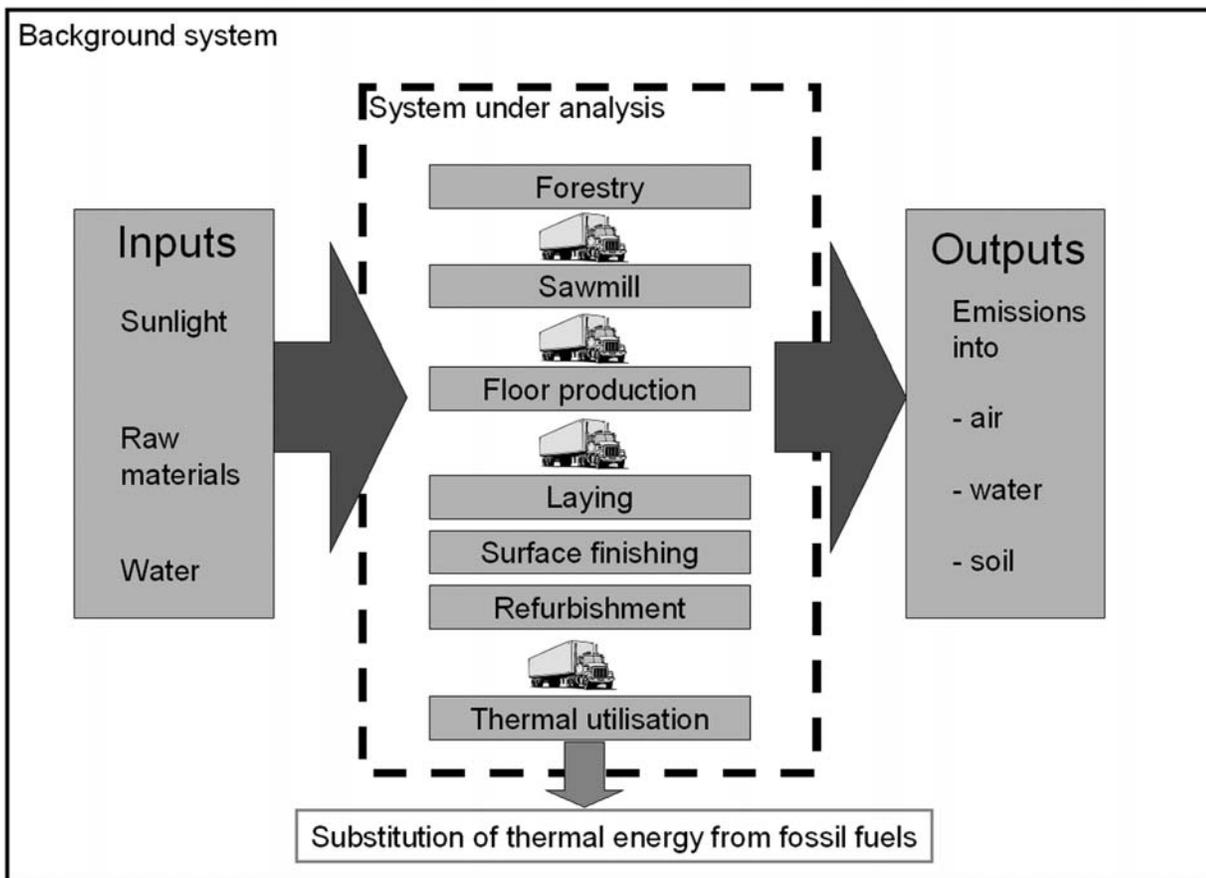


Figure 1—Life cycle of wood floor coverings.

IMPACT ASSESSMENT

In the Impact Assessment, the following categories were looked at: global warming (GWP), acidification (AP), eutrophication (EP), ozone depletion (ODP) and photo-oxidant formation (POCP) (table 1). Furthermore, the use of primary energy is presented. The calculation of the indicator results is based on the characterisation models and category indicators as described in Guinée (2002).

In practice there are several options in the laying and surface finishing unit processes. Therefore, the impact assessment looks at a basic scenario with a solvent-based glue and water-based finish, which are most common in practice. Due to the lack of data for the provision of an oil and wax finish, solid floor boards are assessed without any finish, which is a possible scenario in practice.

In a further step, the results were normalised against data for the whole economy in Germany (IKP 2000). The results show that the photo-oxidant formation potential has the most significant results in comparison to the other impact categories. The results of the sensitivity analysis proved a

potential for improvement in this category. The use of water-borne glue instead of a solvent-borne product reduces the POCP by around 70%.

INTERPRETATION AND CONCLUSIONS

Regarding the impact on climate change, there are two interesting issues. On the one hand, wood floor coverings function as a net storage of CO₂ during their useful life. On the other hand, the provision of energy from residual wood and post-consumer wood can substitute fossil fuels. This means that the production and use of wood products counteracts climate change in two ways: substitution of fossil energy and storage of carbon. The low emissions of greenhouse gases during the life cycle can even lead to a negative contribution to the Global Warming Potential if more emissions are avoided through the substitution process than there are emitted during the life cycle of the product.

The storage of carbon over a period of time is not yet incorporated in LCA methodology. Nebel and Cowell (2003) are currently developing an approach for this methodology.

Table 1—Results of impact assessment

	Solid parquet 8 mm	Solid parquet 22 mm	Multilayer parquet	Solid floor boards*
GWP [kg CO ₂ -equivalent]	7.1	4.4	12.7	0.2
AP [kg S ₀₂ -equivalent]	0.103	0.106	0.223	0.064
EP [kg P ₀₄ ³ - equivalent]	0.0148	0.01 49	0.0339	0.0098
POCP [kg C ₂ H ₄ - equivalent]	0.2821	0.2103	0.4904	0.0808
ODP [kg R11-equivalent]	0.0000041	0.0000039	0.0000062	0.0000022
Primary energy [MJ]	534	529	917	213

*Source: Nebel 2003

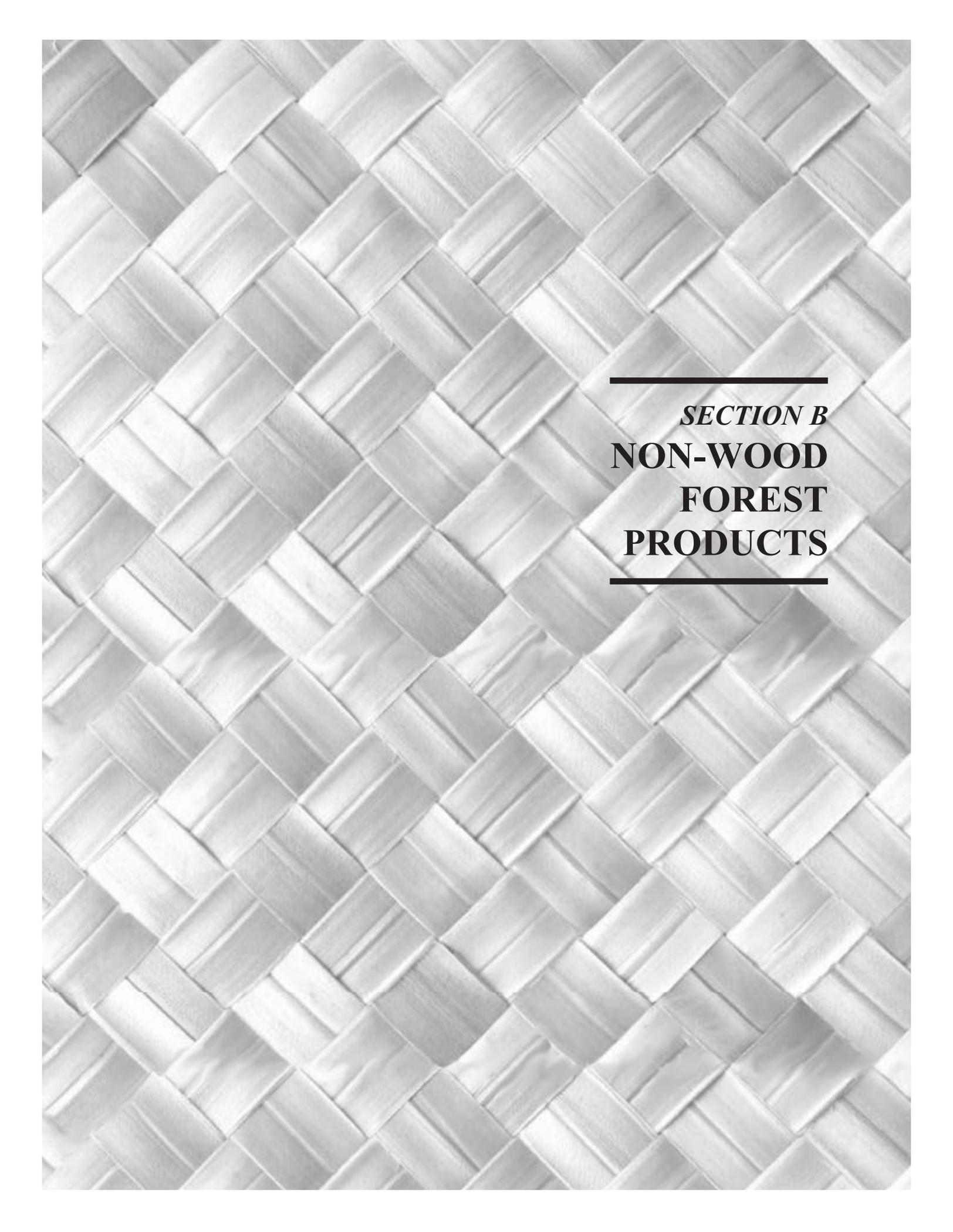
The most important opportunities for improvement are located in the laying, surface finishing, and refurbishment unit processes. The POCP result can be reduced significantly depending on the choice of glue and varnish at each of these stages.

A detailed paper of the full case study will be published in the International Journal of Life Cycle Assessment.

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SECTION B
**NON-WOOD
FOREST
PRODUCTS**

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CONSERVATION AND MANAGEMENT OF HIMALAYAN MEDICINAL PLANTS IN NEPAL

Nirmal K. Bhattarai¹ and Madhav B. Karki²

ABSTRACT

The Himalayas range from Afghanistan to Myanmar with rapidly depleting medicinal plant resources. Nepal, occupying the central portion of the Himalayan range represents 6,076 taxa of flowering plants under 1,534 genera and 216 families. About 5% of the vascular flora is endemic to the country while 30% to the Himalayan range. About 1,600 species have recorded uses in traditional medicine covering 80% of the rural population. About 100 species of wild plants, including medicinal plants endemic to the country and the Himalaya, are harvested for commercial purposes. Medicinal plant based industries are infantile in the country. Over 90% of the commercial collection in Nepal is exported to India, and is the major source and steady basis for the Indian pharmaceutical and aroma industries. The trade in medicinal and aromatic plants is an important source of revenue to the government and a major source of cash income to the rural people of Nepal's impoverished highland villages.

Nepal has a rich medicinal plant resource base, but increasing commercial demands are exceeding supplies. Due to rapidly increasing population and declining crop productivity, rural needs for off-farm employment opportunities are increasing. This results in increased harvesting of forest resources, which is accelerated by the gradually flourishing medicinal plant-based domestic industries. As the result, Nepal is facing challenges to sustain its medicinal plant resource base and safeguard its rich biodiversity.

Recently, attempts to systematically study and evaluate the threat status of wild medicinal plants in the country have been done through national and international efforts. Based on field studies, potential and viable recommendations to develop and manage the country's rich medicinal plant diversity have been provided to the government and donor communities. It is hoped that more concerted efforts will be launched to conserve and sustain medicinal plant resources of the country and the region.

KEY WORDS: Medicinal plants, conservation, management, Himalaya, Nepal.

THE HIMALAYAN REGION

The Himalayan range, popularly known as the Hindu-Kush Himalaya, is one of the world's richest ecosystems in terms of biodiversity. This is due to extreme altitudinal variations with concurrent changes in temperature and precipitation, and differences in soil conditions, which have combined to create a striking vertical zonation in the natural vegetation. The range covers a length of about 3500 km stretching from Afghanistan in the west to Myanmar in the east, and provides a home and protection to more than

12,500 species of higher plants (Dobremez 1996). The region is also the home to more than 125 million people who depend on its immense natural resources for their livelihood.

The Himalayan region is characterized by the limited amount of land available for cultivation, which is typically characterized by tiny holdings distributed over rugged terrain with minimal irrigation facilities. Subsistence agriculture supplemented by livestock and forest products continues to be the main occupation.

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NEPAL

Nepal occupies the central portion of the Himalayan range that separates the arid Tibetan highland in the north and the fertile Gangetic plains to the south, and has diverse topography, the elevation ranging from 60 m to 8848 m. The flora of the surrounding territories, the east Himalaya, west Himalaya, trans-Himalaya and the Indo-Gangetic plains represents the country.

Having widest altitudinal range in the world within short distances, Nepal harbors about 35 major forest types, 75 vegetation types and 118 ecosystems. Press et al. (2000) enumerated 6,076 taxa of flowering plants from the country belonging to 1,534 genera and 216 families including 5% endemic to the country and 30% to the Himalayan range. Despite immense deforestation and other forms of habitat destruction in the past, 39.6 % of the land is still under forest including forest land (29%) and shrub land (10.6%) (FDRS 1999).

MEDICINAL PLANTS OF NEPAL

Despite limited ethnobotanical researches, about 1,600 species of higher plants, representing about 20% of the vascular flora, have been recorded for use in traditional medicine including Ayurveda, Homeopathy, and Unani. Considering the shortage of ethnobotanical studies in many parts of the country and among many tribes and ethnic groups, the number of medicinal plant species is expected to increase considerably in the near future.

MEDICINAL PLANTS IN HEALTH CARE AND ECONOMY

The indigenous mode of herbal treatment is a part of the country's culture. About 80% of the rural population are said to rely, marginally or wholly, on herbal remedies. These remedies are easily available bearing a minimum cost and, in most cases, is the only available means exhibiting considerable effectiveness (Bhattarai 1989, 1990).

Nepal is a leading supplier of a number of medicinal and aromatic herbs to the Indian and other international markets (Bhattarai 1997). Every year 10–15 thousand tons of plant products of more than one hundred species, valued at about 10 million U.S. dollars, are collected in the wild from forest and other vegetation types, most of which is exported. However, some 20 high-demand and high-value products constitute about 80% of the volume and value in trade (Bhattarai and Olsen 2000).

Most of the herbs are exported in their raw forms, while a few receive primary processing. Over 90% of the collections are exported to India in their raw states with which trade links have prevailed since time immemorial. Generally, most of the medicinal and aromatic herbs exported to India are re-exported to other countries either raw or processed, in addition to being used in the Indian pharmaceutical and aroma industries (Bhattarai 1997).

The trade in medicinal plants is an important source of revenue to the government and a major source of cash income to rural people. Their collection, transportation and sale have been generating steady sources of off-farm employment opportunities in remote areas where the majority of the people are poor. Olsen (1998) estimates that 470,000 households in the country are involved in commercial medicinal plant collection, while Edwards (1996) mentions this sector provides up to 50% of a family's income in certain areas of the country. The forestry sector contributes about 4% to the national economy while revenue earned from the nontimber forest products (NTFPs) account for 5% of the total earned from the forestry sector (Edwards 1996).

THREATS TO MEDICINAL PLANT DIVERSITY

Almost all the medicinal plants and their parts used and traded are collected from the wild. In the Nepalese context the use of forest products for local medicinal purposes alone does not suggest accountable threat to their conservation, although Browder (1992) has provided evidence that even indigenous people far from markets can deplete forest goods. Loss of medicinal plant diversity is occurring at all levels. Ecosystems and communities are being degraded and destroyed and species are being driven towards extinction. The major human impacts include a significant lowering of the upper timberline, conversion of forests to arable land, commercial timber cutting, and the construction of roads, irrigation canals, high-tension electric cables, etc. These processes have been largely confined to the last century and reached their peak very recently (Bhattarai 1995).

CONSERVATION AND MANAGEMENT EFFORTS

The conservation of biodiversity and development of herbal medicine have received increased priority very recently. As one of the signatories of the Convention on International Trade in Endangered Species (CITES) in 1973 and the Rio Declaration in 1992, Nepal is committed

Table 1—Protected areas in Nepal

Protected area	Estimated	Area
		(sq km)
1. Royal Chitwan National Park	1973	932
2. Koshi Tappu Wildlife Reserve	1976	175
3. Langtang National Park	1976	1710
4. Royal Shukla Phanta National Park	1976	155
5. Sagarmatha National Park	1976	1148
6. Rara National Park	1977	106
7. Parsa Wildlife Reserve	1984	499
8. Shey-Phoksundo National Park	1984	3555
9. Shivapuri Wildlife Reserve	1985	144
10. Khaptad National Park	1986	225
11. Dhorpatan Hunting Reserve	1987	1325
12. Royal Bardiya National Park	1988	968
13. Makalu-Barun National Park	1991	2330
14. Annapurna Conservation Area	1992	7629
15. Kanchanganga Conservation Area	1998	2035
16. Manaslu Conservation Area	1999	1663

Total area of the country: 147 181 sq km.

Total protected area: 24 599 sq km (16.71%)

to the protection of the environment through strategies and measures as presented in a national action plan. Nepal's National Park and Wildlife Conservation Act-1973 has paved ways to establish protected areas in the country. The last 30 years of nature conservation efforts has resulted in the establishment of a network of 16 protected areas covering 16.71% of the country's land (table 1). Out of 118 ecosystems identified in different physiographic zones in Nepal, 80 are represented in the present protected area system with a varying degree of coverage (BPP 1996). Efforts to extend protected areas to accelerate biodiversity conservation efforts are being considered.

Six species of trees, viz. *Michelia champaca* (Champ), *Acacia catechu* (Khayar), *Shorea robusta* (Sal), *Pterocarpus marsupium* (Bijayasal), *Dalbergia latifolia* (Satisal) and *Bombax ceiba* (Simal) have been protected. Some medicinal plants and their parts have been banned for export in their raw states, although there is no restriction on their collection and transportation within the country, viz. *Cordyceps sinensis* (Yarsagumba), *Nardostachys grandiflora* (Jatamasi), *Rauvolfia serpentina* (Sarpagandha), *Valeriana jatamansii* (Sugandhawal), *Cinnamomum glaucescens* (Sugandhakokila), *Abies spectabilis* (Talispatra), *Taxus wallichiana* (Launth salla), and species of lichen (Jhyau). The collection and trade of tubers of *Dactylorhiza hatagirea* (Panchaunle), the

roots of *Neopicrorhiza scrophulariifolia* (Kutki) and root-bark of *Juglans regia* (Okhar) have been banned.

INITIATION OF THREAT ASSESSMENT

The Conservation Assessment and Management Planning (CAMP) exercise has been recently recognized as a suitable mechanism to direct available information to assess possibly threatened taxa and to initiate adequate conservation measures. Medicinal and Aromatic Plants Program in Asia (MAPPA)-a joint program of International Development Research Centre (IDRC), Canada and the Ford Foundation in collaboration with the Ministry of Forest and Soil Conservation, HMG/Nepal and Species Survival Commission, and the International Union for Conservation of Nature (IUCN) organized the CAMP workshop in Pokhara, Nepal in January, 2001, preceded by a pre-CAMP exercise held at Dhulikhel, Nepal in December, 2000 (Tandon et al. 2001). The CAMP workshop, first of its kind in Nepal, 48 persons participated, including 18 scientists from 10 other countries (Bangladesh, Bhutan, Canada, Denmark, France, India, Pakistan, Sri Lanka, United Kingdom, and United States) and 30 Nepalese including botanists, foresters, university teachers, researchers, traders and collectors. The workshop assessed the threat status of 51 wild medicinal and aromatic plant species of Nepal and suggested different levels of

Table 2—Details on plant species assessed at Pokhara CAMP (2001) (continued on next page)

Plant species/family	Threat status ^a	Habit ^b	Distribution ^c
<i>Michelia champaca</i> (Magnoliaceae)	CR	T	Broad
<i>Pterocarpus marsupium</i> (Papilionaceae)	CR	T	Broad
<i>Rauvolfia serpentina</i> (Apocynaceae)	CR	S	Broad
<i>Aconitum balangrense</i> (Ranunculaceae)	EN	H	Nepal
<i>Alstonia neriifolia</i> (Apocynaceae)	EN	T	EH
<i>Corydalis megacalyx</i> (Papaveraceae)	EN	H	Nepal
<i>Crateva unilocularis</i> (Capparidaceae)	EN	T	Broad
<i>Dactylorhiza hatagirea</i> (Orchidaceae)	EN	H	HKH
<i>Dioscorea deltoidea</i> (Dioscoreaceae)	EN	C	Broad
<i>Ephedra intermedia</i> (Ephedraceae)	EN	H	WH
<i>Gloriosa superba</i> (Liliaceae)	EN	H	Broad
<i>Heracleum lallii</i> (Umbelliferae)	EN	H	Nepal
<i>Operculina turpethum</i> (Convolvulaceae)	EN	C	Broad
<i>Oroxylum indicum</i> (Bignoniaceae)	EN	T	Broad
<i>Otochilus porrectus</i> (Orchidaceae)	EN	EH	HKH
<i>Swertia angustifolia</i> (Gentianaceae)	EN	H	HKH
<i>Taxus wallichiana</i> (Taxaceae)	EN	T	Broad
<i>Aconitum heterophyllum</i> (Ranunculaceae)	VU	H	HKH
<i>Aconitum spicatum</i> (Ranunculaceae)	VU	H	HKH
<i>Allium hypsistum</i> (Amaryllidaceae)	VU	H	Nepal
<i>Alstonia scholaris</i> (Apocynaceae)	VU	T	Broad
<i>Arnebia benthamii</i> (Boraginaceae)	VU	H	WH
<i>Asparagus racemosus</i> (Liliaceae)	VU	S	Broad
<i>Butea monosperma</i> (Papilionaceae)	VU	T	Broad
<i>Curculigo orchioides</i> (Hypoxidaceae)	VU	H	Broad
<i>Delphinium himalayai</i> (Ranunculaceae)	VU	H	Nepal
<i>Ephemerantha macraei</i> (Orchidaceae)	VU	EH	EH
<i>Fritillaria cirrhosa</i> (Liliaceae)	VU	H	EH
<i>Nardostachys grandiflora</i> (Valerianaceae)	VU	H	HKH
<i>Panax pseudo-ginseng</i> (Araliaceae)	VU	H	EH
<i>Paris polyphylla</i> (Liliaceae)	VU	H	HKH
<i>Neopicrorhiza scrophulariifolia</i> (Scrophulariaceae)	VU	H	HKH
<i>Piper longum</i> (Piperaceae)	VU	TH	Broad
<i>Podophyllum hexandrum</i> (Berberidaceae)	VU	H	HKH
<i>Rheum australe</i> (Polygonaceae)	VU	H	HKH
<i>Rheum nobile</i> (Polygonaceae)	VU	H	EH
<i>Rubia manjith</i> (Rubiaceae)	VU	C	HKH
<i>Swertia chirayita</i> (Gentianaceae)	VU	H	EH
<i>Tinospora sinensis</i> (Memispermaceae)	VU	C	Broad
<i>Valeriana jatamansii</i> (Valerianaceae)	VU	H	HKH
<i>Jurinea dolomiaea</i> (Asteraceae)	NT	H	HKH
<i>Meconopsis dhwojii</i> (Papaveraceae)	NT	H	Nepal
<i>Rheum moorcroftianum</i> (Polygonaceae)	NT	H	WH
<i>Arisaema costatum</i> (Araceae)	LC	H	HKH
<i>Aconitum bisma</i> (Ranunculaceae)	DD	H	EH
<i>Aconitum ferox</i> (Ranunculaceae)	DD	H	EH
<i>Lilium nepalense</i> (Liliaceae)	DD	H	HKH

Table 2 (continued)—Details on plant species assessed at Pokhara CAMP (2001)

Plant species/family	Threat status ^a	Habit ^b	Distribution ^c
<i>Maharanga bicolor</i> (Boraginaceae)	DD	H	EH
<i>Maharanga emodi</i> (Boraginaceae)	DD	H	HKH
<i>Pongamia pinnata</i> (Papilionaceae)	DD	T	Broad
<i>Swertia multicaulis</i> (Gentianaceae)	DD	H	EH

^a Threat categories abbreviations: EN (endangered); VU (vulnerable); NT (near threatened); LC (least concern); DD (data deficient).

^b Habit abbreviations: T (tree); S (shrub); C (climber); TH (trailing herb); EH (epiphytic herb); H (herb).

^c Distribution abbreviations: EH (Eastern Himalaya); WH (Western Himalaya); HKH (Hindu Kush Himalaya)

conservation and management needs for each (table 2). The participants got familiarized with the application of recent IUCN Red Listing criteria and the CAMP processes. The workshop also succeeded in developing human resources and organizational capabilities for the future CAMP efforts.

TASKS AHEAD

The forestry development program in Nepal is passing through the tenth plan and medicinal plant resource is possibly one of the most important components of the forestry sector. Despite this, the forestry sector has failed to demonstrate the need for conservation, development and management of these resources. Conservation of natural resources is necessary for future generations, and this need has been so often repeated that the phrase almost loses currency. It is high time to prioritize in situ conservation and ex situ management of prioritized medicinal plants without overlooking their value-addition potentials within the country.

The protected area systems in Nepal have contributed greatly to the in situ conservation of biodiversity including medicinal plant diversity, and the future significance of it must be recognized. Although 16.71% of the country's land including most suitable habitats for different species of medicinal plants has been brought under protection, the pressure upon other forests and pastures has increased beyond their carrying capacities. Yonzon (1993) suggests that a significant proportion of the commercial medicinal plants is collected from protected areas.

In spite of efforts underway, there remain many challenges for the conservation and sustainable management of the wild medicinal plant resources in the country. Medicinal plants have long been regarded as something to be indefinitely exploited. Despite lack of numerical data, there is ample evidence that the majority of wild plant species, due to various human-induced factors are facing different levels

of threat to extinction. It is therefore essential to assess the threat status and identify the conservation needs of the country's flora, particularly for medicinal plant resources. In this regard the Pokhara CAMP exercise may provide a good model for future initiatives. The challenges may be tough but further delay may have irreversible results.

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COMMUNITY-BASED SUSTAINABLE MANAGEMENT OF TENDU LEAVES (*DIOSPYROS MELANOXYLON* ROXB.): A CASE STUDY OF HARDA DISTRICT OF MADHYA PRADESH, INDIA

Arvind Boaz¹ and Olga Boaz²

ABSTRACT

Tendu leaves, as *Diospyros melanoxylon* Roxb., are locally known in the Central Indian State of Madhya Pradesh, have assumed tremendous importance over the last four decades. The leaves are important because they are used for hand-rolling of Beedis, a local cigarette. It is not only an extremely important non-timber forest product that serves as a big revenue earner for the state government but is also an important economic resource to the indigenous tribes and local population during the summer months when they have no other form of employment. Tendu leaves are collected during the months of April to June, primarily from pruned shrubby growth since the pruned leaves are higher in quality. The leaves are then sun dried for a week and stored in gunny bags. The trade has tremendous socio-economic value to the local population and is a source of income to them in the economically tight summer months. Due to extreme exploitation of the collectors, who are mostly local indigenous people, the state government had established state control over its collection and trade as early as in 1964. Cooperatives were formed later in 1989, with the establishment of a three tier cooperative structure. The state and the central governments have continuously sought to empower the local populations, and several steps have been taken to establish ownership rights of the collectors over non-timber forest products. This has culminated in the 73rd constitutional amendment in 1996 that has given the ownership right over non-timber forest products to the gram sabhas (local groups or entities). There is an established network of selling agents composed of wholesalers and retailers. Some big companies also export some beedis (local cigarettes) to neighboring countries like Pakistan, Sri Lanka, Bangladesh, and Nepal and to distant countries such as the United States, France, African and West Asian countries. The quality and sustainable harvesting of the leaves has received a boost due to the new Joint Forest Management Strategy initiated by the state government.

KEY WORDS: Tendu leaves, cooperative, community management.

INTRODUCTION

Tendu leaves is the local name for the leaves of the tree *Diospyros melanoxylon*, a deciduous middle storey tree. Leaves are collected from the forests of Central India, especially Madhya Pradesh, which is its largest producer. The divided Madhya Pradesh produces nearly 35% of the total production of the country whereas the undivided M.P. produced 50% of the leaves prior to November 2000. The scope of the study is to make a more systematic understanding of the true role and potential of non-timber forest products (NTFP) to achieve development and conservation objectives and how government initiatives can empower

the local people to sustainably manage the forest resources. The locality chosen for the raw material production area is the Harda district in western Madhya Pradesh-a province situated in Central India. The study area is situated in between latitudes 21° 53' to 22° 36' N and longitudes 76° 47' to 77° 20' E. It is thought that the commercialization of beedi rolling started from Jabalpur in Central India early in the 20th century. A simple definition of beedi would be that it is a mixture of blended tobacco, wrapped in beedi leaves, cut to size, tied with a thread, roasted in an oven to remove moisture and to give that inimitable flavor that gives satisfaction and enjoyment to the smoker.

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Nearly one lakh (100,000) standard bags of tendu leaves (Each standard bag contains 1000 bundles of 50 leaves each = 50,000 leaves) are collected in India of which Madhya Pradesh produces nearly 27–30 lakh bags annually. The whole collection is managed by a large three tier cooperative structure that was established in 1989. The grass root level leaf collectors are the primary members of the cooperative. Thus, the whole collection is managed by the community. The study area produces 32,000 bags annually. After collection the bags are stored in godowns (brick walled sheds) from where they are sold by the Madhya Pradesh Minor Forest Produce Federation, the Apex state level organization, to traders and manufacturers.

Geographical Settings

The study area lies in the Harda District of Madhya Pradesh. It is located between 21° 53' to 22° 36' North latitude and 76° 47' to 77° 20' East longitude. It is bound on the north by the districts of Dewas and Sehore, in the east by Hoshangabad district, in the south by Betul and East Nimar (Khandwa) districts and in the west by East Nimar and Dewas districts. The total area of the district is 2644.32 square kilometers (km²) with a total forest area of 1059.65 km² (40.07 % of the total area). In this district, the majority of the villages are located within the collection area and therefore, in this study, the total forest area is taken as the raw material production area, i.e. 1059.65 km².

The study area can be divided into the following regions:

- Narmada Plains
- Satpura Hill series
- Budhimai Plateau

The geological strata of the area are as follows:

- Deccan Traps
- Gondwanas
- Metamorphics

The soils of this area are:

- Black cotton soil
- Lateritic soil
- Alluvial soil

As per the FAO soil maps of the world, the soil type is VERTISOLS. These are soils which after the upper 20cms are mixed, have 30% or more clay in all horizons, to at least 50 cms from the surface. At some periods in most years have cracks at least 1 cm wide to a depth of 50 cms unless irrigated and have one or more of the following characteristics-gilgai microrelief, intersecting slickensides or wedge shaped or parallelepiped structural aggregates at some depth between 25 and 100 cms from surface.

The state of water availability is satisfactory, in general, but frequent fires and excess illicit grazing adversely affect young regeneration. The configuration of the study area is mostly undulating with small hills dotting the entire area.

The area in the Narmada River Basin is partially flat with small hills dotting the northern end. The elevational range of the raw material production area (as per Jain 1999) is 250–595 meters above sea level (m a.s.l). The average elevation of the Narmada Plains (found mostly in the Handia Range) is 305 meters (m). A majority of this area will undergo submergence due to the Narmada Sagar Dam that is under construction near Punasa. The Satpura Hill series is undulating. It is comprised of several small hills and spurs protruding in different directions. Mirchibari (730 m), the highest hilltop, is located in this area.

The major land uses in the raw material production area are listed below by category and absolute area in square kilometres:

Major Land Use	Area
• Rainfed crop production	1576.88 km ²
• Irrigated crop production	1272.38 km ²
• Permanent crops	1698.27 km ²
• Pasture (includes savannahs/woodlands which are used for grazing)	215.44 km ²
• Swidden fallow	40.36 km ²
• Forest	1059.65 km ²
• Settled area	Negligible
• Marshy/swamp	Negligible

In the study area, the average annual temperature is 26 °C or 78°F. The average highest daily temperature varies from 26.3°C in January to 41.9°C in May. The annual average rainfall is 1209.8 mm or 47.63 inches. The rainy season is from mid-June to mid-September, when 92.16% rainfall (1115mm) is received. The winter rains (November to February) are meager. The summer months of March to June are dry (Shukla 1984).

Forest Types

The district was carved out of the former Hoshangabad district, vide Madhya Pradesh (M.P.) Govt. Revenue Department Notification No.1240-F-20.8.92 seven-Govt-8, dated July 2, 1998, from the Timarni, Khirkiya and Harda development blocks. The district is comprised of 6 territorial forest ranges, 30 range assistant circles and 122 beats (the smallest unit for management control-a demarcated

forest area under the charge of a beat guard). The forest area is comprised of both reserved and protected forests.

The total forest area is listed below by category and area (acres (ac) or hectares (ha)):

Reserved forest— 242,948 ac or 98 317.652 ha.
Protected forest— 109,415.66 ac or 44 218.446 ha.
Total 352,363.65 ac or 142 536.098 ha.
(including 7,988 ac or 3 232.631 ha. (PF) of
Raj Bahari State forest)

The forest types cover is 38.5% of the entire geographical area.

The bulk of the study area contains teak forests in which intensity of occurrence of teak (*Tectonic grandis*) is more than 50%. As per the classification of Champion and Seth the forest types of the area are:

1. Type 3B/C1-c South Indian Deciduous slightly moist teak forests
2. Type 5A/C1-b Southern Tropical dry deciduous Dry Teak forests
3. Type 5A/C3 Southern Tropical dry deciduous mixed forests

The total population as per the 1991 (latest) census was 3,800,762 or 76,152 households with a decadal growth rate of 26.88%. The female: male ratio was 915:1000. There are 3 towns, 497 villages, 161 village panchayats (local bodies) and 117 patwari halkas (the smallest unit of the revenue bureaucratic governance.) The study area has a schedule caste population of 64104 i.e., 16.84%, schedule tribe (indigenous people) population of 92,064 i.e., 24.18%. The literacy is 38.81% (total literate population is 1,470,768). Most of the villages in the study area are electrified (425 out of 497) and villages with insufficient water during the year are 459. The cattle population of the area is 2,100,753. The area is well connected by roads, with 387 kms of metalled and 1179 kms of wbm (water bound macadam) roads. The Bombay Howrah main B.G. rail line passes through the division.

METHODS

The data were collected from primary as well as secondary sources.

Primary Data Sources

The primary source consisted of the heads/educated members of the tribal households, and the officers and employees of the forests department. The collection of data from the tribal members was done through an interview schedule and observations during the survey. Another set of interviews were held with forest officials. Sufficient care

was taken to formulate the questions in such a manner as to be clearly understood by the respondents, the members of the primary cooperative societies. Essential factors like language and sequence were considered when formulating the questions. Both open and close ended questions were incorporated in the schedule. The villagers were asked questions and wherever there was any difficulty in eliciting responses from the tribal members or there was any confusion, ambiguity or doubt, the question was suitably modified and the sequence was altered sufficiently to suit the local requirement.

Secondary Data Sources

Besides the above primary data collected directly from the fields through various methods stated above, efforts were made to collect secondary data from following sources:

1. Census of Harda district 1991, 2001
2. Records of the local district level officers
3. Secondary data at the grass root level has also been collected from the Forest Range offices, primary cooperatives and the Joint Forest Management (JFM) societies.
4. The Harda District Gazetteer.
5. District statistical report of Harda district.
6. The working plan of Harda Forest Division.
7. Published data of the forest department of the state of M.P.
8. Published report of the Minor Forest Produce Federation of Madhya Pradesh.
9. Book and articles on the subject given in the Bibliography.

RESULTS AND DISCUSSION

Review of Government Initiatives for Empowerment of the Community

Government policy till 1988—The collection of tendu leaves on a commercial scale started in the early 20th century. Initially, tendu leaves growing on Government lands were sold unplucked to the contractors and those growing on private holdings were disposed off, by the owners of these lands, in any manner they liked. The Government had no control over the plucking and disbursement of fair wages to the collectors and this led to the exploitation of the forest dwellers that plucked the leaves as well as landowners who grew leaves. The theft of leaves from government lands was rampant. Therefore, the state Government enacted the Madhya Pradesh Tendu Patta (Vyapar Viniyaman) Adhiniyam, 1964, (The Tendu Leaves Regulation of Trade Act 1964) and took over the trade of tendu leaves through Nationalization (established state monopoly) (Tewari 1981)



Figure 1—New tendu leaves freshly sprouted from root suckers.

in order to control theft of tendu leaves from forests and other government lands. This was also done to ensure payment of proper wages to tendu leaves pluckers, who mostly belonged to weaker sections of the State.

After the state took over the trade in tendu leaves in 1964, the tendu leaves producing areas of Madhya Pradesh were divided into 1826 units. Units were formed in such a way that a unit produced 2500–3000 standard bags (each bag of 50,000 leaves, i.e. 1000 bundles of 50 leaves each). The government appointed purchasers for each unit. Agents for purchase of leaves at each collection center were also appointed. The agents collected and delivered the leaves to the purchaser at the collection centers. The price paid by the purchaser was based on the number of standard bags of tendu leaves delivered to him. Over the years, it developed into a highly exploitative system in which the middlemen and traders exploited the collectors and kept most of the profits.

This system continued till 1980. To overcome the weaknesses of this system, the practice of lump sum payment for a unit was introduced in 1980. In the same year, the State Government appointed Madhya Pradesh State Cooperative Marketing Federation (MARKFED) as its agent in some units to save the tendu leaf pluckers from being exploited by the private individuals and companies, who normally worked as agents.

In order to give more benefits to forest dwellers in collection and trade of tendu leaves, the Madhya Pradesh State Minor Forest Produce (Trading and Development) Cooperative Federation was formed in 1984 and the work of tendu leaf collection was entrusted to LAMPS (Large Area Multipurpose Societies) and PACS (Primary Area Cooperative Societies). However, during the period 1984 to 1988, the activities of the Federation in regard to tendu



Figure 2—Maturing leaves.

leaf trade were confined to a few districts to the State, and the Cooperative Societies played only a negligible role. (Boaz, O. 1998)

Change Over to Cooperative Structure

The State Government decided to cooperatize the trade, in order to give the forest dwellers (who collected tendu leaves) a sense of involvement in the trade and to ensure more benefits to them from the trade. The essence of this new scheme is that the collection of tendu leaves is done by the Cooperative societies of actual collectors of tendu leaves, so that the tribal members and other backward classes could secure commensurate monetary benefits from the trade. The Primary Cooperative Societies actually labored in the trade. For the implementation of the new scheme, a three tier Cooperative structure was designed. At the primary level, 1947 Primary Forest Produce Cooperative Societies were constituted with the membership of only actual pluckers. The chairman of the societies was chosen from amongst the members only. At the secondary level, 86 District Forest Produce Cooperative Unions have been formed. Madhya Pradesh State Minor Forest Produce Cooperative Federation, which had come into existence earlier in 1984, is at the apex level of the three-tier structure.

The Resource Base and Characteristics of the Raw Material

The new leaves start appearing in the month of March (fig. 1). They are crimson in color. At the time of plucking the leaves turn green (fig. 2). Normally it takes 45–50 days for the leaves to become mature for plucking. The collection in this area starts in the middle of May and continues until the first week of June, about a week before the onset of monsoon. The product is primarily used as a smoking agent to roll beedi, a kind of local cigarette. This is the only use of this product. The leaves are stored after primary processing and drying. The leaves are utilized for Beedi



Figure 3—Fresh flush of tendu leaves in Community Pruned Area.

rolling and are normally used within one year. Old leaves of more than one year lose their aromatic flavor and color and are then used for inferior quality Beedi rolling (Boaz, A. 1998).

The Production Process

There are several steps involved in the production process.

Pruning

The production process starts with pruning. It is an established fact that pruning of the trees and bushes results in better quality leaves that are not only bigger but also more appropriate for Beedi-making. Pruning is carried out from the end of February to the middle of March. Initially, when the collection of the leaves was done by the private sector, they engaged local people through an agent called as the “Munshi” who carried out pruning over extensive areas. After cooperatization, the State government has initiated steps to empower the local pluckers, through its three-tier cooperative structure, to start doing the actual pruning. Initially, the State Government allotted Indian Rupees (INR) 5.00 (about US\$ 0.1) per standard bag. They enhanced it to INR 10.00 (about US\$ 0.2) in 1998 and presently the price is INR 20.00. The work is normally done through the currently well-established Village Forest and Village Forest Protection Committees, who are given a lump-sum amount to carry out the pruning work. Thus, the complete control over pruning activity is now in the hands of the local communities who decide on the area, extent and time period of pruning. Since the amount allotted for pruning is insufficient to prune the entire area where tendu trees and bushes occur, the societies and the JFM committee members do voluntary pruning to get a better crop. Most pruning is done in tracts that have a bushy or young crop of tendu



Figure 4—Indigenous people collecting tendu leaves.

(fig. 3). It is also important to know that fire is also a major factor for improving the quality of the leaves in the forest areas. As forest ground fires move through these forests burning the small shrubby growth of shrubs, this results in a flush of high quality leaves. This practice was adopted to a great extent in the past, but has now been restricted by the community as they have realized that it is extremely harmful for the forest health. There is no cultivation of tendu leaves in this area. (MP Laghu Vanopaj Sangh 1994)

Collection Process

The leaves are mostly plucked from bushes as they are considered better for rolling of beedis. Leaves are also plucked from small trees. According to Gupta and Guleria (1982) the process of plucking of the tendu leaves consists of five closely related steps:

1. Walking to the tendu growing areas
2. Plucking of leaves
3. Walking back to the residence
4. Sorting and tying leaves in small standard sized bundles.
5. Walking to the collection centers and delivery of the bundles to the “Phad Munshi”.

Because the activity is carried out in the hot summer months of April to June, the collectors leave their homes early in the morning. Almost the entire family is involved in this activity. Young children also accompany their parents. The activity is extremely important as it contributes a major share of the income of these forest dwellers in the lean agricultural season. In nearly all the villages within the study area where tendu leaves occur, almost all the families participate in the collection work (fig. 4). In most of the cases the round-trip distance traveled by a tendu-leaf



Figure 5—Back from the jungle after a good leaves collection.



Figure 7—Purchase of leaves at PHAD (Purchase Center) and their spreading out in the open field for sun drying.



Figure 6—The whole family tying tendu leaves in bundles.

collector is about 2-5 kms/day (fig. 5). After the collectors reach their home, the leaves are graded and tied in bundles (fig. 6). All infected, immature, torn and small leaves are rejected. Usually the leaves are tied with a twine made of *Dhak* (*Butea monosperma* Lank Taub). Half of the leaves (25) are bundled on one side and the other half on the other side, in order to avoid greater thickness at one end due to the vein of the leaves and consequent slipping of the leaves. The bundles are then taken in the evening to the phads for selling to the phad munshi.(fig. 7). Each collector family is given a collectors book in which the phad munshi enters the quantity received from the collector each day, and then signs the book verify his/her authorization. The collector is paid weekly on the basis of this record and so cannot be deceived (Boaz 2002).

An estimate of the average time spent on this activity is detailed below:

S.No.	Particulars of work	Time spent in minutes
1	Walking time (round trip)	60
2	Plucking time	240
3	Grading, sorting & tying of bundle	240
4	Delivery of bundles at 'Phad'	120
Total		660 = 11 hrs

Source: Prasad and Bhatnagar (1991)

Nearly 70% of the annual production in the raw material production area is collected from the wild naturally reproducing population. The remaining 30% of the annual production is collected from the managed population in a forest environment. These remaining areas are pruned for better leaf production by the villagers belonging to the forest protection committees, village forest committees and the Primary cooperative societies. Funding for pruning is received from the M.P. Minor Forest Produce Federation (INR 20 per bag in 2002). In some areas, these committees organize pruning from their own funds and on a voluntary basis.

The data for tendu leaf production for the last five years are given below (MP MFP Federation 2000).

1996	26,840 standard bags
1997	23,838 standard bags
1998	32,133 standard bags
1999	33,379 standard bags
2000	36,815 standard bags



Figure 8—Turning bundles upside down after 3 days for uniform drying in sun.



Figure 9—Dried tendu leaves bundles ready for packing in gunny bags.

There has been a decrease in production in 1997 compared to 1996. This fluctuation in production has been partly due to natural causes such as: temperature, unseasonable rains and drought that affect the sprouting of leaves, hail, floods and insect infections.

Leaf Procurement

Since tendu leaves are a nationalized minor forest product, they can only be purchased by the government or its authorized agent. The state government has appointed the M.P. Minor Forest Produce federation as its sole agent. The federation in turn works through the District Unions and the Primary Forest Cooperative Societies. These societies have been established for a group of villages depending upon the quantity of tendu leaves produced in the area. Normally, one primary cooperative society is formed over an area producing 2000–2500 standard bags of tendu leaves. Only genuine collectors can become members of these cooperative societies. These collectors then elect a President and an executive committee from amongst the membership. The local forester is the ex-officio Secretary of the society and acts as a facilitator. The Primary Societies open a



Figure 10—Tendu leaves packed in gunny bags ready for transportation to godowns.

purchase center for procurement of leaves from a group of villages. These centers, known as “PHADS,” are established in specific locations so villagers do not have to walk far (not more than 2-4 kms) to sell their collected product. The Primary Societies appoint a clerk known as *Phad Munshi* at each collection center for procuring leaves, paying wages to the pluckers and maintaining the accounts of the leaves as well as the funds. He also acts as a link between the villagers and the federation to get facilities like group insurance to the collectors. A supervisory government functionary known as the “Phad Abhirakshak” (who is usually a forest guard) is appointed by the federation to control the quality and quantity of the leaf. He also ensures timely and proper payment. The payment is made in the presence of the local panchayat officials to keep a check on frauds and avoid cheating of the mostly illiterate collectors. A nodal officer is appointed for each Primary Society to control and regulate the flow of cash. This nodal officer is usually a forest deputy ranger or forester. Transportation, in the form of a jeep, is made available to the Nodal officers during the season. The Federation also appoints the local Territorial Divisional Forest Officer as the Managing Director of the District Union and his sub-divisional officer as the deputy Divisional Manager to oversee the work and ensure smooth collection and storage of the product. Each Unit has about 20 to 40 purchase centers. At present, there are over 20,000 collection centers in the State.

Primary Processing

After the leaves are purchased by the phad munshis, they are spread out in open fields for air drying. To keep a count of the number of gaddis, the collectors are asked to make “*Chattas*” or groups of 100 bundles in a linear manner for ease of counting and checking by the supervisory staff. The hot scorching sun dries the leaves and they are turned upside down, on the third day, to ensure proper



Figure 11—Tendu leaves packed in gunny bags being transported by bullock carts.



Figure 12—Tendu leaves packed in gunny bags being transported by trucks.

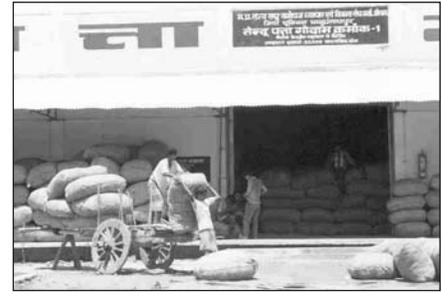


Figure 13—Leaves being taken inside godown.

drying on both sides (fig. 8). In some areas, where there is an attack of termites, some insecticide is spread over the fields prior to spreading out the bundles for drying. After the 6th or 7th day, the leaves are collected together in heaps of 5,000–10,000 bundles (fig. 9). The packing of bundles is now done. Packing is itself an art and packing parties from Gondia, a district in Maharashtra, are usually called. Packing is extremely important as the dry leaves become brittle and are easily damaged in packing. On packing day, the heaps are watered in the evening and covered with jute bags (*Bhhakkus* as they are called locally), and left to soften for 3–4 hours. The leaves get softened during this period due to the moisture and steam generated because of the heat of the dry leaves. The softened leaves are then carefully counted and packed in thin gunny bags of size 90 cms x 125 cms (fig. 10). Each bag can hold around 500 to 800 bundles depending upon the size of the leaves. The bundles are carefully set from the bottom upwards in such a manner that they are laid layer upon layer. This avoids breakage of leaves even at a later stage when the leaves become dry and are subject to manhandling during transportation to distant places. Once the jute bags are filled, the openings are stitched closed and left to dry in the open for about two days. After drying, the bags are transported (fig. 11, 12) to godowns (brick walled sheds), where they are stored (fig. 13, 14) until they are sold.

All the above operations are managed by the cooperative society with the help of the forest department who act as facilitators. Over the years, through a gradual process of empowerment and motivation, the collectors have learned to manage the operations efficiently. It was heartening to note that in spite of the whole operation being so time-consuming and exacting, all operations were carried out with ease and all of the product collected was safely stored inside the godowns before the onset of monsoon.



Figure 14—Tendu leaves gunny bags stored in godown (brick walled permanent sheds).

Socio-Economic Impact on Local population

The empowerment of the local communities has led to the sustainable management of tendu leaves as now the communities feel confident that the effort that they will make in its management is for their own benefit. It has led to the augmentation of rural income as it gives massive employment generation especially in summers—the economically scarce period when no other employment is available. This takes care of both unemployed and under-employed in the Harda district as the total annual money distribution in Harda district is INR 25 million (INR 15 million as wages and INR 10 million as income distribution after sale of the product). The total value of tendu leaves produced in Central India (Madhya Pradesh and Chattisgarh combined) is INR 3,000 million (collection wages INR 1,800 million + income distribution of INR 1,270 million). The major impacts on the socio-economic conditions of the local population in Harda district are summarized below:

1. The tendu leaves trade contributes about 16% of the collector's annual household in Harda.
2. It prevents the need for migration to search of work during summer months.

3. The gradual empowerment of local populations has led to overall improvement of community facilities at the village level by returning INR 3 million/yr of financial resources back to the primary cooperatives in the form of income distributions.
4. There has been a gradual increase in production of tendu leaves due to re-investment of income (INR 2 million annually) being used to improve forests and sustainable community management of the resource. This has resulted in increased income from this resource to the locals.
5. Better returns from tendu leaves has led to increased food security due to increasing agricultural production (increased input of good quality seeds, fertilizers and insecticides) and increased buying power.

Critical Success Factors

1. An effective legal framework for nationalized NTFP trade.
 2. The appointment of the Minor Forest Produce Federation as a sole agent for trading and development of nationalized NTFPs in 1964.
 3. Cooperatization of tendu leaf trade in 1989 with the establishment of a huge three-tier coop structure composed of:
 - 1947 primary forest cooperatives
 - 80 district unions
 - An apex federation
 4. Establishment of ownership rights for the local population over NTFP in line with the provisions of the Panchayat (Extension to the Schedule Areas) Act, 1996 and their endowment based on the following principles:
 - Harvesting of NTFPs on a non-destructive basis.
 - Members of gram sabhas will be free to collect forest products for their own use.
 - The manner, frequency and intensity of collection for any other use to be in accordance with prescriptions of a management plan prepared by Zila Panchayat (District Government) in conformity to guidelines issued from time to time.
 5. Distribution of net profit from trade to the primary cooperatives and collectors
 - 100% net income generated from tendu patta trade to primary cooperatives, who are obligated to redistribute it as follows:
 - 50% to primary collectors,
 - 20% for development of NTFPs and regeneration of forests, and
 - The remaining 30% goes to rural infrastructure development/cash payments.
- Joint Forest Management policy implemented in state for ensuring community participation in sustainable NTFP/forest management.

The Community Response

1. The community organized themselves, through government facilitation, into a well managed cooperative structure. A total of 8 cooperative societies were formed in Harda district and 1947 in the states. Greater than 2.4 million collector's families, mostly tribals, were enrolled as members.
2. The members of the society were free to choose the chairman of the society from amongst themselves. This led to informed decision making at the society level and great confidence building.
3. The low-income pluckers were made owners of NTFP and not just mere wage earners. This motivated them to participate in all aspects like collection, primary processing, godowning and marketing of tendu leaves. This also brought about an awareness of their rights and consequent empowerment.
4. The massive structure of the cooperatives did away with exploitative practices and ensured weekly payment of proper wages to collectors through a watchdog committee of local villagers at each collection center.
5. The community took an active interest in implementation of the biggest social security insurance process in the country.
6. The members took part in participatory decision-making that involved the entire community for establishment of infra-structural projects based on income generated from tendu leaves for the general good. The community thus became proud owners of the assets generated and this led to greater harmony within the community.
7. The community realized that whatever actions that they undertook in the cooperative society were for their own good. This ensured pruning of bigger areas through community participation leading to improvement of quality/ quantity of leaves.
8. The whole process helped convert open access resource to community managed resource and helped establish linkages with the Joint Forest Management committee.
9. The active participation of the community has ensured dovetailing of traditional knowledge about the sustainable harvesting of tendu leaves. This has helped in the government approach of participatory forest management and ensured better returns to the local population.

Conservation Issues

1. Since the product is leaves, it does not have much adverse damage on survival and growth of the plant. Moreover, the harvesting period is limited to only two months in a year, hence the product has a very big potential for sustainable harvesting.
2. Since the best leaves are obtained from pruned shrubs, there is a tendency to maintain it as such by constant pruning, leading to a preponderance of shrubby growth. This has a negative impact on seed production and may lead to the plant becoming susceptible to diseases.
3. Though the tendency of setting fire to the forests to encourage growth of root suckers has been greatly curbed due to active community participation, it is still prevalent in certain areas. The involvement of the JFM network is a welcome step to curb this menace.
4. Since tendu leaves provide a major economic activity in lean summer months, they help in forest conservation. Otherwise, the local population would have engaged in the most readily available economic activity, which is cutting down forests to sell for fuel-wood. This economic activity would then lead to forest destruction.
5. In certain areas, there is need for improvement of plucking techniques as the local populations tend to pluck immature leaves as they seek to pluck more leaves and to ensure that others do not pluck the leaves left by them. Also, the local populations tend to strip the whole branch, because it is easy but this is harmful because all leaves get plucked, even immature ones, and are later discarded.

CONCLUSIONS

Future Implications

1. The success of the cooperatization of tendu leaf harvest has led the state government to make forays into the management of non-nationalised NTFPs. The government needs to provide a greater role as a facilitator as this field as this field has a vast potential to ensure livelihood security to the dependent population.
2. There is also a need for better marketing of tendu leaves as the market has stabilized and there is need to diversify through better product research and extending the horizon of marketing the product.

3. There is also a need for better pruning practices to be put into place so that the whole collection area is subjected to pruning over a periodic cycle, like coupes (standard yearly working areas) working in forestry working plans.

The community-based sustainable management of tendu leaves in Central India is one of the best examples of a successful cooperative model of NTFP sustainable management. Through various government initiatives, the community has been empowered and made owners of the forest products and have been successfully engaged to sustainably collect, process and market a perishable and exacting NTFP, like tendu leaves and ensure proper profit sharing. As a result, this has not only improved their economic status through equitable sharing of profits, but also their village infrastructure and NTFP development, as well as regeneration of forests by re-investment of part of the profits earned from sales of the NTFP resource.

ACKNOWLEDGMENTS

The authors would like to thank all the officers and staff of Harda Forest division, who constantly supplied information and helped us interact with the tribals living in the remotest areas of Harda district and Forest Division. We owe our heartfelt thanks to the tribals inhabiting the remote tracts of Harda forest division, who whole-heartedly spent long hours with us and supplied us with information that gave this paper a new vision. We could get an in-depth look into the dependent status of the local population and the efforts and problems they had to face to bring the community management of tendu leaves in Harda district to its present status.

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THE ECONOMIC ASPECTS OF *AGAVE AMERICANA*: A CASE STUDY OF ITS SUSTAINABLE MANAGEMENT BY A TRIBAL CO-OPERATIVE SOCIETY IN JAGDALPUR DISTRICT OF CHHATTISGARH, INDIA

Olga Boaz¹ and Arvind Boaz²

ABSTRACT

Agave americana is a non-timber forest product that has been planted over extensive areas in Central India. The leaves yield a fiber used for rope making. The present study is about a successful project in Jagdalpur district in Chhattisgarh state of India, aimed at providing sustainable livelihood support to the fringe forest area villagers through establishment of a primary processing center based on the processing of Sisal leaves. Work on this project started in April 1990. A co-operative society was registered vide Registration No. AR/BTR/162 dated April 23, 1990. It had 38 members out of which 70% were tribals. Presently, each beneficiary cuts mature leaves from the plantations, cures and takes out the fiber and makes nearly 5 kgs of fiber each day. They are paid in INR (Indian Rupee) 12 per kg through society funds. The fiber is collected by the society and sold to the end-users. The annual production of Sisal Fiber from this unit is nearly 15–18 tons. The beneficiaries have been trained to make rope and art objects for which there is a growing demand with higher returns. The net income after wage payment and meeting expenses like repairs and electricity is redistributed annually to the beneficiaries as a bonus. The society has been running successfully for the past 12 years and the net monthly income to each member is about INR 1500. The members have started replanting the plantation areas with suckers and bulbils, so that perennial supply of leaves is ensured.

KEY WORDS: Sisal leaves, tribal co-operative society, sustainable livelihood support.

INTRODUCTION

Agave americana is a non-timber forest product that has been planted over extensive areas in Central India. The leaves yield a fiber used for rope making. Initially, the forest department started planting this species as a hedge plant on the periphery of plantations as a protection against grazing. Later, the potential of this species as a producer of strong fiber was realized and a scheme was launched by the Government of India for its large scale propagation. The Forest department had planted Sisal over 171 hectares (ha) in the *Kolchur* area of Jagdalpur district. About 5000 plants were planted per ha. Looking into the success of the plantations, the local foresters thought of establishing a processing unit to convert sisal leaves to fiber that had ready demand. Moreover, there were hardly any sustained means of livelihood for the tribals, who survived only on primitive agriculture and collection of non-timber forest products. A

co-operative society comprising of the local people was registered vide Registration No. AR/BTR/162 dated April 23, 1990. It had 38 members out of which 70% were tribals. Four electric decorticating machines, a shed and water tank were established. The total cost of the project was INR 2.50 lakhs and funds were drawn from the District Rural Development Agency (DRDA). Work on the project started in April 1990. The society has been running successfully since the past twelve years and has provided sustained employment and profit to its members. The society has been running successfully for the past 12 years and the net monthly income to each member now comes to about INR 1500-2000. The members have also started replanting the plantation areas with suckers and bulbils, so that a perennial supply of leaves continues. This project is one of the most successful models of sustainable NTFP management providing sustainable livelihood support to the downtrodden.

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Figure 1—A well established Agave plantation near Kolchur.

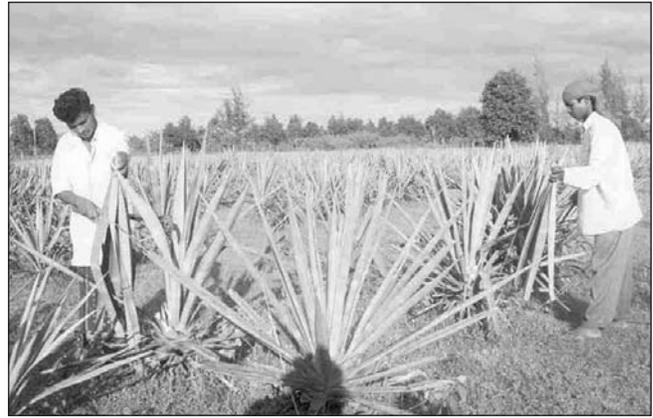


Figure 2—Society members cutting Agave leaves from plantations.

METHODS

The success of the project prompted the authors to study it in detail. Normally, such projects are launched with much fanfare but due to lack of continuity of effort on the part of the departmental staff and lack of capacity building in the beneficiaries, they are gradually abandoned. The method employed by the authors was to gather both primary and secondary data. The secondary data was taken from available official records and the accounts maintained by the committee. Then an interview schedule was designed and the members of the co-operative society were interviewed to get all information regarding their way of working and how they were able to manage all operations right from cutting of leaves to selling the produce. The members of the society praised the forest corporation staff who acted as their guides and facilitators to help them run their show. The foresters were also interviewed to get the details of the help they had extended over the years to make the society members so educated and motivated so as to run the processing unit independently, without any subsidy or financial help from the forest department or the government. The authors also contacted the end-users to enquire about the quality of the material supplied by the society and their level of satisfaction and why they had come back again and again every year to buy the material from this co-operative society.

RESULTS AND DISCUSSION

The Co-Operative Society

The co-operative society was established on the initiative of the local forest officers in 1990. The underprivileged people of the villages adjoining the sisal plantations (fig. 1) were chosen. The criteria of selection were that all members would be chosen from tribals and those living below the poverty line and should not be land owners or with means of sustained income. The co-operative society

was registered under the Madhya Pradesh Co-operative Societies Act vide Registration No. AR/BTR/162 dated April 23, 1990. It had 38 members initially who belonged to the Muriya, Mahara, and the Dhakad communities of Bharni, Kolchur, Takragud and Joldaguda villages. The by-laws of the society provided that the President and the Secretary of the society would be elected from amongst the members and a facilitator or advisor would be the local forest guard/forester.

The Process Adopted

It was indeed good that right from its inception, the co-operative society was managed independently and did not run on the crutches of the forest department. Initially the District Rural Development Agency (DRDA) provided funds for the project in the amount of INR 2.50 lakhs. Two electric decorticating machines, a shed, and water tank were established. A working capital of INR 1.00 lakh was also provided for the project. Work on the project started in April 1990.

The society members decided amongst themselves that the work will be carried out on job basis and only the members will be able to use the machines for decortication of the fiber. The decorticated finished fiber will be bought at a fixed rate to be decided by the committee. The society will bear the cost of electricity and any repairs to the machines and will then sell the produce to the buyers.

The actual processing method adopted by the members was that each beneficiary went to the plantations in the morning to cut mature leaves (fig. 2). He tied them into bundles (fig. 3) and transported them (fig. 4) to the processing unit site at Kolchur. Here he decorticated the leaves in the electric decortication machine (fig. 5), when his turn came. Afterwards, he cured the leaves in the water for about four hours and then cleaned the fiber by beating to free it



Figure 3—Society members tying cut leaves in bundles.



Figure 4—Society members transporting cut leaves bundles to the Kolchur processing centre.

of any powder that clung to it during decortication. The cleaned fiber was then hung up for drying (fig. 6). The final product was then weighed and tied in bundles of 50 kgs. The beneficiary was paid on the basis of the quantity in kgs of the fiber he produced.

Financial Implications

The rates paid to the beneficiaries for making one kilogram of finished Agave fiber and its selling rate per kilogram obtained by the society in different years are provided in table 1.

Table 1—Purchase rate and selling price of Sisal fiber

Year	Purchase rate paid to beneficiaries	Selling price of fiber
	-----INR/kg-----	
1990-1993	8.00	15.00
1994-1997	10.00	16.00
1998-2000	11.00	18.00
2001-2003	12.00	20.00

The average fiber production from 100 kgs of green leaf after decortication is around 4 to 4 1/2 kgs. On an average each active beneficiary produces around 125 kgs of fiber



Figure 5—Society members decortivating Agave leaves on motorized decortivating machines at Kolchur Centre, Jagdalpur.



Figure 6—Drying Agave fiber after decortication in the sun.

per month and gets around INR 1500/ per month as wages. The processing unit is closed during the three monsoon months of July, August and September when annual repairs to the machinery is done and the society members get employment elsewhere in farmers fields, plantation activity etc. Thus, on an average the beneficiaries get employment in this processing unit for a period of nine months and earn a wage of nearly 13,500 annually.

It was noticed that not all members of the society were equally active in the working of the committee. Every year the number of active members varied and was around 9 in the initial years but has now swelled to 16 in response to the gradual stabilization of the working of the society and its growing income (table 2).

Table 2—Progress of Sisal fiber production at Kolchur

Year	Quantity of fiber produced	Wages paid	No. of beneficiaries
	<i>kgs</i>	<i>In INR</i>	
		<i>12 per kg</i>	
2000-2001	9,569.50	1,14,834	9
2001-2002	15,276.50	1,83,314	14
2002-2003	17,797.50	2,13,570	16



Figure 7—Making rope from Agave fiber.



Figure 9—Making handcraft from Agave fiber.



Figure 8—Agave fiber and rope ready for sale.

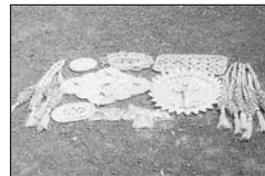


Figure 10—Various handcraft articles made from Agave fiber.

Table 3—Financial Report of the Kolchur co-operative society

Year	Unsold fiber of last year	Produced during year	Total	Sold during year	Net profit	Balance unsold fiber in stock
	<i>kgs</i>	<i>kgs</i>	<i>kgs</i>	<i>kgs</i>	<i>INR</i>	<i>kgs</i>
2000-2001	5 393.50	10 386.00	15 779.50	9 683	28936	6 096.50
2001-2002	6 096.50	15 403.50	21 499.50	12 182	75236	9 317.50
2002-2003	9 317.50	17 797.50	27 115.00	17 587	140341.50	9 528.00
Total		43 587.00		39 452	244513.5	9 528.00 =INR 190560

The society has been efficiently managed by the members themselves with the forest department playing a facilitatory role. They have been successful in regularly marketing their produce (fig. 7) and also limit their expenses. This has resulted in a regular profit to the society each year. The society regularly pays all its electric and machine repair bills and has earned the rare distinction of being a co-operative society that has got its accounts regularly audited and submitted to the co-operative department. The seed capital of INR 1 lakh that was given to it has now swelled to nearly INR 4 lakhs and the society is managing to buy all the fiber produced from its own funds (table 3).

The society has also made forays into value addition to the fiber produced in the last three years. It has started to make rope (fig. 8) from the fiber that has its demand in the Electricity Board where it is used by the linesmen. The rope is sold at INR 30/ per Kg whereas the fiber is sold currently at only INR 20/- per Kg. The making charges of rope are only INR 4 per Kg and there is wastage of 10% during processing. This leads to a net value addition of INR 4/ per Kg. Another innovation that is being tried is the manufacture of handcraft items (fig. 9, 10, 11) from the fiber that has very good demand. This has a very high value addition potential.

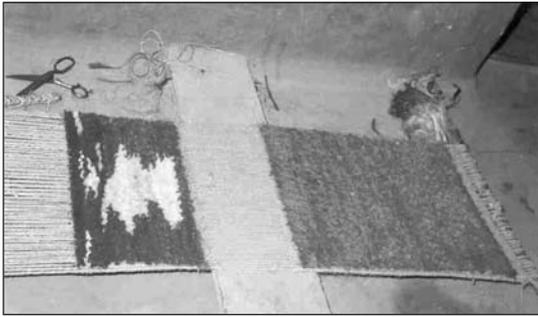


Figure 11—Sisal rug made from Agave fiber.

CONCLUSIONS

The co-operative society established at Kolchur is an ideal example of a beneficiary-managed small enterprise that has managed to not only survive but grow and make the members stand on their own feet, and ensure sustainable employment to its members based on the sustainable management of the non-timber forest product *Agave americana*. This has been made possible by the constant facilitatory approach of the forest corporation that has resulted in development of skills in the local communities and has developed confidence amongst them to not only manage a small processing unit but also bring in further value addition to the primary product for their own economic development.

ACKNOWLEDGMENTS

The authors would like to thank the ex-President, Shri Laxman S/o Mosu and the present President of the committee, Shri Jalander S/o Bhorka of Bharni village, who painstakingly gave details of the development of this co-operative society and the efforts they had to make to get the society to its present status. We are also indebted to Shri Anoop Kumar Bagchi, the local Forester and present facilitator of the committee, who took over the society in 1997 and has been responsible for the facilitation and motivation of the local beneficiaries and has supplied us with most of the data. We are also thankful to all other members of the society who supplied us with valuable information.

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GUM TAPPING IN *STERCULIA URENS* ROXB. (*STERCULIACEAE*) USING ETHEPHON

M.N.B. Nair¹

ABSTRACT

A dry exudate from *Sterculia urens*, known as gum karaya, is one of the least soluble gums used for many industries such as petroleum and gas, textiles, paper and pulp, pharmaceuticals, medicine and several other products. The commercial tapping of karaya is done by blazing, peeling, or by making deep cuts at the base of the bole using an axe or a sickle. These methods often lead to the death of the tapped trees. On account of crude tapping methods and over exploitation, the population of karaya trees has markedly declined. In the absence of cultivation of these trees in regular plantation, there is a grave concern about the loss of wild germplasm of *S. urens*. As gum karaya is vital for tribal economy and its trade value is substantial, there is a pressing need to develop a scientific and sustainable tapping method to increase the yield and ensure the survival of the tapped trees. A simple and safe technique of tapping with substantial increase in the yield is developed using ethephon to enhance gum yield and wound healing. After 45 days a thick wound tissue has developed at the injured region and nearly replaced the damaged tissue. The wound is completely healed 60 days after tapping. The yield has increased about 20 to 30 times over the control and about 10 times more than the traditional tapping methods used by the local people. There was a marked difference in the yield among individual trees, presumably due to heterozygosity. The systematic and scientific tapping technique using ethephon as a stimulating agent for gummosis or gumresinosis could ensure substantial improvement and sustainable production of these materials. The concentration used for treatment is critical for each species. If it exceeds the optimum amount there will be possibility of die back and death of the plants.

KEY WORDS: Gum Karaya, tapping, Ethephon, *Sterculia urens*.

INTRODUCTION

Gum Karaya is the dry exudate of *Sterculia urens* and *S. villosa*. It is collected from *S. urceolata* and *S. foetida* in Indonesia, *S. setigera* in Africa and from *S. caudata* in Australia (Gautami and Bhat 1992). It is also known by the name Indian tragacanth, as it resembles gum tragacanth produced by *Astragalus* sp. Gum karaya is one of the least soluble gums used for many industries such as petroleum and gas, textile, paper and pulp, leather and allied products, ammunition and explosives, electrical appliances, adhesives, confectionery, medicine, pharmaceuticals and cosmetics (Gautami and Bhat 1992). There is high demand of export of gum karaya from India (1746 Mtn 2002, source TRIFED). Overall yield has decreased from 6838 metric tons (MT) in 1975–1976 to 461.3 MT in 1990–1991. During this period the price increased from Rs. 7491 per MT to Rs. 83, 361

(Gautami and Bhat 1992). Production increased to 6701 MT in 2002 (source GCC).

Sterculia is native of dry deciduous forests of dry rocky hills and table lands of tropical climate. This genus has about 100 species and India has 8 species present in tropical Himalayas, West and Central India, Deccan Plateau and throughout Eastern and Western Ghats (Gautami and Bhat 1992). Commercial tapping of gum Karaya is done by blazing, peeling or by making deep cuts in the base of the tree trunk with an axe or sickles. These methods are wasteful and injurious to the trees, often leading to their death. On account of crude tapping method and overexploitation, the population of karaya trees has markedly declined. In absence of cultivation of this tree in regular plantations, there is grave concern about the loss of wild germplasm of *S. urens*. The Government of Madhya Pradesh, Rajasthan and Uttar Pradesh have banned tapping and collection of gum

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Table 1—Gum yield when treated with distilled water, 190 mg, 285 mg and 390 mg active substance

No	Yield in control treated with distilled water gr	190 mg. active substance in 1 ml gr	285 mg. active substance in 1 ml gr	390 mg. active substance in 1 ml gr
1	0	157	86	35
2	0	84	90	111
3	2	25	40	172
4	2	31	254	37
5	3	20	140	52
Total	7	316	610	406
Average	1.4	63.2/tree	122/tree	81.2/tree

karaya to allow recovery and regeneration of this tree. As gum karaya is vital for the tribal economy and its trade value is substantial, there is a pressing need to develop a scientific and sustainable tapping method to increase the yield and to ensure the survival of the tapped trees. Here I present a simple and safe method for tapping that result in substantial increase in the yield.

MATERIAL AND METHODS

A preliminary observation showed that ethephon enhances gum formation and wound healing in *Sterculia urens* (Nair et.al. 1995). I selected 15 trees in the village of Ghati near Gwalior Highway No. 3 for experiments to find out the optimum concentration of ethephon to induce maximum production of gum with minimum injury to the tapped trees. Using a specially devised knife, holes each of 5 millimeters (mm) diameter and 2–3.5 cm depth (based on the thickness of the bark) were made on the tree trunk 20 to 30 centimeters (cm) distance at 1 meter (m) above the ground. The holes were angled towards the base of the tree to prevent the backflow of the introduced solutions. One hole in each tree is maintained as the distilled water control and the rest were treated with ethephon (2-chloroethyl phosphonic acid). One milliliter (ml) of ethephon containing 190/285/390 milligrams (mg) of active substance (one ml of distilled water for controls) was dispensed into each hole. Five trees were used for each concentration. The first collection of gum produced in the control and treated holes were made after 15 days. The succeeding 3 collections were done after every 10 days and the data were pooled (table 1).

It was noticed that the trees treated with 285 mg of active substance of ethephon have yielded highest amount of gum and therefore this concentration was used for further experiments. The tapping experiments were repeated at

Ghati in Madhya Pradesh and Cheedipalem in Andhra Pradesh. Fifteen trees of various sizes and ages were selected for the study in both the sites. The trees were tapped in March, May and November 1995 in Ghati using 285 mg of active substance to understand the seasonal variation in the yield. The tapping of trees at Cheedipalem were done in February and May in 1996. The karaya trees are tapped by the tribal people with the help of Girijan Cooperative Corporation in Andhra Pradesh (GCC). The yields from the traditional tapping method and the method using ethephon were compared. The tribal people remove 50 to 55 cm length of bark across the trunk with a sickle and collect the gum as tears or as irregular fragments. The tapped trees often fail to regenerate after some years. The trees were tapped throughout the year except in the rainy season.

RESULTS AND DISCUSSION

The gum produced in the control and treated holes were shown in the table 1. The ethephon treatment resulted in the increase of about 40 to 85 times more than the control. The harvest from the ethephon treated trees was of high quality gum. Histological examination of the unwounded trees showed an absence of any special tissue, which produces gum in *Sterculia*. Tangential bands of gum cavities were present in the bark of the treated bark. The elongated cavities are parallel to the longitudinal axis of the stem and anastomose tangentially Multiseriate rays are observed amidst the anastomosing cavity system. The gum cavity is formed lysigenously.

The gum started oozing out of the holes within 3 to 4 hours and gets hardened when comes in contact with air. The gum can be hand picked as large lumps. The control holes were completely dry after 30 days. In many cases the

Table 2—Tapping experiments conducted in March, May and November 1995 at Ghatti (Madhya Pradesh) showing the yield of gum karaya when treated with ethephon (285 mg of active substance)

Number	Girth of the tree	Number of holes	Total yield (control)	Total yield (March)	Total yield (May 1995)	Total yield (November)
	cm					
1	90	3	0	287	410	45
2	140	5	0	240	408	37
3	190	6	0	426	820	43
4	360	12	0	902	1340	180
5	130	5	9	358	550	28
6	150	5	2	490	670	52
7	270	9	5	683	1180	213
8	230	8	0	649	974	88
9	120	6	2	367	723	50
10	130	6	0	121	503	74
11	130	6	0	334	648	63
12	260	9	4	716	1036	81
13	205	7	6	653	947	90
14	190	6	3	306	828	33
15	215	7	5	568	841	56
Total		100	36	7108	11 878	1133
Average	187.33	6.7	3/tree	473.87/tree	791.87/tree	75.63/tree

control holes produced negligible amount of gum. It was found that the damaged tissues of the ethephon treated holes were nearly replaced with wound tissue after 45 days. The injury was completely healed after 2 months.

The result of the tapping done at Ghati Madhya Pradesh, in March, May and November 1995 is shown in table 2. The highest amount of gum is produced in May and least amounts in November. The tapping experiments conducted in Cheedipalem also shows copious gum production in the summer months (table 3). The yield of gum when tapped using ethephon is about 10 times more than the yield when tapped using traditional method. The injury made by the traditional tapping is very large (50 to 55 cm long).

International trade of gum karaya is exclusively indigenous to India and is vital for the tribal economy. It has now become one of the important sources of income for the state from the forest as a non-wood forest product (NWFP) because the commercial extraction of wood from the forest has become limited. Owing to the lack of scientific tapping technique and post harvest processing it has become difficult to utilize this product optimally. In the present study, the gum production was increased substantially as a result

of using ethephon. It also ensures minimum injury to the trees so that the tree is regenerated easily, thus guaranteeing sustainable production of this gum.

In *S. urens*, lysigenous formed gum ducts are present in the pith and cortex of the young stem (Shah and Setia 1976) but they are absent in the secondary phloem. The gum cavities are induced upon ethephon treatment. According to Abeles (1973) ethylene may cause formation of gum cavities of pocket or cyst in plants. Ethephon is used to stimulate latex flow in para rubber (*Hevea brasiliensis*), resin enhancement in pines (Peters et al. 1978), gum production in *Acacia senegal* (Bhatt and Mohan-Ram 1990), *Anogeissus latifolia* (Bhatt 1987), *Azadirachta indica* (Nair et al. 1980, 1985). It also increases gumresinosis in *Mangifera indica* (Bhatt and Shah 1985) and *Commiphora wightii* (Bhatt et al. 1989). Ethephon is a nontoxic, environment-friendly, inexpensive and easily available plant growth regulator (PGR) manufactured in India and used extensively in agriculture and horticulture.

The gum exudation in karaya tree is highest in April-May, the exudation is about 10 times more than the production in November. Therefore it is suggested that the gum karaya tapping for commercial purpose be done only during

Table 3—Tapping experiments conducted in February-March and April-May 1996 at Cheedipalem (Andhra Pradesh) showing the yield of gum karaya when treated with Ethephone (285 mg of active substance)

Number	Girth of the tree	Number of holes	Total yield (Feb.-March)	Total yield controls	Total yield (April-May)
	<i>cm</i>		----- <i>gr</i> -----		
1	127	5	390	4.0	670
2	163	6	183	0.0	415
3	110	4	344	5.0	620
4	125	5	396	4.0	681
5	320	11	910	5.5	1362
6	203	7	671	4.0	1164
7	88	3	282	0.0	485
8	92	3	208	0.0	358
9	230	8	553	4.0	1005
10	141	6	489	0.0	841
11	129	5	510	3.0	877
12	238	8	760	5.0	1307
13	146	6	493	3.5	848
14	136	5	461	3.0	792
15	107	4	426	2.0	623
Total		86	7076	43.00	12 048
Average	157	5.7/tree	472/tree	2.86/tree	803/tree

March to May and the trees may be given rest in the remaining part of the year. This will ensure the regeneration of the tapped trees, sustainable supply of this gum and good economic return. This technique is simple, needs no specialized skills and can be taught to unskilled tribals living in the forest fringes.

CONCLUSION

The future of natural gum and resin industry is uncertain and therefore, a thorough economic study of the national and international trade is necessary. Synthetic products are preferred by the industry because of the uncertain supply and cost of natural gums and resins. However, unstable oil prices, decreased production and high costs of the synthetic material create a promising future for natural gums and resins. In spite of the competition from synthetic products, natural gum and resins are preferred in certain industries as they are superior.

The tapping methods used are brutal and injurious to the plants, often leading to their death. The technology available is old and the innovations are essential for sustainable

yield and quality control. A concerted effort by researchers and agencies such as research institutions, Universities and non-governmental agencies is urgently needed to improve all aspects of the industry such as tapping, collection, processing, grading, classification and marketing. Research and development are completely lacking in the area of utilization of natural gums and resins. The industry completely depends on traditional and certain ad hoc investigations by individuals. Research into genetic improvement and selection of species for production of gums and resins should be initiated which may lead to establishment of plantations of these species. Gum and resin industry can provide employment and a steady additional income to rural people and thereby stop their migration into the towns and cities.

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THE ENDANGERED BARK

Bikash Rath¹

ABSTRACT

Indian-made agarbattis, also known as incense sticks, have been one of the major products of Indian identity throughout the world. This appeared to be a flourishing industry until a few years ago when it was discovered that the supply of raw materials was decreasing rapidly. The agarbattis are manufactured using non-timber forest products like Sal resin, Guggul (gum resin of *Commiphora mukul*), bamboo sticks, and several other products.

Among the raw materials, the supply of the binding material has concerned agarbatti manufacturers mostly because the criteria for selecting this binding material, the glutinous bark of *Persea macrantha*, are rarely encountered for any other single item. Hence, this bark (called jigat in powder form) was the most preferred binder. However, overexploitation caused the rapid depletion of this resource and thus, other alternatives were sought. The bark of *Litsea glutinosa* and *Litsea monopetala* emerged as the most preferred substitutes. The final result was the extensive debarking of these *Litsea* species.

Although not recognised by IUCN, all these three species are now facing grave danger of extinction in many parts of India (e.g., Orissa). Much work needs to be done at various levels to ensure the conservation of these valuable species. A step in this direction is the development of a bio-polymer, which is supposed to successfully replace the product from the glutinous bark of the above species.

Scientific data on some of these species needs to be revised and updated. For example, Pojo (clearly identified as *L. monopetala*, but also suggested as *Litsea glutinosa*) is found as three different types according to the primary collectors whereas reference books do not identify all these varieties. A local scholar indicates that Pojo may belong to an altogether different genus i.e., *Phoebe* (Lauraceae). Also, the current status of *Persea macrantha*, declared 'rare' in Orissa 75 years ago, has yet to be updated.

KEY WORDS: agarbatti, *Persea macrantha*, *Litsea glutinosa*.

INTRODUCTION

A number of plant species have been threatened by non-scientific exploitation of their bark. The present article is concerned with some of these species belonging to the Lauraceae family, viz. *Persea macrantha* (Syn. *Machilus macrantha*), *Litsea glutinosa* (Syn. *Litsea sebifera*, *Litsea chinensis*), and *Litsea monopetala* (Syn. *Litsea polyantha*).

These three are evergreen trees sometimes reaching a height of 20 meters (m) or more. Their utility has evolved during the last four to five decades from a useful source of

medicinal ingredient to one of the most important sources of income-generating non-timber forest products (NTFPs) for both the primary and wholesale suppliers. This metamorphosis is a result of the rapid growth of the agarbatti (incense sticks) industry which consumes almost the whole production of the bark of these three species. This industry is valued around Rupees 1000 crores with an annual growth rate of 10–15% and provides employment to around 1.5 million people, mostly to women who are engaged in the delicate job of agarbatti rolling.

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MATERIALS AND METHODS

This paper has been prepared on the basis of inferences gathered by field visits, secondary references, and personal communication with scientists and the concerned stakeholders.

RESULTS AND DISCUSSIONS

Ecology of the Concerned Species

All these three species are shade-bearers and are often found occurring near streams or in moist locations. In Orissa, these (specifically the *Litsea* spp.) are found both in Sal and miscellaneous forests². Their distribution is sporadic for the most part³, although the growth of purported root suckers⁴ may contribute to the population density significantly in certain localities.

The Significance of Jigat in Agarbatti Making

Jigat is a vernacular word meaning “sticky” that is used in the Karnataka state of India. Karnataka’s capital city Bangalore has been the center of agarbatti industry for many decades. The bark of *Persea macrantha* and *Litsea glutinosa/monopetala* is more or less strongly mucilaginous in nature and while fresh, tends to arrest the palm when pressed by the hand. In dry condition, the sticky nature apparently disappears; but when some water is added to the bark powder, the binding power re-manifests itself. This is why the powder is known as “jigat” in the industry.

An agarbatti is ideally meant for religious purposes and is supposed to be purely an herbal product. There are four basic components of agarbatti: aromatic ingredients (like Sal⁵ resin, etc.), ignition support (charcoal powder), holding support (bamboo stick), and binding material (jigat).

The best and most suitable binding material is that which has the following properties:

- Does not act as a fire-retardant.
- Does not act as a highly inflammable material.
- Does not affect/damage the aroma or natural fragrance of the ingredients.
- Strongly binds the mixture of charcoal & aromatic ingredients (hereinafter called the CA mixture) to the bamboo stick.
- Is cost effective.

The bark of *Persea macrantha* fulfills all these parameters. A substitute to that, but of comparatively lower grade, is the bark of *Litsea glutinosa/monopetala*.

However, the use of some other substitutes (like the Indian Gum Arabic produced from trees like *Acacia nilotica*) is also in vogue particularly in cases where quality control is not mandated. As such, use of even boiled rice as an adhesive has been reported from the producers of very inferior grade agarbattis.

Synthetic Substitutes: Uncertain Future

Not long ago, the National Research Development Corporation of Government of India claimed that it possessed the know-how of producing an agro-based biopolymer (developed by the Forest Research Institute), which could very well act as a substitute of jigat. “Laboratory trials indicate that the new binder is better than jigat. Samples were sent to leading agarbatti manufacturers for their assessment trials and overwhelming reports are pouring in that it is very much suitable for agarbatti making,” said the NRDC web page (NRDC 2003).

However, confusion regarding the validity of this claim prevails with a statement issued by the user-side that “The Forest Research Institute, Dehradun is trying to identify alternate binding materials, but these are not as effective in binding as jigat”(Aroma-India 2003).

An agarbatti manufacturer of Orissa told this author that he once tried a paste-like adhesive (not known if it was the same one developed by the Forest Research Institute) which performed well, but he discontinued its use simply because it raised the production cost by 15%. This man was capable of ensuring his requirement of natural binding materials from local and outside sources without much difficulty and hence, could afford rejecting a good substitute on the grounds of a slight increase in the cost of production. However, people like him may be forced to accept such substitutes when the situation of short supply in jigat turns extremely critical.

Varieties of Jigat Traded in India

More than three varieties of jigat bark are distinguished in trade in India and these are often named after their

² Misc. forests are usually distinguished from pure patches of Sal forests or Teak forests due to the abundance of a number of other species.

³ The sporadic occurrence of both these species of *Litsea* in Orissa was reported even during the early decades of 20th century when commercial extraction of their bark was yet to begin.

⁴ When shown a photograph of what appeared to be the root suckers of Pojo, noted taxonomist of Orissa Dr. Bhawani Chowdhury suggested that it could be something else (coppice shoots) and not necessarily root suckers.

⁵ *Shorea robusta*.

place/state of production (for example, the Chhindwara variety). This distinction is basically qualitative and more or less indicates the binding capacity. The less quantity required the better. For example, 1 (kilogram) kg of good quality material is supposed to have a capacity of binding 6 kg of CA mixture on average; whereas the low grade material has the capacity of binding only 3 kg of the same.

The common trade name of this bark is *Maida lakri* or *Meda chhali*⁶. In Orissa, this is known as *Medha-* or *Mashani chhali*.

Demand, Production and Utilization of Jigat

Large varieties of joss sticks⁷ are manufactured in India and it is said that almost every manufacturer has his own formulation. With a change in formulation, the quantity of jigat to be used may also vary. However, on an average, it constitutes roughly 17% of the agarbatti unless the latter is of a very special type.

The bark may take 5 to 6 days for sun-drying in summer, which reduces its weight by 50 to 60%. The time taken for drying depends on the thickness of the bark, weather conditions, and amount of exposure to the sun. Usually, the primary collectors bring the bark to the agents of the wholesaler either without drying or in semi-dried condition. Probably the best drying procedure adopted by the primary collectors is in the Shimilipal Bio-sphere Reserve of Orissa (India) where they reportedly spread the large strips of bark on large granitic outcrops and while the upper surface of the strips is exposed to direct sunlight, the lower surface is dried up by the heat produced from the hot, rocky surface. This facilitates proper drying in a shorter period of time.

In Orissa, the average production of this bark between 1992–93 and 1997–98 was approximately 6908 quintals (as per official reports) when the government allowed leases of the same to the private parties. However, the production figures, which are primarily furnished by the lessee, are often underreported so as to evade royalty and hence, the actual production is supposed to be 30 to 50% higher.

Official data further show that there was a declining trend in the output of jigat bark in Orissa during the periods 1995-96 to 1997-98 with the average production of first four years being reduced from 9337 quintals to 2050 quintals in the next two years. However, reliable sources⁸ confirm that even after the ban was imposed, the annual

production was still around 5000 quintals through illegal means.

The dried bark is pulverized to yield the jigat powder. Saw-dust is reportedly added by a number of suppliers as an adulterant so as to keep the price of the powder almost same as that of the bark.

Given the fact that the average annual production of agarbatti in Orissa is around 200 tons, the annual demand of the glutinous bark in the state seems to be more than 35 tons which suggests that most of the state's production of these barks is supplied to other states. In fact, agarbatti-manufacturers of Orissa often purchase this raw material not directly from the primary collectors or the lease-holders but from the big traders of Bangalore (Karnataka) or Kolkata (West Bengal) and others who receive the supplies from the lease-holders in various states. Hence, the primary collectors usually have no link with the end users. Various factors seem to be responsible for this. For instance, the quality and quantity is assured on the part of the big traders on the outside whereas the primary collector is not able to do that (i.e., ensure required quantity and quality as per demand) because of a number of limitations of his own.

Socio-Economic Factors Facilitating the Indiscriminate Exploitation

To understand the situation regarding the jigat-producing species, an appraisal of the socio-economic conditions of the primary collectors is necessary because these people have been instrumental in causing the rapid decline of these species.

Popular NTFP of Non-Domestic Consumption

In Orissa, the popular NTFPs important in the livelihood of the poor people are the Kendu (*Diospyros melanoxylon*) leaves, Mahua (*Madhuca indica*) flower/seeds, Char (*Buchanania lanzan*) seeds, Neem (*Azadirachta indica*) seeds, and Tamarind (*Tamarindus indica*). Among these, some (like Kendu leaves) are not consumed at the domestic level. The bark of Joisondha (*Litsea glutinosa*) and Pojo are among the most popular NTFPs of non-domestic consumption because of the following reasons:

1. The window of seasonality for bark collection is comparatively greater than that of any other NTFP.
2. Bark collection needs comparatively little labour in primary processing.

⁶ *Chhali* means bark.

⁷ It may be mentioned here that incense- or joss sticks are basically used in spiritual centers or places of worship as a symbol of surrender (to the deity, for example) or to purify the atmosphere.

⁸ Traders and former lease-holders like Sawarmal Gadodia.

3. The bark is not a perishable item and if dried properly, can be stored for long periods of time without any special arrangements. And storage does not reduce the value/quality of the bark unlike most NTFPs.
4. Where there were dense populations of such trees, the primary collectors had the potential to earn Rupee (Rs.) 100 (approximately US \$2) per day per person, whereas the fixed (by the Government of Orissa) minimum daily wage is Rs. 50. The potential to earn this much is hardly available in the case of other NTFPs.

This is why the ban on the extraction of this bark has not been so successful in stopping the illegal exploitation.

Therapeutic Applications

Consumption of jigat for medicinal purpose at domestic level is occasional, rare and negligible. The bark-paste of *Litsea glutinosa* and/or *L. monopetala* is applied on bruises, contusions and fractured limbs and is also consumed in diarrhoea. On the other hand, bark of *Persea macrantha* is used in asthma and rheumatism.

There was a time the bark of *Litsea glutinosa* was recognized as 'one of the best known and most popular of native drugs' (Kirtikar and Basu 1981), but such popularity is hardly noticed now. Although the rural and tribal people still utilize the medicinal properties of these barks, popularity of and access to modern health care system has reduced such utilization to its minimum.

Not only the bark, but also other parts of these species have been useful in various treatments. In fact, the 'Litseas' were more popular for their medicinal contributions than for their timber. Thus, these medicinal properties were documented in detail in the old texts of Ayurveda and Unani medicine. Recently, scientific research has established the anti-bacterial properties of the bark of *L. glutinosa*.

Incompatible Trends of Growth in the Prices of Jigat Bark

An assessment made by this author based on information received from both the primary collectors as well as

the traders suggest that the increase in the wholesale price of glutinous bark was not compatible with the procurement price (which meant exploitation of or underpayment to the primary collectors) for some years. Thus, while the average wholesale price (per kg) increased from Rs. 5 in 1989 to Rs. 15 in 1995–96, the state-wide corresponding increase in the procurement price (on average) was from Rs. 2 in 1989 to Rs.4.50 in 1995–96. Again, the procurement price was not uniform throughout the state. Traders took advantage of primary collectors in areas where collectors were not aware of the commercial value of this bark and offered as little as 10 to 25% of the standard market prices to the primary collectors. If the bark still retained its popularity as a major source (NTFP) of income for the primary collectors, then this was simply because of their miserable financial condition and lack of better options. In fact, many collectors often brought the material to traders in un-dried or semi-dried condition because, the collectors being extremely poor, they wanted to cash in their collection immediately even though this meant the product lost value. This helped the procurer exploit them further because he (procurer) took this opportunity for bargaining for a much lower price⁹.

System and the Agency of Exploitation of Medha Bark

In the past, the Forest Department leased out the glutinous Medha bark to private parties who had local agents in different places. These agents had direct contact with the primary collectors who disposed of their collection to the agents. The primary collectors often worked in groups. A group of two or more persons handled a single mature tree. The collective work ranged from cutting down the tree to debarking it from top to bottom. The entire job usually took one day for completion. A full-grown tree may have yielded up to 2 quintals of raw bark.

Sometimes even the thicker roots are not spared and the root bark is also taken. Such indiscriminate and unscientific-based exploitation has caused the virtual extinction of the species in many areas.

Current Status of Jigat Producing Trees in Orissa/India

The status of *Persea macrantha* was highlighted through the concern expressed by the agarbatti manufacturers of India who face acute problems of acquiring this bark. Reproduced below is the extract from a report published in a leading English daily *The Times of India* (July 19, 2000):

⁹ Both government and non-government organisations have facilitated collectivization of trade by the primary collectors in nontimber forest produce so as to ensure a better price for their produce besides other benefits. This attempt has been successful in the trade of few NTFPs like Hill brooms (*Thysanolaena maxima*). However, it remains only as a dream so far the glutinous bark is concerned. A provision in the lease agreement paper signed in 1999 clearly states that the primary collectors of Medha bark would have to form 'societies' of their own and that, the lessee would procure the bark only from such societies (and not directly from the forests through his own staff); but this was not to be followed in practice since the lessee would never be comfortable with such a provision. Thus, the primary collectors are still an unorganized lot the advantage of which is taken by the middlemen/traders.

“Though Indian incense sticks are all the rage abroad, according to the Federation of Indian Export Organisations (FIEO), “there is an urgent need to encourage the cultivation of the *Persea Macarantha*¹⁰ tree whose bark yields jigat, a binding agent used in the manufacture of agarbatti.”

Incense stick manufacturers are facing a serious problem of raw material shortage. While the supply of jigat is turning increasingly problematic, producers admit that a search for a synthetic substitute is inevitable. Even if large-scale planting of the Macarantha tree is undertaken, they explain, it would be years before the yield comes in.”

This demonstrates the acute problem of jigat bark scarcity. And no doubt, this is primarily due to unavailability of sufficient number of mature trees of the species. Of course, “unavailability” is a relative term as with the number of trees constant, stupendous increase in the demand may conclude that the necessary supply/resource is unavailable or scarcely available. But reports suggest that the demand for jigat was never followed by a proportionate rise in the number of mature *Persea macrantha* trees. Rather, the existing population was so badly affected that state governments had to impose restrictions on the bark collection.

The case of *Litsea glutinosa* and *L. monopetala* in Orissa was similar to the above case. Primary collectors of Shimilipal Bio-sphere Reserve claim that approximately 75% of the population of *Pojo* (evidently, *Kala Pojo*) has been lost due to the indiscriminate exploitation of the species¹¹.

Persea macrantha was declared “rare” in the province of Bihar and Orissa more than 75 years ago. At that time, the tree was not located in most parts of the present day Orissa and was sighted only in one location there. Subsequently, the species was spotted at another location (Rustuguda valley of Kashipur, presently in the Rayagada district) in 1930s. But after that sighting there was no more departmental information on the status of this species in the state. It was only when this author talked to one of the retired officials of the Forest Department that the latest data became available. Some 20 years back, the forest officer Mr. B.K. Kanungo (now retired) discovered this plant (*P. macrantha*) in the forests of Harisankar area, western Orissa.

This observation was made by accident¹² and not during a planned survey for *Persea macrantha*. This was Mr. B.K. Kanungo’s first and (to date) last direct acquaintance with the species in the state and, as an expert on the forest botany of Orissa, he also believes that the tree is very rare in this location. However, there is no present evidence as to whether or not the species still survives despite the rapid degradation in forest density.

Unrecognized Threat Status

Persea macrantha was not considered a threatened species in India even when the species became vulnerable. The report compiled by the Botanical Survey of India on the basis of the proceedings of a seminar on the threatened plants of India held at Dehradun in 1981 did not suggest its vulnerability. And the web page of the World Conservation Monitoring Centre/IUCN also failed to notice its vulnerable status simply because it did not refer to up-to-date literature in many cases. However, recent studies revealed the status of this species in some of the southern states of India, where it was once plentifully available compared to its current status as:

State	Threat status
Tamilnadu	Critically endangered
Karnataka	Endangered
Kerala	Vulnerable

(Source: Medplan Conservatory Society 1999)

Rapid depletion of resources like *Persea macrantha* and *Litsea glutinosa* facilitated research by government institutions to develop a suitable, synthetic substitute that would reduce exploitive pressure on these trees, but it is ironic that their threat status has yet to be properly determined and officially recognized.

Lacuna in Departmental Approach and Policy

Preparation of an updated appraisal of the threatened flora and fauna at regular intervals has not been possible for the Forest Department in Orissa mostly due to want of resources (finance and manpower) as a result of which the Department has not been in a position to suggest adequate policy changes pertaining to the individual species of concern. While lease agreements mention that the DFOs would assess the status and ensure the sustainability of trees producing jigat bark, no such appraisal report is

¹⁰ Macrantha

¹¹ As a result, they have now to move to far distant places in search of these trees since the local resources have been already finished up. For them, a day’s labour for *Pojo* bark collection means working for 12 hours or more because a lot of time is spent in traveling (by foot).

¹² Personal communication. September 10, 2002.

known to be incorporated into the Working Plans¹³. Instead, the Working Plans usually tend to ignore these trees as NTFP species.

In the new NTFP policy adopted since March 2000, commercial exploitation of all tree bark by private parties has been banned. However, the DFOs¹⁴ are empowered to exploit this banned bark on behalf of government agencies, if they can ensure a sustainable production, which means that scope for its exploitation still exists despite its critical population status.

Recent Findings

There is no confusion regarding the botanical identity of Joisondha (*Litsea glutinosa*), but as far its counterpart Pojo is concerned, there seems to be a need for some fresh research regarding the botanical re-identification of this species. Although one species—*Litsea monopetala*—has long been identified as Pojo, the primary collectors belonging to the Hill Khadia community (primitive tribals who have experts knowledge of local flora and fauna) of Shimilipal Biosphere Reserve (Orissa, India) have distinguished, as discovered by this author, at least three different varieties of Pojo based on bark quality, as follows:

Local name	Popular name	Grade of bark	Other characters
Reshunia (female)	Kala Pojo	I	Originally cream – coloured inside, the bark turns black soon after its exposure & hence the name.
Reshunia (male)	Lal Pojo	II	Bark more or less of fleshy red colour. Doesn't turn black on exposure to the extent shown by the Kala Pojo.

Athla	Balia Pojo	III	Resembles the Gr. II variety, but causes itching sensation in the body. The bark-paste feels like having sand grains in it & hence the name (<i>Balia</i> means sandy).
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Among these three varieties, the bark of the first type (Kala Pojo) is the most preferred as it is supposed to be qualitatively better than the other varieties, whereas that of Lal Pojo is accepted only as a poor grade substitute to the former when the first type is not available or scarcely available. However, the third type is generally not accepted as it is supposed to be useless due to its 'sandy' feeling. All three of these varieties are claimed to be glutinous in nature¹⁵.

Needless to say, the excessive exploitation that continued in the name of Pojo bark collecting has mostly affected the first variety—the Kala Pojo. Populations of the so-called Lal Pojo have been comparatively less affected, and populations of Balia Pojo are almost out of danger.

So while declaring Kala Pojo an endangered species, we face the difficulty of ascertaining its botanical identity. No reference book on the flora of Orissa tells us exactly which species is Kala Pojo and which one is the Lal Pojo. To follow Kirtikar and Basu (1981), only *Litsea monopetala* can be inferred as Kala Pojo since the blaze of this plant is said to darken on exposure unlike that of *Litsea glutinosa* which assumes a dirty brown color under a similar condition.

But such an inference is contradicted by the findings of a recent study by the local scholar Ravindra Kumar Mishra¹⁶. Mishra, while working on a project sponsored by the Ministry of Environment and Forests (Government of India), conducted ecological research in the Shimilipal region and along with other plant specimens, he collected the specimen of Kala- and Lal Pojo without having any idea about their significance or commercial importance. These specimens have now been identified as *Phoebe lanceolata*

¹³ The document in which timber-cutting operations as well as the exploitation of other forest products (if any) are scientifically planned by the forest officers.

¹⁴ Divisional Forest Officers

¹⁵ The author had examined two different samples of Lal Pojo one of which appeared glutinous while the other one just felt woody without showing any remarkable glutinosity. It is yet to be confirmed if there exist two or more varieties of what is known as Lal Pojo and also, whether *Litsea glutinosa* is one of them.

¹⁶ Attached to the Botany Department of Utkal University, Bhubaneswar(Orissa).

and *Phoebe wightii*, respectively, for Kala- and Lal Pojo¹⁷. When I informed the local scholar Mishra that Pojo had been identified as *Litsea monopetala*, he, being surprised, rechecked his notes and reaffirmed the earlier conclusion that his specimens did in fact belong to the genus *Phoebe*. Also, the specimen of leaves that I collected from a so-called *Kala Pojo* tree did not show some of the characteristics of the leaves of *Litsea monopetala* (for example, the lower surface was devoid of any marked pubescence). However, due to financial and other constraints, the present author failed to pursue further research in this regard.

CONCLUSION

Information received from the field as well as secondary sources certainly suggest that *Litsea glutinosa* and *Litsea monopetala* (if it is the *Kala Pojo*) have already been endangered in the state and most likely, are critically endangered in some localities¹⁸. Although the multiplication power of Pojo is remarkable¹⁹, the rate of exploitation is exceeding the rate of multiplication, and therefore the survival of Pojo populations are under threat.

Keeping this in mind, I recommend that:

- The lacuna in the botanical information on Pojo should be eliminated.
- The status of Pojo and Joisontha as threatened should be properly determined.
- Scientifically-based debarking must be ensured by all possible means.
- Regeneration behaviors of Pojo and Joisontha must be studied and the controversy regarding the supposed Pojo “root suckers” must be solved.
- Plantation activities for these species must be taken up because wild regeneration alone can not compensate the loss in their population under the present circumstances and also because increasing demand for their bark can not be met with from the wild collections (if sustainable extraction is to be ensured).

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¹⁸ This apprehension is supported by the fact that in the neighbouring state of Andhra Pradesh, *L. glutinosa* has been found to be ‘critically endangered’ as per the latest survey (Shankar and Ved, 2003: 283).

¹⁹ In fact, this phenomenon was used by the lease holders to counteract the allegation that their operations caused great harm to these resources; for, they said that by their exploitation the trees multiplied themselves manifold through the manifestation of new shoots (which appeared as ‘root suckers’) which, in turn, ensured them a steady supply of the bark since these shoots assumed the minimum exploitable size within three years on an average.

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DEVELOPING INVENTORY METHODOLOGIES FOR NON-WOOD FOREST PRODUCTS: LESSONS LEARNED FROM AN ANALYSIS OF CASE STUDIES IN AFRICAN COUNTRIES

Wulf Killmann¹, Francois Ndeckere², Paul Vantomme² and Sven Walter²

ABSTRACT

Appropriate and biometrically valid inventories of non-wood forest resources are an essential prerequisite for their sustainable management and harvesting. However, methodologies for the precise assessment of forest resources yielding non-wood forest products (NWFP) are not yet sufficiently elaborated, neither can they be easily implemented by resource managers in the field. Under a joint European Commission—FAO partnership programme supporting sustainable forest management in African countries, inventory methodologies and experiences for assessing non wood forest resources were reviewed and analysed through 2 sub-regional expert consultation meetings covering dry to humid forest ecosystems. In these workshops, specific NWFP life forms (such as fruits, bark, lianas, leaves, roots) were identified for the elaboration and field testing of inventory protocols. They include assessment methodologies for: bark (johimbe, *Pausinystalia johimbe* in Cameroon); wild mushrooms (various species in Malawi); quinquéliba leaves (*Combretum micranthum* in Benin); baobab fruits (*Adansonia digitata* in Kenya); and leaves of the liana *Gnetum buchholzianum* in Central African Republic. For each NWFP life form, a specific inventory protocol was designed and tested. The results of the field work were analysed and improved inventory protocols were formulated for each selected NWFP. The results of these field studies and the improved inventory methodologies for the selected NWFP will be published as a practical field manual of generic NWFP assessment guidelines for use by resource managers.

KEY WORDS: Inventory, methodology, non-wood forest products, Africa.

INTRODUCTION

Rural people in Africa are heavily dependent on non-wood forest products (NWFP) for a wide range of needs including food, medicines and construction materials. Most of these NWFP are for subsistence, and several are important sources of income and employment at the local level, with some being traded even at the international level.

In order to determine the sustainable harvesting level of a given NWFP, be it for subsistence or commercial utilization, accurate information is needed on the growth and regenerative capacity of the resource providing the given product. Although there is often considerable indigenous knowledge for specific NWFP, there is a lack of documented or scientific information suitable for the determination of sustainable yields readily available to forest users.

Practical methodologies for assessing NWFP resources and for monitoring the impact of their harvesting are not widely available.

This paper summarizes work done under the EU-FAO Partnership Programme GCP/RAF/354/EC dealing with the component-Development of techniques for NWFP resource assessment in African ACP countries and covers the period 2000–2003.

MATERIALS AND METHODS

Within the framework of the above project, 2 consultation workshops were held with African forest inventory experts: one for Anglophone countries (15–17 October 2001, Lusaka–Zambia); and one for Francophone countries (12–15 February 2002, Yaoundé–Cameroon). The objectives of these consultations were:

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- Disseminate and discuss available information on NWFP assessment methodologies (Wong et al. 2001);
- Elaborate a list of key NWFP from various African eco-regions and for which specific inventory methods are most needed;
- Identify partners in African countries and select with them key NWFP for the development and field testing of inventory protocols for the selected product.

Six case studies were implemented. For each, a draft inventory protocol was designed and tested in the field. The results are used for the preparation of a field manual on the NWFP inventory guidelines. The case studies, with their respective product(s), country of implementation and main author are:

1. Inventory of populations and quantification of the production of quinquéliba leaves (*Combretum micranthum*) in North Benin (Nestor Sokpon).
2. Testing techniques for the quantification of *Pausinystalia johimbe* bark in the Lokoundje-Nyong Forest in Cameroon (Belinga Salomon-Janvier).
3. Testing of techniques for assessment of wild fruit yields: Case of Baobab (*Adansonia digitata*) in Dry land forest of Kenya (Chikamai Ben).
4. Utilization of local knowledge to assess harvesting yield of wild mushrooms in Malawi (Meke Gerald).
5. Using Adaptive Cluster Sampling method (ACS) for the quantification of leaves of the liana species (*Gnetum buchholzianum*) in the Ngotto dense humid forest in the south west of the Central African Republic (Bonannee Michel).
6. Testing inventory technique approaches—comparison of inventory of single species to multiple-species in National Forest of Kitwe—Zambia (Fabian M. Malambo).

Overall technical support to the above authors was provided by Jenny Wong.

RESULTS

A summary of the key findings of each case study is given here below:

1. Inventory of populations and quantification of the production of quinquéliba leaves (*C. micranthum*) in dry forests of North Benin.

Objective—Inventory of populations and the quantification of the production of *C. micranthum* leaves in dry forests of North Benin, and which are used by the local people for making tea.

Site selection—In the Atacora Department, parallel with the road from Tanguieta to Batia.

Sampling design and methodology—The systematic sampling method was used in this study. Five transect lines at 5 km distance of each other and perpendicular to the road Tanguiéta–Batia (Département de l’Atacora) were subdivided in 44 sub-transects (of 0.5 to 5 km long and 100 to 150 m wide). These transects were done in those areas suspected to have *C. micranthum* trees. At random, plots were selected along these transects for habitat description of *C. micranthum*.

In a total of 26 plots (of 20 m² up to 25 000 m²) an exhaustive inventory of all species and tree measurements of all *C. micranthum* was done. Leaves were counted on randomly selected branches and their dry weight measured.

Data analysis and results—The inventory revealed the existence of different vegetation groups of *C. micranthum* and assessed their population dynamics; and estimated the potential leave production capacity of each vegetation group and for *C. micranthum* trees of different sizes and shapes.

Recommendations and conclusions—The pilot inventory revealed the many different habitats and vegetation groups with *C. micranthum*. It further showed that a systematic sampling design is less appropriate in view of the sporadic, but very gregarious, distribution of *C. micranthum* trees. The sampling design must therefore be adjusted to install sample plots along those transects where the species actually occurs, and to adjust the size of the sampling plot (from 20 m² to 25 000 m² rectangular or square) as to take into account the wide variety of different vegetation groups with increasing levels of gregarious occurrence of *C. micranthum*.

2. Testing techniques for quantification of *Pausinystalia johimbe* bark in the Lokoundje-Nyong Forest in Cameroon.

Objective—To develop and test appropriate quantification techniques for the bark production from trunk and branches of Johimbé (*P. johimbe*) trees.

Site selection—The Lokoundje-Nyong Forest concession (with a forested area of 129 188 ha).

Sampling design and methodology—Data from a previous forest inventory (ONADEF inventory of 1995 using a systematic sampling design at 0.5% level) served as a basis to assess the population of *P. johimbe* trees. Updating data on *P. johimbe* was done through a systematic sampling along transect lines at 4 km distance and containing 0.5 ha

plots (250 m x 20 m). In each plot, distribution and size classes of Johimbé trees was measured, and amounts of bark from trunk and branches of selected trees was quantified in order to establish bark yields against tree size classes and tree characteristics.

Data analysis and results—The case study revealed only minor errors regarding the number of Johimbé trees sampled as compared with the numbers from the 1995 inventory (2.8% error margin). It further showed that there is an exponential growth of bark yields from trunks with increasing diameter till diameter at breast height (DBH) 60 cm while bark yields from branches represents only 0.7 % of total production of bark from the trunk.

Recommendations and conclusions: The study also suggested chemical analysis of johimbe bark in order to determine the johimbine concentration of the bark in function of different provenances and from different parts from the tree trunk and/or branches, as to identify and map those provenances with the highest johimbine content and to improve bark harvesting efficiencies and regulations.

3. Testing techniques to assess fruit yield: the case of Baobab (*Adansonia digitata*) from the dry lands of Kenya.

Objective—To develop a simple and reliable method for estimating the number of fruits in the canopy of a single tree; and particularly to test whether randomised branch sampling is a useful method for estimating fruit yield in Baobab trees.

Site selection—The sites were distributed in a stretch measuring about 60 km x 20 km along the Nairobi-Mombassa highway in Kibwezi Division (Makueni District) and were subjectively selected to ensure that a range of tree densities and sizes were included to reflect the structure of the Baobab population. The plots were located with their centers one metre from a selected fruiting Baobab tree with a radius measured to the middle of the furthest tree (within 100 m from the center).

Sampling design and methodology—The sampling design and field measurements were modifications of methods used by various researchers with modifications to take into account the architecture of the baobab tree. Basically, all the sample trees were assessed for the following variables/parameters: distance (correcting for the slope) from the center of the plot, diameter at breast height (1.3 m above ground level), total height, crown width and depth. In each plot, one fruiting tree was randomly selected for total fruit counts.

Data analysis and results—The number of fruits per tree is extremely variable and probably has a non linear relationship with the standard measures of tree size. The mean tree size and densities also varied from one site to another. Effect of some ecological factors of the study sites in terms of soil characteristics (depth, fertility and moisture), type of landscape and the total basal area of other (competing) tree species may have influenced individual tree shape and fruit yields. Fruit yield can be reasonably well predicted from tree height and projected crown area. The study suggests that primary branch sampling was more accurate and precise than secondary branch sampling. The poorer performance of secondary branch sampling is probably a result of the fact that a smaller proportion of the tree crown is sampled.

Recommendations and conclusions—Trials indicate that a simple randomised branch sampling can be used to estimate fruit yield for Baobab (but often still with fairly large errors). Although sometimes discrepancies may be large, the time savings are great as Baobab can be a very large tree with several thousands fruits. The fact that branch sampling worked at all is encouraging as the Baobab trees are often very misshapen. Using a selection method based on branch size or increasing the number of branches sampled may improve on the quality of the estimates and should be examined in further tests.

4. Using local knowledge as a basis for stratification of inventory sites: wild mushroom inventory in Liwonde Forest Reserve, Malawi.

Objective—To develop and test simple data collection techniques for a seasonal product. The product being wild edible fungi harvested from forest reserves in Malawi. The specific purpose was that a combination of a biometric inventory protocol on sites identified by harvesters would be able to better represent the mushroom productivity of the forest than the fixed plots. The intention being that the results of the field inventory would mirror data collected in the market place.

Site selection—Twenty four species of wild edible mushrooms occurring in the rainy season over a period of 3 to 5 months were studied. The trial was located in Liwonde Forest Reserve in Machinga District in the Southern Region of Malawi, and which is managed under total protection as a water catchment area for Lake Chilwa. Local people are allowed to harvest NWFP in this reserve for free such as wild mushrooms, medicinal plants, grass and wild fruits. Rapid resource assessment, key informant interviews and resource mapping were used to identify the study site.

Sampling design and methodology—This case study was composed of three distinct elements: (1) selection of mushroom sites identified by local harvesters; (2) enumeration of mushroom productivity on selected sites; and (3) market data collection to verify field data.

The plots used in this study are fixed in location and relatively close to the road (as is the most likely source for mushroom harvesting). A random number table was used to select distance from one plot to the next (along the road). In each plot, harvested mushroom species were identified and fresh weighing of the products was done. As for sale purpose, 11 of the 13 species encountered in the field sampling were present at the markets.

Data analysis and results—Comparison of field and market data shows that mushroom species which gave higher yield in the field survey were also the most abundant in the market. The field yield gives yield in terms of a unit area of forest while the market data gives the quantity per seller. The study has shown that not all mushroom species are harvested to the same extent. The study showed that there was only a weak relationship between mushroom species and sites.

Recommendations and conclusion—The study found out that there are several species of mushrooms that are eaten in the area, and that the sampling methods to be developed should aim at developing general productivity estimation methods for all the species collected. Sampling plots should be located in the areas where villagers collect mushrooms.

Productivity of harvestable yield can be estimated from the roadside markets. However, for accurate measurement of harvestable yield, which would in turn give the productivity of the harvesting sites, it is necessary to accompany collectors into the forest, where data enumerators would need to record area searched and quantity of different species collected. Weight should be used for measuring yield; however, counts can complement weight measurements.

Ten randomly located plots of 2 m x 100 m were able to capture mushroom production at a site. Since the different mushroom producing sites were not characterised, plots can be repeated in blocks to maximise the accuracy of the yield estimate. However, with more resources, sites need to be characterised, and plots be blocked according to site characteristics. The blocks can be regarded as treatments as they represent different growing conditions. Also with more resources, the season can also be segmented and be regarded as blocks or treatments.

5. Using adaptive cluster sampling method (ACS) for the quantification of liana species (*Gnetum buchholzianum*) in the Ngotto Dense humid forest in the south west of the Central African Republic.

Objective—Using adaptive cluster sampling method (ACS) for the quantification of the leaves of a liana species (*G. buchholzianum*).

Site selection—Ngotto dense humid forest concession (Permis d'Aménagement Forestier No. 169, 188.064 ha)

Sampling design and methodology—Adaptive cluster sampling method (ACS)—Opening up of 10 transect lines in those areas where the liana is found (and which were identified through a Rapid Rural Appraisal in the villages laying in the forest concession). Mapping of the distribution areas of the lianas along the transects and with help of GPS.

In a random selected transect in each of the above identified areas, systematic sampling plots (10 m x 10 m) are set-up every 100 m in which all *G. buchholzianum* liana stems are counted, measured, including number/weight of leaves and length of stems.

Data analysis and results—The study yielded estimates of (green) leaf production of *G. buchholzianum* by forest type and estimated the total (green) leaf production at 1 150 tonnes for the area of the forest concession in which the liana is found (87 004 ha).

Recommendations and conclusions—The ACS method proved to be very useful to present/map the variability in the distribution and frequency of the liana over a large forest area. However this method showed also some constraints such as: the method works well when only a limited number of species is to be inventoried and of which the parameters to be measured are simple (numbers, weights), and for practical reasons when the resource is easy identifiable in the forest (trees, liana).

6. Comparative assessment of alternative sampling designs for NWFP in Mwekera National Forest, Kitwe-Zambia.

Objective—To evaluate the costs and benefits in terms of data quantity of carrying out multi-species against single species inventory, and to recommend some protocols in the assessment of selected species and products.

Site selection—Local knowledge about the most harvested products was used to identify six fruit species and two tuber/corn species at the Mwekera National Protected Forest Reserve. The dominant vegetation of the area is miombo

woodland. The study work was undertaken by the School of Natural Resources at the Copper Belt University in Zambia.

Sampling design and methodology—Two sampling methodologies were involved in this case study: The first is the multi species inventory method (MSI) using the systematic cluster sampling based on 2 km x 2 km grid. Six fruit tree species and two herbaceous plants have been inventoried using this MSI technique. The second is the single species inventory method (SSI) on the ground of the experiences gained from the MSI method. Two species *Uapacca kirkiana* (fruit tree) and *Satirya siva* (herbaceous plant) were inventoried in 272 plots using respectively simple random sampling for the first species and stratified systematic sampling for the second species.

Data analysis and results—MSI approach is recommendable for groups of species which have similar life forms, sizes and where populations are isolated rather than clumped. Trees and herbs cannot be sampled in the same sampling design because of scale constraints. Cost efficiency difference between systematic and random sampling is little. Using simple designs to inventory abundant clumped species can give acceptable precision.

Recommendations and conclusion: The study revealed that NWFP in Mwekera National Protected Forest Reserve in Kitwe–Zambia are heavily exploited tree species for both their fruits and charcoal. Likewise tuber/corm species are subject to heavy and illegal harvesting, mostly for sale in urban areas. Forest authorities should address this issue quickly before these fruit trees/ tuber species are wiped out of this National Forest Reserve. The study recommends for these NWFP species inventories on a regular basis so that they can be incorporated in local joint management plans that are now being introduced in the area.

CONCLUSIONS

Although significant advances in research on both the socio-economics and the biology of NWFP have occurred in the last decades, methodologies for NWFP assessment at the national as well as the forest management unit level are still very rudimentary and yet not widely available in practice. The multitude and variety of NWFP, the multiplicity of interests and disciplines involved in NWFP assessment, organizational and financial constraints, and the lack of nationally, recognised common terminology and units of measurement, all contribute to make the assessment of NWFP and of the resources providing them a difficult task.

Development work on fine-tuning appropriate and specific inventory and monitoring methodologies for NWFP is progressing, but it is still not yet at the level for practical use and at an economical acceptable cost for resource managers at national or at local levels. It is hoped that through this work, awareness is raised to increase research on this topic.

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THE U.S. NONTIMBER FOREST PRODUCTS ASSESSMENT: OVERVIEW AND ISSUES

Susan J. Alexander¹

In 1998, members of the Non-Wood Forest Products subcommittee of the Forest Products Study Group, in the U.N. North American Forestry Commission, developed an outline for a document to describe scientific and management knowledge about nontimber forest products (NTFPs) for Canada, the United States, and Mexico. The U.S. team developed a wide range of studies and papers on the current state of NTFPs in the United States. The papers were published in a book (Jones et al. 2002).

Nontimber forest products are important to U.S. society and to sustainable forest management. Papers in the first section of Jones et al. (2002) make it clear that gathering and use traditions of NTFPs are long-standing and common to most, if not all, American subcultures. Such traditions cross cultural, class, gender, age, and urban-rural residence lines. Nontimber resources and uses are as varied as the people who gather them. The second section deals with commerce and conservation. Nontimber products constitute important components of both formal and informal American trade and conservation systems. Markets and labor structure are explored and discussed, as are ecological sustainability issues with respect to increasing demand. In the United States, NTFPs such as medicinal herbs and edible wild mushrooms are becoming common on the shelves of drug and grocery stores. Rapidly rising demand for these products poses the risk that market expansion will outpace the knowledge needed for socially and ecologically sustainable management. Requests for commercial access to NTFPs on both public and private lands have increased exponentially in the past two decades. Private landowners are also exploring options for using incomes from NTFPs to supplement or supplant revenues from timber harvests. Commercial NTFP harvesting does contribute to forest dwellers' livelihoods, but these activities can only support a low population density. Management to increase profitability can lead to loss of species diversity and ecosystem simplification.

Lower species diversity in temperate systems, however, may mean economically viable NTFPs may occur at higher densities. Certification and domestication in agroforestry systems may be tools that can be used to address issues of increasing demand. Inventory and monitoring is essential to sustainable management.

Section 3 focuses on Native American claims. Papers focus on NTFP tenure issues on federally managed lands and Indian reserved rights, such as treaties and other government-to-government agreements. Reserved rights are one vehicle by which informal tenure rights become formalized. Subsistence use in Alaska was formalized by the 1980 Alaska National Interest Land Conservation Act, that provides for subsistence use for rural residents, both Native and non-Native on public lands and Native Alaskans on native lands. The Act established a priority use for subsistence. The land base affected by the Act is significant, as 12% of Alaska is in Native Corporate ownership (due to the Alaska Native Claims Settlement Act of 1971), 52% is Federal land, and 33% is State land.

The last two sections of the book focus on policy and management issues. Ecosystem management increased the visibility of NTFPs for Federal land managers. In addition, an Executive Order regarding environmental justice in management has emphasized the need to increase public participation opportunities in decision-making. In the USDA Forest Service National Forest system, stewardship contracting has resulted in the use of new and existing resource management contracting tools to attain better stewardship of public resources. A discussion on customary claims and legal pluralism points out the myth of legal centralism, in which actors assume there is one law of the state for all administrations, by one set of institutions. In actuality, all people function in a system of legal pluralism, in which behavior pursuant to more than one legal order occurs.

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The focus of this national overview of NTFP policy and management is on issues linked to sustainable NTFP management, including existing use, trade, and management patterns; ecological and cultural/spiritual concerns that increased demands for NTFPs have endangered; and tensions among different claimants to these products, particularly on federally managed lands. The collection of papers describes the ways in which NTFPs are important in the United States, including their sociocultural, economic, and ecological values. The collection also outlines NTFP-related tenure conflicts, including tensions over who has a voice in policy and management decisions that affect NTFPs and their harvesters, buyers, and processors. Several research and information needs arose from the combined efforts of all the authors. There are no regularly collected data on harvest for personal use, commercial sale, or cultural and traditional use for most NTFPs in the United States. Production and value from private lands is unknown for the vast majority of NTFPs. This is significant, as private citizens and corporations own 71% of U.S. commercial forests. Non-government organizations also own land or have easements on more U.S. forestlands. The state policy arena is complex and not well studied. Access issues and harvest tenure rights are poorly understood. Inventory and monitoring of most NTFPs is nascent. The internationalization of environmental protection and trade has significant implications for conservation and marketing.

Emery (2002) states that in the United States, NTFPs have been gathered and are being gathered from biomes as variable as the temperate rain forests of the Pacific Northwest, the deserts of the Southwest, the prairie grasslands, the semi-tropical forests of the Southeast, and the New England coast. They contribute to the livelihoods of people from diverse ethnic and racial backgrounds in a variety of ways, and the social and ecological contexts within which these uses occur have profound implications for their future. The potential value of studies that help us to understand the issues surrounding NTFPs is great. Policies that fail to acknowledge the biological and social complexities of NTFP use run the risk of creating results that are ecologically perverse or socially unjust, or both. Studies of past and present NTFP use can provide a roadmap to effective and equitable use for the future.

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A STRATEGY FOR NONTIMBER FOREST PRODUCTS RESEARCH AND TECHNOLOGY TRANSFER FOR SOUTHERN UNITED STATES

James L. Chamberlain¹

In mid-2001, the Southern Research Station (SRS) and the Southern Regional Office (R8) of the U.S. Forest Service worked through a 3-day facilitated discussion to develop a strategy to guide research and technology transfer on nontimber forest products (NTFPs). In all, more than 14 specialists took part in developing the strategy, representing the Forest Service Washington and Region 8 Offices, the National Forests, Research, and State & Private Forestry. Technical disciplines represented during the process included ecology, botany, social science, inventory and monitoring, and marketing and management. The guide establishes strategic goals and recommended actions to advance the knowledge concerning the management of forest resources for NTFPs. It is intended to help direct research efforts of the Southern Research Station concerning the ecological, economic, and social sustainability of market and non-market NTFPs, as well as the inventory and monitoring of these products on public and private forestlands. A corresponding purpose is to guide technology transfer efforts in Region 8, state and private forestry, as well as the national forest system with SRS scientists.

The southern region team (SRS and R8) acknowledges several factors as inspiration for developing the regional strategy. First and foremost, the recently published "National Strategy for Special Forest Products," issued by the Washington Office (USDA Forest Service 2001), established an action plan to guide the agency in managing the resources on national forest lands from which special forest products (SFPs) originate, and to assist state and private forest managers with the same. The national strategy also recognized the social, economic, and ecological importance of the resources that produce SFPs and the need for leadership and collaboration in integrating SFPs into forest management. In addition, the regional team recognized that a lack of information concerning the ecological, economic and social aspects of NTFPs that could be provided through

research impedes efforts to improve management. Major issues concerning sustainability and management include harvesting practices and levels as well as silvicultural standards, guidelines and prescriptions. Further, the regional efforts were inspired by growing concerns for the social factors, especially long-term collection rights, a way of life for many rural folks, and family incomes and traditions. The need to ensure the availability of nontimber forest resources for recreational collection also inspired the regional team to craft a strategy.

Although many definitions are used for products that originate from the forests that are not timber-based, but are of biological origin, the regional strategy embraces the use of the term special forest products (SFPs) to provide consistency. These products can be organized into four major product categories: culinary, wood-based crafts, floral and decoratives, and medicinal and dietary supplements. Perhaps the most important of the Southeast's culinary forest products are ramps (*Allium tricoccum*), which is widely eaten as a spring tonic, and often the mainstay of festivals and fundraisers. Some of the more important wood-based SFPs include sassafras (*Sassafras albidum*) stems for walking sticks, willow (*Salix* spp.) stems for furniture, and cypress (*Taxodium distichum*, *T. ascendens*) knees used for carvings. Floral products include crooked wood (*Lyonia* spp.) gathered from the forests of Florida and used in dried flower arrangements, grapevine (*Vitis* spp.) and smokevine (*Aristolochia macrophylla*) used to make wreaths and baskets, and galax (*Galax urceolata*), gathered for the national and international floral industries. The southern forests are the source of more than 50 plant species collected for their medicinal values.

The regional strategy recognizes that increasing levels of collection of SFPs have triggered concerns about the long-term social, ecological, and economic sustainability

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of the resources from which these products originate. There is too little information to accurately assess the current situation and to make informed decisions concerning management of nontimber forest resources. The strategy defines four strategic goals and associated actions within the framework of ecosystem management to address the ecological, economic and social aspects affecting SFPs. The goals and selected actions include:

1. Provide knowledge and information to maintain viable populations of SFPs
 - a. Develop the best inventory methods for species or groups of species
 - b. Assess ecological impacts of SFP harvesting on the SFP and associated species
 - c. Determine sustainable harvest practices and levels for selected SFPs
2. Provide knowledge and information to ensure the economic sustainability of SFP markets
 - a. Determine the value and volume of the major commercial SFPs
 - b. Define the scope and scale of established and emerging markets
 - c. Determine the economic impacts to local people and communities
3. Produce and provide information on the different aspects of human interaction with SFPs and incorporate an understanding of the human dimension into policy, planning and management decisions
 - a. Identify SFP collectors, the SFPs they collect, and their functional and livelihood uses of these products
 - b. Examine compliance with existing SFP regulations, and implications for management strategies and law enforcement
 - c. Establish a process of collaborative planning with collectors, and other agencies and interested publics
4. Promote public understanding of SFP uses, users, conservation, and future potential
 - a. Determine methods to create public understanding of SFPs throughout the south
 - b. Develop education and outreach programs that target harvesters, land managers, school groups and others

Achieving these goals depends on developing a proactive technology transfer program that supports and complements the efforts of State and Private Cooperative Forestry,

the National Forest System, and other public and private partners. Technology transfer actions include communicating research results in formats that can be easily used with a wide range of constituents. Developing an interactive web-based communications system that provides timely and practical materials is essential. Further, an integrated technology transfer program is needed that addresses the needs of all clients and partners, including non-English speaking publics. Through a concerted and directed effort, the SRS and Southern Regional Office can advance the knowledge base through research and improve management of southern forests for nontimber forest products.

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MANY VOICES, MANY VALUES: COMMUNITY ECONOMIC DIVERSIFICATION THROUGH NONTIMBER FOREST PRODUCTS IN COASTAL BRITISH COLUMBIA, CANADA

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INTRODUCTION

Worldwide, the traditional industrial model of resource extraction has resulted in the depletion of the very resources upon which these industries depend. Communities that have relied heavily on conventional resource extraction must now seek out opportunities for more diversified and sustainable investment and employment. In many forested regions, nontimber forest products (NTFP) are becoming the next resource frontier. The National Research Council (2002) observes that nontimber forest products are “emerging globally as a tool for the establishment of sustainable forest communities”.

In other resource sectors, research has conventionally trailed resource depletion and has often been poorly integrated with training, investment and employment development, and community capacity building. Policies to support sustainable utilization of NTFP are often absent or are “add ons” to timber management regimes.

A North Island NTFP Demonstration Project was therefore initiated by Royal Roads University on Vancouver Island, British Columbia (BC), to address the requirements of sustainable utilization and development of local NTFP resources. Building on work begun in the mid-1990s, this project demonstrates that support must be given simultaneously to the ecological, economic and social aspects of sustainable development of NTFPs. The project also demonstrates the need for an institutional base at the regional, domestic and international levels to accelerate progress toward the goals of sustainable utilization, and to curb the dissipation of intellectual and social capital that results from fragmented, short-term research and development projects.

NONTIMBER FOREST PRODUCTS DEVELOPMENT IN BRITISH COLUMBIA

The context of NTFP development in British Columbia is undoubtedly similar to that in many other jurisdictions, especially those in North America. In British Columbia, forest lands are managed for multiple uses. This is accomplished by incorporating a range of other forest uses and values into the management of the land base for timber production. Society’s concerns for values such as old-growth forests, riparian areas, biological diversity, visually sensitive areas, wildlife, and recreation are accommodated within a timber management framework. Many researchers, land managers, Indigenous peoples, stakeholder groups, and members of the interested public argue that the research, policy and legislative base, and operational forest management practices are not adequate to achieve sustainable utilization of the full range of both consumptive and non-consumptive forest uses. Nowhere is this void more apparent than in the case of NTFPs (also referred to as “non-wood products” or “botanical forest products”).

While no definitive data are available, it is believed that the commercial harvest of NTFPs—primarily wild mushrooms and floral greens—contribute some \$280 million in direct sales annually to the British Columbia economy (Wills and Lipsey 1999). The B.C. Ministry of Forests (1995) estimates that more than 200 plant species are harvested commercially within the province. Within British Columbia, this harvest is not subject to any legislative or regulatory regime, outside of parks, although regulation is possible under the B.C. Forest Practices Code.

Until very recently, there has been little biological, ecological, economic or social research in British Columbia with the objective of achieving a better understanding of

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NTFPs. Research reports (which only began in the early to mid-1990s) are, in most cases, overview documents that identified issues and questions, and collected the limited data available on NTFPs in British Columbia.

With very few exceptions, the values and volumes of harvest NTFP species are unknown. Almost nothing is known about harvester populations. There are no standardized inventory methods, or methods for determining sustainable harvest levels. There is little or no information available on how to enhance NTFP production, or how to best manage forest lands to achieve optimum production of both timber and nontimber species. There are no defined property rights for NTFPs (other than the general property rights of the Crown, and yet-to-be-defined Aboriginal rights).

The NTFP industry is fragmented, highly entrepreneurial (in the sense that individuals enter and exit the market regularly) and primarily small-scale. The current vacuum in policy and management creates few incentives for NTFP businesses (and especially harvesters) to organize in such a way as to enable government or researchers to engage in sustained dialogue with a defined stakeholder group.

In the absence of adequate information and management approaches, the NTFP industry has become increasingly characterized by problems of the “unmanaged commons”:

- conflicts among users,
- concerns of traditional users, particularly Indigenous peoples, that their interests will be trampled in the rush to commercialization,
- neglect of economic values of NTFPs relative to timber, and
- low levels of investment in developing and sustaining a profitable industry (Tedder et al. 2002).

Internationally, considerable attention has been paid to NTFPs in tropical and sub-tropical areas (for example, the Non-Wood Program of the Food and Agriculture Organization of the United Nations). Comparatively little attention has been paid to these resources in temperate and boreal forests. Thus, the problems and needs identified above for British Columbia are both domestic and international in scope.

As noted above, virtually all of the research and community development activity focussed on NTFPs in British Columbia dates from the mid-1990s. Public and political attention to this resource sector was sparked by the so-called “pine mushroom gold rush” and the discovery of

taxol (extracted from the Pacific yew (*Taxus brevifolia* Nutt.)) as an effective cancer treatment. First Nations (i.e., indigenous) communities have been at the forefront of interest in NTFP development.

NONTIMBER FOREST PRODUCTS ON NORTHERN VANCOUVER ISLAND

On Northern Vancouver Island, the past eight years have seen an expanding program of NTFP activity. From their initial status as an unknown acronym, NTFPs are now considered to be among the high potential emerging industries for the region (Cathy Denham 2003, personal communication). Conferences, workshops, research projects, and educational programs have been initiated and funded by a range of agencies including the Canadian and British Columbia governments, First Nations, local governments, forest companies and non-profit organizations. Since 2001, the key initiative in the region has been the North Island NTFP Demonstration Project, led by Royal Roads University in collaboration with more than a dozen partner groups. The project is implemented through a multi-disciplinary research team that includes academic faculty, independent researchers, industry and community representatives, and federal, provincial, and First Nations researchers and managers.

Accomplishments

The project has achieved both specific results in research, training and local economic development, and less tangible but equally important results in fostering networks and relationships among individuals and organizations that will support continuing development of the NTFP sector.

- Interdisciplinary participative research projects have included the development and testing of an inventory methodology for NTFP presence and abundance, capability mapping of key NTFP species, and investigation and evaluation of co-management approaches for timber and nontimber species (see Titus et al. 2004, in this proceedings). The projects have all been designed to maximize stakeholder participation, training and capacity building and have helped build bridges among researchers, harvesters and other stakeholders in the NTFP community.
- Capacity building and liaison has been a focus of the project and its predecessor activities. Activities have included conferences, workshops, planning meetings, presentations, consultation with groups throughout the region, collaboration on joint funding applications and support for projects undertaken by partner organizations. These activities have culminated in the creation of the

Mt. Waddington Innovation Centre Society, which was formed to establish and operate a Nontimber Forest Products Innovation Centre in the region. Liaison and capacity building activities have extended beyond the region to the provincial, Canadian and international levels and have led to the development of a Centre for Nontimber Resources at Royal Roads University (see below under “Next Steps”).

- Education and training activities have ranged from informal and formal workshops to applied training for harvesters and entrepreneurs as part of collaborative research projects. Assessment of training and education needs has led to the creation of the first University-accredited Certificate Program in Nontimber Forest Products. Northern Vancouver Island is hosting the initial offering of the program with financial and in-kind support from First Nations educational funding sources, the Community Futures Development Corporation of Mt. Waddington, the Ministry of Forests and the Pacific Forestry Centre of the Canadian Forest Service.
- Entrepreneurship support and business mentoring have included both broadly based information and support service and focused support for committed entrepreneurs. With support from project staff, businesses have started or expanded in products such as ferns and mosses, floral greens harvesting and production of wreathes and garlands, harvesting and processing of bracken fern fiddleheads, and mushroom harvesting and processing. Research and educational activities have employed more than 30 local people, including experts and trainees in wild foods, wild fungi, ecological inventories, natural health products, tourism, and cedar bark harvesting and processing in different aspects of the project.
- Policy innovation and institutional development are an integral component of the project. The absence of a policy regime for NTFPs and specifically the absence of defined property rights are a central and critical challenge in the sustainable utilization of nontimber resources (Tedder et al. 2002). Project team members are collaborating with the British Columbia Ministry of Forests to design pilot stewardship projects that could establish a range of management experiments such as First Nations-forestry company co-management projects, stewardship leases held and managed by harvester groups, and regional multi-stakeholder management boards or associations. The North Island is one of three regions on the B.C. coast where these management experiments will take place, once implementation of the strategy is approved by the Ministry of Forests executive.

More information on the North Island project can be found at www.island.net/ntfp/ and on the Royal Roads University website (www.royalroads.ca).

Challenges

At a recent meeting of NTFP researchers, one participant observed that “NTFPs are on the corner of a lot of desks, but they don’t occupy anyone’s entire desk”. NTFP research, training and development have been fragmented and marginal compared to other streams of activity, be they forestry, economic development, horticulture, natural health products, fine arts and crafts, tourism, the food industry or education. The species themselves and the broad range of products and services derived from them make the concept of an “NTFP sector” both complex and elusive.

There tend to be several NTFP industries, which differ significantly from each other in terms of markets, industrial organization, harvester populations, and “status”. Developing a focus and a strategic direction for NTFPs often involves convincing a wide variety of individuals and agencies that they, too, are in the NTFP business or that this sector offers potential benefits to them. In this regard, networking, raising awareness, and the development of partnerships are essential and very time-consuming aspects of the North Island project.

Fostering business development and new investment in NTFP businesses has been among the greatest challenges in the project. Historically, the small business sector has not been strong on the North Island, especially in the forest sector, which is dominated by large companies owned and managed from outside the region (and sometimes outside the country). At an early stage in the project it was thought that the natural candidates for NTFP business development would be displaced or underemployed forest workers. This has proven not to be the case, although such workers have shown increasing interest in harvest activities and in working on research projects. The most promising pool of NTFP entrepreneurs appears to be existing business people looking for new opportunities. Unfortunately, this pool is quite small on the North Island, there has been little influx of new entrepreneurs and investors to the region, and publicly-funded programs tend not to provide support to existing businesses or focus on business retention. Because the markets for NTFPs are almost entirely outside the region, the need for support in identifying markets and market trends, product development, package design, and other services essential to the production and marketing of higher value, specialized products is much higher than it would be in an urban area.

The absence of appropriate institutional arrangements for managing NTFPs, and more particularly the absence of property rights for NTFPs on Crown (public) lands is a major impediment to the rational and sustainable development of the sector. Even where traditional or more contemporary management strategies exist informally at the community level, these strategies are neither recognized nor affirmed by formal government decision-making rules.

As noted earlier, individuals engaged in NTFP harvesting are often poorly organized and somewhat marginal to the main stream of social and economic life in British Columbia. Where individuals are limited in their ability to access formal decision-making structures (and where the absence of property rights encourages secrecy as a way of protecting resource use), stakeholder pressure for policy development and public investment in the sector tend to be muted or absent². In this regard, the contemporary negotiation of Aboriginal land and resource rights (the treaty-making process and other forums) in British Columbia provides one of the few clear forums for discussion of these issues and helps explain the significance of NTFP for many indigenous communities. At the same time, uncertainty about the extent and nature of Aboriginal rights and title contributes to the difficulties in achieving local consensus on appropriate institutional arrangements for NTFP s and discourages the senior policy community (both public and private) from venturing into discussions that are potentially fraught with controversy.

Lessons Learned

Experience with the North Island NTFP Demonstration Project and with a variety of other projects undertaken by members of the research team leads to the following general conclusions:

- The complex, interconnected imperatives of sustainability must be reflected in research, development, capacity building and policy building that incorporate all significant environmental, economic and social realities;
- Local applied projects cannot flourish without specialized expertise and research support and without appropriate policy and industrial infrastructure that can only be implemented at the provincial or national level, or both;

- Provincial, federal or international research centres or agencies cannot be effective without the efficient extension, practical application, and “buy in” possible only through local projects that are genuinely supported and implemented by local communities; and
- Structures and processes that link local, regional, national and international “nodes” are required so that information can be shared efficiently, capacity is built quickly, and innovation is diffused effectively.

To respond to these findings, the project team, other members of Royal Roads University, and partners and colleagues at the regional, provincial, national and international levels have developed two organizations that will form a prototype for networking and mutual support in pursuit of sustainable utilization of nontimber resources. These are the Mt. Waddington Nontimber Forest Products Innovation Centre (based on the north end of Vancouver Island), and the Centre for Nontimber Resources (based at Royal Roads University, Victoria, BC). The former will operate at a local level, and the latter will operate more widely. The North Island Demonstration Project will eventually be subsumed and expanded under these two organizations.

NEXT STEPS

Mt. Waddington Nontimber Forest Products Innovation Centre

The purpose of this Centre is to encourage, facilitate and support the sustainable utilization of nontimber forest products on Northern Vancouver Island and the Central Coast of British Columbia. The Centre will be established and operated by the Mt. Waddington Innovation Centre Society. The working group (consisting of partners in the North Island NTFP Demonstration Project) and other community representatives have identified five priority areas of activity for the Centre:

Business development—The Centre will provide a business perspective to those involved with NTFPs. The Innovation Centre will assist in determining the commercial feasibility of various NTFPs including issues of sustainability of the product, packaging, and transport to market.

² Edwards and Stein (1998: 371) observe in regard to the “commoners” of the New Forest in England that, “...a sub-section of the total user community, the traditional grazers (‘commoners’) of the area have encountered over 900 years of governance whereby individuals outside their own immediate community (from a ‘higher’ socio-economic standing) have controlled the collective-choice decision-making arenas on their behalf. As a result, the commoners have failed to develop the necessary skills to participate effectively in contemporary collective-choice decision-making arenas, nor does their culture present them with the will to do so. As a result, evolution of operational rules has been very much influenced by new types of users (such as recreational users), who have greater access to the collective-choice decision-making arenas...” Many North Islanders, Aboriginal and otherwise, would agree with such observations about ‘outside governance’ whether political or economic.

Research and information management—Research will focus on supporting business development efforts, and local forest management that supports co-management for timber and nontimber production. Providing useful and accessible information to the regional community will be a priority for the Centre.

Training and education—The Centre will collaborate with Royal Roads University and potentially other post-secondary institutions in the delivery of accredited programs and will also develop and deliver targeted training to meet specific local needs. Programs for youth and school populations will also be developed in collaboration with educational and community organizations.

Community development/discussion forum—There is currently no regional forum for representation of the NTFP community. The working group expressed a strong desire for such a forum to discuss issues such as land use rights, licensing, certification, export assistance, control of resources and other relevant issues and to ensure that the interests of nontimber resources and those dependent on them are fully represented in public policy development.

Coordination of First Nations' interests—First Nations' interests and representation are key elements in the development and management of the Centre, and are reflected in the membership of the Board of Directors, the operating principles of the Centre, and its proposed management, staffing and services.

Centre for Nontimber Resources (CNTR)

The CNTR will be based at Royal Roads University, in Victoria, BC. The purpose of the CNTR is to support and encourage sustainable utilization of nontimber forest resources in the temperate and boreal regions of the world. "Sustainable utilization" refers to the protection and enhancement of subsistence, cultural, recreational and commercial uses, as well as the protection of ecosystem values. The principal focus of the Centre is the wise use of nontimber forest resources to diversify and sustain rural and resource-dependent economies. The Centre will initially concentrate on research on botanical and mycological resources.

The Centre will accomplish its purpose by:

- Supporting primary and applied research that is directed to all aspects of sustainable utilization of nontimber resources, particularly research that is directed to linking, integrating and applying research results from multiple disciplines and integrated research methodologies;

- Developing, delivering and fostering the delivery of educational and training programs at the community, industry, undergraduate and graduate levels, and encouraging the development of nontimber resource curriculum in the K-12 school system;
- Supporting the application and extension of research in all areas of nontimber resource utilization, including commercial, subsistence, recreational and traditional uses;
- Contributing to the development of policies and institutional arrangements that promote the sustainable utilization of nontimber forest resources; and
- Liaising with and supporting all sectors and communities concerned with the sustainable utilization of nontimber resources, including Indigenous peoples and communities, other rural and resource-dependent communities, other research and educational institutions, industries and their organizations, the public sector, and non-governmental organizations.

The management and operation of the Mt. Waddington Innovation Centre and the Royal Roads CNTR will be independent, but mutually supportive. It is envisaged that the linkages between the two will encourage the creation of other local "innovation centers" throughout the province, and will provide models for networking centers to link regional, provincial, national and international communities of NTFP researchers and practitioners, thereby supporting healthier, more diversified and more stable rural communities.

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CO-MANAGEMENT FOR NONTIMBER FOREST PRODUCTS IN COASTAL BRITISH COLUMBIA, CANADA

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INTRODUCTION

Some classical forest management activities can be modified to enhance both timber and nontimber values in the coastal forests of British Columbia, with income from nontimber forest products (NTFPs) partially off-setting increased forest management costs. There are three potential areas of immediate interest in which total forest values could be increased: whole-plant extraction before tree harvesting for the native plant horticultural trade, co-management through silvicultural treatments to enhance a semi-shade understory shrub (salal (*Gaultheria shallon*)) for floral greenery, and co-management for mosses.

CO-MANAGEMENT FOR WHOLE-PLANT EXTRACTION BEFORE TREE HARVESTING

Uncontrolled removal of entire plants for the horticultural trade can deplete species in the wild. However, as all plants are lost through road building, their removal from planned roadbeds could provide material for the horticultural sector while also providing sustainable income for forest-based community members. Likewise, removal of species that would not survive canopy removal or logging activity from planned cut blocks would also lessen pressure on wild stocks. Clear communication and procedures can be used to ensure that forest planning activities take removal of horticultural species into account.

Fern and moss (*Rhytidiadelphus loreus*) survival on timber cut blocks is now being monitored in a study on northern Vancouver Island, near Port McNeill (fig. 1). An operational trial has been completed, and demonstrated that it is economically viable to harvest two species of ferns (*Blechnum spicant* and *Polystichum munitum*) from planned roadways. The trial included training of local residents in

the identification, harvesting, processing and marketing of the ferns. It was found that the learning curve for this economic activity was quickly overcome. Initially, an average of 44 *B. spicant* bare-root products were harvested per hour, but this soon climbed to over 90 per hour. Based on the harvest trials and market research, it is estimated that a harvester could anticipate earning approximately \$200 CAD³ to \$400 per day (excluding transportation and equipment costs) in the sustainable salvage of ferns on northern Vancouver Island.

An unexpected spin-off of the marketing side of the work was the discovery that most horticultural merchants would only purchase ferns from harvesters if they could be assured that the ferns were picked in a sustainable manner. This was easily accomplished, given that the ferns came from planned roadways, through the auspices of the North Island NTFP Demonstration Project and Royal Roads University. Increasing pressure for certified sustainable NTFP products may reduce exploitation of ferns in the wild.

CO-MANAGEMENT FOR SALAL

Salal makes up ~95% of the floral greenery exported from Canada. There are 22 firms in the floral greenery sector in British Columbia, with collective gross revenues (1997) of \$55–60 million, and 12–15,000 pickers. Salal is a semi-shade ericaceous species that retains its leaves for several years. Shade- rather than sun-leaves are picked, and therefore forest management activities that produce partial shade provide co-management opportunities. These include: (1) modify clearcut harvesting patterns to increase semi-shaded forest edge, (2) use partial harvesting systems that retain overstory (e.g., shelterwood), (3) plant high-value conifer species that do not form dense canopies (e.g., *Thuja plicata*), (4) fertilize young stands to decrease period of time over which sun-leaves are produced, and increase

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³ All values in Canadian dollars (CAD); 1.00 CAD = 0.747 USD; = 0.650 EUR; = 1.09674 AUD; = 1.26 NZD; = 88.2 JPY.

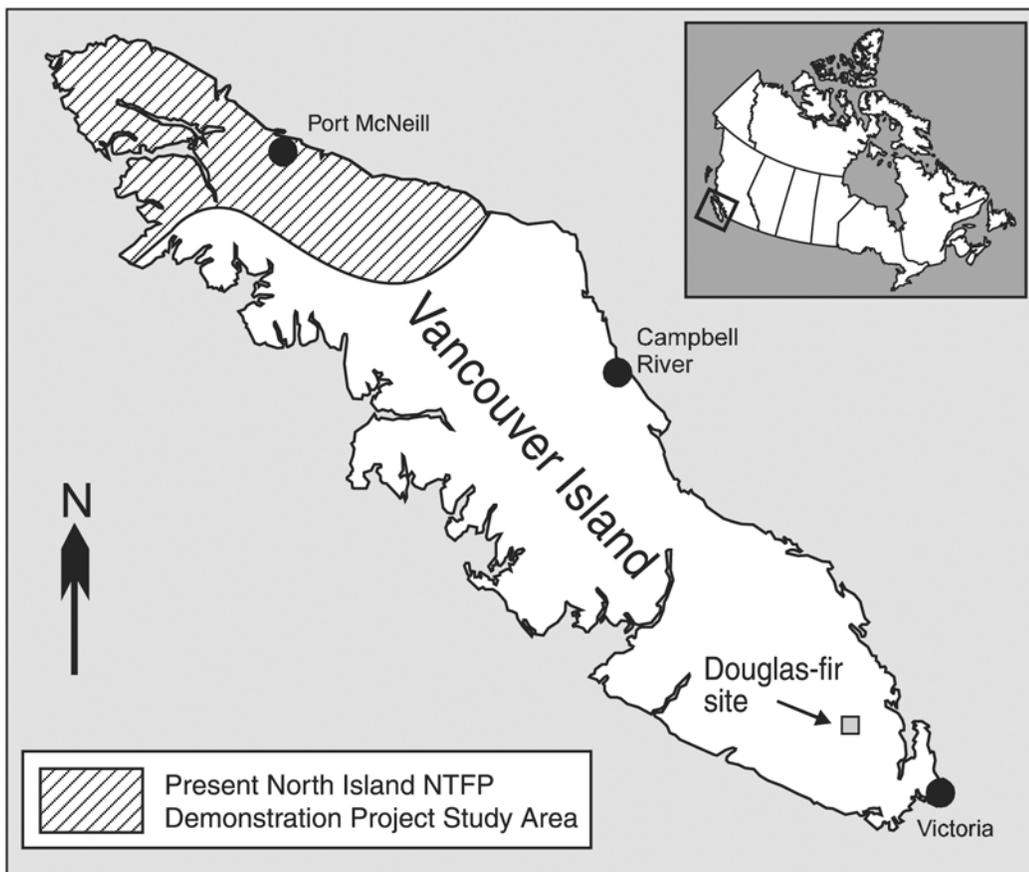


Figure 1—Location of study sites on Vancouver Island, British Columbia

salal nutrition and productivity, (5) prune young stands to improve picker access to high quality salal immediately beneath developing trees, and (6) thin stands, especially using multiple entries, and combine with fertilization. The commercial salal resource on Vancouver Island is showing signs of exploitation, from reduction in total stem length to death of plants, and this is beginning to result in migration of workers to increasingly remote areas. Co-management may be one way of increasing productivity in the short-term, thereby alleviating pressure on an increasingly scarce resource until policies can be put in place to ensure a sustainable salal sector.

Salal is associated with reduced growth of conifer regeneration on the north coast of Vancouver Island, and stands on some nutrient-poor site types are often fertilized ($\sim 250 \text{ kg ha}^{-1} \text{ N} + \sim 100 \text{ P kg ha}^{-1}$) at ~ 10 years of age to enhance early tree growth. Salal also responds well to this treatment, and amounts harvested from plots varying in time from fertilization were recently compared with amounts harvested from adjacent control plots, near Port McNeill (fig. 1). Fertilized sites produced up to $\sim 1000 \text{ kg ha}^{-1}$ of salal

(worth $\sim \$2,200 \text{ ha}^{-1}$ @ $\$2.20 \text{ kg}^{-1} = \1.00 lb^{-1}) 3 years after treatment, while adjacent control stands lacked commercial salal. Salal productivity on fertilized sites then declined as tree canopies closed, and commercial salal was not present on sites >6 years after fertilization because of shading. Productivity on control plots increased over time, and one older site ultimately produced as much as younger fertilized sites ($\sim 1000 \text{ kg ha}^{-1}$). The key difference was that these amounts were available on fertilized sites 13 years after tree planting, as compared to 18 years for unfertilized sites. This represents a reduction of 5 years in the time it took for commercial salal to become available to harvesters. Further work will be therefore be required to determine if (1) the increased salal productivity after fertilization resulted from the added nutrients or from enhanced tree growth that created a favourable semi-shade condition, and (2) whether salal productivity over the commercial lifespan of salal in a stand is increased by fertilization (i.e., from the time picking is initiated once a semi-shade condition is reached until salal is shaded out and no longer of commercial quality), or if the decreased time for picking through increased tree growth following fertilization is not balanced

by an increase in salal productivity over a shorter time period. If fertilization increases total commercial salal productivity over a stand rotation, then salal harvesting may help justify wider use of fertilizer in this region.

On the drier south coast of Vancouver Island, the total above-ground biomass of salal increased proportionally from ~4,000 to ~10,000 kg ha⁻¹ as canopy cover decreased from ~95% to ~55% with increasing levels of thinning in a Douglas-fir stand near Victoria (fig. 1). However, commercial salal productivity increased from ~\$200 ha⁻¹ at low light levels (~95% canopy) to ~\$500 ha⁻¹ at intermediate light levels (~80% canopy) and then unexpectedly decreased to ~\$350 ha⁻¹ in the most intensively thinned treatment (~55% canopy) because of insect and disease damage to leaves at higher light levels. This emphasises the need for a wide range of knowledge on the biology of plants used for NTFPs and the ecosystems in which they are found, including insect herbivory and pathology.

Future work will focus on quantifying commercial salal productivity on a wide range of sites so that preferred habitat and forestry treatments that enhance commercial salal productivity can be identified, and both timber and NTFP values quantified.

CO-MANAGEMENT FOR MOSSES

Moss is increasingly of value as an NTFP. Changes in forest structure through operational treatments such as spacing, thinning and clearcutting will influence the abundance and diversity of mosses and other ground-level species, but specific responses of mosses to forest management activities are not yet well understood. These responses were examined in a chronosequence of sites on northern Vancouver Island (submontane very wet maritime variant of the Coastal Western Hemlock biogeoclimatic zone, CWHvm1), near Port McNeill (fig. 1). Variability in moss species occurrence and abundance were compared across stands of different operational forest treatment types (clearcut, spaced, thinned) within five stand age classes (2- to 130-years-old). Options for facilitating local community input and indigenous ecological knowledge into timber and nontimber co-management were also examined.

Mosses, liverworts, ferns, herbs and shrubs were sampled in twenty 1-m² quadrats in 10 stands, (epiphytic mosses are not common in the ecosystem studied, and were therefore not included.) The 10 stands consisted of a pair of control and treated stands within each of 5 age classes: (1) 2-year-old clearcut and 130-year-old mature stand, (2) 19-year-old control and spaced stand, (3) 27-year-old control

and 34-year-old spaced stand, (4) 56-year-old control and 60-year-old thinned stand, and (5) 70-year-old control and thinned stand.

Heterogeneity (an index of species diversity), equitability (the ratio between observed species and maximum species diversity), abundance (of all observed moss species, measured as percent cover) and moss volume (of the three most common species only—*Hylocomium splendens*, *Kindbergia oregana*, *Rhytidiadelphus loreus*—measured as percent cover x moss stem length x unit area) were calculated for mosses species in each of the stands in the chronosequence.

Overall, sixteen moss species were found on the sites (table 1). There was increasing moss heterogeneity with increasing age of stand, but no clear correlations with stand treatment. Equitability for moss species was lowest in the 19-year-old stands, increased in the 27- to 34-year-old stands, and stabilized thereafter.

Statistically significant relationships could not be established for many of the 16 species of moss that were found. Regression analyses ($n = 199$) showed that stand age class and stand treatment were both statistically significant factors in explaining volume of *Hylocomium splendens* (step moss), while stand basal area and stand density (stems ha⁻¹) were more useful for explaining *H. splendens* cover. A positive relationship with stand age class and a negative relationship with stand treatment were found for both volume and cover of *Kindbergia oregana* (Oregon beaked moss). No statistically significant relationships were found between *Rhytidiadelphus loreus* (lanky moss) cover and any of the environmental factors measured in the field, although the volume of *R. loreus* increased with stand age. Adjusted R^2 -values for these analyses were all <18.5%.

The low R^2 -values, while statistically significant, indicated that over 80% of observed variability in moss species cover and volume was not explained by stand age class, treatment, basal area, height, or density. Abundance (percent cover) of other species, including liverworts, ferns, herbs and shrubs, was used as a factor to discern ecological interactions with moss; however, none of the relationships were statistically significant.

It is presently unclear what a sustainable ground moss harvest strategy would be on northern Vancouver Island. Management prescriptions must be based on accurate predictions of moss occurrence and abundance, and should also draw on indigenous and local ecological knowledge. There is a need for moss co-management field trials in

Table 1—Mosses, liverwort and fern species found in a chronosequence of 10 stands from 2- to 130-years-old on northern Vancouver Island.

Mosses	Liverworts	Ferns
<i>Aulacomnium palustre</i>	<i>Lophozia incisa</i>	<i>Athyrium filix-femina</i>
<i>Homalothecium</i> ssp.	<i>Conocephalum conicum</i>	<i>Blechnum spicant</i>
<i>Atrichum selwynii</i>	<i>Lepidozia reptans</i>	<i>Dryopteris expansa</i>
<i>Hypnum</i> ssp.	<i>Calypogeia muelleriana</i>	<i>Polystichum munitum</i>
<i>Hylocomium splendens</i>	<i>Plagiochila porelloides</i>	<i>Pteridium aquilinum</i>
<i>Isoetecium stoloniferum</i>	<i>Riccardia</i> ssp.	
<i>Kindbergia oregana</i>	<i>Scapania bolanderi</i>	
<i>Leucolepis acanthoneuron</i>		
<i>Mnium</i> ssp.		
<i>Pogonatum macounii</i>		
<i>Plagiothecium undulatum</i>		
<i>Plagiomnium insigne</i>		
<i>Dicranum</i> ssp.		
<i>Rhizomnium glabrescens</i>		
<i>Rhytidiadelphus loreus</i>		
<i>Sphagnum</i> ssp.		

which permanent plots are established and moss from them picked prior timber being cut, with subsequent monitoring for moss re-growth. The use of applied research, indigenous ecological knowledge, and adaptive forest management could enable access to NTFP opportunities that are both ecologically and economically sustainable.

CONCLUSIONS

These studies have shown that there is potential for co-management to (1) increase both timber and nontimber values in coastal forests in British Columbia, (2) produce material from planned roadways that is eminently suitable for the certified NTFP trade, and (3) reduce, even in the short-term, pressure on valuable NTFP species through increased productivity, until policies can be developed to ensure the sustainable use of NTFP species. The work on Vancouver Island is preliminary, and some is the first of its kind in British Columbia. The lessons learned will guide further work planned for the future, on both the coast and elsewhere in British Columbia.

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DEVELOPING METHODOLOGIES FOR THE ELABORATION OF NATIONAL LEVEL STATISTICS ON NWFP: LESSONS LEARNED FROM CASE STUDIES AND FROM A GLOBAL ASSESSMENT

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ABSTRACT

Reliable and periodical assessments of quantities and values of production and trade at the national level of non-wood forest products (NWFP) are essential for policy formulation governing the sustainable development of forests. However, such statistics do not yet exist for most countries, neither is the already available data comparable among countries. Under a joint European Commission–Food and Agriculture Organization (FAO) partnership programme in support to sustainable forest management in Africa, Asia and Latin America, the NWFP Programme of FAO has developed a standard reporting format to assist countries in recording statistics on the production and trade of major NWFP. This approach was used in order to compile NWFP country profiles for all countries of Latin America, Caribbean, Africa, Near East and Asia. The result of this global assessment has been published as a separate chapter of the Forest Resources Assessment 2000 (FAO 2001). From the lessons learned by implementing this global survey, specific case studies to improve NWFP data gathering methodologies were carried out in selected African and Caribbean countries (Suriname, Cameroon, and Madagascar). The results of the case studies were analysed and recommendations for improved NWFP data gathering methodologies were formulated.

KEY WORDS: Statistics, production, trade, methodologies, non-wood forest products.

INTRODUCTION

In many countries, non-wood forest products (NWFP)³ play an important role in the daily life and well being of their population, particularly in remote areas. In addition to subsistence consumption, NWFP may also be commodities traded on local, national as well as international markets. Internationally traded NWFP, such as bamboo and rattan products, gum Arabic, aromatic oils and medicinal plants, achieve higher prices as compared to NWFP traded locally and can contribute significantly to poverty alleviation and local economical development.

However, despite their (real and potential) importance, no regular and standardized evaluation of the socio-economic contribution of NWFP is being carried out by national institutions, as is the case for timber or agricultural products. In the FAO Yearbook of Forest Products, for example, statistical data on NWFP such as cork, tannins, bamboo and

various oils were covered during the period 1954 to 1971 (Chandrasekharan 1995). Today, reliable information and statistical data are mostly unavailable, both on the economic value of the products and their contribution to the national economy, and on the sustainability of their exploitation (e.g. resource availability, harvesting impact, etc.). Some information may be available at the local level, on a specific product or in a specific area, but this information generally cannot be extrapolated at the country level. At the national level, production and trade statistics on major NWFP remain the exception. In the best case, available information is restricted to selected products that are of particular interest to specific regions/countries, such as bamboo products in China, rattan in the Philippines, gum Arabic in Sudan, or Brazil nuts in the Amazon.

Accurate, reliable information and market outlook studies on non-wood forest products (NWFP) utilization and trade are an essential tool for forest management decision-

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³ NWFP consists of goods of biological origin other than wood, derived from forests, other wooded lands and trees outside forests (FAO 1999).

makers at all levels. In most countries, the current coverage and quality of existing information is inadequate for policy analysis and decision making at national level for forest development.

FAO currently assists national governments and institutions to improve the availability of national qualitative and quantitative data related to NWFP. This effort includes: the development of a standard framework that describes the key information required for the evaluation of NWFP utilization at the country level; the improvement and/or elaboration of methodologies for the collection and validation of the required information—including more precise product nomenclature and corresponding product classification; and the compilation of standardized national reporting formats on NWFP.

These activities were carried out within the framework of the European Commission (EC)–FAO Partnership Programme on data collection and analysis for sustainable forest management in African, Asian, South American, Caribbean and Pacific Countries, from 1998 till 2002; and were funded by the European Commission (Directorate-General VIII).

MATERIALS AND METHODS

Under the above mentioned joint EC-FAO partnership programme, the NWFP Programme of FAO has developed a standard reporting format to assist countries in recording statistics on the production and trade of major NWFP. This approach was used in order to compile NWFP country profiles for most countries of Latin America, Caribbean, Africa, Near East and Asia. The result of this global assessment has been published as a separate chapter of the Forest Resources Assessment 2000 (FAO 2001).

During the project, information on NWFP was gathered, reviewed and compiled to assess the socio-economic significance and ecological impact of NWFP utilization for each country. Existing gaps in the available information, and the constraints related to data collection on NWFP, were identified to elaborate proposals for an adequate monitoring of NWFP utilization. Desk studies were carried out in order to compile draft “country briefs” on NWFP. A standard format for the presentation of the information for the country briefs was elaborated, which includes key information requirements for the evaluation of NWFP utilization. Regional workshops for data validation were held in Africa, Latin America and Asia from 1998 till 2002. The draft country briefs were discussed with country representatives during these workshops with the aim to validate available information.

Regional syntheses were compiled based on all the information collected and includes the identification of major commercialized NWFP and key species, as well as a discussion of the ecological, socio-economic and policy aspects related to NWFP.

The aim of these activities is to help the institutions concerned to respond to three key questions related to the collection and analysis of statistical data on NWFP:

- What kind of information is required to assess production and trade in NWFP?
- What kind of national information is already available on NWFP?
- What needs to be done in order to improve the availability of statistical data on production and trade of major NWFP?

WHAT KIND OF INFORMATION IS REQUIRED?

Monitoring of the resources and evaluation of the economic value of the products for the entire variety of NWFP in a given country is neither feasible nor desirable. The project aimed at identifying NWFP of national relevance for which monitoring and evaluation are strongly needed. Exported and widely used products in national markets were identified in contrast to NWFP of minor importance or significance limited to a selected region. This prioritization will help countries to focus their efforts initially on improved data collection for major NWFP. A further step would then be to include other NWFP as their institutional capacities improve.

In order to evaluate both the socio-economic importance of NWFP utilization and the ecological impact of NWFP exploitation, key information on the product, resource and economic value should be collected:

(a) Product information: “WHICH products?”

For the aim of this project, NWFP were classified mainly according to their end uses, for example as: foods, medicinal plants, fodder, ornamentals, handicrafts, exudates...etc. Information on these categories of NWFP is found more frequently in the literature. The first step is (to check) the correct botanical identification of the plant or animal species. In some cases, this identification can be difficult because the same commercial product can be extracted from more than one species and, vice versa, several different NWFP can be taken from a single species.

(b) Resource information: “HOW is the product harvested?”

Resource information on whether the species used is gathered from wild sources or cultivated (or both) is important. The exploitation of wild species versus cultivated species (generally integrated in a man-made management system) has direct implications on choices at the management level and can have far reaching ecological and socio-economic impacts. Another important element is to describe which part of the plants is harvested (e.g. roots, bark, fruits, leaves, exudates, wood, etc). In fact, the harvesting of different parts of plants has a different impact on the ecology and survival of the species harvested. Knowledge on the habitat of the exploited species is also important as harvesting of NWFP might cause degradation of the habitat if the exploitation is carried out in an unsustainable way. Besides this information, it is important to know the cultural and socio-economic context of the NWFP utilization (for example, access to the resources, the main social categories of harvesters, users, traders, etc.).

(c) Socio-economic information: “HOW MUCH?”

In order to evaluate the economic importance of NWFP, quantitative data is required on production and trade. Figures should indicate both quantity (tons, m³, etc.), product status (dried, graded, semi-processed, etc.) and value (US\$) for a given period (year).

WHAT KIND OF INFORMATION IS AVAILABLE?

The information compiled by implementing this global survey showed that NWFP are still a major source of food and income in many countries of the world. However, few countries monitor their NWFP systematically, so an accurate global assessment is difficult. This section provides a summary of NWFP for which data have been collected and describes the most important NWFP in each region, with estimates of economic value where available. Some of the major problems associated with collecting and analysing data on NWFP are discussed, and suggestions for improving this situation are advanced. The full report with the global and regional synthesis is available (FAO 2001), while detailed country assessments are available on-line from the FAO Forest Department webpage by clicking on “country information”.

Asia is by far the world’s largest producer and consumer of NWFP, not only because of its population size but even more because of the traditional use of a vast variety of different products for food, shelter and cultural needs (FAO

2002a). Asia is unique in that most countries in the region have included data on production and trade of major NWFP in their national statistics for many decades and have developed their own nationally applicable definitions, terminology and classifications for their “minor forest produce”. The types and the relative importance of the listed products change from country to country, but the most important products at the regional level are rattan, bamboo, medicinal and aromatic plants, spices, herbs, resins, mushrooms, forest fruits and nuts, vegetables and fodder. In addition the Philippines, Indonesia and Malaysia include assessments of NWFP resources in their national forest inventories.

China and India are by far the world’s largest producers and consumers of various NWFP. China produces and processes more wild products than any other country in the world. There is growing interest worldwide in its natural foodstuffs, traditional medicines and herbs and in its handicrafts, made mainly from rattan and bamboo. Thus, China dominates world trade in NWFP. It is closely followed by India and then by Indonesia, Viet Nam, Malaysia, the Philippines and Thailand.

Rattan is the most important internationally traded NWFP in the world. At the local level, it is of critical importance as a primary, supplementary and/or emergency source of income in rural areas. Indonesia hosts the bulk of the world’s rattan resources (by both volume and number of species) and is the largest supplier of cane, with an estimated annual production of 570 000 tonnes.

Bamboo is by far the most commonly used NWFP in Asia. Although international trade in bamboo products is still of lesser importance than trade in rattan or medicinal plants, it has dramatically increased in the last decade. Unlike rattan, bamboo is moving out of the craft industry phase and now provides raw material for industrial products (shoots, construction poles, panelling and flooring products, pulp). This has important repercussions for the bamboo resource base. Bamboo is increasingly becoming a domesticated crop grown by farmers. Harvesting of bamboo in forests is still important in Myanmar and the Lao People’s Democratic Republic and in remote mountain forests in northern India, central China and Viet Nam.

Medicinal plants are of major importance in continental Asia, particularly for the higher-elevation regions of Nepal, Bhutan, northern India and Pakistan and southwestern China. High-value medicinal plants include *Nardostachys jatamansi*, *Dioscorea deltoidea* and *Swertia chirayta*. In the drier regions in continental and south Asia, fodder is the main NWFP.

The rich forests of insular and Southeast Asia have traditionally been a major source of a wide variety of non-wood forest products. Those for which there is significant production and trade include bamboo and rattan, medicines and herbs (*Ephedra* sp., *Anamirta cocculus*, *Cinnamomum camphora*), essential oils (*Styrax* spp., *Pogostomon cablin*, *Cassia* spp., *Citronella* sp.), spices, sandalwood, fruits and resins.

The extensive pine forests in the region provide the resource for the collection of pine-related products such as resins, seeds and mushrooms. China and Indonesia dominate the world's production of oleoresins (naval stores) from all sources (largely *Pinus* spp.), which ranges between 1.1 and 1.2 million tonnes annually. China has emerged as the world's largest producer of resin, with an annual production level of nearly 400 000 tonnes. Pine nuts (seeds of *Pinus gerardiana*, *P. pinea*, *P. koraiensis* and *P. cembra*) are an important product with a growing and high-value market, particularly in developed countries. Wild edible mushrooms, particularly morels belonging to the genus *Morchella*, are another product of considerable economic and commercial significance.

The most important NWFP in Africa are medicinal plants, edible products (mainly edible plants, mushrooms, bush meat and bee products) and fodder (Walter 2001). Products of relevance for specific sub-regions are exudates (East and West Africa), cork and aromatic plants in North Africa (Sabra and Walter 2001), ornamental plants and living animals (insular East Africa) and rattan (Central Africa). NWFP are collected in all kinds of habitats, whether in closed or open forests, woodlands (e.g. miombo woodlands in East and southern Africa) or shrublands (mainly in arid zones). Many products (e.g. shea butter) are derived from trees outside the forest located in agricultural fields, fallow areas or home gardens.

NWFP provide important foodstuffs, in particular during the "hungry season" and in marginalized areas affected by conflict. Non-wood forest products provide an important source of income for women. Important edible plants include fruits (e.g. *Irvingia gabonensis*), nuts (e.g. *Vitellaria paradoxa*), seeds (e.g. *Cola acuminata*), vegetables (*Gnetum africanum*), bark (e.g. *Garcinia* sp.), roots (e.g. *Dioscorea* sp.), spices (e.g. *Piper guineense*) and mushrooms. Bushmeat is an important edible product, in particular in the humid parts of Central and West Africa. Honey and beeswax are of major importance in East and Southern Africa.

Fodder is of great importance in the arid and semi-arid zones. Exudates are another group of products of major

importance for sub-Saharan Africa. Important products include gum arabic (*Acacia senegal*, *Acacia seyal*) as well as resins such as olibanum (*Boswellia papyrifera*), myrrh (*Commiphora myrrha*) and opopanax (*Commiphora* spp.). These products are mainly provided by three East African countries, the Sudan (gum arabic, olibanum), Ethiopia (olibanum) and Somalia (myrrh, opopanax).

Depletion of habitat and/or overexploitation are the main threats to the resources providing NWFP. Overexploitation has been documented for species such as *Acacia farnesiana*, *Cyathea* spp., *Cycas thouarsii*, *Gnetum africanum*, *Podocarpus* sp., *Prunus africana*, *Warburgia salutaris* and *Xylopia aethiopica* as well as for some species of rattans, orchids, reptiles, birds, frogs, lemurs and primates. Some of these species (e.g. *P. africana*) are included in the annexes of the Convention on International Trade in Endangered Species (CITES).

The most important NWFP in Latin America are edible products (nuts, fruits and palm hearts, mushrooms and maté), resins, latexes and essential oils (pine resins, natural rubber and eucalyptus oil), medicinal plants, fibers and construction materials (palm fibers, bamboo), fodder, colorants and tannins (FAO 2002b). In the Amazon region, the most well-known edible products, with a considerable domestic, regional and international market, are Brazil nuts and palm hearts. Palm hearts are extracted from wild stands of *Euterpe* spp. or from cultivated palm species like *Bactris gasipaes*. The fruits of *Euterpe* spp. are also an important ingredient in foods and drinks. Latex extracted from *Hevea brasiliensis* is the basis for the production of natural rubber.

In Argentina, Uruguay, Paraguay and southern Brazil, the leaves of *Ilex paraguariensis* are used to brew maté, an extremely popular tea-like beverage. Brazil, Argentina (*Pinus elliottii*), Honduras and Venezuela (*P. caribaea*) are important commercial producers and exporters of pine resin. Mexico, Guatemala (Petén) and Belize are major producers of Chicle, which is a latex tapped from the sapodilla tree (*Manilkara zapota*) and is used for making chewing gum.

The South American region has a long tradition of medicine based on plants, for example *Cinchona* spp. is the source of the antimalarial drug quinine. World production of quinine bark is approximately 8 000 to 10 000 tonnes per year. Important producer countries in South America are Brazil, Bolivia and Colombia. Quebracho colorado (*Schinopsis* spp.) is a source of tannin in Argentina and Paraguay.

Bamboos are largely used in construction, furniture and handicrafts in Colombia, Ecuador and Venezuela. In non-tropical South America (particularly Chile), the young branches of *Salix viminalis* are split and woven for the production of furniture, baskets and other household items. Other frequently used fibers in the region include the leaves of several palm species.

In terms of forest management, there is very little experience in South America with management of NWFP or with integrated management of forests for timber and NWFP. Trials have been conducted for some species. However, most harvesting is done opportunistically and often in a predatory manner. The result is that wild populations of various species are threatened by overexploitation and habitat destruction.

Over the years there has been a general reduction of the proportion of South American NWFP in the international markets, as shown by trade statistics for commercial products (for example latexes, gums, resins). The Brazilian government agency for statistics, Instituto Brasileiro de Geografia e Estatística (IBGE), surveyed the production of some 34 products based on their past economic importance. In 1980, 11 of these had economic value (i.e. production value higher than US\$200,000) and the total production value was US\$160.2 million. By 1995, the number of products had decreased to six and the production value had dropped to US\$65.4 million (ITTO 1998). The decline, in many cases, can be ascribed to competition from synthetic substitutes or products from domesticated sources, but in some cases it is caused by the degradation of the natural resource base. On the other hand, some other products have seen a sharp rise in demand. In Bolivia, for example, in the past ten years recorded palm heart extraction increased from 11 to 4185 tonnes.

As reported in the 'Temperate and Boreal Forest Resources Assessment' (UNECE/FAO 2000) there are, in general, few reliable and systematically collected data on NWFP production for most OECD countries. National potentials, quantities and value by product category and the volumes traded or consumed are poorly known and/or documented in their national forest statistics. A few European countries maintain some regular statistics on NWFP for which harvesting permits are issued by the forest authorities, such as mushrooms, berries, game meat and hunting. Key NWFP on which data are reported include, in order of importance: Christmas trees (including production from plantations on farms and from cuttings in forests), mushrooms, berries and game meat. A few countries also report on decorative foliage, cork, pine resin, herbal plants, honey and nuts (particularly chestnuts, acorns, hazelnuts and stone pine nuts). For nuts, herbal plants and honey, reported data

on total country production include significant outputs from agricultural lands and are usually reported in agricultural statistics.

In Canada and the United States, a great variety of NWFP are gathered, mainly for personal use, and their collection is widespread among rural populations. However, only a few products are included in national forest product statistics. In Canada reported products include: Christmas trees, pelts and maple syrup. Reported data from the United States cover five products: Christmas trees, mushrooms, pelts, maple syrup and commercial fish catch. Even so, the records on mushrooms refer to only four major species from among 25 to 30 species that are commercially used. There are no data for some widely consumed products such as game meat and berries.

LESSONS LEARNED FROM THE GLOBAL NWFP ASSESSMENT

This study confirmed that there is a serious lack of quantitative data at the national level on non-wood forest products and even less on the resources that provide them, with the exception of Asia where there is a tradition of national collection of information on NWFP resources and consumption. Information is scarce and often mixed with agricultural production statistics. Statistical data, where they exist at all, are mostly limited to selected internationally traded products and, in this case, data are usually limited to export quantities. Information on the resource base and on subsistence use of NWFP is non-existent, mainly because of the multitude of products used by local people and the technical difficulty and high cost of measuring and reporting on them.

Even when data exist, they are seldom based on recurrent, statistically designed surveys and inventories, and it is therefore difficult to assess the reliability of the information. For example, even in Asia much of the information is based on national inventories which may be up to ten years out of date. A similar problem exists for the economic value associated with the products because value can be calculated at different stages of production and processing. The data obtained from traditional forestry institutions responsible for the forest resources often differ from the trade data reported by customs agencies.

Because of the factors described above, as well as the lack of internationally agreed-upon terminology, concepts, product classification and clear definitions, statistical data on NWFP resources and production are not usually comparable among countries or regions. Therefore, regional and

global aggregation of production and value is very difficult. A classification system with unified terminology and measurements is needed.

Most of the products are extracted from natural stands in various types of forest and woodland ecosystems. However, among the current issues of global resource monitoring is the lack of management of non-wood resources. For products in high demand, this often leads to unsustainable harvest levels and the potential endangerment or extinction of the species. This has serious socio-economic implications for people dependent on the availability of these resources. Some important products, such as bamboo, are evolving into farmed crops, while others, such as many medicinal plants, are becoming endangered because of deforestation and/or overharvesting. The use of synthetic substitutes has made many others, such as guta percha, balata, sorva, copal and piassaba fibers, obsolete.

What Needs to be Done in Order to Improve the Availability and Quality of Statistical Data on Production and Trade of Major NWFP?

In addition to the above desk studies and the regional data validation workshops, “pilot studies” were initiated in given countries to develop and/or improve appropriate methodologies and data gathering mechanisms for collection, validation and compilation of statistical data on NWFP. These methodologies should provide reasonable estimates of the production, consumption and trade in NWFP and be cost-effective, widely applicable and relevant to other countries in the region. In addition, the aim is to evaluate the coverage of NWFP through national statistics and to identify key institutions involved or needed in the collection of statistical data, as well as the methods used for data collection. Finally, necessary steps to improve the availability of statistical data on NWFP were elaborated, as well as the identification of related training and capacity building needs in the countries.

Case studies were implemented in Suriname (Rahan-Chin 2002), Cameroon (Mbolo 2002) and Madagascar. Lessons learned from the case studies and the above assessment showed that for most countries statistical data on NWFP are scarce and mainly available for exported NWFP. However, only a few exported NWFP do have specific product classification codes and are included in the International Harmonized Commodity Description and Coding System (HS) of the World Custom Organization (WCO). Most other information on NWFP is based on the analysis of licenses and permits which are issued by various govern-

mental organizations, mostly those departments in charge of forestry, but also from those covering agriculture, industry, customs or trade. The available data mainly shows the economic value of exported products and are insufficient for appropriate monitoring and evaluation of the management of natural resources.

The Surinam study suggests that a lead institutional infrastructure is needed and a refinement of data to be collected. The current objective of the collection of statistical data is to assess the value and revenues from NWFP for the government. These data are insufficient for the appropriate monitoring and evaluation of the management of resources providing NWFP.

The following major constraints have been identified regarding statistical data collection: there is no legal definition of what are to be considered NWFP; no uniformity exist in data collection; there is little or no coordination or exchange of information among the different line ministries (forestry, agriculture, industry, customs) involved along the NWFP production, processing and trade chain; the NWFP sub-sector is not organized and an institutional infrastructure needed for proper management of NWFP is lacking; a comprehensive inventory of the existing NWFP is not available; and there is a lack of trained personnel and funding.

A methodology for improved statistical data collection and analysis was elaborated and included the following major elements: identify and agree upon a lead institution to coordinate NWFP related work; identify the kind of data needed and points of data collection; elaborate and maintain a NWFP-related database linked to relevant existing databases on production and trade in the country; develop data collection standardized forms; develop identification guides on species which provide NWFP for use by i.a. custom officials; and training of concerned staff and stakeholders.

The main objective of the Cameroon study was to review available information on NWFP and to propose an appropriate methodology to improve the quality and quantity of statistical data on NWFP for Cameroon. Preliminary results of the study were presented and discussed in two workshops held in Yaoundé, Cameroon in March and November 2001.

The study shows that various methodologies are already in place in order to assess the production and commercialization of NWFP in Cameroon, including single-product

inventories, qualitative resource inventories, systematic samples and market studies. Taking into account the current use of NWFP in Cameroon, the study identifies ten priority species, for which an improved monitoring and evaluation of their use is recommended: *Gnetum* spp, *Garcinia lucida*, *G.kola*, *Raphia* spp., rattan (e.g. *Laccosperma secundiflorum*), *Prunus africana*, *Pausinystalia johimbe*, *Baillonella toxisperma*, *Guibourtia tessmannii* and *Scorodophleus zenkeri*.

The study proposes a methodology that monitors NWFP from the resource to the final consumer in order to assess key information on: (1) geographical distribution; (2) potential production; (3) actual production (collected quantities); (4) national consumption; (5) trade; and (6) social aspects, such as contribution to employment.

The proposed methodology was tested for the leaves of *Gnetum* spp. Field tests were carried out in Elig-Nkouma (South Cameroon), the port of Idenau and the international airport of Yaoundé. These tests showed that: (1) in Elig-Nkouma 4.15 t of *Gnetum* spp. were produced, which corresponds to 0.85% of the national production (488.57 t) during the 6 weeks of the field test; (2) more than 90% of the national production (446.57 t) was exported to Nigeria and Europe; and (3) the consumption in the cities of Yaoundé and Douala was 22.3 t, which corresponds to 4.6% of the total production. The test also documented ecological problems related to the harvesting techniques applied and highlighted the socio-economic importance of the consumption and commerce of *Gnetum* spp. in Cameroon.

The study concluded that in order to improve the quality of statistical data on NWFP in Cameroon, it is recommended to (1) harmonize and co-ordinate the NWFP activities of the stakeholders concerned by taking into consideration their objectives, activities, methodologies applied, etc.; and (2) share and distribute the information already available, for example through the establishment of a national database by a governmental agency.

A key issue emerging from implementing all above mentioned activities showed that the best available NWFP statistics so far, are those on NWFP which are internationally traded. However, also for this group, the above assessment studies revealed that a lot of work still needs to be done, particularly regarding their appropriate classification and corresponding product coding. Products traded internationally are classified by custom agencies according to the harmonized commodity description and coding system, generally referred to as “harmonized system” or simply “HS”. It is a multipurpose international product nomenclature developed by the World Customs Organization

(WCO- www.wcoomd.org/ie/index.html). It comprises about 5,000 commodity groups; each identified by a six-digit code, arranged in a legal and logical structure and is supported by well-defined rules to achieve uniform classification. The system is used by more than 177 countries and economies as a basis for their Customs tariffs and for the collection of international trade statistics. Over 98% of the merchandise in international trade is classified in terms of the HS. Only commodities entering external merchandise trade are included.

For those NWFP, which have a specific HS code, trade statistics can be easily compiled from international trade databases such as Comtrade. For example the HS code used by custom agencies world-wide to “classify” plaiting materials made of bamboo is 1401.10. However, many internationally traded NWFP, like bamboo shoots for example, do not have a specific HS code.

In this regard, the FAO NWFP Programme and the International Network for Bamboo and Rattan (INBAR), with the support of custom agencies of key producer countries such as China, have developed a proposal for amendments to the HS codes for major bamboo and rattan products, through an international expert meeting held in Rome, 2002. A set of new HS codes covering 17 different bamboo and rattan products were identified, reviewed and endorsed at the meeting, and will be submitted to the WCO Review Subcommittee Meeting of September 2003.

Bamboo and Rattan products are the ‘flagships’ of NWFP, and it is hoped that the lessons learned on identifying and implementing new HS trade codes for bamboo and rattan products can be expanded to other major groups of NWFP such as medicinal plants, forest gathered wild vegetables, wild mushrooms, fruits and nuts.

CONCLUSIONS

Many lessons have been learned during the compilation of the global assessment on NWFP production and trade data under the EC–FAO Partnership programme. Among the most important ones is the fact that NWFP are still a major source of food and income in many countries of the world, but few countries do monitor their NWFP systematically. Statistical data on NWFP are incomplete, scattered or not comparable among countries.

However, monitoring of the resources and evaluation of the economic value of the products for the entire variety of NWFP in a given country is neither feasible nor desirable. A phased approach is suggested by addressing first those NWFP which are of national relevance and for which

monitoring and evaluation is needed for policy and forest/rural development decision-makers. Exported or widely used products in national markets should be addressed first in contrast to NWFP of minor importance or significance limited to a selected region. The selection of relevant NWFP should help the country initially to focus their efforts to improved data collection.

Countries can, with the support from FAO and other appropriate international organizations, make NWFP more visible in their existing national production and trade statistical systems by including specific product codes for major NWFP into their existing national product classifications, with the aim to include them into international statistical classifications in the future, such as the HS.

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BENEFIT SHARING ARRANGEMENTS IN THE FIELD OF NON-WOOD FOREST PRODUCTS: STATUS AND LINKS TO CERTIFICATION

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ABSTRACT

For agricultural and timber products, benefit-sharing arrangements (BSA) and certification schemes have been established in order to monitor and evaluate the ecologically friendly, economically viable and/or socially equitable use of these products. BSAs have been developed regarding species with medical properties in the areas of bioprospecting and trade. Other non-wood forest products (NWFP) covered by BSA include cosmetics, animal products and exudates (gum arabic). Key certification schemes relevant for NWFP are forest management certification, social certification, organic certification and product quality certification. This paper describes BSA in the field of NWFP and discusses linkages between BSA and certification as potential tools for the promotion of improved benefit-sharing.

KEY WORDS: Non-wood forest products (NWFP), certification, sustainable forest management, organic products, product quality, benefit-sharing.

INTRODUCTION

A multitude of non-wood forest products (NWFP⁴) are derived from forests and used by local communities in developing countries for subsistence and income generation. Income-generating activities consist mainly of the collection and sale of unprocessed NWFP such as medicinal plants, fruits, gums, resins and honey. The benefits local populations receive from the trade in these products are often considered inadequate compared to the benefits received by other stakeholders.

This paper describes benefit-sharing arrangements (BSA) in the field of NWFP and discusses linkages with certification initiatives which might be potential tools to promote equal benefit-sharing.

BASIC DEFINITIONS

Benefit-sharing

Benefit-sharing arrangements have been proposed and established in order to promote and ensure the “fair and equitable sharing of the benefits” arising out of the use of

natural resources (see article 1 of the Convention on Biological Diversity, CBD). These arrangements aim to balance the interests of various key stakeholders in the trade in NWFP and other forest products. Stakeholders include local communities, small or large-scale private sector enterprises, consumers, governmental bodies and non-profit intermediaries (see fig. 1).

The benefits obtained through such arrangements can be monetary and non-monetary, shared in the short, medium and long-term and should be mutually agreed upon by the stakeholders concerned (table 1). Benefit-sharing agreements are mainly made among a provider, recipient and intermediaries of genetic material and may be applied during the identification, development and commercialisation of a product (Ten Kate and Laird 1999).

The concept of benefit-sharing is being applied to the trade in various forest products, such as NWFP, wood products and forest services. The mechanisms used to implement BSA include trust funds, ethical trade agreements, certification, charitable donations, taxes and producer-trader

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⁴ “NWFP consist of goods of biological origin other than wood derived from forests, other wooded land and trees outside forests” (FAO, 1999).

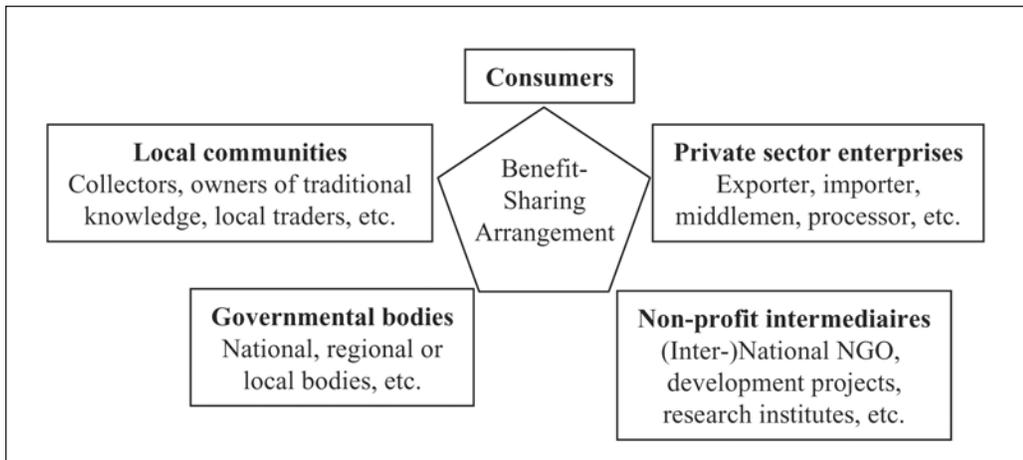


Figure 1—Main stakeholders involved in benefit-sharing arrangements.

partnerships. In the forestry sector, the issue of benefit-sharing is partly addressed through collaborative approaches to forest management such as community forestry, social forestry, and joint forest management. It is also addressed through the establishment of Forest User Groups (e.g. Nepal) or Share Holding Integrated Forest Tenure (e.g. in China) (FAO, forthcoming; Rechlin et al. 2002).

Certification

Certification is a procedure in which written assurance is given that a product, process or service is in conformity with certain standards (International Organization for Standardization/International Electrotechnical Commission 1996).

Although different definitions and categories of certification exist, the main types of certification schemes distinguish between first, second and third party certification as well as between system-based and performance-based certification schemes (table 2). Many, but not all, certification systems provide labels for certified products or services. A certification label or symbol indicates “that a product, process or service has been certified against a certain standard” (Dankers 2002).

While certification schemes have mainly been developed for timber and agricultural products, they are becoming more relevant for the use of NWFP. Depending on their basic concepts, certification schemes such as forest management certification programmes, social certification systems, organic agriculture and product quality certification, focus on different areas such as production, trade, marketing, processing and manufacturing (for further details, see Walter 2002a, 2002b).

Forest management certification programmes, including chain-of-custody certification, mainly assess the ecological aspects of resource management, both at the forest and the species or product level. Many different programmes exist on the international, regional and national level, which focus almost exclusively on timber products and include NWFP only marginally.

Social certification systems, such as fair and ethical trade, assure that labour conditions are acceptable and benefits are equally shared among those involved in production and trade. Such trade initiatives foster business partnerships and management supply chains, which include secure and fair commercial deals and support the provision of market information (Kruedener 2000). Important criteria focusing on social issues include: (1) tenure and customary rights; (2) fair returns and adequate benefits; (3) safe and healthy working environment; (4) impact on local/indigenous communities; (5) economic viability; (6) absence of child labour; and (7) ethical marketing (Mallet 2000; Burns and Blowfield, no date).

“Organic agriculture is a holistic production management system which promotes and enhances agroecosystem health, including biodiversity, biological cycles, and soil biological activity...” (FAO/WHO 1999a). Wild gathered and semi-domesticated NWFP can also be considered organic and many NWFP such as pine nuts, mushrooms and herbs are increasingly commercialized as organic food products.

Product quality certification aims at ensuring that defined production standards have been taken into consideration. These standards can focus on the product itself as well as

Table 1—Examples of monetary and non-monetary benefits for developing countries

Monetary benefits	Non-monetary benefits
<ul style="list-style-type: none">• “Up-front” payments• Milestone payments• Royalties• Research funding• License fees• Salaries• Equity and profit-sharing opportunities• Higher sale price of products	<ul style="list-style-type: none">• Contributions to local economy and at the village level, e.g. livelihood improvement such as infrastructure and food security• Community empowerment through improved negotiation capacities• Strengthened capacity of local populations in the sustainable use of natural/genetic resources• Exchange of staff and training• Capacity building and transfer of technology• Sharing of research results• Increased scientific capacities, e.g. through support to research activities

Source: United Nations Environment Programme/Convention on Biological Diversity (2000), Ten Kate and Laird (1999), FAO (2000a)

on the way it is processed and manufactured. Product quality parameters include product identity, purity, efficiency and safety. These parameters are relevant for a wide range of internationally traded NWFP mainly used in the food and pharmaceutical industry. One example of international commodity and general standards relevant for the food industry is the Codex Alimentarius, which aims at developing and disseminating international food standards to protect consumer health and to facilitate international fair trading practices regarding foods (FAO/WHO 1999b; Health Canada, no date).

BENEFIT-SHARING IN THE CONTEXT OF NWFP

The documentation of different BSA by Ten Kate and Laird (1999), FAO (2000a), and CBD (2002), shows that arrangements in the field of NWFP cover both the identification of new products and the actual trade in NWFP.

The identification and development of new products is best documented for bioprospecting activities carried out by the pharmaceutical industry (table 3). BSA directly related to the international trade in NWFP are documented for a wide variety of products such as medicinal plants, cosmetics, exudates, edible products and wildlife-based products.

Identification and Development of New Products

Research in the identification of new, nature-based products is carried out by various industrial sectors. However, most documented cases of BSA are related to the pharmaceutical industry. This is mainly because, compared to others, the pharmaceutical sector requires greater investments of time and money.

The search for commercially valuable biochemical and genetic resources from plants, animals and microorganisms—so called bioprospecting—is carried out in two different ways in order to develop new drugs:

- Random screening of chemicals found in nature; and
- Selective screening of chemicals based on traditional knowledge of the medical application of organisms, especially medicinal plants. Ethnobotanical screening, mainly carried out by small companies and academic institutions, is designed to save time and money and is “...5,000 times more effective than random collection” (Rural Advancement Foundation International 1994, Rosenthal 1998).

One third of all plant-derived prescription drugs with known anti-tumour properties come from rainforest species (Anonymous, no date). However, most of the commercial benefits of the trade in genetic and biochemical resources found in developing countries are realized in developed countries. Pharmaceutical products based on traditional medicine have probably returned less than 0.001 percent of their profits to the local communities who originally used these resources (Posey 1990, quoted by Guérin-McManus, no date). The annual world market of medicines derived from plants originally used by indigenous people (e.g. *Rauwolfia serpentina*, *Cinchona* sp., *Atropa belladonna*) is estimated at US\$43 billion (idem).

In order to assure that (1) the provider(s) of genetic resources and/or traditional knowledge receive adequate property rights and (2) the share of benefits be equally distributed among all stakeholders, including men and women in local communities, national states and private companies, BSA related to the identification of new drugs were developed.

Table 2—Basic principles of certification systems

Certification principles	Definition	Examples
First party verification	Internal assessment of production systems and practices. company standards, (e.g. Weleda,	Sustainable Forestry Initiative (SFI), business ethics standards, Wala), codes of practice, codes of conduct (e.g. Body Shop)
Second party verification	Assessment of a second party (e.g. customer or trade associations), who assess the company according to contractual obligations.	EU Regulation 2092/91
Third party verification	Independent assessment of a separate accredited third party.	Forest Stewardship Council (FSC), International Federation of Organic Agriculture Movements (IFOAM)
Standards	“Documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purposes” (International Organization for Standardization 1996).	Standards by various accreditation and certification bodies.
System-based standards	Focus on the <i>process</i> and evaluate whether specific systems are in place which allow organizations and/or producers to achieve their (performance) objectives.	Environmental management systems International Organization for Standardization (ISO) 14001/14004, Social Accountability 8000, SFI ^a , Pan European Forest Certification Scheme (PEFC) ^b , Canadian Standards Association (CSA) ^a
Performance-based standards	Focus on the <i>outcome</i> , the quality of goods and/or services, which should be in accordance to defined standards.	FSC, Rainforest Alliance/ SmartWood, IMAFLORA, CFV, ERA, WWFMedPO

Source: Carey (2000), Costa and Ibanez (2000); Maas and Ros-Tonen (2000), Fern (2001), Dankers (2002), Blowfield (no date), Sierra Club (no date), Temple-Inland Forest (no date).

^a SFI, PEFC and CSA are mainly system-based certification schemes, which include some performance-based standards (Fern 2001).

^b PEFC is mainly based on the Pan-European forest process on criteria and indicators for sustainable forest management (Fern 2001). Major inter-governmental processes or initiatives on criteria and indicators for sustainable forest management, covering some 150 countries, are documented by FAO (2001).

Recently, vast experience has been gained in BSA related to bioprospecting through the work of the International Cooperative Biodiversity Group (ICBG) which undertook eight projects in tropical countries (Rosenthal 1998).

A key component of many bioprospecting projects is the establishment of trust funds, which aim at facilitating the distribution of monetary benefits while avoiding the problems related to direct cash payments (United Nations Environment Programme/Convention on Biological Diversity 2000). In the case of the Suriname ICBG bioprospecting project, a Forest People's Fund was set up in 1994 with a US\$50,000 contribution from an American pharmaceutical

company, followed by another US\$10,000 “up-front” payment in 1996. The fund was intended to compensate communities for their ethnobotanical contributions to the project and aimed at creating conservation incentives, financing sustainable management projects, providing research and training exchanges and supporting other socially and environmentally sound projects (Guérin-Mc Manus et al., no date).

Although trust funds are intended to be a useful mechanism for the distribution of monetary benefits, the following questions need to be considered when planning their design:

Table 3—Key characteristics of pharmaceutical, botanical medicine and cosmetic industry

	Pharmaceutical industry	Botanical medicine industry	Natural personal care and cosmetic industry
Definition	Industry involved in the discovery and development of new drugs (natural, semi-synthetic, synthetic) ^a	Industry dealing with botanicals, produced directly from whole plant material.	Segment of the personal care and cosmetic industry, which includes botanical ingredients in their products ^b
Years to develop new products	10–15+	<2–5	<2–5
Costs to develop new products (million US\$)	231–500	0.15–7	0.15–7
Annual global sales (billion US\$)	300	40	n/a
Share natural products/all products of global market (in %)	25–50	100	n/a
Market for natural products (billion US\$)	75–150	20–40	2–8

Source: Ten Kate and Laird (1999)

Explication: n/a = Information not available

^a 41% of the top 150 prescription drugs in the United States contain at least one active compound derived from animal or plant genetic resources (Ten Kate and Laird 1999).

^b The natural segment of this industry is estimated to 10% of the total sales (Ten Kate and Laird 1999).

- How can a fair and equal distribution of monetary benefits be ensured?
- Which mechanisms are most appropriate to facilitate the distribution of monetary benefits?
- Who should be the principle beneficiaries: those individuals or groups who actively participated in the BSA, or everyone in the village (or region or country)?
- How are local communities defined—geographically, ethnically or politically?
- What are the most relevant non-monetary benefits and how are they taken into account?

TRADE IN NWFP

BSA directly related to the trade in NWFP cover a wide range of sectors, including the pharmaceutical, botanical medicine, personal care and cosmetics, and food industry sectors. However, the supply channels for raw materials are similar and wholesalers, including exporters, traders, brokers and agents, sell to a range of different industries (Ten Kate and Laird 1999). Examples of BSA related to trade in medicinal plants, cosmetics and the wildlife industry are described below.

Medicinal Plants

Although sound statistics on trade in medicinal plants do not exist, it is estimated between 2,500 (Schippmann et al. 2002) and 6,000 (TRAFFIC 1993) medicinal plants are currently traded world-wide. CBD (2002) and Ten Kate and Laird (1999) document BSA for the trade in *Trichopus zeylanicus* (India), *Ancistrocladus korupensis* (Cameroon), *Prunus africana* (Cameroon), *Calophyllum lanigerum* (Malaysia), *Taxus brevifolia* (USA), *Piper methysticum* (Pacific Islands), *Panax vietnamensis* (Vietnam) and *Pilocarpus jaborandi* (Brazil). In at least three cases, these BSA failed:

- *Anisistrucalduc korupensis*—the U.S. National Cancer Institute stopped conducting research and development when the toxicity of the active substance they were interested in, michellamine B, was discovered (Laird and Lisigne 1998);
- *Prunus Africana*—the main exporter annulled an agreement with governmental organizations and local harvester groups due to a disagreement with governmental organizations, which limited the maximum annual sustainable quota to 300 t of bark (FAO 2000a);

- *Pilocarpus jaborandi*— promised benefits by the exporter such as steady income, roads, schools and clinics never materialized. In addition, many of the 25,000 collectors of wild gathered jaborandi leaves might lose an important source of income if plantations are established (Ten Kate and Laird 1999).

One major mechanism to facilitate the proper disbursement of monetary benefits used by most of the BSA in the field of medicinal plants is trust funds (also see above). Harvesters of *Prunus africana* bark in Cameroon, for example, who were organized in a Prunus Harvesters Union, paid a part of their income (equivalent to 2 kg of bark) to the Village Development Fund. Five months after the fund was set up, some US\$1,500 had been generated. This money was intended to be used by the village for a long-awaited water project (FAO 2000a).

Cosmetics

The main monetary benefits provided by the natural segment of the personal health care and cosmetic industry are derived from charitable donations as well as guaranteed markets and higher prices paid for raw materials. The main mechanisms available to secure market access and improve prices are raw material sourcing partnerships.

One example of such a partnership involves The Body Shop (Ten Kate and Laird (1999), which established some 25 trade partnerships (e.g. in Brazil, Ghana, Nicaragua, United States) with local communities in 1997. Criteria for these partnerships included:

- Working with community organizations that already exist to represent the interests of the social group concerned;
- Working with groups with limited access to resources, education, healthcare, and other outlets for their goods;
- Trade must benefit the producers, so benefits must be redistributed throughout the community in ways that promote development;
- The partnership must be commercially viable—price, quality, capacity, and accessibility must be carefully considered; and
- The activity must meet Body Shop standards for environmental and animal protection.

Wildlife Industry

One example of BSA in the wildlife sector is Zimbabwe's Communal Areas Management Programme for Indigenous Resources (CAMPFIRE). In Zimbabwe it was recognized that wildlife resources would only be conserved

if private and communal landowners derived economic benefit from their protection and were given responsibility for conservation and management. CAMPFIRE aims at providing a structure to ensure the sustainable use of these resources.

The programme aims at improving local income by returning benefits from wildlife activities such as safari hunting, game cropping, tourism, and live animal sales, to local communities. In addition, CAMPFIRE contributes to the improvement of infrastructure, capacity building and future security of local communities (World Bank, no date; CAMPFIRE, no date).

Regarding monetary benefits, CAMPFIRE aims at:

- Returning money to producer communities derived from natural resource use;
- Providing the communities with the full choice of how to use this money;
- Ensuring a participatory, transparent, accountable and democratic process of distribution of monetary benefits (Child 1996).

Child (1996) concludes that, as a result of this approach, "CAMPFIRE has benefited local communities and councils with up to 70,000 households and 80 wards [villages] getting direct benefits".

CERTIFICATION SYSTEMS—TOOLS TO PROMOTE THE ADEQUATE SHARE OF BENEFITS?

Comparing the main objectives of BSA with certification schemes (fig. 2), the closest links exist between BSA and social certification systems, since both focus on the equal sharing of benefits among stakeholders related to the commercialization of products.

BSA are contractual arrangements among stakeholders and do not normally involve an independent "third" party. Therefore, they correspond to first or second party certification systems where the arrangement could be considered a guiding principle or standard. The Swiss draft guidelines on access and benefit-sharing point out that "stakeholders are encouraged to collaborate in creating a system of certification...which would confirm the abidance to the guidelines by the stakeholders being certified. When creating this system of certification, the involved stakeholders are encouraged to consider the suitability of any existing institution or mechanism already involved in certification and standardisation" (Swiss State Secretariat for Economic Affairs 1999: 7/12).

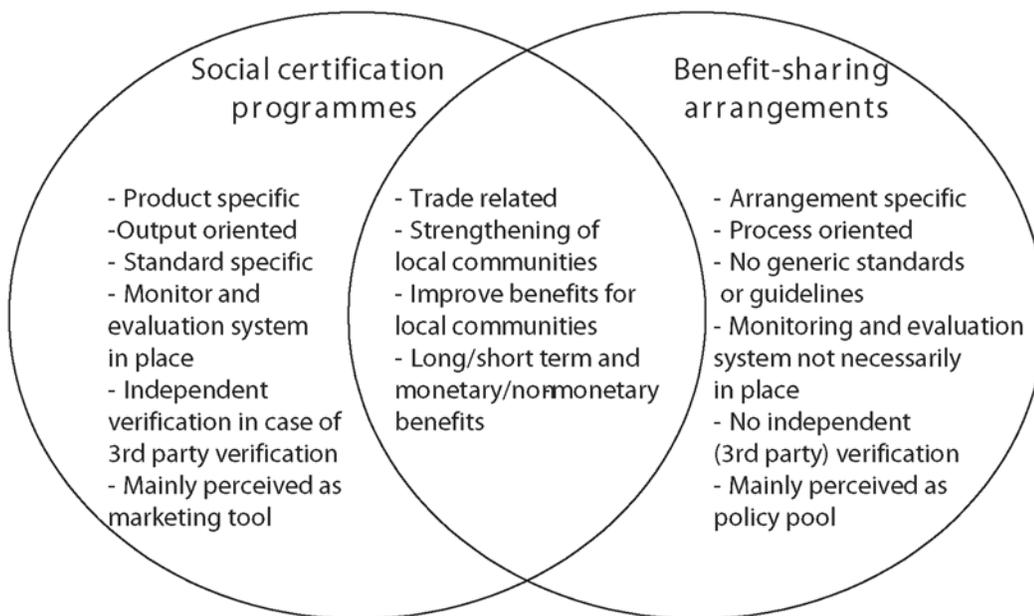


Figure 2—Commonalties and differences between social certification systems and BSA.

Lessons could also be drawn from an in-depth analysis of the complementarities of the certification and benefit-sharing approaches, taking into account that the principles of the CBD might enhance certification programmes, while standard setting and verification might strengthen BSA.

Other certification schemes, such as forest management, organic and product quality certification, do not focus on benefit-sharing as such, but provide additional benefits as mentioned in table 1.

Forest management certification schemes and criteria and indicators for sustainable forest management include social standards to various degrees. Examples include FSC's principles 2 (tenure and use rights responsibilities), 3 (indigenous people's rights), 4 (well-being of forest workers and local communities) and 5 (benefits from the forest) and criterion 6 (other social benefits) of the Pan-European Forest Process on Criteria and Indicators for Sustainable Forest Management, which defines the minimum criteria to be used in European schemes applying to the PEFC (FAO 2001, FSC 2002, PEFC 2002).

The application of these standards indirectly contributes to the improvement of benefits for local producers since they:

- Provide binding and verifiable agreements between key actors;
- Strengthen or clarify user rights;

- Provide value-addition and market premium prices for certified products;
- Empower normally disadvantaged stakeholders, especially local communities;
- Act as a catalyst of social reform processes through stakeholder participation and consultation;
- Provide market niches for specific products or services;
- Encourage the establishment of collaborative partnerships and/or global alliances between producers and consumers for the responsible use of forest resources (FAO 2000b, Kruedener 2000, Gesellschaft fuer Technische Zusammenarbeit 2002).

However, forest certification might also cause disadvantages for producers and other stakeholders. These disadvantages include high financial and managerial costs and reduced short-term revenue due to lower output volumes (FAO 2000b). In order to prevent additional possible disadvantages, rural development programmes must compliment certification initiatives in order to provide community leverage or reinforcement of existing tenure agreements (Meek 2001).

ISSUES AND PERSPECTIVES⁵

Both certification and benefit-sharing are potential tools to promote the sustainable use of NWFP and reduce the

⁵ Derived from Walter (2002a).

negative effects of international trade in NWFP on the resource system. However, an in-depth analysis is still required in order to identify the key factors leading to either the success or failure of the application of these tools. Crucial issues which should be taken into consideration when analysing BSA and certification systems include:

- Which certification programmes or BSA exist and under what conditions are they most suitable and for whom?
- Which mechanisms are most appropriate to facilitate the distribution of monetary benefits? Who should be the principal beneficiaries? How should they be organized?
- How relevant are these mechanisms in the promotion of the sustainable use of NWFP, taking into account that they are only applied for selected species and specific locations?
- What are the impacts of certification and benefit-sharing as policy tools that provide a multitude of non-monetary benefits such as improved capacity, stakeholder participation and consultation, and the recognition of custom, tenure and user rights?
- How do certification and benefit-sharing mechanisms actually contribute to poverty alleviation? Will they remain tools providing benefits to a limited number of people or will these mechanisms contribute to the improvement of local livelihoods on a larger scale?
- Are certification and benefit-sharing mechanisms able to promote the production of NWFP by forest dependent people as opposed to the production of these products through farming? (This is particularly so for medicinal plants, where “competition” between farmed and wild gathered products is high.)
- What is the potential of certification and benefit-sharing as market tools? For which products, certified or produced in the context of BSA, does a market actually exist that allows the payment of a premium price?
- How do the additional costs that result from certification and benefit-sharing influence the application of these mechanisms?
- How applicable are certification and benefit-sharing mechanisms for rural areas and dispersed people?
- How applicable and effective are certification and benefit-sharing mechanisms as tools for the improved traceability of supply chains?

- What methods can be applied in order to define sustainable harvesting levels, taking into account the lack of ecological information on many species providing NWFP? Do species-specific standards sufficiently avoid negative ecological effects on the entire production system?
- Can certification programmes be used as voluntary control tools to monitor and evaluate the compliance with laws and regulations such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)? For example, CITES requests that trade in appendix II species, which risk becoming threatened with extinction, be closely controlled so as not to be detrimental to the survival of the species (CITES 2002). This control could be provided by certification systems.

These and many more issues have to be clarified in order to assess the relevance and applicability of certification and benefit-sharing as tools for the sustainable use of NWFP.

The FAO NWFP Programme, in collaboration with other programmes, organizations and agencies, aims at contributing to this assessment by:

- Collecting, analysing and disseminating information on (1) relevant stakeholders involved in certification and benefit-sharing (e.g. private sector, governmental and non-governmental organizations) as well as (2) existing certification and benefit-sharing mechanisms for NWFP (e.g. labelling systems); and
- Implementing case studies which aim at assessing the impact of certification and benefit-sharing on the sustainable use of selected NWFP.

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