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Cover photo: *Members of an artisanal cooperative in Uganda making chairs from rattan*
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Editorial focus and readership

Unasylva is an international journal of forestry and forest industries, produced quarterly in separate English, French and Spanish editions. *Unasylva* covers all aspects of forestry: policy and planning; conservation and management of forest-based plants and animals; rural socio-economic development; species improvement; industrial development; international trade; and environmental considerations, including the role of forests and trees in maintaining a sustainable base for agricultural production at the micro and macro levels as well as the effects of environmental change on forestry.

Articles submitted should be of interest to the broadest possible cross-section of *Unasylva*'s readership, which represents the following groups:

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- industrial forestry operators, both government and private;
- individual professional foresters, especially those concerned with inter-national forestry.

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Abbreviations and acronyms should be defined the first time they are used; for example, the International Centre for Research in Agroforestry (ICRAF).

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Articles should be accompanied by appropriate bibliographies. The name of the author(s) and date of publication should be indicated at appropriate points in the text (e.g. Franklin and Forman, 1987; Viana *et al*., 1996), with the full reference given in a separate list at the end of the article. Note that the term *et al*. is used in the text reference when there are four or more authors. However, it should never be used in the bibliography, where all authors must be named.

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EDITORIAL

Rattan

Worldwide, hundreds of millions of people trade in or use rattan for purposes ranging from furniture - the most well-known rattan product - to walking sticks, umbrella handles, baskets, matting, hats, ropes, birdcages, fish traps and numerous other local uses. However, rattan resources (which comprise some 600 species), throughout their natural range in the tropical forests of Asia and Africa, are being depleted through overexploitation, poor forest management and loss of forest habitats.

This issue of *Unasylva* spotlights this important but perhaps underappreciated non-wood forest product (NWFP). The first article, by C. Sastry, gives an overview of the resource and major issues for the global development of rattan, looking at resource management, technology and research as well as trade and industry. Sastry also discusses the potential of rattan as a plantation crop for both smallholders and large-scale planters.

Taxonomic knowledge of rattan species is patchy, and confusion in nomenclature has proved a challenge to rattan research and development. In the second article, J. Dransfield discusses issues in rattan taxonomy and the biology and ecology of this group of plants. He also addresses difficulties in assessing the conservation status of rattans.

Although most species by far are native to Asia, 20 species in four genera are endemic to Africa. However, the development of the rattan resource in Africa has until recently been hindered by a lack of basic knowledge about the exact species used, their ecological requirements and the social context of their utilization. T. Sunderland discusses the status of rattan resources in Africa and examines the issues influencing development of their utilization and trade.

Although like many NWFPs rattan is typically exploited from the wild, it can also be cultivated. In Kalimantan, Indonesia, rattan planted in a traditional rice-swidden system has long had a vital role as a primary, supplementary and/or emergency source of income. However, as demonstrated in the article by B. Belcher, the role of rattan in rural livelihood strategies is changing as a result of combined policy and economic factors, especially the recent large-scale establishment of oil-palm and pulp plantations.

Can rattan harvesting be managed sustainably? S.F. Siebert examines this question, with a focus on a study of the ecological effects associated with cane extraction in Central Sulawesi, Indonesia. Management of the existing resource is also considered against the alternatives: clearing for cash crops on the one hand, and rattan cultivation on the other.

Post-harvest treatments for rattan, including seasoning, oil curing, bleaching and protection from insects and fungi, are necessary to increase market value. W. Liese

summarizes challenges and constraints encountered in treatment, processing and utilization of rattan, noting the progress made in overcoming these over the past 20 years, particularly in Asia.

Finally, L.T. Hong, V. Ramanatha Rao and W. Amaral describe work carried out by the International Plant Genetic Resources Institute (IPGRI) on the identification, diversity and conservation of rattan genetic resources - research that is needed in order to foster sustainable management and utilization of the species.

The articles in this issue have all been adapted from papers presented at the Expert Consultation on Rattan Development, which was held in Rome from 5 to 7 December 2000 to assess the current status of the resource and its utilization, identify the major issues facing the rattan industry and formulate recommendations for promoting economic and technical cooperation for the development of rattan globally. The complete papers will be published in the proceedings, which will be available from the Forest Products Division, FAO Forestry Department, towards the end of 2001.

A problem underlined by the expert consultation, and voiced by many authors in this issue, is the absence of reliable statistics on rattan at all levels. National forest inventories, with few exceptions, do not include rattan, and quantitative information on the resource base and volume and value of trade is scarce. Because of wide variation in figures from different sources, data in different articles may seem contradictory. Readers should keep in mind that figures quoted in these articles are estimates only.

Collection of statistics and exchange of information on rattan are among the main objectives of the International Network on Bamboo and Rattan (INBAR), established in 1997 with a global mandate to promote the development of bamboo and rattan for socio-economic and environmental well-being (see profile of INBAR in *Unasylva,* 198: 48-53). In addition, international agencies such as the Center for International Forestry Research (CIFOR), the International Tropical Timber Organization (ITTO), IPGRI and FAO deal with rattan, either through specific programmes or indirectly in their livelihood support programmes.

Given its economic, ecological and socio-cultural importance to a large number of people in the world, there is an urgent need to ensure a sustainable supply of rattan. Attention to property rights, quality improvement, control of illegal harvesting, market information, prevention of post-harvest losses and supportive tax policies are recommended to help improve benefits to harvesters and producers, providing incentive to maintain the resource sustainably.

Rattan in the twenty-first century - an overview

C.B. Sastry

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An overview of major issues and needs for the global development of rattan.

Humans have used rattan for their livelihoods and subsistence for many centuries. Although rattan is confined mainly to Southeast Asia, the material has found its way to many other parts of the world throughout history, including ancient Egypt, parts of Europe during the Renaissance period and France during the reigns of Louis XIII and Louis XV (UNIDO, 1983).

Furniture is the most popular rattan product; here, rattan furniture awaiting export at a factory in Cirebon, Java, Indonesia - S.F. SIEBERT

Rattan is sold and used for a variety of purposes besides furniture, as can be seen in this shop in Banjermasin, South Kalimantan, Indonesia, selling mats, baskets, cages and other rattan products - J. DRANSFIELD

Worldwide, more than 700 million people trade in or use rattan for a variety of purposes. Furniture is the most popular rattan product, but rattan is also used to make carpet beaters, walking sticks, umbrella handles, sporting goods, hats, ropes, cordage, birdcages, matting, baskets, panelling, hoops and a host of other products.

While the rattan industry in Indonesia, the largest producer country, is well supplied with raw rattan, a rapid decline of natural rattan resources is hindering the supply of the rattan industry in other producer countries. This article identifies the major issues facing the rattan industry, and needs for the global development of rattan.

Rattan is a spiny climbing palm with some 600 species; one of the most commonly utilized is the large-diameter species* Calamus manan*, shown here in cultivation in Sarawak, Indonesia - J. DRANSFIELD

OVERVIEW

Rattan, a spiny climbing or trailing palm with some 600 species, is strictly an Old World plant. Its distribution is limited to tropical and subtropical Asia and the Pacific, where ten of the l3 known genera are endemic, and equatorial Africa, where four genera occur, of which three are endemic. The greatest diversity is in the Malay peninsula and Borneo. There is a secondary centre of diversity in New Guinea (IFAD, 1991; Wan Razali, Dransfield and Manokaran, 1992).

Almost all rattan is collected from natural forests. In recent years, uncontrolled harvesting and deforestation have exhausted the desired species in many rattan-producing countries in Asia. Yet only a small proportion of the approximately 600 species of rattan are used for commercial purposes. There is potential to develop some of the currently underutilized and lesser known species. Additional benefits may accrue from intervention in the sector to systematize resource use, management, marketing and processing (IFAD, 1991; Manokaran, 1990; Wan Razali, Dransfield and Manokaran, 1992).

Trade

Rattan is one of the most important non-wood forest products (NWFPs) in international trade. However there are no really reliable statistics on the volume and value of trade, either globally or for individual countries. Asia leads all the other regions of the world by far in the production and export of rattan and rattan products.

Among the producer countries, Indonesia dominates the world rattan trade; it has a clear advantage over other countries with its abundant supply of wild and cultivated rattan (an estimated 80 to 90 percent of the world's raw materials). The annual allowable cut from the 11.5 million hectares of the country's rattan-rich forested areas is estimated at 700 000 tonnes. Indonesia's actions therefore will have a large impact on the global rattan market (INBAR, 1998; Soedarto, 1999). The Philippines, Malaysia, China, Thailand and other countries of Indochina are also important contributors to the global rattan trade.

Rattan furniture trade probably represents less than 4 percent of world trade of all furniture. However, in Asia the rattan furniture industry represents substantially more than 25 percent in value of all furniture industry output, and it is growing (UNIDO, 1983; ESCAP, 1991; FAO, 1998).

The markets for rattan consumption in Europe, North America, Japan and other industrialized nations seem to be growing steadily. However, there is an urgent need for studies of the marketing and future prospects of rattan in those countries.

Rattan bundled for export in Indonesia - the leading country in the world rattan trade - W. LIESE

Industry

The rattan industry is highly fragmented; more than 90 percent of all factories are cottage and small-scale enterprises employing fewer than 50 people. In general, rattan furniture manufacturing is highly labour-intensive, employing at least 1.2 million people in Asia, of whom an estimated 500 000 work in the manufacturing sector and another 700 000 in the collection, primary processing and transportation of raw materials (in most cases on a seasonal basis). The low degree of mechanization and labour intensity of the rattan industry are also reflected in the low average investment per worker in modern rattan factories: about US$2 000, which is about one-tenth of the investment per worker in a conventional furniture plant (UNIDO, 1983; IFAD, 1991; ESCAP, 1991).

In the 1970s and 1980s, the rattan industry in Southeast Asia and China grew at rates between 20 and 50 percent per year in terms of exports. The mid-1990s saw a significant downturn in most of Asia, especially in resource-poor countries, owing to shortages of raw material, restrictive government policies and economic crisis (INBAR, 1998; ESCAP, 1991).

To promote domestic processing industries, while helping to alleviate the depletion of the resource base, governments of major rattan-producing countries in Asia embraced a ban on export of raw cane and/or heavy duties on export of semi-processed rattan products. While there was an initial glut of raw material supplies in resource-rich countries such as Indonesia and Malaysia, the shift from the traditional practice of exporting raw rattan to the export of semi-processed and finished products has promoted local industries (ESCAP, 1991). A significant increase (almost 200 percent) was reported in the export value of rattan products (mainly furniture) from Malaysia in the 1990s as a result of the export ban. Indonesia reported a similar experience; export value increased from US$200 million in 1987 (effective date) to an average of more than US$300 million per year in the 1990s (Soedarto, 1999). However, in order to increase its foreign exchange earnings, Indonesia lifted its ban on export of raw rattan in 1999 (Pabuayon, 2000). The Philippines is again sourcing rattan from Indonesia to feed its starving industry and to revive sagging exports. In China and Thailand, however, canes are being smuggled from some parts of Southeast Asia to keep up these countries' industry and exports.

MAJOR ISSUES

Assessing and managing the resource base

The rapid growth of the industry from the 1970s to the early 1990s led to overexploitation and wasteful utilization of the resource and consequent depletion of the stock, especially of desired species. For some countries, the dwindling supplies of rattan resulting from overexploitation and steady loss of forest habitat have posed a serious threat to the rattan industry, resulting in declining exports and the closure of several operations since the mid-1990s. The countries whose exports have been hardest hit are the Philippines and China (INBAR, 1998; ESCAP, 1991; Abd. Latif, 2000; Pabuayon, 2000; Soedarto, 1999), but Malaysia and Thailand are also affected.

To protect the rattan industry and cope with any increase in global demand for rattan, there is an urgent need for sustainable management. A first step is to determine accurately the extent of the resource. Figures for most countries are approximate or absent (INBAR, 1998). However, a step in the right direction has been taken recently through the joint efforts of the Forest Research Institute Malaysia (FRIM), the International Network for Bamboo and Rattan (INBAR) and the United Kingdom's Department for International Development (DFID) in developing techniques for taking inventories of rattan (Nur Supardi, Hamzah and Wan Razali, 1999).

Forest departments manage rattan stocks by:

- limiting harvests to an allowable cut;
- managing resource flows by granting or selling harvesting rights.

Licensing rules vary among countries, but the aim of all is to limit overexploitation. In practice, licensed holders rarely adhere to harvesting guidelines, since they are not strictly enforced by field officers. This is a major reason for the depletion of stock, wasteful harvesting practices and the loss of royalties to governments. To promote sustainable resource management, some countries are exploring long-term tenure control through community-based forest management institutions (INBAR, 1998; Pabuayon, 2000).

A rattan nursery at the Forest Research Institute Malaysia (FRIM) - W. LIESE

Plantation development

Plantations of rattan, either in logged-over forest areas or as an agroforestry crop in rubber or other tree plantations, are needed in order to relieve pressure on overexploited natural forests and ensure stable supplies of desirable species for the industry. Although significant advances have been made in the understanding of rattan as a potential plantation crop, much is still unknown. Apart from a few exceptions such as Indonesia and Sabah, Malaysia, rattan plantation development

has been slow because of technical or financial problems (INBAR, 1998; Abd. Latif, 2000; Pabuayon, 2000; Soedarto, 1999; Wan Razali, Dransfield and Manokaran, 1992). Some growers have also reported problems in harvesting small-diameter plantation cane (M.N. Salleh, personal communication). Thus, further research is needed on the characteristics of plantation species.

To date, more than 3l 000 ha have been planted in Malaysia with the large-diameter *Calamus manan.* Of these plantings, 7 000 ha are in rubber plantations throughout the country. In addition, large plantations of mainly *Calamus caesius* and *Calamus trachycoleus* have been established on a total of 10 000 ha. Other rattan species considered for plantation development include *Calamus scipionum* and *Calamus palustris* (Abd. Latif, 2000).

An estimated 37 000 ha of mostly high-value rattan species are grown in Indonesia. However, in the Philippines, where scarcity is more pronounced, only 6 000 ha have been planted (INBAR, 1998). China has established more than 20 000 ha of rattan plantations in the public domain, employing both domestic and imported species. In general in the region, private sector cultivation of rattan, in both large- and small-scale plantations, has not been encouraging and has failed to respond to local raw material scarcities.

Policy initiatives (incentives and regulations) to increase small-scale rattan cultivation have had limited impact as government policies and economic conditions make investment in other resources more attractive. In addition to economic constraints, other factors that hinder small farmers and pose high risk for many large investors include the long gestation period of rattan (at least 10 to 12 years), the absence of secure tenure over resources and difficult market conditions.

The financial profitability of industrial-scale rattan plantations in Asia is currently uncertain, as other land uses are more lucrative. Nevertheless, both large- and small-scale plantations in Indonesia and Malaysia have shown some promise. In several countries, governments have initiated interventions to enhance rattan cultivation, justified by the economic benefits that have accrued to rural households in Indonesia and smallholder rubber plantations in Malaysia (INBAR, 1998).

Domestic forest policies can give incentives for rattan plantation development by providing tenurial security to rattan gatherers and planters, credit and technical assistance for plantation development, and favourable harvesting and marketing arrangements. Basic infrastructure such as transport and effective mechanisms to link sellers with local and foreign buyers are also needed in order to improve the profitability of rattan production, processing and manufacturing activities (Pabuayon, 2000).

In addition, incorporation of plantations into community-based forest management schemes, with or without vertical integration in processing, could be an important policy direction. Some lessons can be learned here from the success of the rattan plantations established in Kalimantan, Indonesia, a century and a half ago (IFAD, 1991; INBAR, 1998; Belcher, 1999).

Although rattans are not indigenous to Latin America, there is growing interest in cultivation of Asian rattans in Argentina, Belize, Bolivia, Colombia, Cuba and Trinidad and Tobago. In recent years, Cuba has successfully introduced rattan from Viet Nam, Malaysia and China in a 2 000 ha plantation with the help of the International Development Research Centre (IDRC) and INBAR (IFAD, 1991).

It may be too early for Africa to plan large-scale rattan plantations. Rattan is confined to the equatorial rain forests and is of little economic importance at present, although it has gained recognition as an underexploited crop in West Africa (Editor's note: see article by Dransfield in this issue). Kenya and Zambia have received financial and technical support from IDRC for research and introduction of rattan species from

Asia. DFID and the International Fund for Agricultural Development (IFAD), through INBAR, have recently initiated systematic taxonomic and socio-economic research, respectively, on rattan in Ghana, Nigeria, Cameroon, Ethiopia, the United Republic of Tanzania and Uganda (IFAD, 1991).

Technology issues

Rattan passes through many hands that perform one or several levels of processing before it reaches its final state. In most developing countries, rattan processing is still at the craft level, carried out in a great number of tiny workshops (Aguilar and Miralao, 1985; UNIDO, 1983; IFAD, 1991; ESCAP, 1991). Because of the high labour intensity of the work (i.e. scraping, drying, splitting, sizing, bending, cording and chemical treatments), even when mechanized, good designs and modern technologies are essential to meet standards for export.

In recent years, many technical developments have taken place in the manufacture of rattan products. However, skilled workers and good supervisors are in short supply for higher-end processing. Also, for most small-scale processors, lacks of credit availability and technical assistance limit adoption of modern and efficient technology (UNIDO, 1983; ESCAP, 1991; Abd. Latif, 2000). Large manufacturers dominate the market; with their better, more sophisticated machinery, more contemporary designs and quality control measures they are able to produce high-quality products that can fetch higher prices. In Indonesia and the Philippines, they have also found ways to reduce the cost of production by farming out specific tasks to smaller firms, mainly in the primary processing area, thus benefiting the sector as a whole (INBAR, 1998; ESCAP, 1991; Abd. Latif, 2000; Pabuayon, 2000).

Given rattan's potential as an industrial material, several countries in Southeast Asia have adopted low-cost automation and mechanization to improve the productivity of their factories. Some governments have provided incentives by way of supportive policies, soft loans and tax breaks to the domestic industry. In addition, a few countries, such as Malaysia, have set up service centres at the district level to provide training, technology transfer and other support. In Malaysia a Small-Scale Entrepreneurs Development Unit (SSEDV) has also been created, with financial support from the World Bank and the government, to provide technical and training support to the industry. An Agroforestry Unit established at FRIM has provided training and planting material for rattan planting in rubber plantations by smallholders.

The results of all these efforts are increased foreign exchange earnings and employment opportunities in both the rural and urban sectors (Abd. Latif, 2000; INBAR, 1998; Pabuayon, 2000).

Research and development and information exchange

In addition to INBAR, which is a recent entrant into international forestry research and development, several forest research institutes, national agricultural research centres and regional and international organizations (including the International Union of Forestry Research Organizations [IUFRO], FAO and other UN agencies, institutions of the Consultative Group on International Agricultural Research [CGIAR], the International Tropical Timber Organization [ITTO] and the Asian Development Bank) are carrying out or supporting research and development on rattan. Regional networks such as the Forestry Research Support Programme for Asia and Pacific (FORSPA), the Asia-Pacific Association of Forestry Research Institutions (APAFRI) and the African Rattan Network are also actively involved in rattan development. A Rattan Information Centre, financed by IDRC, was set up in Malaysia in 1982. It acts as a comprehensive depository of rattan literature and a document and retrieval system, publishes regular news bulletins and disseminates information to interested parties.

National research on rattan is at an advanced level in Asia, with several active projects funded by international agencies. Some progress has been achieved in the past two decades on rattan silviculture and ecology, plantation technology and development of innovative technologies for low-cost mechanization and automation, grading and inventory methods. However, continued effort is needed from governments, industry and international agencies to maintain the gains achieved. Particular emphasis should be given to resource assessment and conservation, socio-economics and marketing and furniture design. Networking among institutions is vital to share knowledge and to benefit the countries less privileged in research and development capabilities.

An expert evaluation of both the informal and the formal INBAR networks, carried out by IFAD, underlined the need for a Regional Rattan Research Centre in Asia. Indonesia is a possible location, given its pre-eminent position in global rattan trade. The evaluation also indicated that there is also a need to establish a rattan seed bank to ensure good-quality seeds of good progenies in order to improve plantation quality and yield (IFAD, 1991; ESCAP, 1991).

In most developing countries rattan is processed at the craft level, involving labour-intensive tasks such as manual removal of silica from the cane prior to splitting and weaving into mats and baskets, as shown here in Sarawak, Indonesia - J. DRANSFIELD

CONCLUSIONS

Rattans were once abundant in the tropical forests of Asia but have become scarce in many countries today, primarily because of overexploitation and shrinking forest area. Natural regeneration seems to be inadequate, and there is a general decline in the planting of rattan because of various technical, economic and policy constraints, including, for example, the long gestation period of rattan, the absence of secure tenure over resources and difficult market conditions. Given rattan's economic, ecological and socio-cultural importance to hundreds of millions of people in the developing world, steps must be taken to ensure its future.

Requirements for future development include the following.

- Sustainable management of the resource is essential through actions that include the development of rattan plantations (both in agroforestry situations and in degraded forest areas, including shifting cultivation) and home gardens. Serious efforts are needed to address the problems of reckless harvesting, loss of productivity and poor management.
- Suitable conservation measures must be implemented urgently (De Zoysa and Vivekanandan, 1994; Rao and Rao, 1996). A number of Asian rattans are under serious threat from loss of habitat and overexploitation. According to the World Conservation Union (IUCN) Red List, at least 117 species are threatened in the wild (Walter and Gillett, 1998). A necessary step is an initial

survey of available stock, hot spot areas, distribution of populations and current levels of exploitation.
- Continuous product and market development and formation of effective business partnerships are needed.
- Institutional support structures and government-private sector coordination must be strengthened, including financing schemes for small and medium-sized enterprises. There is also an urgent need for policy interventions (supporting credit, tenure and community forest management, for example) and support for macroeconomic and sectoral policies affecting the rattan sector.
- International ties with furniture makers in the consumer countries would be advantageous to help promote rattan products in the "green" market (i.e. among environment-conscious consumers).
- Technology adoption and commercialization need to be furthered, and institutional networking strengthened.

In addition, continuing research and development is needed in response to dynamic changes in markets and to address medium- and long-term objectives. Main areas for research include:

- resource assessment and conservation (biodiversity of the resource base, methodology for resource survey and assessment, evaluation of uses by indigenous peoples, species selection and provenance trials, germplasm conservation and management);
- resource production and management (use of marginal and degraded lands, genetic improvement, sustainable management of natural habitats, plantation technology, pests and diseases, post-harvest losses, harvesting technology, socio-economic aspects of resource production and management);
- resource utilization (properties-product relationships, lesser-known species, quality improvement and grading, product research and development, technologies for small-scale enterprises, socio-economic studies including women in development and marketing studies).

It is difficult to make predictions for the future of rattan in the twenty-first century when the basic data needed for the forecast are utterly lacking. There also remain many uncertainties about the trade and cultivation of cane, i.e. about future patterns of supply and demand, shifts in global rattan trade, economics of cultivation and yields and the policies that affect the sector. There are thus more questions than answers on the future of rattan.

Bibliography

Aguilar, F.M. Jr. & Miralao, V.A. 1985. *Rattan furniture manufacturing in Metro Cebu. A case study of an export industry*. Handicraft Project Paper Series No. 6. Manila, the Philippines, Ramón Magsaysay Award Foundation.

Belcher, B. 1999. *The bamboo and rattan sectors in Asia: an analysis of production-to-consumption systems*. INBAR Working Paper No. 22. Beijing, China, INBAR.

De Zoysa, N. & Vivekanandan, K. 1994. *Rattans of Sri Lanka: an illustrated field guide*. Colombo, Sri Lanka, Sri Lanka Forest Department and International Development Research Centre.

ESCAP. 1991. *Report of the workshop on the expansion of trade in rattan and rubber wood furniture.* Unpublished report. Bangkok, Thailand, Economic and Social Commission for Asia and the Pacific (ESCAP).

FAO. l998. *Tropical palms*, by D.V. Johnson. Non-Wood Forest Products No.

10. Rome.

IFAD. l99l. *Research needs for bamboo and rattan to the year 2000*. Rome.

INBAR. 1998. *Assessment of socio-economic issues and constraints in the bamboo and rattan sectors*. Unpublished report. Beijing, China.

Abd. Latif, M. 2000. Production and utilization of bamboo, rattan and related species: management and research considerations. In *XXI IUFRO World Congress 2000. Sub-plenary papers and abstracts*, Vol. 1, p. 393-406. Kuala Lumpur, Malaysia, IUFRO.

Manokaran, N. l990. *The state of the rattan and bamboo trade*. RIC Occasional Paper. No. 7. Kepong, Malaysia, Forest Research Institute Malaysia.

Nur Supardi, M.N., Hamzah, KA. & Wan Razali, W.M. 1999. *Considerations in rattan inventory practices in the tropics*. INBAR Technical Report No. 14. Beijing, China, INBAR.

Pabuayon, I. 2000. Addressing rattan technology needs for Asia. Paper presented at the XXI IUFRO World Congress 2000, 7-12 August, Kuala Lumpur, Malaysia.

Rao, R. & Rao, A.N., eds. 1996. Bamboo and rattan genetic resources and use. *Proceedings of the second INBAR-IPGRI Biodiversity, Genetic Resources, and Conservation Working Group Meeting and Report on the Workshop on Rattan Resources and Their Development in Indonesia*. New Delhi, India, International Plant Genetic Resources Institute (IPGRI) Office for South Asia.

Soedarto, K. 1999. *The state of bamboo and rattan development in Indonesia*. Unpublished report. Beijing, China, INBAR.

UNIDO. 1983. *Manual on the production of rattan furniture*. New York, USA, United Nations Industrial Development Organization (UNIDO).

Walter, K.S. & Gillett, H.J., eds. 1998. *1997 IUCN Red List of threatened plants*. Gland, Switzerland and Cambridge, UK, World Conservation Union (IUCN).

Wan Razali, W.M., Dransfield, J. & Manokaran, N. 1992. *A guide to the cultivation of rattan*. Malayan Forest Record No. 35. Kepong, Malaysia, Forest Research Institute Malaysia (FRIM).

Uses of rattan in South Asia

C. Renuka

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Although the rattan products of South Asian countries have lower market value than those of Southeast Asia, rattan is recognized as an extremely useful forest product in countries throughout the region.

In India, rattan has an important role in the rural economy; many people in remote areas earn their living through extraction and cleaning of rattans. Urban people are employed in small-scale rattan industries. Rattan is not only important as a commodity for the furniture and handicraft industries, but also has a great many other traditional uses: Ancient books report medicinal uses; rattans are used for raft making, house construction, baskets and poles for carrying goods; and rattan leaves are used extensively as a thatching material. In the Nicobar Islands, India, the spiny sheath is used for scraping coconut, while the tribal people of northeastern India make extensive use of long canes in bridge construction. Some species of rattans are used in tribal rituals and festivals.

In Nepal, besides local uses, rattans have great cultural value. The Tharu people (an ethnic group) use rattan sticks in temples, believing them to be holy and capable of warding off evil spirits. Priests keep rattan sticks with them while attending religious functions. Rattans within the temple compounds are well protected and cannot be harvested.

Some indigenous people in Bangladesh use young leaves, roots and shoot tips of rattans as medicines and as a vegetable. Rattans are among the most important natural resources of forests in Bangladesh, but cane-based industries are beginning to close because resource depletion has resulted in shortages of raw materials; the industry currently uses imported raw materials. The closures are expected to have a direct effect on socio-economic conditions, particularly for the workers in rattan industries - mostly women who depend on the work to meet their basic needs.

The rattan craft is a traditional occupation in 18 of the 24 districts of Sri Lanka. It is estimated that about 3 000 people are directly engaged in rattan industries, earning at least one-third of family income through the craft. Shortage of raw material, however, is challenging the industry, and bamboo, plastic and cotton materials are replacing rattan. Since 1986 rattan exports from Sri Lanka have been negligible, allegedly because of the low quality of the products.

Intercropping rattan with rubber and other crops

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In Malaysia, rattan species have been intercropped with rubber (*Hevea brasiliensis*) trees in either well-managed commercial rubber plantations or smallholdings and abandoned or semi-abandoned plantations. Rattan interplanting in well-managed commercial rubber plantations was established according to a concept similar to agroforestry, which was aimed at increasing the yield of land and supplementing the income of smallholders/rural people. The income was estimated to be more than sufficient to cover the costs of replanting rubber (Salleh and Aminuddin, 1986).

So far only three rattan species have been found to be suitable for growing under rubber in peninsular Malaysia: *Calamus manan*, *Calamus scipionum* and *Calamus palustris*. The techniques of planting *C. manan* under rubber trees have been well developed. The age of rubber trees at intercropping and planting densities per hectare are important factors that need to be determined before embarking on planting. Four- to seven-year-old rubber trees were found to be best for intercropping with *C. manan*.

Although intercropping rattan with rubber trees appears feasible, rattan should be viewed as a supplementary crop only. In the planning phase, rattan planting should be timed for harvesting when the rubber trees are reaching the stage at which they need to be replanted, i.e. at around 25 years of age. This would minimize the difficulties encountered during harvesting of rattan and prevent damage to the rubber tree that could occur if the cane is harvested earlier. A longer planting time would mean that the canes are allowed to reach maturity and are more suitable for commercial processing.

Different clones of rubber probably vary with regard to their suitability as support and shade trees because of differences in branching habits, maximum height attainable, strength of branches, adaptability to soil conditions and proneness to wind damage. Clones with low branches were found to be suitable for intercropping with rattan because rattan can easily climb on them (Aminuddin, Nur Supardi and Abd Ghani, 1991). Clones with high, strong branches are only suitable for supporting mature rattan, but can hold two to four rattan plants. No studies have been carried out to investigate whether latex production of individual rubber trees is affected

by the presence of rattan plants.

With intercropping of rattan and rubber, some management problems can occur. Rattan can hinder tapping operations. The dense crown of rattan can prolong the drying of the boles of the rubber trees after rain. Rattan harvesting can damage the branches of the rubber trees as well.

INTERCROPPING SYSTEMS WITH OTHER CROPS

Planting rattan under other crops such as oil-palm is still under investigation. The growth of six-year old *C. manan* planted under 13-year-old oil-palm at the Malaysian Palm Oil Board Paka plantation, in Terengganu, appeared good. Annual height increment was 1.5 m (Nur Supardi and Suboh, unpublished data). However, there are some management problems that have to be solved first. The rattan crown hindered the harvesting of oil-palm fruit bunches and, consequently, caused a drop in the quantity of fruits collected. When the oil-palm frond was pruned, the rattan crown fell to the ground, causing shoot damage.

The Forest Research Institute Malaysia (FRIM) is investigating rattan planting (*C. manan* and *C. caesius*) integrated with bamboo. *Gigantochloa laevis* was chosen as an alternative support tree for rattan. In the trial, rattan is treated as the main crop and the use of bamboo as a support tree is expected to ease rattan harvesting later. Such integrated planting should also increase land yield with harvests of bamboo shoots from the third year onwards, although the study needs to be monitored further before the suitability of *G. laevis* as a support plant can be established.

Bibliography

Aminuddin, M., Nur Supardi, M.N. & Abd Ghani, I. 1991. Rattan growing under rubber in peninsular Malaysia: status, problem and prospects. *In* S. Appanah, F.S.P. Ng and Roslan, eds. *Malaysian forestry and forest products research. Proceedings of the conference*. Kepong, Malaysia, Forest Research Institute Malaysia. p. 79-86.

Salleh, M.N. & Aminuddin, M. 1986. Rattan as a supplementary crop in rubber plantation. *In* C. Rajarao and L.L. Amin, eds. *Proceedings of the Rubber Growers Conference,* Ipoh, Malaysia, 20-23 October 1986. p. 261-273. Kuala Lumpur, Malaysia, Rubber Research Institute of Malaysia.

Taxonomy, biology and ecology of rattan

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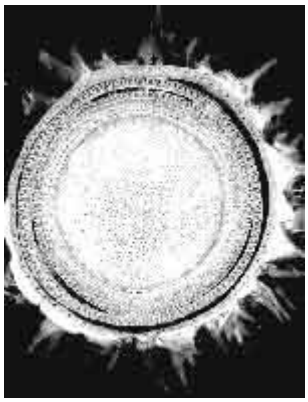
Gaps in taxonomic knowledge and confusion in nomenclature are challenges to rattan research and development.

Rattans are spiny climbing palms which are found in the Old World tropics and subtropics and exploited particularly for their flexible stems. The word "rattan" is derived from the Malay "*rotan*", the common name for climbing palms. Rattan is collected mainly from wild populations, although considerable efforts have recently been focused on the provision of raw cane from cultivated sources.

Cross-section of rattan stem embraced by leaf sheaths - W. LIESE



The most important product of rattan palms is the cane, the solid rattan stem stripped of its leaf sheaths. (N.B. Rattans are always solid, unlike bamboo which is usually hollow.) The canes are either used in whole (round) form, for example, in furniture frames, or split, peeled or cored for matting and basketry. The range of indigenous uses of rattan canes is vast, from bridges to baskets, fish traps to furniture and crossbow strings to yam ties. Other plant parts of some species of rattan are also utilized and contribute to the survival strategies of many forest-based communities. Fruits of many species are eaten. The palm heart (growing point of the stem) is often harvested for food and, in the Lao People's Democratic Republic and northeastern Thailand, two species - *Calamus tenuis* and *Calamus siamensis* - are intensively cultivated for this purpose. Leaves are used for thatching and the petioles (leaf stalks) and rachises (axes of the leaves) of robust short-stemmed species may even be used as fishing poles. The very spiny leaf rachis of an undescribed species in Bali is used as a food grater, and the whip-like climbing organs of several species have been used to snare flying foxes. Fruits and leaves are sometimes used in traditional medicines. Leaflets of a few species are used as cigarette papers, and leaf sheaths of others as toothbrushes. Many species are ornamental, especially when young, and are sold locally as horticultural subjects. Finally, some species of *Daemonorops* (e.g. *D. draco*) provide one source (there are other non-palm sources) of dragon's blood, a red resin that exudes between the fruit scales and is used medicinally and as a dye.

Coconut grater made from the leaf stalks of a* Calamus *species, Bali, Indonesia - J. DRANSFIELD

Not all rattans are equally useful, and not all have potential commercial applications. Stem diameter varies greatly from 2 to 3 mm among the smallest species to 10 cm in exceptionally large species. Species of different diameters are used for different purposes. Furthermore, within a size class, not all species are of equal quality; some are inflexible and prone to breakage, others are of poor external appearance. While there may be substantial spontaneous uses for many species (Dransfield and Manokaran, 1994; FAO, 1998; Sunderland, 1998), it is estimated that only 20 percent of the known rattan species are of any commercial value (Dransfield and Manokaran, 1994).

In many areas, the sustainable exploitation and commercial utilization of the rattan resource are hindered by the lack of a sound taxonomic base, which is necessary for meaningful and reproducible research, inventories of the resource, population studies, distinction of commercially valuable species and assessment of silvicultural potential. This article summarizes current knowledge and problems in rattan taxonomy. It also gives a general overview of the biology and ecology of the group and brief information on conservation status and growth rates - areas of research critical to the development of the resource.

TAXONOMY

Rattans are climbing palms belonging to the Calamoideae, a large subfamily of the palm family (Palmae or Arecaceae). There are around 600 different species of rattan belonging to 13 genera (see Table). These are concentrated solely in the Old World tropics; there are no true rattans in the New World, although climbing representatives of two other palm groups are known in Central and South America. Similarly, there are no rattans in Madagascar. All of the species within the Calamoideae are characterized by overlapping reflexed

All of the species within the Calamoideae - shown here* Plectocomiopsis mira*, Sarawak - are characterized by overlapping reflexed scales on the fruit - J. DRANSFIELD

(bent or curved backwards) scales on the fruit, and all are spiny, a necessary pre-adaptation to the climbing habit (Dransfield, 1992b). (Some species are shrubby palms of the forest undergrowth and do not in fact climb; nevertheless, reproductive features link them with other species that are climbers, and they are hence included in the rattan genera.)

Of the 13 genera of rattan, three (*Laccosperma* [syn. *Ancistrophyllum*], *Eremospatha* and *Oncocalamus*) are endemic to Africa. Although some species within these genera are utilized locally and form the base of a thriving cottage industry, they have only recently begun to attract attention from commercial concerns (Dransfield, 1992b; Sunderland, 1999; Editor's note: see also article by Sunderland in this issue).

The largest rattan genus is *Calamus*, with about 370 species. *Calamus* is predominantly an Asian genus and ranges from the Indian subcontinent and south China southwards and east through Malaysia and Indonesia to Fiji, Vanuatu and tropical and subtropical parts of eastern Australia. It is represented in Africa by one species, *C. deërratus*, which exhibits high variability among populations. Most of the best commercial species of rattan are members of the genus *Calamus*. The remaining rattan genera, *Daemonorops*, *Ceratolobus*, *Korthalsia*, *Plectocomia*, *Plectocomiopsis*, *Myrialepis*, *Calospatha*, *Pogonotium* and *Retispatha*, have a range centred in Southeast Asia and extending from there eastwards and northwards (Uhl and Dransfield, 1987; Dransfield, 1992a).

Rattan genera: number of species and their distribution

Genus	Number of species	Distribution
Calamus	~370-400	Tropical Africa, India, Sri Lanka, China, south and east to Fiji, Vanuatu and eastern Australia
Calospatha	1	Endemic to peninsular Malaysia
Ceratolobus	6	Malay Peninsula, Indonesia (Sumatra, Borneo, Java)
Daemonorops	~115	India and China to westernmost New Guinea
Eremospatha	10	Humid tropical Africa
Korthalsia	~26	Indochina to New Guinea
Laccosperma	5	Humid tropical Africa
Myrialepis	1	Indochina, Thailand, Myanmar, peninsular Malaysia and Sumatra
Oncocalamus	4	Humid tropical Africa
Plectocomia Philippines	~16	Himalayas and south China to peninsular Malaysia, Singapore, Sumatra, Java, Borneo and the
Plectocomiopsis	~5	Lao People's Democratic Republic, Thailand, peninsular Malaysia, Borneo, Sumatra
Pogonotium	3	Two species endemic to Borneo, one species in both peninsular Malaysia and Borneo
Retispatha	1	Endemic to Borneo

Source: Modified from Uhl and Dransfield, 1987.

Despite the commercial importance of rattan, basic knowledge of the resource is somewhat limited and the rattan flora of Africa and much of Southeast Asia remains poorly known. Since most taxonomic studies have been country-based, there is a

tendency for unidentified species to be described as new local endemics when they may well be species described and well known in neighbouring areas. Such problems occur particularly where species distributions cross political boundaries, for example in Indochina.

In addition, a rather narrow species concept has led to a proliferation of new names. Resolving some of the taxonomic and nomenclatural problems related to this has been difficult, given language barriers and the difficulty of exchanging material. In China, in particular, several taxa widespread in Asia have been described as new Chinese species or varieties. Painstaking work has been needed to resolve the major taxonomic problems of Indochinese rattans (Evans *et al.*, 2001).

Similarly, in Africa, three large rattans with different ecology and different cane quality were at some time all referred to in different countries as *Laccosperma secundiflorum*. A regional approach was needed to sort out this basic taxonomy.

A material difficult to substitute

In the absence of rattans, local communities throughout the tropics use a variety of plant resources for the purposes for which rattan is used - basketry, matting, binding, etc. However rattan, if available, is preferred, and few products other than true rattan have the strength and flexibility to be utilized for furniture production. Bamboo, raffia (*Raphia* spp.), willow (*Salix* spp.) and buri palm (*Corypha utan*) are used locally for some sorts of furniture, but in the international market these products do not command prices comparable to those of rattan furniture. Of the other genera of climbing palms, only *Desmoncus* spp. furnish stems of sufficiently good quality to be used as rattan substitutes. While rattan substitutes may be locally significant and socially important, there is no doubt that rattan is pre-eminent.

Taxonomic work of this kind is not purely an academic exercise; it is an essential basis for the development of the rattan resource and underpins the conservation and sustainable development objectives that are much advocated for rattans. Species delimitation must be clearly understood; it is essential to know which species are of commercial importance and how they may be distinguished from other species. This knowledge is critical for meaningful inventories of commercially important taxa and assessment of the silvicultural potential of each species, based on sound ecological knowledge. Reference to a structured systematic framework also ensures that any experimental work undertaken is replicable.

Local classification

The development of extensive indigenous classification systems for rattans often reflects the social significance of rattan, and these taxonomies have developed to reflect rattan as it grows in the forest, as well as how it is used. For example, a widespread species may be referred to by many names because its range encompasses a number of language groups. Often, one species can be given many names, reflecting the different uses of the plant or the various stages of development from juvenile to adult. Commonly, blanket names for "cane" are given to a wide range of species.

Some species that have no use are often classified according to their "relationship" to those that are utilized. These are often along kinship lines, and species may be referred to as "uncle of..." or "small brother of..." reflecting their perceived relationship with and similarity to species that are widely utilized. In the past, the uncritical use of vernacular names has created serious confusion and contributed to the misconception that all species are of commercial potential. This confusion could be avoided if the literature on rattan would refer always to the species by their Latin names. Glossaries that link local and Latin names have often been used uncritically,

resulting in confusion and unverifiable research results. Citations of species names that are linked to actual herbarium specimens allow verification and reproducible research.

BIOLOGY AND ECOLOGY

The range of rattans extends from sea level to more than 3 000 m elevation, from equatorial rain forests to monsoon savannahs and the foothills of the Himalayas. Thus the large number of rattan species is matched by great ecological adaptation and diversity. Most, admittedly crude, ecological preferences for rattan species have generally been identified during taxonomic inventory work, yet these broad ecological summaries are invaluable as a basis for establishing cultivation procedures.

A major gap in the knowledge of rattans, even of the commercial species, is an understanding of population dynamics and demography. Information on the population structure, distribution, rate of regeneration and the number of harvestable stems per hectare of each species is essential to a solid understanding of potential sustainability.

Forest type and light requirements

Throughout their natural range, rattan species are found in a wide variety of forest and soil types. Some species are common components of the forest understorey. Others rely on good light penetration for their development; hence some species are found in gap vegetation and may respond well to canopy manipulation. Some species grow in swamps and seasonally inundated forest, while others are more common on dry ridge tops.

Cultivation trials on many of the Southeast Asian species, as well as recent germination trials of the African taxa, have indicated that seeds will germinate under a wide range of light conditions. The resultant seedlings will remain for long periods on the forest floor until the light becomes sufficient for them to develop, as could happen for example through tree fall. This seedling bank is a common feature of the regeneration of most species and is a well-recognized component of forests where rattans occur.

Life form

Rattans can be clustering (clump-forming) or solitary; some species, such as *Calamus subinermis*, can be both. Other species have short or subterranean stems. Clustering species sometimes possess more than 50 stems of varying ages in each clump and produce suckers that continually replace stems lost through natural mortality or harvesting. Some clumps can be harvested many times on a defined cycle if the light conditions are conducive to the remaining suckers being able to develop and elongate. Ensuring that stem removal through harvesting does not exceed stem replacement is the crux of rattan sustainability.

An even more crucial component of sustainability is the monitoring of the exploitation of solitary species. *Calamus manan*, one of the most commonly exploited rattan species, is single-stemmed; thus the impacts of harvesting this species are much greater than those of harvesting clustering rattans. Sustainability of such species relies on recruitment through sexual rather than vegetative means.

Flowering

Another ecological feature of palms that is important in terms of management is that rattans display two main modes of flowering: hapaxanthy (flowering once) and pleonanthy (multiple flowering). Hapaxanthy is characterized by simultaneous production of flowers after a period of vegetative growth. Flowering and fruiting is

followed by the death of the stem itself. In single-stemmed hapaxanthic rattan species, the whole organism dies after the reproductive event. However, in clustering species the organism continues to regenerate from the base, and it is only the individual stem that dies.

In pleonanthic species, flowers are produced continually and flowering and fruiting do not result in the death of the stem.

All the species of *Korthalsia*, *Laccosperma, Plectocomia*, *Plectocom-iopsis* and *Myrialepis,* and a few species of *Daemonorops* are hapaxanthic. All other rattan species are pleonanthic.

In terms of silviculture, the mode of flowering affects the cutting regime and stem selection for harvest, particularly if the cultivated resource is to supply seed for further trials. Furthermore, in many hapaxanthic species, stems tend to be of low quality because they have a soft pith which results in poor bending properties. These stems are also more prone to subsequent insect attack because of increased starch deposition.

Fruits and seeds

The leaf sheath of* Daemonorops sabut *has interlocking combs of spines that provide galleries for nesting ants - J. DRANSFIELD

Rattan fruits are often brightly coloured (yellow, orange or red) and the outer seed coat (sarcotesta) is also attractive to birds and mammals. Hornbills and primates are the main dispersers of rattan seeds in both Southeast Asia and Africa, with primates and elephants also sharing a preference for the ripe fruit. Fruits are often ingested whole and pass through the intestinal tract with the seed intact, or are sucked and spat out.

In the Asian taxa, the seed is usually covered with a sarcotesta. Incomplete removal of the sarcotesta often results in delayed germination, which suggests that it contains some chemical germination inhibitors. Once this outer layer is fully removed, the germination of commercial species such as *C. manan* and *Calamus caesius* is both rapid and uniform. In contrast, commercially important species in Africa have a relatively robust seed coat which acts as a barrier to imbibition, causing a dormancy that can last from 9 to 12 months before germination commences. This physical dormancy has caused some difficulties in the cultivation of some species, and research has been undertaken to reduce the germination times. Soaking the seeds in water for at least 24 hours prior to sowing is probably the most effective means of inducing early germination (Sunderland and Nkefor, 2000).

Several attempts have been made to develop methods for long-term storage of rattan seed. Pritchard and Davies (1999) demonstrated the possibility of short-term hydrated storage of rattan seed for periods of up to six months.

Rattan and ant relationships

Several species of rattan (e.g. some species of *Laccosperma, Eremospatha, Korthalsia, Calamus* and *Daemonorops*) have developed morphological adaptations that provide nesting sites for ants, such as hollowed out acanthophylls (thorn-like organs), interlocking spines that form galleries, curved back leaflets that tightly clasp the stem, or inflated leaf sheath extensions. This relationship is complex and has yet

to be fully investigated. One part of the relationship, for example, is the "farming" of scale insects by the ants. The scale insects feed on the rattan phloem cells, secreting a sweet honeydew that the ants then feed on. The ants, in turn, may protect the rattan from other predators (unfortunately including rattan harvesters and unwitting botanists); however, this complex relationship requires further study.

CONSERVATION OF THE RESOURCE

Threats to rattan come from several sources including:

- decreasing natural forest cover leading to loss of habitat;
- selective exploitation of stems for the furniture industry;
- increased exploitation for handicrafts;
- exploitation for palm hearts (one of the most damaging of all threats, currently most serious in the Lao People's Democratic Republic);
- biotic factors such as increased populations of wild pigs (caused by clearing of land for agriculture and loss of predators) which churn forest soils and remove seedlings, as seen in certain parts of peninsular Malaysia (Supardi, Dransfield and Pickersgill, 1998).

Of the approximately 600 species of rattan, the World Conservation Union (IUCN) Red List records 117 taxa as threatened to some degree; of these, 21 are endangered, 38 are regarded as vulnerable, 28 as rare, and 30 as indeterminate (Walter and Gillett, 1998). However, while this listing may give some indication of the global threats to rattan species, the conservation status is known with precision for only very few of the listed species. Species are assigned to these categories based on crude estimates of distribution and threat rather than on detailed studies. A little is known about the precise distribution and conservation status of a very few species, such as *Ceratolobus glaucescens*, which are restricted to certain geographic areas and soils. At the other end of the scale are species such as *Calamus poilanei*, which have a wide natural range but for which the remaining population and the degree of threat cannot be estimated based on factors such as remaining forest cover and distribution of soils because they are overexploited throughout their range. Monitoring of the amount of cane emerging from the forest and on-the-ground surveys in the forest can only suggest that the population is severely overexploited.

Efforts to conserve valuable rattan resources by introducing sustainable management systems have not proved very successful, and conservation of the resource in reserves where rattan harvesting is strictly forbidden requires control and policing which have proved virtually impossible in all reserves in Southeast Asia. There is therefore a serious need to focus additional effort on rattan conservation.

CONCLUSIONS

Existing information on the natural history and ecology of rattans (summarized in Wan Razali, Dransfield and Manokaran, 1992; Dransfield and Manokaran, 1994) is sufficient as a basis for developing rattan plantings of the best quality species such as *C. manan* and *C. caesius*. There remain major gaps in the knowledge of the taxonomy of rattans, particularly in Myanmar, the Indonesian islands of Sulawesi and Maluku, and New Guinea. There are also major gaps in the understanding of rattan demography, information essential to the development of sustainable harvesting strategies.

Bibliography

Dransfield, J. 1992a. *The rattans of Sarawak*. Kew, UK, Royal Botanic Gardens and Sarawak Forest Department.

Dransfield, J. 1992b. The taxonomy of rattans. *In* W.M. Razali, J. Dransfield

and N. Manokaran, eds. *A guide to the cultivation of rattan*. Forest Record No. 35. Kuala Lumpur, Malaysia, Forest Research Institute Malaysia.

Dransfield, J. & Manokaran, **N., eds.** 1994. *Rattans*. Plant Resources of South-East Asia No. 6. Indonesia, PROSEA.

Evans, T.D., Sengdala, K., Thammavong, B., Viengkham, O.V. & Dransfield, J. 2001. A synopsis of the rattans (Palmae, Calamoideae) of Laos and neighbouring parts of Indochina. *Kew Bulletin*. (in press)

FAO. l998. *Tropical palms*, by D.V. Johnson. Non-Wood Forest Products No. 10. Rome.

Pritchard, H.W. & Davies, R.I. 1999. Biodiversity and conservation of rattan seeds. *In* R. Bacilieri and S. Appanah, eds. *Rattan cultivation: achievements, problems and prospects*, p. 51-60. Malaysia, International Cooperation Centre on Agrarian Research for Development (CIRAD).

Sunderland, T.C.H. 1998. *The rattans of Rio Muni, Equatorial Guinea: utilisation, biology and distribution*. Report for European Union Project No. 6 ACP-EG-020, Proyecto Conservación y Utilización Racional de los Ecosistemas Forestales de Guinea Ecuatorial (CUREF).

Sunderland, T.C.H. 1999. New research on African rattans: an important non-wood forest product from the forests of Central Africa. *In* T.C.H. Sunderland, L.E. Clark and P. Vantomme, eds. *Non-wood forest products of Central Africa: current research issues and prospects for conservation and development*, p. 87-98. Rome, FAO.

Sunderland, T.C.H. & Nkefor, J.P. 2000. The propagation and cultivation of African rattans. Paper presented at the international workshop African Rattans: A State of the Knowledge, Limbe, Cameroon, 1-3 February.

Supardi, N., Dransfield, J. & Pickersgill, B. 1998. Preliminary observations on the species diversity of palms in Pasoh Forest Reserve, Negri Sembilan. *In* S.S. Lee *et al*., eds. *Conservation, management and development of forest resources,* p. 105-114. Malaysia, Forest Department.

Uhl, N. & Dransfield, J. 1987. *Genera Palmarum*. Lawrence, Kansas, USA, Allen Press.

Walter, K.S. & Gillett, H.J., eds. 1998. *1997 IUCN Red List of threatened plants*. Gland, Switzerland and Cambridge, UK, World Conservation Union (IUCN).

Wan Razali, Dransfield, J. & Manokaran, N., eds. 1992. *A guide to rattan planting*. Kuala Lumpur, Malaysia, Forest Research Institute Malaysia.

Important rattan species of Malaysia

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About 30 of the 106 species of rattan that occur naturally in peninsular Malaysia are collected and utilized by the country's rattan industry. The most important commercial canes come from the genus *Calamus*. The following are the five most important species in terms of utilization. All produce high-quality canes and are exploited heavily from the natural forest. All five species are also cultivated, although only *C. manan*, *C. caesius* and *C. trachycoleus* are cultivated on a large scale; the other two species are cultivated on a trial basis:

Calamus manan is the best large-diameter (> 18 mm) cane and is usually confined to the steep slopes of hill dipterocarp forests. It is abundant at 600 to 1 000 m altitude and grows well when planted on flat lowlands. It is a solitary and high-climbing rattan reaching 100 m or more. For optimum growth, the species requires about 60 percent light. It grows well under rubber trees, with growth rates of around 0.3 to 3.0 m per year. It is mainly used for making furniture frames.

Calamus tumidus is classed in the large-diameter group but its canes are smaller than those of *C. manan*. The canes, as are those of *C. manan*, are used for furniture components, and also for making walking sticks. It is similarly solitary and high-climbing, and is common in freshwater swamp forest, in peat swamp forest and on alluvial flats.

Calamus scipionum is a widespread lowland species growing at altitudes up to 200 m. It is found on alluvial soils in the floodplains of rivers and in secondary forests, but not in primary dipterocarp forests. The cane is used for making walking sticks and umbrella handles because it has long internodes. The species is a clustering type with five to ten stems per clump, climbing high up to 50 m or more. The growth rate of the cane is slower than that of *C. manan*, at about 0.15 to 1.5 m per year.

Calamus caesius is the best smaller-diameter (< 18 mm) cane. It is used for all types of binding and weaving in the furniture industry, and in the finest baskets. The species is found from lowlands (alluvial flats, freshwater swamps and margins of peat swamp forests) to hill slopes up to 800 m altitude. It is high-climbing (100 m or more), and is a clustering species with more than 100 stems per cluster; this is an advantage, as repeated harvests are possible without the need for replanting. Clumps

tend to be rather close and dense.

Calamus trachycoleus is another small-diameter cane. It is a clustering dioecious species with a more open type of clumping, producing additional stems via long stolons, which have the potential of increasing the number of aerial stems exponentially. Like *C. Caesius*, it needs no replanting. It is found growing on seasonally flooded riverbanks on alluvial clays and on the margins of peat swamp forests. In general, the canes of this species have shorter internodes, smaller diameter and thinner layer of silica than those of *C. caesius*. However, there is more demand for *C. trachycoleus* for weaving purposes because its cane is softer, more pliable and easier to work with.

Rattan resources and use in West and Central Africa

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The rattans of Africa, although less celebrated than their Asian relatives, have significant potential to contribute to both rural development and the global market.

Four genera of rattan palms, repre-sented by 20 species, occur in West and Central Africa. Like their Asian relatives, the rattans of Africa form an integral part of subsistence strategies for many rural populations and provide the basis of a thriving cottage industry.

A bridge made of rattan stems in Nyang, Cameroon - one example of the role of rattan in rural life in West and Central Africa - T. SUNDERLAND

African rattans have long been recognized by donor agencies and national governments as having a potential role on the world market as well as a great role within the regional non-wood forest products (NWFPs) sector. As increased interest is being shown in the potential role of high-value NWFPs to contribute to conservation and development, rattan is frequently mentioned as a product that could be developed and promoted in a useful way. However, the development of the rattan resource in Africa has until recently been hindered by a lack of basic knowledge about the exact species used, their ecological requirements and the social context of their utilization. Hence it has not been possible to design appropriate management strategies that might be implemented to ensure their sustainable and equitable exploitation. Recent research has concentrated on providing information on the taxonomy, ecology and utilization of these species. Now that this baseline information is available, rattan research in Africa is currently concentrating on the

development and promotion of the rattan resource from both ecological and socio-economic perspectives.

TAXONOMY AND BIOLOGY OF AFRICAN RATTANS

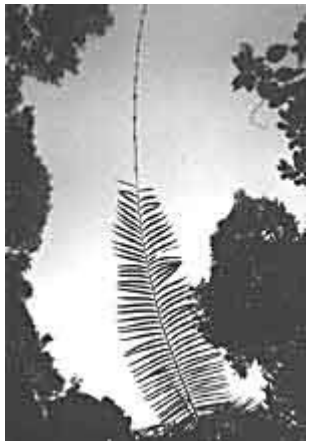
Morphological distinctness from Asian rattans

The four genera of African rattan are relatively easy to differentiate, particularly through the morphology of their climbing organs. Calamoid palms climb with the aid of one of two organs: either a flagellum (a shoot arising directly from the sheath and regarded as a modified flower [Baker *et al*., 1999]) or a cirrus (a whip-like extension before the leaf with short, curved thorns that often resemble a cat's claw [Tomlinson, 1990]). Flagella occur only in certain species of *Calamus*, including *C. deërratus*, the sole representative of *Calamus* in Africa.

The other Calamoideae, particularly those of Asian origin, climb with the aid of a cirrus. However, in the three rattan genera endemic to Africa, *Laccosperma*, *Eremospatha* and *Oncocalamus*, the cirrus has a form that is unique within the Calamoideae; it occurs as an extension between reduced, thorn-like leaflets termed anthophylls. This structure is also present in some members of unrelated genera present only in the New World (*Chamaedorea*, *Desmoncus*) (Uhl and Dransfield, 1987).

As have other members of the genus *Calamus*, *C. deërratus* has pairs of unisexual flowers (a common feature within the Calamoideae); however, the other endemic rattan genera of Africa are un-usual within the Calamoideae also for their flowers. For example, the genera *Eremospatha* and *Laccosperma* have pairs of hermaphroditic flowers, a feature unique within the Palmae (Uhl and Dransfield, 1987; Baker *et al*., 1999). (Less commonly, *Laccosperma* may also have triads of flowers.)

Leaf of* Laccosperma acutiflorum *showing the unique form of its cirrus with acanthophylls - T. SUNDERLAND



In addition, *Oncocalamus* species have a complex flower cluster that is distinctive among the Palmae (see Photo). The unusual flower cluster of the African taxa, and *Oncocalamus* in particular, suggests that a complex evolution of the Calamoideae has occurred in Africa with much extinction, caused by dramatic climatic upheaval, leaving only isolated lineages. This assertion is supported by the speciation patterns exhibited today by African palms, which have a distinct Guineo-Congolian centre of diversity, probably as a result of the maintenance and later speciation of forest refugia during periods of climatic change.

Cane anatomy and quality

The thickness of the fibre walls, the proportion of fibre tissues and the metaxylem vessel diameter, which appear to be the determinants of rattan quality, differ significantly among the African genera (Oteng-Amoako and Ebanyele, 2001; Wiener and Liese, 1994).

Laccosperma species have a relatively high proportion of thick-walled fibres and relatively narrow-diameter metaxylem vessels, and thus canes of greater density than those of the other genera. As a result, they have the best strength properties and are known for their durability.

C. deërratus and *Eremospatha* species have similar cane anatomies, with higher proportions of thinner-walled fibres and larger metaxylem vessels than those of *Laccosperma* species. These result in a greater amount of empty space in the stems, and consequently these two species also exhibit similar lower density and strength although, in utilization, *C. deërratus* is usually considered of inferior quality relative to desired species of *Eremospatha*. Further anatomical studies, which are currently under way, might shed more light on this anomaly.

Oncocalamus has very thin fibre walls and very large metaxylem vessels and possesses the least desirable density and strength properties of any of the African rattans. These species are particularly weak and brittle and not valued as a source of cane (Profizi, 1986; Defo, 1997; Defo, 1999; Sunderland, 1999).

ECOLOGY AND DISTRIBUTION

***Complex flower structure of* Oncocalamus mannii** - T. SUNDERLAND

Rattans are widespread throughout West and Central Africa and are a common component of the forest flora. Some species have particularly large ranges; for example, *Laccosperma secundiflorum* and *Eremospatha macrocarpa* occur from Liberia to Angola, while *C. deërratus* occurs from the Gambia across to Kenya and southwards to Zambia. In terms of diversity, the greatest concentration of rattan species and the highest levels of endemism are found in the Guineo-Congolian forests of Central Africa. Eighteen of the 20 known African rattan species occur in Cameroon. The diversity of rattans in the upper Guinea forests, by comparison, is somewhat poor, with only seven species, none of which are endemic to that region.

Within this forest zone, rattans grow in a wide range of ecological conditions. Most species occur naturally in closed tropical forests and are early gap colonizers. Many require extremely high levels of light and respond well to a limited reduction in the forest canopy. Forest disturbance, for example through selective logging activity, encourages the regeneration of rattans, and these palms are often a common feature along logging roads and skid trails. Some species, such as certain species of *Oncocalamus*, because they demand so much light, are often the earliest colonizers of heavily disturbed areas. Other species of rattan, notably *C. deërratus*, grow in permanently or seasonally inundated forests or swamps, while yet other species, such as *Laccosperma opacum* and *Laccosperma laeve*, are highly shade-tolerant and prefer to grow under the forest canopy.

The seeds of most rattans in Africa are dispersed predominantly by hornbills (Whitney *et al*., 1998). However, primates, especially drills (*Mandrillus leucophaeus*), mandrills (*Mandrillus sphinx*), chimpanzees (*Pan troglodytes*) and gorillas (*Gorilla gorilla*), as well as elephants, are also key dispersal agents (White and Abernethy, 1997; Sunderland, 2000). The seeds are often scattered far from the mother plant. Some additional, although limited, dispersal results from predation and caching by rodents. Interestingly, significant germination also occurs near parent plants through natural fruit fall, particularly in areas where overhunting has led to a significant decline in animals to disperse the seeds.

Despite intensive fieldwork and herbarium collection, especially in the past several years, no obvious phenological pattern has been identified for flower development and seed production in most African species.

Conservation status of African rattans

It is reported that the demand for rattan is increasing, and much more cane is being processed in many areas of Africa today than five or ten years ago (Sunderland *et al*., 2001). The increased demand has led to a significant decline in wild stocks and considerable local scarcity, particularly around urban centres (Profizi, 1986; Morakinyo, 1995; Sunderland, 1998; Sunderland, 1999; Defo, 1999; Oteng-Amoako and Obiri-Darko, 2001). Nonetheless, the commercial rattan species are at present considered "not threatened" on a continent-wide basis (Table 1).

COMMERCIAL UTILIZATION AND TRADE

Although many of the African rattan species are used locally for multiple purposes, the commercial trade concentrates on the bulk harvest of only a few widespread and relatively common species (Sunderland, 2001). Table 2 presents the major commercial species of rattan utilized in each region.

During the colonial period there was a significant trade in cane and cane products in Africa. In particular, Cameroon and Gabon supplied France and its colonies (Hédin, 1929), and Ghana (formerly the Gold Coast) supplied a significant proportion of the large United Kingdom market during the period between the two World Wars (Gold Coast Forestry Department, 1934). In 1926 Cameroon exported 100 tonnes of raw rattan cane to France, valued at US$50 000. The export industry was not restricted to raw cane; in 1928 an additional US$50 000-worth of finished cane furniture was exported from Cameroon to Senegal for the expatriate community there (Hédin, 1929).

In the 1970s, the United Nations Industrial Development Organization (UNIDO) promoted an initiative in Senegal to exploit wild cane for large-scale production and export (Douglas, 1974), but this enterprise folded not long after its establishment because of problems in securing a regular supply of raw material.

TABLE 1.**Conservation status of African rattan species**

Species	Geographical range *(million ha)*	IUCN Category
Calamus deërratus	804.9	Not threatened
Eremospatha barendii	Only 1 collection	Endangered
E. cabrae	191.8	Not threatened
E. cuspidata	189.1	Not threatened
E. haullevilleana	270.4	Not threatened
E. hookeri	110.2	Not threatened
E. laurentii	273.2	Not threatened
E. macrocarpa	426.0	Not threatened
E. quinquecostulata	0.9	Vulnerable
E. tessmanniana	0.6	Vulnerable
E. wendlandiana	60.4	Not threatened
Laccosperma acutiflorum	148.5	Not threatened
L. laeve	122.6	Not threatened
L. opacum	180.8	Not threatened
L. robustum	153.7	Not threatened
L. secundiflorum	319.5	Not threatened
Oncocalamus macrospathus	70.1	Not threatened
O. mannii	12.9	Not threatened
O. tuleyi	1.8	Vulnerable
O. wrightianus	0.3	Endangered

Note: Conservation status has been estimated mainly on the basis of the World Conservation Union (IUCN) criterion "extent of occurrence" (with other IUCN criteria also taken into account). Although approximate, this is the best estimate possible in the absence of data from large-scale population studies.

Currently, large quantities of raw cane enter the urban centres of West and Central Africa each day. Table 3 summarizes the results of some attempts to quantify the trade in specific markets in recent years.

Very limited data are available on current or recent rattan exports from countries in Africa (Oteng-Amoako and Obiri-Darko, 2000). Komolafe (1992) reported a limited export of finished products from West Africa to Europe and raw rattans to Asia, including China and the Republic of Korea. There have been recent reports of export of raw cane from Ghana and Nigeria to Southeast Asia (Sunderland, 1999) and of a flourishing export trade from Nigeria to the Republic of Korea (Morakinyo, 1995).

TABLE 2. **Commercially important rattan species by region**

Region	Primary commercial species	Other commercially used species
West Africa (Senegal, Côte d'Ivoire, Ghana, Benin, western Nigeria)	*Laccosperma secundiflorum* *Eremospatha macrocarpa*	*Eremospatha hookeri* *Calamus deërratus*
West/Central Africa (eastern Nigeria, Cameroon, Congo, Gabon, eastern Guinea)	*Laccosperma robustum* *Eremospatha macrocarpa*	*Laccosperma secundiflorum*
Central Africa (Democratic Republic of the Congo, Central African Republic)	*Laccosperma robustum* *Eremospatha haullevilleana*	*Eremospatha macrocarpa*
Southern/East Africa (Zambia, Uganda, Kenya, United Republic of Tanzania)	*Calamus deërratus*	*Eremospatha haullevilleana*

Harvest and transport

The conditions and circumstances under which rattan is harvested and transported in Africa are remarkably consistent throughout its range. Most of the harvesting for commercial trading is undertaken as a secondary occupation by individuals, usually farmers, hunters or other rural people; rattan harvesting provides them with extra revenue, particularly to meet occasional needs such as medical expenses or annual school fees (Trefon and Defo, 1998; Sunderland, 1998). Many cash crop farmers also harvest rattan to obtain extra capital to purchase planting stock and other agricultural inputs.

In general, rattan harvesters tend to return to the same forest area each time they need to cut cane. If the harvester is not native to the area, the chief of the local village is paid a small retainer for providing access to the forest. Harvesters usually prefer to collect as close to a motorable road as possible in order to avoid carrying the bundled canes (which they bear on their heads) for long distances. However, local scarcity near many urban centres now forces many harvesters further into the forest (Sunderland, 1998; Defo, 1999; Profizi, 1999). The added carrying resulting from this increased range is slowly generating an increase in raw cane prices, which is being felt at the market level.

Village-based harvesters transport the harvested rattan to the urban markets themselves, or they may sell at the village to a local trader who then transports the cane for sale to urban artisans (see Falconer 1994; Oteng-Amoako and Obiri-Darko, 2001; Defo, 1999; Sunderland *et al*., 2001) (see the Figure, on p. 23). Some urban-based artisans, if close enough to the wild resource, harvest rattan themselves.

The development of a wide network of logging roads through many forest areas in West and Central Africa has enabled greater access to otherwise inaccessible areas of forest and has resulted in increased rattan exploitation. Indeed, logging trucks often transport harvested rattan (Defo, 1997; Sunderland, 1998).

Long-term indigenous management systems for the rattan resource are unknown in Africa, despite recent optimistic reports of what appeared to be such (Sunderland, 1999). Throughout its range rattan is considered an "open-access" resource; there are very few, if any, customary laws regulating its harvest from the wild. Many national forestry codes still do not regulate the exploitation of NWFPs, and the overharvesting of many commercially important products, including rattan, continues unabated and uncontrolled. Even those states that require licences and permits for the extraction of forest products often do not adequately enforce the regulations or monitor the exploitation of the resources. However, these legislative and institutional constraints to sustainability are currently being addressed, particularly in Ghana, Nigeria and Cameroon, where the current paradigm shift to community-based forest management systems, with direct technical support from the state, is enabling the inclusion of high-value NWFPs such as rattan in forest management plans for the first time. A particular objective of the African Rattan Research Programme is to draw a direct relation between the ecology and utilization of rattan in Africa and the long-term policy interventions required to ensure its sustainability.

The harvesting techniques usually used in Africa also have an impact on the potential sustainability of rattan extraction, particularly for clustering species. To obtain access to the mature stems, harvesters often cut all the stems in a cluster, even those that are not yet mature enough for exploitation and sale. This occurs particularly where resource tenure is uncertain or weak. However, where those who harvest the rattan have more defined resource tenure, younger stems are not removed and are left to regenerate and provide a future source of cane, usually on a two- to three-year rotation. The current shift from state control of forest resource management to community-based management regimes may thus be a reason for optimism about the potential for long-term sustainable and equitable exploitation of the resource.

TABLE 3. **Scale and value of the African rattan trade in selected urban markets**

City	Sample size *(no. of enterprises)*	Estimated amount of cane used per month *(m)*	Estimated mean annual value *(US$)*	Reference
Lagos, Nigeria	not known	180 000	1 141 180	Morakinyo, 1994
Accra, Ghana	27	not known	64 080	Falconer, 1994
Kumasi, Ghana	11	not known	95 475	Falconer, 1994
Ankasa, Ghana	12	4 300 (all species)	62 000	Holbech, 2000
Bata, Equatorial Guinea	15	20 550 (all species)	27 400	Sunderland, 1998
Douala, Cameroon	25	26 955 (large-diameter) 28 875 (small-diameter)	127 405	Sunderland *et al*., 2001
Yaounde, Cameroon	31	23 165 (large-diameter) 29 765 (small-diameter)	103 500	Sunderland *et al*., 2001
Kinshasa, Democratic Republic of the Congo	114	13 760 (large-diameter) 14 448 (small-diameter)	56 600	Minga, 2001

Processing and transformation

Processing of raw cane essentially entails the removal of the epidermis (skin) from the stem and the drying of the raw cane prior to its use. Throughout much of Africa raw cane is processed manually: the stems are scraped with kitchen knives to remove the skin, and drying is usually undertaken in the open air. This rudimentary

means of processing is not only labour-intensive, but also results in inferior-quality cane and hence limits the value of the finished products. Inferior quality has led to speculation that the quality of cane in Africa is inherently poor (J. Dransfield, personal communication). However, this speculation has not been supported by thorough anatomical studies, and it is possible that, if processed and transformed more efficiently, cane from Africa could rival that of Asia in quality.

Improved methods of processing and transformation would also provide long-term conservation benefits. Most notably, a more durable and longer-lasting product would make it possible to harvest less cane from the wild. In addition, from the social perspective, the enhanced value of better-quality products produced by urban artisans could help enhance livelihoods.

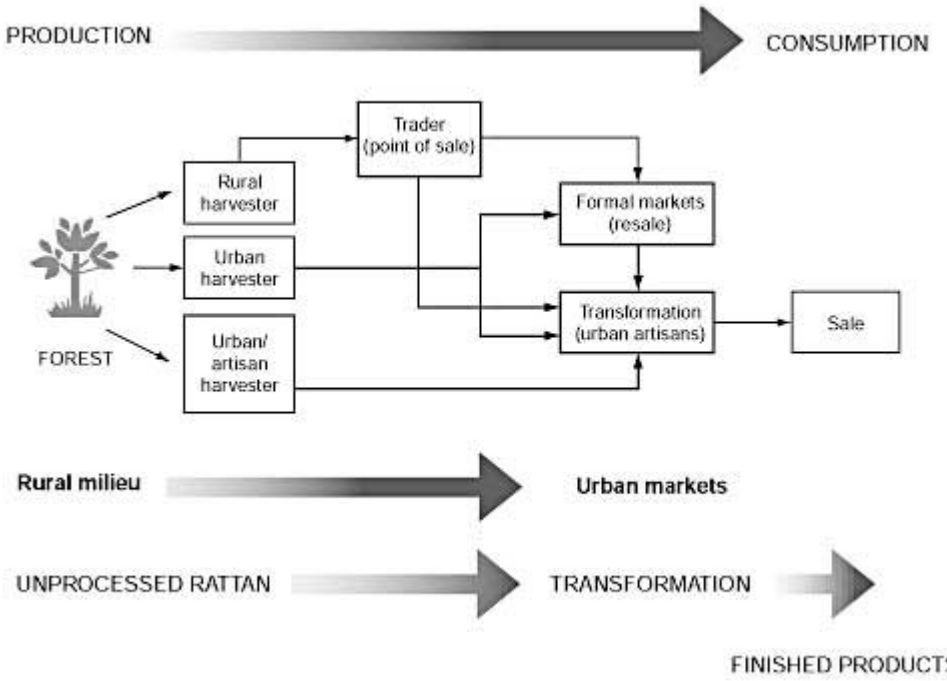
Local rattan scarcity near many urban centres now forces many harvesters deep into the forest, where they shelter in temporary camps - T. SUNDERLAND

In this respect, there are initiatives to introduce appropriate processing and transformation technologies from Asia that are suitable for the African milieu (Sunderland and Nkefor, 1999). A model processing unit has recently been constructed in Limbe, Cameroon and will be used primarily as a training and demonstration unit. Similar units will be established in Ghana and Nigeria over the course of the next two years.

DISCUSSION: MANIFOLD ROUTES TO SUSTAINABILITY

Local scarcity and irregular supply of unprocessed rattan associated with increased demand are among the major constraints to the continued development of the industry. The sustainable harvesting and management of the African rattan resource are primarily hindered by a paucity of sound information on stocking, growth, yield and harvest intensity. In addition, the lack of adequate land and resource tenure precludes many attempts at long-term and sustainable harvesting, and the fact that rattan is usually an open-access resource hinders the prospects for long-term sustainable management.

Generalized "production-to-consumption" system for rattan in Africa



However, the African Rattan Research Programme is currently developing research strategies to help address these constraints. These include the long-term study of mortality, recruitment and phenology in natural forests and the assessment of cane regrowth under a range of harvesting regimes. The results from these studies will help identify the most appropriate harvesting regime for each species based on a detailed understanding of its basic ecology. The determination of these regimes has significant policy implications and provides the basis for community-led management strategies now being implemented in target countries.

The African Rattan Research Programme in Limbe, Cameroon runs training courses for local farmers who have expressed an interest in planting rattan - T. SUNDERLAND

In addition, although African rattans are currently harvested exclusively from wild populations, the ecological and social factors prevalent in the region would be favourable to the development of a cultivated and managed rattan resource. The traditional rattan cultivation practices seen in some areas of Southeast Asia, e.g. cultivation in mixed gardens by sedentary cultivators or in recently burned forest by shifting cultivators (Godoy, 1992), are not known in West and Central Africa. However, the African Rattan Research Programme has recently undertaken research on aspects of seed storage and pre-treatments, and the planting material made available through this research has been used to establish an experimental silvicultural trial of *L. secundiflorum* planted beneath rubber trees that are no longer productive. Community-based trials concentrating on the introduction of rattans into

agroforestry systems and enrichment planting of farm bush and secondary forest, within the legislative context of community forest management, have recently been established in Cameroon and will soon be followed by similar initiatives in Ghana and Nigeria. Annual growth rates as well as the economic viability of these cultivation systems are currently being monitored and assessed.

CONCLUSIONS

As essential biological, ecological and socio-economic information on the African rattan resource becomes available and suitable strategies to ensure sustainability are implemented, there is significant potential for the rattans of Africa to contribute, not only to regional development, but also to the global market. Through applied forest management regimes, and through the development of community-based management supported by appropriate legislatory frameworks, African rattans could provide an opportunity for the useful and sustainable development of rural areas as well as for forest conservation through extractive management. It is essential that baseline research contribute to the development and implementation of forest policy. The African Rattan Research Programme is working to provide the management guidelines necessary, within the context of national forest legislation, for sustainability strategies to be adopted and implemented adequately.

Bibliography

Baker, W.J., Dransfield, J., Harley, M.M. & Bruneau, A. 1999. Morphology and cladistic analysis of sub-family Calamoideae (Palmae). *In* A. Henderson and F. Borchsenius, eds. *Evolution, variation and classification of palms*. *Memoirs of the New York Botanical Garden*, 83: 307-324.

Defo, L. 1997. *La filière des produits forestiers non-ligneux: l'exemple du rotin au Sud-Cameroun*. Yaounde, Cameroon, University of Yaounde.

Defo, L. 1999. Rattan or porcupine? Benefits and limitations of a high value non-wood forest product for conservation in the Yaounde region of Cameroon. *In* T.C.H. Sunderland, L.E. Clark and P. Vantomme, eds. *Non-wood forest products of Central Africa: current research issues and prospects for conservation and development*, p. 237-244. Rome, FAO.

Douglas, J.S. 1974. *Utilization and industrial treatment of rattan cane in Casamance, Senegal (return mission)*. New York, United Nations Industrial Development Organization (UNIDO).

Falconer, J. 1994. *Non-timber forest products in southern Ghana*. *Main report.* Chatham, UK, Natural Resources Institute.

Godoy, R. 1992. Raw materials for craft industries: the case of rattan. *In* T. Panyatou and P. Ashton, eds. *Not by timber alone: economics and ecology for sustaining tropical forests*. Washington, DC, Island Press.

Gold Coast Forestry Department. 1934. Shipments of rattans to the UK and USA from the Gold Coast. *Gold Coast Forestry Department Annual Report*. Accra, Gold Coast (Ghana).

Hédin, L. 1929. Les rotins au Cameroun. *Rev. Bot. Appl*., 9: 502-507.

Holbech, L.H. 2000. *Non-timber forest products survey: market survey and trade route assessment around the Ankasa Protected Area.* Unpublished report for the Protected Area Development Programme, Western Region, Ghana.

Komolafe, D. 1992. Cane makers face raw material scarcity. *Daily Times* (Nigeria), 5 August, p. 30.

Minga, M.D. 2001. L'impact de l'exploitation du rotin sur la préservation de la forêt à Kinshasa, République Démocratique du Congo. *In* T.C.H. Sunderland and J.-P. Profizi, eds. *New research on African rattans*. Beijing, INBAR. (in press)

Morakinyo, A.B. 1994. *The ecology and silviculture of rattans in Africa: a management strategy for Cross River State and Edo State, Nigeria*. Bangor, UK, University College of North Wales. (M.Sc. dissertation)

Morakinyo, A.B. 1995. The commercial rattan trade in Nigeria forests. *Trees and People Newsletter*, No. 25.

Oteng-Amoako, A.A. & Ebanyele, E. 2001. The anatomy of five economic rattan species from Ghana. *In* T.C.H. Sunderland and J.-P. Profizi, eds. *New research on African rattans*. Beijing, China, International Network on Bamboo and Rattan (INBAR). (in press)

Oteng-Amoako, A. & Obiri-Darko, B. 2000. Rattan as a sustainable industry in Africa: the need for technological interventions. Paper prepared for the Expert Consultation on Rattan Development, Rome, FAO, 5-7 December.

Oteng-Amoako, A.A. & Obiri-Darko, B. 2001. Rattan as a sustainable cottage industry in Ghana: the need for development interventions. *In* T.C.H. Sunderland and J.-P. Profizi, eds. *New research on African rattans*. Beijing, China, INBAR. (in press)

Profizi, J.-P. 1986. Notes on West African rattans. *RIC Bulletin*, 5(1): 1-3.

Profizi, J.-P. 1999. The management of forest resources by local people and the state in Gabon. *In* T.C.H. Sunderland, L.E. Clark and P. Vantomme, eds. *Non-wood forest products of Central Africa: current research issues and prospects for conservation and development*, p. 133-137. Rome, FAO.

Sunderland, T.C.H. 1998. *The rattans of Rio Muni, Equatorial Guinea: utilisation, biology and distribution*. Report for European Union Project No. 6 ACP-EG-020, Proyecto Conservación y Utilización Racional de los Ecosistemas Forestales de Guinea Ecuatorial (CUREF).

Sunderland, T.C.H. 1999. New research on African rattans: an important non-wood forest product from the forests of Central Africa. *In* T.C.H. Sunderland, L.E. Clark and P. Vantomme, eds. *Non-wood forest products of Central Africa: current research issues and prospects for conservation and development*, p. 87-98. Rome, FAO.

Sunderland, T.C.H. 2000. *The taxonomy, ecology and utilisation of African rattans (Palmae: Calamoideae)*. London, University College, and Kew, UK, Royal Botanic Gardens. (Ph.D. thesis)

Sunderland, T.C.H. 2001. Indigenous nomenclature, classification and utilisation of African rattans. *In* L. Maffi, T. Carlson and E. López-Zent, eds. *Ethnobotany and conservation of biocultural diversity*. Advances in Economic Botany. New York, New York Botanical Garden Press. (in press)

Sunderland, T.C.H., Defo, L., Ndam, N., Abwe, M. & Tamnjong, I. 2001. A socio-economic profile of the rattan trade in Cameroon. *In* T.C.H. Sunderland and J.-P. Profizi, eds. *New research on African rattans*. Beijing, China, INBAR. (in press)

Sunderland, T.C.H. & Nkefor, J.P. 1999. *Technology transfer between Asia and Africa: rattan cultivation and processing*. Technical Note No. 5. Richmond, UK, African Rattan Research Programme.

Tomlinson, P.B. 1990. *The structural biology of palms*. Oxford, UK, Oxford University Press.

Trefon, T. & Defo, L. 1998. *Can rattan help save wildlife?* APFT Briefing Note No. 10. Brussels, Avenir des peuples des forêts tropicales.

Uhl, N. & Dransfield, J. 1987. *Genera Palmarum*. Lawrence, Kansas, USA, Allen Press.

White, L. & Abernethy, K. 1997. *A guide to the vegetation of the Lopé Reserve, Gabon*. New York, Wildlife Conservation Society.

Whitney, K.D., Fogiel, M.K., Lamperti, A.M., Holbrook, K.M., Stauffer, D.M., Hardesty, B.D., Parker, V.T. & Smith, T.B. 1998. Seed dispersal by *Ceratogymna* hornbills in the Dja Reserve, Cameroon. *J. Trop. Ecol.*, 14: 351-371.

Weiner, G. & Liese, W. 1994. Anatomische Untersuchungen an westafrikanischen Rattanpalmen (Calamoideae). *Flora,* 198: 51-61.

Rattan processing and marketing in Africa: technology needs for a sustainable industry

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Advances in processing, transformation and promotion are essential if Africa's share of international trade in raw and finished rattan products is to be increased.

The rattan production-to-consumption system in most producing countries of Africa is a low-input and labour-intensive system. After collection from the natural forest, rattan is processed into different products at village and urban centres using simple tools. The products are then sold in urban and rural domestic markets, usually in the open along roadsides.

Furniture, shopping and laundry baskets and serving trays are the major products from urban areas, while carrier and storage baskets are the main products at the rural level. The quality of finished products is variable. In general, the highest-quality products are produced in Ghana, Nigeria, Cameroon and the United Republic of Tanzania; in other African countries the industry is very rudimentary.

The quality of a rattan product depends mostly on the quality of the raw material, the ingenuity of the weaver, the efficiency of the tools and equipment used and the use of other inputs such as finishes and varnishes.

Raw material. For a quality finished product, rattan weavers prefer mature stems with long internodes, devoid of discoloration, fungi and insect damage and of seasoning defects such as shrinkage, cracks and splits. Other requirements for quality include uniform diameter (absence of tapering) and glossy or bright colour.

Stems of **Laccosperma secundiflorum** ***being air-dried in Bata, Equatorial Guinea*** - T. SUNDERLAND

Primary processing. In Africa, raw rattan is processed manually; removal of the skin (epidermis) using simple domestic knives is followed by drying in the open air with little or no preservative treatment. Raw materials treated in this way are often marred and infested with fungi and borer insects. The greatest processing needs are, therefore, simple but efficient scraping tools and effective preservative

methods to protect raw rattan from biological hazards. The Southeast Asian method of enhancing raw material by boiling green rattan in diesel or coconut oil should be investigated for possible adoption in Africa.

Transformation into finished products. Research on desired physical properties such as ease of bending, sanding, glue bonding, drying and bleaching is essential for production of quality finished products. Techniques that merit further evaluation for the indigenous species of Africa include the use of steam to bend rattan (to replace blowtorches which leave scorch marks), the use of staples and dowels instead of nails and liberal application of varnish on finished products. Transfer of technology in regard to product designs and the use of modern processing machines from Southeast Asia may be necessary.

The rattan sector in Africa is characterized by low-technology processing and transformation - T. SUNDERLAND

Promotion. Appropriate grading and standardization of raw rattans and their products should be introduced in order to develop the market for quality rattan products.

Rattan furniture for sale in Bata, Equatorial Guinea - T. SUNDERLAND

Better packaging of graded products is essential, as is bulk transport of goods to reduce costs. Display or promotion centres for the exhibition of finished products and the sale of raw rattan could be beneficial to rattan producers and processors. Promotional fairs and advertisements - organized by national rattan associations in collaboration with export promotion councils and small-scale industries of rattan-producing countries - could be effective means of increasing public awareness.

Relaxation of trade restrictions and export levies could serve as an incentive for primary stakeholders to boost market supply. Rattan entrepreneurs should be encouraged through sponsorship to attend international trade fairs to exhibit their products. Market research should be conducted periodically to ensure fair and equitable prices for the commodity in the international market.

Rattan cultivation and livelihoods: the changing scenario in Kalimantan

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An analysis of the changing role of rattan in people's livelihoods in an area of Indonesia where it has been cultivated in a traditional rice-swidden system for more than 100 years.

Rattan, as is the case for many non-wood forest products (NWFPs), is typically produced under extensive conditions - the bulk of the world's supply still comes from wild resources - by people with relatively little economic and political power. Individual producers tend to harvest small quantities in remote and highly dispersed production areas, often under open access property regimes. Product quality varies enormously. These characteristics lead to high transaction costs for trade and relatively low bargaining power for producers, low commodity prices and low incentives for sustainable management (Belcher, 1997). As a result, resource depletion is widespread.

A 15-year-old rattan garden in Pasir district, East Kalimantan, Indonesia - CIFOR/3096/C. GARCIA

However, rattan can also be cultivated under relatively extensive conditions. This article focuses on an area of Kalimantan, Indonesia, where rattan has been cultivated as part of a traditional rice-swidden system for more than 100 years. Swidden farmers manage "rattan gardens" over long periods: peak harvesting of rattan is 24 to 30 years after planting. Rattan has been a major source of cash income during periods of high demand (especially during a boom in the 1980s) and has had important socio-economic functions such as providing a means for saving, a

tool for risk management and a marker of land-holding.

Today, however, a combination of policy and economic factors has sharply depressed demand and prices, while rapid, externally generated changes (new roads, large-scale establishment of oil-palm and pulp plantations) have created new pressures and opportunities for people living in the area. The article analyses these changes with the aim of identifying how rattan's potential for improving the livelihoods of poor people and providing jobs and valuable foreign exchange can be realized.

RATTAN CULTIVATION IN KALIMANTAN

The rattan cultivation system in Kalimantan probably dates back to the mid-nineteenth century (Van Tuil, 1929; Feaw, 1992). The details of the domestication process are not known, but the transition from wild gathering to planting within a rice-swidden system would have been a relatively small step. Rattan seeds or seedlings can be established simultaneously with the rice crop at very low extra cost. Studies carried out by the Center for International Forestry Research (CIFOR) (Belcher *et al.*, 2000; Garcia-Fernandez, 2001) have shown that rattan cultivation requires an extra seven or eight person-days in the first year, and small inputs for weeding and protecting the young rattan plants afterwards. Once the plants are established, they can be harvested periodically for many years using simple technology, for just the cost of the harvesting labour (cutting and carrying).

Rattan was originally used mainly for subsistence purposes. It began to be important in trade in the 1920s (Fried and Mustofa, 1992) and by the end of the 1960s it had become an important economic crop with the increased motorization of river transportation, a greater number of traders and exporters and regular increases in rattan prices. At the same time, alternative sources of income were lost as forest products that had been important, such as resins and gums, became less valuable through removal of trees and the development of synthetic substitutes. By the end of the 1970s, rattan was the main source of income for most villages of the study area, with many farmers concentrating on rattan cultivation and purchasing rice to meet their requirements.

CIFOR's Kalimantan case study

This article is based on an ongoing study being carried out by the Forest Products and People Programme of the Center for International Forestry Research (CIFOR). The study focuses on the Pasir and Kutai Barat districts of the Indonesian province of East Kalimantan. The residents are mainly indigenous people (Dayak tribes) who live in scattered villages accessible by river and, increasingly, by road. They practise swidden agriculture; rice is the mainstay, with several other field crops grown, supplemented by hunting, fishing and collecting from the forest and increasing integration in the cash economy.

The study includes village- and household-level socio-economic surveys, ecological surveys, economic research, and spatial and land-cover analyses based on community mapping and time series remote sensing (optical and radar satellite) imagery (Belcher *et al*., 2000).

As with most CIFOR research, the project involves collaboration with local partners (in this case, the Centre for Social Forestry at the University of Mulawarman, Samarinda) and two international partners (The Centre for Earth Observation Science, University of Manitoba, Canada [with support from the Canadian International Development Agency] and the European Union-supported FORRESASIA project).

This article has been modified from Belcher *et al.* (2000); for more detail

on the research activities described here, these papers can be requested from CIFOR.

Cultivation system

The details of the system vary from farmer to farmer and place to place, but the basic elements are consistent (Weinstock, 1983; Mayer, 1989; Godoy, 1990; Peluso, 1992; Fried and Mustofa, 1992; Belcher, 1997). Farmers plant rattan seeds, wildings or seedlings in a newly created agricultural field (or "*ladang*") as part of a shifting cultivation system. The main agricultural crop is upland rice, planted along with maize, cassava and banana, among other food crops. The main rattan species used is *Calamus caesius* (more than 90 percent of plantings), although several other species are also grown.

Farmers start the swidden cycle in May by slashing undergrowth vegetation and then felling the trees in a selected area of primary or secondary forest. In August, after a drying period of a month or so, the field is burned, and by September farmers start planting the hill rice which will be harvested in February. Rattan seeds or seedlings are planted either after slashing (before burning, as some believe that the heat from the burning improves germination) or at the same time as the rice.

The young rattan plants are protected in the *ladang*, and when the farmer shifts to a new swidden plot one to two years later the rattan is left to grow up with the secondary forest vegetation. The average size of a rattan garden is 1.4 ha. The density of rattan clumps ranges from about 50 to 350 plants per hectare, with a mean of around 170 (Garcia-Fernandez, 2001).

Harvesting of *C. caesius* typically commences eight to ten years after planting. Some of the other species mature more quickly. Most of the cultivated species (including *C. caesius*) have multiple stems and can sustain repeated harvests. Production peaks 24 to 30 years after planting and begins to decline after 37 to 43 years (Garcia-Fernandez, 2001).

An intermediary in the rattan trade in the Pasang district of East Kalimantan; rattan stems are sold through a network of traders, which influences both prices and benefits to the producers - CIFOR/3064/C. GARCIA

The rattan stems are cut, cleaned and dried for sale through a network of traders. The main market for the primary cultivated species has been the *lampit* (rattan mat) industry in South Kalimantan (although this industry has largely collapsed, as discussed below) and the furniture and handicrafts industry, primarily in Java. A substantial portion has also been smuggled to Malaysia (Haury and Saragih, 1996; 1997) and on to other countries with large rattan furniture manufacturing industries (especially the Philippines and China).

Rattan had a boom period in the 1980s with the rapid development of the* lampit *(rattan mat) industry in South Kalimantan, but export restrictions led to a decline in this industry in the 1990s - CIFOR/1856/B. BELCHER

TRADITIONAL ROLE OF RATTAN IN LOCAL LIVELIHOODS

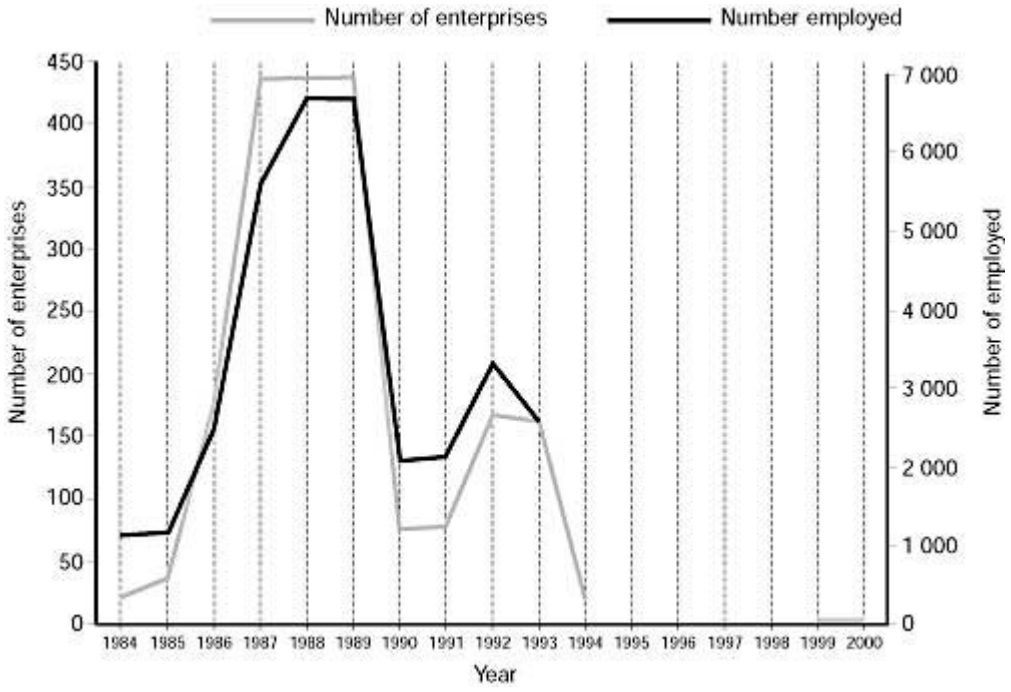
The traditional rattan cultivation system provides a source of cash income in areas where there are few other opportunities to earn cash. Rattan gardens offer a valuable risk management tool in which the rattan is available as a long-lived, low-maintenance source of savings/income. This is especially important in systems without other well-developed risk management institutions (such as bank accounts or insurance policies). Rattan can be harvested to respond to urgent needs for cash, in reaction to medical emergencies, for example, or for ceremonial requirements.

The traditional rattan cultivation system offers the advantage of low-cost establishment and maintenance with relatively high yields. Harvesting is very flexible - the rattan continues to grow for years, so there is no penalty for delaying harvesting to coincide with labour availability or higher prices.

Rattan gardens also have an important marker function for property ownership. Within the traditional system, rattan gardens are respected as a sign of occupation. With recent large-scale state-sanctioned land appropriation by oil-palm, pulp and mining companies, rattan gardens have been used successfully to demonstrate ownership and claim financial compensation (however meagre) from usurping companies.

The rattan gardens, which are essentially secondary forests, are also a source of other valuable forest products and services, providing habitat for medicinal plants, ritual plants and plants and animals valued for food (Matius and Pilipus, 2000). They also have important cultural value: rattan gardens represent an important tradition and provide links to ancestors, and many rattan gardens have been inherited through generations.

1
Rattan matt (*lampit*) industry in Amuntai, South Kalimantan, 1984 to 1993



CHANGES IN THE RATTAN INDUSTRY: BOOM AND BUST

The economic role of rattan expanded in the 1980s with the rapid development of the *lampit* industry in South Kalimantan. In 1984 there were just 21 *lampit* manufacturing enterprises in Amuntai, the centre of the industry, making 64 000 m^2 of *lampit*. By 1987 the industry was at its peak, having swelled to 435 units producing more than 1 million square metres (Figure 1). Demand and prices for cultivated *C. caesius* reached unprecedented highs. Farmers report that competition among buyers was very high. Traders would come to the villages, offering advances of cash and consumer goods to secure rattan supplies.

One of the main markets for the primary cultivated species has been the furniture industry in Java - CIFOR/1857/B. BELCHER

With the boom in the rattan sector in the 1980s, a series of regulations were swiftly put in place, ostensibly aimed at protecting the resource and encouraging the domestic processing industry (see Box on policy instruments affecting rattan in Indonesia). This was in line with a tradition in Indonesia of heavy government intervention in resource industries, often in collusion with powerful private interests (de Jong *et al.*, 2001).

The ban on the export of unprocessed and semi-processed rattan acted as a subsidy for domestic manufacturers of rattan products by increasing domestic supply and thus reducing raw material prices (Bennet and Barichello, 1996). However, while

the rattan processing industry in Indonesia has grown substantially as a result, the lowering of raw material prices has been at great cost for the people involved in raw material extraction and cultivation.

Policy instruments affecting rattan in Indonesia

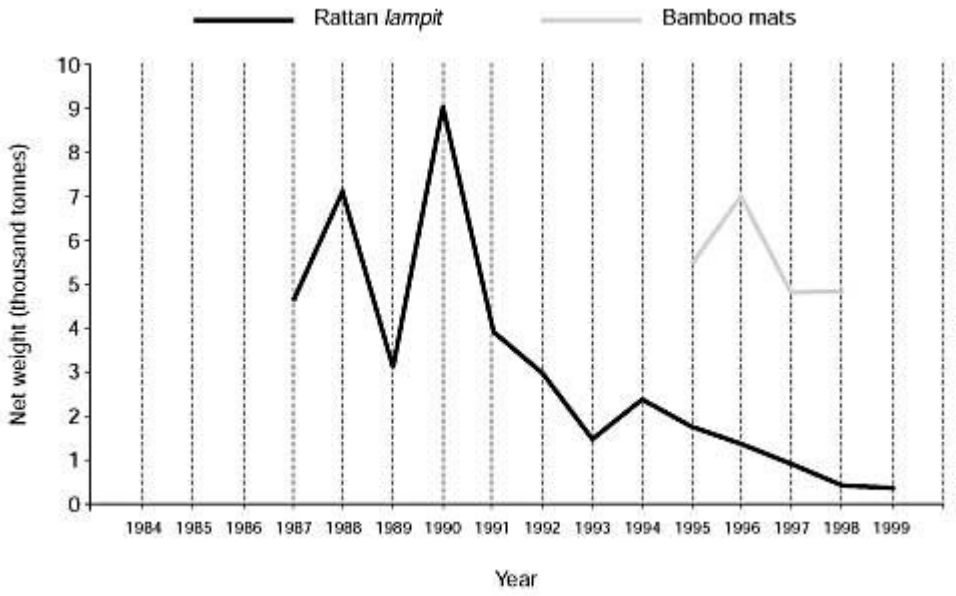
- **Ban on the export of unprocessed (raw) rattan, October 1986**
- **Ban on the export of semi-finished rattan, January 1989 (replaced in 1992 with a prohibitive export tax)**
- **Reclassification of rattan webbing from finished product to semi-finished product,1992, further reducing demand for cultivated rattan species used for this product**
- **Regulation of the rattan processing industry, with restrictions on investments in the area, e.g. closure of all foreign and domestic investment in raw rattan processing and semi-finished rattan production and of foreign investment in finished products manufacturing, 1989 (later relaxed to allow investment in rattan processing outside Java, and finally fully relaxed in 1995), which has probably kept rattan processing capacity lower than it would otherwise have been**
- **Establishment of a Joint Marketing Board (ASMINDO), an approved exporters system and an export quota system for *lampit*, by a Ministry of Trade Decree**

One of the most important changes for the rattan growers of Kalimantan was the move to establish the Joint Marketing Board, ASMINDO, "to prevent unhealthy competition" among *lampit* exporters (ASMINDO, 1997). The measures used were very similar to those used by the Indonesian plywood marketing board, APKINDO (see Barr, 1998). ASMINDO imposed export restrictions on its membership in order to manage supply, in an effort to control quality and increase unit prices. Individual manufacturers reported that the quota was assigned on the basis of political connections and payments.

These measures led to severe reductions in manufacturing and export of *lampit*. There were also large fluctuations in value added, as the unit price changed (in nominal terms) from US$6.38 to as low as US$1.22 and back up to US$8.39 per square metre in 1987, 1990 and 1995, respectively. The total number of enterprises dropped from 435 in 1987 to 20 in 1994, and now the industry is virtually moribund. There is only one factory still operating in Amuntai, and a few others in other cities make some *lampit* alongside other products, primarily for the domestic market.

ASMINDO officials lay the blame for this situation on changing tastes and decreased demand in the main importing country, Japan. In fact, Japanese imports of a Chinese substitute for rattan *lampit*, made from bamboo, expanded dramatically in 1995 to fill the gap created when the Indonesian prices increased and quantities decreased (Figure 2).

2
Japanese imports of rattan* lampit *from Indonesia and bamboo mats from China, 1984 to 1999



The drastic reduction in output has likewise reduced demand, and prices, for raw material. Raw material prices have changed little in nominal terms since 1987, and have decreased in real terms. In more remote areas of Kalimantan, where transport and other transaction costs are higher, there have been no buyers for several years.

The price slump following the introduction of restrictions on exports was a hard blow to all rattan farmers, most of whom were not aware of the reasons for the slump. They had already experienced ups and downs in prices of rattan, so they were waiting for the good times to come back. As the situation has not improved, more and more farmers have begun to seek alternative sources of cash income. Farmers in villages with better access to alternative opportunities have reduced the harvesting from existing rattan gardens and, in some places, stopped planting new gardens altogether.

EXPANSION OF LARGE-SCALE PLANTATIONS

Oil-palm has been one of the most dynamic of Indonesia's agricultural subsectors, and significant expansion of oil-palm plantations has occurred in several areas, including Kalimantan. This has led in many cases to direct competition for land. Plantation concessions have been given on land that was used and managed under customary tenure ("*adat*") by indigenous people for swidden agriculture and rattan gardens. According to the definitions used by the Indonesian Government, rattan gardens are seen as degraded forests, and they were thus deliberately targeted for conversion to plantations (especially oil-palm or pulp plantations) (Fried, 1995).

Industrial oil-palm plantations typically cover several thousand hectares, often in rattan growing areas. By 1998, an estimated 70 000 ha were planted to oil-palm in East Kalimantan (with substantially larger areas in neighbouring provinces). Nearly 4 million hectares have been designated for conversion in East Kalimantan and, by 1999, applications had been approved for the release of more than 450 000 ha (Casson, 2000). In the study village of Modang many people were displaced and large areas of productive rattan gardens were destroyed as a result of the establishment of a large oil-palm plantation in the early 1980s. More recent attempts to establish oil-palm plantations have led to severe, sometimes armed, conflict between company employees and villagers resisting the appropriation of their land (Casson, 2000). In Lempunah village, for example, conflict has led to malicious destruction, sometimes through burning, of rattan gardens and forest by the plantation company, and burning of vehicles and buildings as well as uprooting of newly planted oil-palm plants by villagers (C. Gonner, personal communication).

However, oil-palm also has a "pull" effect. Oil-palm growing is seen as an interesting

new opportunity by local people who appreciate benefits such as regular cash income (palm kernels can be harvested every week), a guaranteed market and a more modern lifestyle. Indeed, the main reasons for people's resistance seem to be the lack of adequate compensation for land that they consider theirs, and the wish to maintain a broad range of economic activities. People do not want to limit their options. The oil-palm companies, in contrast, encourage (or compel) people to concentrate their efforts on oil-palm growing, partly to ensure more efficient production and sufficient raw material to run their processing factories at capacity and partly, in all likelihood, to foster a dependence among growers.

Another significant land-use change has been the large-scale planting of pulp plantations. Many of these have been situated on lands defined as degraded, and rattan gardens fall into this category. The spatial analysis performed as part of the case study showed a very high correlation of rattan growing areas with pulp plantations.

PLANTATIONS AND FOREST FIRES USHER IN A NEW REALITY

Wildfires burned several million hectares of Kalimantan in 1997 and had a major impact on the rattan gardens. The areas hit hardest were logged-over forests and areas of new oil-palm and pulp plantations. Many of the fires were set deliberately to clear land for plantations, and fire was used as a weapon in land conflicts (as described above). In some villages, fires destroyed up to 90 percent of the rattan gardens.

Beyond the physical damage, the fires of 1997 had a very traumatic effect on local people. Rattan gardens had been seen as a source of security. While prices might fluctuate, the rattan could always be sold for cash if and when it was needed; many people regarded their rattan gardens as a kind of savings account. With the sudden widespread burning of rattan gardens, that sense of security was replaced by the recognition that rattan gardens too are vulnerable. This new reality, combined with the low prevailing prices, had a determining effect on the decision of many villages to give up rattan cultivation for other, more promising, activities. As the hardest hit villages were also coincidentally the ones with the best access to other opportunities, the trend towards change was reinforced.

Other villages, especially those dominated by Benuaq and Bentian ethnic groups, still maintain their interest in rattan gardens, even after the price slump and the destructive fires, in the hope that prices will soar again. This continued interest may be a result of their limited choice: in these remote villages rattan is the only source of cash. No other commodity is traded in the area. However, the villagers are no longer investing in establishing large rattan gardens, and only cut small amounts on a regular basis to meet their subsistence needs.

Most young people interviewed in the CIFOR surveys place their hopes on plantation crops such as oil-palm or pulpwood. They acknowledge that their low level of education and expertise prevents them from obtaining salaried positions with large companies and even from migrating. Condemned to stay in the village, they long for the regular incomes from oil-palm or rubber. Rattan, with prices currently so low, is seen as an outdated product, inherited from their forefathers. But such perceptions may quickly change if prices go up and if returns to labour again become favourable. There is evidence that people will respond quickly to rising prices for rattan; for example, increased demand for two small-diameter species stimulated farmers to plant them more abundantly. The importance of having rattan planting among the available economic options is especially great in more remote areas where there are few alternatives.

SHOULD RATTAN BE SUPPORTED?

The question arises as to whether this system should be subsidized or otherwise

supported and, if so, how? Clearly, the rattan gardens are an integral part of the livelihood systems of a large number of people. For the most part, the stresses placed on the system have been generated from outside. There is therefore a strong argument in favour of countervailing measures to overcome the forces that have depressed raw material prices and undermined an integrated NWFP production system. With a more favourable policy environment the system could be economically competitive, especially in the more remote areas where there are limited (or no) alternative income-generating activities.

There is also a strong argument for removing barriers and even for actively supporting the rattan cultivation system from a national perspective, as this production supplies a valuable export industry. Exports of rattan products generated more than US$350 million in 1995 and again in 1996, then dropped during the crisis years of 1997 and 1998, recovering to almost $300 million in 1999 (Indonesia Central Board of Statistics, 1995-1999). In addition, in conservation terms, the financial value of rattan allows a long fallow period during which the forest can regenerate, providing ecological (and economic) benefits related to biodiversity, forest cover, carbon sink and climate control.

Two main sets of actions would be required to support the rattan system. First, rattan cultivation could be promoted by reducing the trade barriers that depress domestic raw material prices - including internal barriers such as the ubiquitous illegal fees charged to traders, as well as official export taxes. Industry has resisted this option, fearing that higher raw material prices would threaten its competitiveness. Additional measures would thus be needed to help the industry become more competitive - for example, research and extension to improve the cultivation system for more efficient raw material production; improved market information to enhance trade; and improved design, quality, efficiency and marketing of manufactured products.

Second, and more importantly, there is a clear need to recognize and accommodate traditional land-use systems and long-standing *de facto* use rights, and a need for more careful land-use planning to avoid the large-scale displacement of forest-based people.

CONCLUSION

The situation in Kalimantan illustrates the importance of considering whole systems in order to identify the real problems. While rattan resources (both wild and managed) may be diminishing, the underlying reasons for decline in the rattan sector are social, economic and political, not technical. The case in East Kalimantan is unusual in that the rattan is cultivated, but the same forces that have led people to abandon their rattan gardens have also led to unsustainable management and resource depletion elsewhere.

Sustainable management of NWFPs, generally, and rattan, specifically, will require improved institutional mechanisms: secure property rights for rattan managers or producers, transparent markets and reduced transaction costs to reduce the risk and increase the efficiency of the trade. People can only be expected to manage a resource sustainably if they are currently able to capture sufficient benefits and can reasonably expect to continue to do so in the future. The case in East Kalimantan demonstrates that even a system that can (technically) be managed sustainably may be seriously undermined by outside forces (and, not least, by misguided policies). While technical research will also be needed (on improved treatment to prevent post-harvest losses, for example), it should take place within the context of an understanding of the system and the real constraints and opportunities.

Bibliography

ASMINDO. 1997. *Lampit rotan: Sebelum dan sesudah tata Niaga.* (Rattan

lampit: before and after the control system.) (unpublished report)

Barr, C.M. 1998. *Bob Hasan, the rise of APKINDO, and the shifting dynamics of control in Indonesia's timber sector.* Ithaca, New York, Cornell University Southeast Asia Program.

Belcher, B.M. 1997. *Commercialization of forest products as a tool for sustainable development: lesson from the Asian rattan sector.* University of Minnesota, USA. (Ph.D. thesis)

Belcher, B.M., Levang, P., Garcia-Fernandez, C., Dewi, S., Achdiawan, R., Tarigan, J., Riva, W.F., Kurniawan, I., Sitorus, S. & Mustikasari, R. 2000. Resilience and evolution in a managed NWFP system: evidence from the rattan gardens of Kalimantan. Paper presented at the workshop Cultivating Forests: Intermediate Systems for NWFP Production, Lofoten Islands, Norway, June.

Bennet, C. & Barichello, R. 1996. Value-added and resource management policies for Indonesian rattan: aims, outcomes and options for policy reform. *In* B.D. Nasendi, ed. *From rattan production-to-consumption in Indonesia: policy issues and options for reform*, p. 23-35. Bogor, Indonesia, Forest Products and Forestry Socio-economics Research and Development Centre, Forestry Research and Development Agency.

Casson, A. 2000. *The hesitant boom: Indonesia's oil palm sub-sector in an era of economic crisis and political change.* CIFOR Occasional Paper No. 29. Bogor, Indonesia, CIFOR.

de Jong, W., Rohadi, D., Mustikasari, R., Belcher, B. & Levang, P. 2001. *The political economy of forest products in Indonesia: a history of changing adversaries.* Bogor, Indonesia, CIFOR. (in press)

Feaw, T.C. 1992. The history of rattan cultivation. *Malayan Forest Record*, 35: 51-55.

Fried, S. 1995. *Writing for their life: Bentian Dayak authors and Indonesian development discourse*. Cornell University, Ithaca, New York. (Ph.D. dissertation)

Fried, S.T. & Mustofa, A.S. 1992. Social and economic aspects of rattan production, Middle Mahakam Region: a preliminary survey*. German Forestry Group Report*, 21: 63-72.

Garcia-Fernandez, C. 2001. *Traditional management systems in Indonesian tropical forest: silvicultural aspects and ecology*. Universidad Complutense de Madrid, Madrid, Spain. (Ph.D. thesis)

Godoy, R.A. 1990. The economics of traditional rattan cultivation. *Agroforestry Systems*, 12: 163-172.

Haury, D. & Saragih, B. 1996. *Processing and marketing rattan*. SFMP Document No. 6a. Samarinda, Indonesia, Indonesian Ministry of Forestry/German Agency for Technical Cooperation (GTZ).

Haury, D. & Saragih, B. 1997. *Low rattan farmgate prices in East Kalimantan - causes and implications.* SFMP Document No. 12. Samarinda, Indonesia, Indonesian Ministry of Forestry/GTZ.

Indonesia Central Board of Statistics. 1995-1999. Indonesia foreign trade statistics - exports. Jakarta, Indonesia, Badan Pusat Statistik (BPS-Statistics).

Matius, P. & Pilipus, Y.A. 2000. *Traditional versus non-traditional agroforestry systems in the Kutai District of East Kalimantan: a comparison of the diversity, abundance, structure and utilization of plants.* Samarinda, Indonesia, Centre for Social Forestry, University of Mulawarman. (unpublished research report)

Mayer, J. 1989. Rattan cultivation, family economy and land use: a case from Pasir, East Kalimantan. *German Forestry Group Report*, 13: 39-53.

Peluso, N.L. 1992. The rattan trade in East Kalimantan, Indonesia. *In* D.C. Nepstad and S. Schartzman, eds. *Non-timber products from tropical forest: evaluation of a conservation and development strategy.* Advances in Economic Botany Vol. 9, p. 115-127. Bronx, New York, New York Botanical Garden.

Van Tuil, J.H. 1929. Handel en cultuur van rotan in de zuideren oosterafdeeling van Borneo (Trade and cultivation of rattan in the southern and eastern divisions of Borneo). *Tectona*, 22: 695-717. (in Dutch)

Weinstock, J.A. 1983. Rattan: ecological balance in a Borneo rainforest swidden. *Economic Botany*, 37(1): 58-68.

Development of rattan for edible shoots in the Lao People's Democratic Republic

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Although globally rattan is seen principally as a cane-producing plant, in the Lao People's Democratic Republic (and also in northeastern Thailand) rattans also supply edible shoot tips. These are consumed locally or exported to Southeast Asian communities in France, the United States and elsewhere.

The trade in edible rattan shoots from wild plants is large, unquantified and essentially unregulated. *Daemonorops jenkinsiana* thrives in the north in areas of shifting cultivation and appears to be the main source of shoots for the markets there. Its profusely clustering clumps survive fire, deforestation and repeated shoot removal very well. The cane of this species is not highly sought after, so trade in its shoots has little effect on overall commercial cane production. However, in some places valuable cane-producing species are targeted, and this trade is of greater concern.

Rattan plantation development is beginning to get under way in the country, and plantations for edible shoot production are a dynamically growing subsector. Small-scale nursery trials have been made for six or seven species with commercial potential. Only one or two very small trials of plantations for cane production have begun, but one species (*Calamus tenuis*) has already become a major commercial success in plantations for edible shoot production (Sengdala and Evans, 1999; Belcher, 1999; Evans and Sengdala, 1999). Many fields begin producing saleable shoots only a year or so after planting and can then be harvested monthly for many years thereafter, offering a return that is competitive with rice production. Rattan prefers sites where regular flooding would damage most other crops.

In the Lao People's Democratic Republic the techniques for rattan cultivation for edible shoot production were first developed in 1994, inspired by large-scale commercial planting in Thailand of three species (mainly *Calamus viminalis* with some *Calamus siamensis* and *C. tenuis*) which began three years earlier (Jarenrattawong, 1997; Evans and Sengdala, 1999). It is estimated that more than 50 planters have planted areas of more than 100 ha planted in at least five provinces.

The outlook for expanding edible shoot production is much better than that for cane production. There is a large domestic market, and the Lao

People's Democratic Republic competes only with Thailand in supplying the export market. Furthermore, planting is spreading rapidly without the need of special policy support because, unlike cane, shoots of *C. tenuis* offer a rapid and proven return on the open market.

The edible shoot sector seems to be the most promising area for support of rattan development. The Lao Forestry Research Centre, Oxford University and Kew Gardens (the latter two are in the United Kingdom) have drawn up a programme, and funds are currently being sought.

The shoot subsector could also offer some spin-off benefits for the cane sector. The plantations have little potential for conversion to cane production because the rattan is grown in open sun with no available climbing supports. However, the abundance of cheap seedlings and the widespread expertise in growing these species will make cane plantations easier to establish if economic conditions become attractive in the future.

Bibliography

Belcher, B. 1999. Constraints and opportunities in rattan production-to-consumption systems in Asia. *In R.* Bacilieri and S. Appanah, eds. *Rattan cultivation: achievements, problems and prospects*, p. 116-138. Montpellier, France, CIRAD-Forêt/Kuala Lumpur, Malaysia, FRIM.

Evans, T.D. & Sengdala, K. 1999. From non-timber forest product to cash crop - the recent spread of rattan cultivation for edible shoot production in the Lao PDR. *Lao Journal of Agriculture and Forestry*, 1999(2): 40-47.

Jarenrattawong, J. 1997. Rattans in Thailand. *In* A.N. Rao and V.R. Rao, eds. *Rattan - taxonomy, ecology, silviculture, conservation, genetic improvement and biotechnology*, p. 115-116. Serdang, Malaysia, International Plant Genetic Resources Institute (IPGRI).

Sengdala, K. & Evans, T. 1999. Rattan cultivation in Lao PDR: achievements, problems and prospects. *In* R. Bacilieri and S. Appanah, eds. *Rattan cultivation: achievements, problems and prospects*, p. 210-216. Montpellier, France, CIRAD-Forêt/Kuala Lumpur, Malaysia, FRIM.

Sustainable harvesting of wild rattan: viable concept or ecological oxymoron?

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The article examines the viability of managed harvesting - with a focus on a study of the ecological effects associated with cane extraction in Central Sulawesi, Indonesia - considered against contrasting alternatives: clearing for cash crops, and rattan cultivation.

Rattan, one of the world's most important non-wood forest prod-ucts (NWFPs), offers a vivid example of the difficulties and uncertainties inherent in ascertaining sustainable extraction levels and impacts associated with harvesting. Rattan is collected almost exclusively from wild populations, and market demand for cane is strong. Indonesia supplies perhaps as much as 90 percent of the world's commercial rattan cane (Dransfield and Manokaran, 1994), and most is gathered from forests in which management has been largely absent or ineffective (Barr, 2000). There have been little or no monitoring or management of wild rattan harvesting and virtually nothing is known about ecological effects associated with extraction.

Mature* Calamus zollingeri *plant growing in Lore Lindu National Park, Central Sulawesi - S.F. SIEBERT

Sustainable harvesting of NWFPs has been advocated as a means of simultaneously conserving forests and encouraging economic development (Anderson, 1990; Freese, 1997) and is now an integral component of most tropical forest conservation and management efforts (CIFOR, 1999). However, many ecologists contend that NWFP harvesting is neither ecologically sustainable nor economically viable (Kramer, van Schaik and Johnson, 1997; Rice, Gullison and Reid, 1997) and that the notion of sustainable extraction is an ecological oxymoron (Struhsaker, 1998). Is sustainable harvesting of wild rattan an oxymoron? If not, under what biophysical, socio-economic and institutional conditions might harvesting be viable?

This article documents an attempt to assess and monitor ecological effects associated with cane extraction in primary forests, based on five years of ongoing research by the author in Central Sulawesi, Indonesia. The study focused on *Calamus zollingeri*, a commercially important large-diameter rattan used in furniture manufacturing. The article focuses on only two among the many direct and indirect ecological effects examined in the study:

- direct impacts to the plant and to plant parts and cane growth;
- ecological impacts of using floater logs to transport cane to market.

In addition, the article points out that possible adverse effects to other flora or fauna must be weighed against those of alternative economic activities (e.g. converting forests to annual or perennial cash crops). Finally, it examines the viability of managing wild rattan harvesting versus rattan cultivation.

CALAMUS ZOLLINGERI CANE HARVESTING AND MONITORING METHODS

A study to examine the ecological effects of cane harvesting was carried out in Lore Lindu National Park in Central Sulawesi. It focused on *Calamus zollingeri*, which is abundant in and around the park at altitudes below 1 150 m. *C. zollingeri* is a robust, clustering rattan found throughout Sulawesi, the Mollucas and other islands of eastern Indonesia and is one of the most important large-diameter canes in the furniture industry (Dransfield and Manokaran, 1994). Virtually all *C. zollingeri* cane is collected from unmanaged, wild populations in primary forests. Despite prohibitions, huge quantities of *C. zollingeri* cane are collected from Lore Lindu National Park and

cane harvesting shows no signs of declining (author's observation). Indeed, given expanding export demand and the central Indonesian government's inability to enforce prohibitions against collecting, rattan harvesting is likely to accelerate.

One of the challenges in assessing ecological sustainability is determining and establishing monitoring protocols for the vast array of possible direct and indirect biological effects. Table 1 summarizes the primary direct and indirect effects associated with *C. zollingeri* cane harvesting in Central Sulawesi and the methods used to assess and monitor them in this study. Principal effects associated with rattan cane harvesting include:

- at the species level - effects to plants (genets), canes (ramets) and cane production and growth;
- at the ecosystem level - effects on ecosystem nutrients, forest structure, forest succession and vertebrate food resource availability;
- indirect effects from transporting cane to market and incidental hunting of birds and mammals.

TABLE 1. **Potential effects of rattan cane harvesting and monitoring methods**

Potential effect	Monitoring methods
Species level	
Plant (genet) survival	Resampling of permanently marked plants
Plant population structure Cane (ramet) production Cane growth	Resampling of permanently marked plants and replicated sampling of random transects
Ecosystem level	
Nutrient stocks	Determination of nutrients in foliage and canes and of the volume of cane extracted per unit area
Forest structure Forest succession and composition Understorey trampling	Long-term monitoring of sample plots
Vertebrate food resources	Biweekly sampling of marked plants
Invertebrate use	Not investigated in this study
Other	
Cane transport (floater logs)	Determination of weight of rattan extracted, tree species and volume used as floater logs and location of trees extracted
Hunting	Not investigated in this study

Methods

The use of belt transects (three per subwatershed), each measuring 10 × 500 m or 10 × 1 000 m, randomly established perpendicular to the contour and located approximately 500 to 1 000 m apart, was found to provide an effective, quick and easy way to assess and monitor *C. zollingeri* populations. Belt transects can reliably sample the abundance and distribution of rattan and other lianas that tend to have patchy or clumped populations (Hegarty and Caballe, 1991).

Local rattan collectors were actively involved in the project and helped to identify relevant research questions and appropriate field sampling methods. With three experienced rattan collectors sampling upslope in 10 m segments, an average of 500 m of transects were sampled per day. Workers on the project recorded the identity of all rattan species, the number of canes per plant, cane lengths and evidence of harvesting within 5 m of either side of the transect line. At the same time, data on slope, elevation, light regime, soil, canopy height and dominant tree species were gathered along each transect.

To monitor potential harvesting effects on individual plants, more than 100 mature *C.*

zollingeri plants encountered along the transects were permanently marked (with flagging and metal tags) in 1996, and the number of canes, cane lengths, evidence of cane harvesting and associated environmental conditions were recorded (as noted above). This article summarizes data from marked plants located in primary forests at altitudes below 1 000 m that were in well-drained sites and not affected by tree felling (n = 74). In addition, three permanent 1 × 1 m sample plots were established around each plant to monitor the effects of cane harvesting on understorey vegetation (i.e. extent and persistence of trampling).

A mature* Calamus zollingeri *plant with numerous vegetative sprouts and canes, marked with flagging and metal tags for monitoring of potential harvesting effects on individual plants - S.F. SIEBERT

The marked plants and associated plots were resampled annually for four years. Marked plants were monitored for flowering and fruiting phenology and for evidence of their use by birds and mammals on a biweekly basis for two years. Any evidence of damage to forest vegetation along the transects (i.e. branches broken or trees cut to harvest cane) was noted each year and the persistence of damage was monitored for four years (e.g. natural and cut tree falls, trampling while harvesting cane).

Leaf and cane nutrient contents and losses associated with harvesting were assessed in paired leaf and cane samples (Siebert, 2001). Impacts of using logs to transport cane to market were investigated by identifying the species, volume and location of trees harvested to float cane downriver over a two-year period.

Throughout the duration of this study, rattan (including marked plants) was harvested as desired by local collectors. In general, long canes (i.e. greater than 20 m) that could be readily pulled from supporting vegetation were preferred and no canes shorter than 10 m were cut.

Ecological effects of cane harvesting on plants, canes and cane growth

During the first sampling in 1996, an average of 149 *C. zollingeri* plants with a total of 1 431 canes of which 66 were of harvestable length (i.e. greater than 10 m) were recorded per hectare (Table 2). In 2000, the study recorded an average of 143 plants with 1 595 canes and 46 harvestable canes per hectare in the same watershed. Populations of *C. zollingeri* exhibited extremely patchy distribution;

massive plants (i.e. with more than 20 canes) dominated the understorey and canopy along some portions of the transects, while no *C. zollingeri* were observed in other areas. This variance is reflected in and largely explains the high standard deviations of the mean figures in Table 2.

TABLE 2. **Differences in *Calamus zollingeri* plant and cane populations over four years (based on 100 m^2 sample plots along three random transects)**

Component surveyed	1996 (*n* = 205)		2000 (*n* = 150)	
	Mean no./ha	Standard deviation	Mean no./ha	Standard deviation
Plants	149	±103	143	±118
Canes	1 431	±1 402	1 595	±1 437
Harvestable canes (>10 m)	66	±120	46	±84

C. zollingeri occurred in both high-light (e.g. canopy gaps) and densely shaded environments, but was absent in poorly drained or seasonally flooded sites. No evidence of mortality or dieback to *C. zollingeri* plants was observed, irrespective of the frequency or number of canes harvested. For example, on marked plants no cane harvesting-induced mortality was recorded even though approximately 33 percent were harvested each year and in 2000 canes were frequently cut on reaching 10 m in length.

TABLE 3.***Calamus zollingeri*** **cane production and growth over four years on marked plants (*n* = 74)**

Parameter	1996	2000
Mean number of canes/plant	12.4**	15.6**
Mean number of harvestable canes/plant (canes >10 m)	1.0*	0.7*
Mean cane length *(m)*	22.4**	11.4**
Mean length of harvestable canes (canes >10 m) *(m)*	26.0**	17.3**
Total length of harvestable cane (all plants) *(m)*	1 953	880

** Significantly different at *P* = 0.005 based on paired sample t test.
* Significantly different at *P* = 0.05 based on paired sample t test.

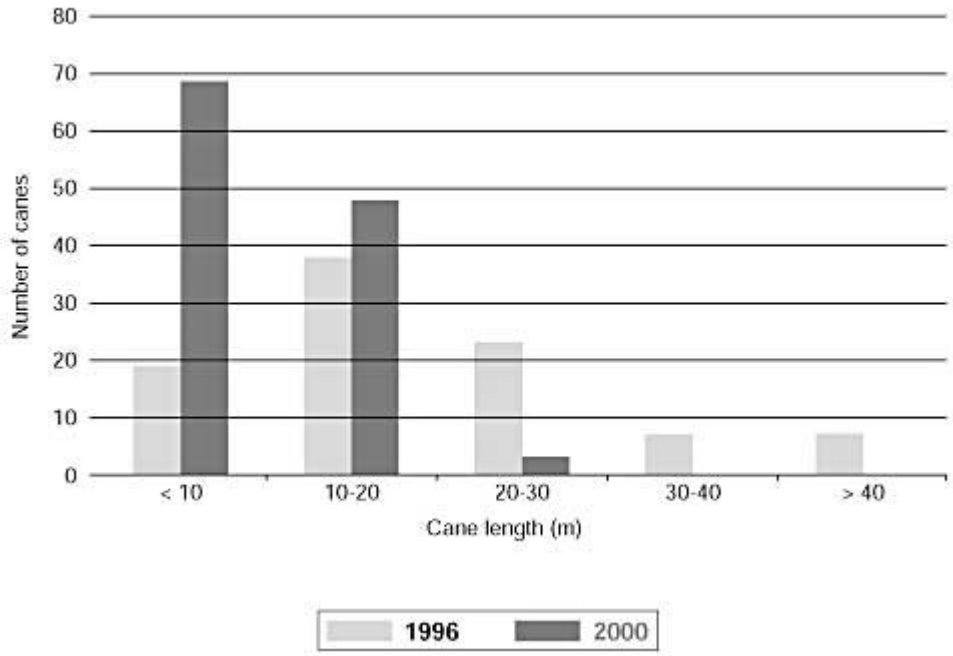
On marked *C. zollingeri* plants the mean number of sprouts per plant was significantly greater in 2000 than in 1996 (Table 3). However, the mean number of harvestable canes per plant (i.e. canes longer than 10 m) was significantly lower in 2000 than in 1996, as was the mean length of harvestable canes and the total amount (i.e. length) of harvestable cane. In fact, in 2000 the amount of harvestable cane was less than half that recorded on the same plants in 1996. The impact of intensive cane harvesting is readily apparent from a comparison of cane length distribution classes in 1996 and 2000 (see Figure). For example, 37 canes longer than 20 m were recorded on marked *C. zollingeri* plants in 1996, but only three canes longer than 20 m were found on the same plants four years later.

These data have several important implications for the management of wild rattan. First, repeated cane harvesting appears to stimulate the production of new canes. Indeed, an average of 3.5 new canes per plant and an average of 4.7 m of cane growth were observed on marked plants one year after harvesting. The production of new sprouts or canes and rapid cane growth suggest that large numbers of canes could continue to be available in the future. Second, repeated cane harvesting significantly reduces mean cane length, which in turn reduces returns to labour and requires collectors to travel further into the forest.

In addition, cutting all mature canes may preclude sexual reproduction; this is

supported by the absence of flowering and fruiting on marked rattan during two years of biweekly monitoring. While *C. zollingeri* is clearly capable of vigorous vegetative growth, sexual reproduction is important for maintaining species vigour and diversity over the long term.

Distribution of* Calamus zollingeri *cane lengths on marked plants in 1996 and 2000



Effects of cutting trees for use as floater logs

The use of rivers to transport rattan, timber and other forest products is common throughout Asia. Transporting rattan to market in the southern region of Lore Lindu National Park entails dragging rattan to the Lariang river, cutting and bundling the cane, cutting small trees for flotation and then floating the bundles down the river for 2 to 14 days to a roadside access point. Tree cutting has been reported to be a serious threat to biological diversity and forest conservation in the park (BCN, 1996; Schweithelm *et al.*, 1992).

The study found that eight tree species were regularly used to float rattan (*Artocarpus teysmannii*, *Evodia latifolia*, *Grewia multiflora*, *Horsfieldia* sp., *Macaranga hispida*, *Macaranga triloba*, *Pterospermum celebicum* and *Trema orientalis*). Not surprisingly, floater trees were lightweight, fast-growing pioneer species. Floater logs averaged 25 cm in diameter and 3 m in length and typically floated a 50 to 60 kg bundle of cane. Canes were cut to 4 m lengths before bundling; the number of canes per bundle varied with cane diameter. The study recorded an average of 135 tonnes of rattan extracted each year from the watershed (from October 1996 to October 1998). Based on a conservative estimate of 50 kg per rattan bundle, a total of 2 350 logs were required to float cane down the river each year from the case study watershed.

In the southern region of Lore Lindu National Park, rattan is transported by lashing to floater logs and floating down the Lariang River - S.F. SIEBERT

Floater logs were harvested almost exclusively from fallowed shifting cultivation fields and, to a lesser extent, from naturally disturbed riparian floodplains along the Lariang river. Over the four-year study period, no evidence was found of floater log cutting in primary forests in this region of Lore Lindu National Park. According to rattan collectors, floater logs are rarely harvested from primary forests because suitably sized light woods are uncommon there and because primary forests are further from the river than fallowed swiddens. Thus, there is little evidence to support the claim that cutting small, early successional trees to float cane threatens primary forests or biological diversity in Lore Lindu National Park, at least within this case study watershed.

Rattan is floated down the river to a roadside access point, where it is loaded on trucks for delivery to cane processing facilities - S.F. SIEBERT

Research limitations

As conservation biologists note (e.g. Struhsaker, 1998), it is probably impossible to ascertain reliably all the possible ecological effects associated with NWFP

extraction. The monitoring methods employed in this study, while time-consuming and reasonably rigorous, were not comprehensive and certainly did not assess all possible effects associated with wild rattan harvesting. For example, no information was gathered on invertebrate use of *C. zollingeri* or hunting by rattan collectors. It should also be emphasized that monitoring was carried out for only four years. Repeated harvesting of all mature cane could, over a longer period, adversely affect plant vigour or cane production and growth. Thus, this study does not prove that *C. zollingeri* cane harvesting is ecologically sustainable or that it is without adverse ecological effects. Nevertheless, the use of randomized and replicated sampling methods over a four-year period is biometrically rigorous (Wong, 2000) and can provide the basis for assessing ecological impacts and initiating adaptive management practices.

RATTAN HARVESTING VERSUS CULTIVATION: SOCIAL, ECONOMIC AND INSTITUTIONAL CHALLENGES

Even if harvesting wild rattan appears to be ecologically viable, socio-political and institutional aspects of cane extraction and declining wild rattan supplies may make it necessary to cultivate rattan. A few large-scale efforts (e.g. those of the Sabah Forest Development Authority [SAFODA], Malaysia) have shown that large-diameter, furniture-quality rattans can be grown in large plantations, while the long history of cultivating small and medium-sized rattan (*Calamus caesius* and *Calamus tracycoleous*) in swidden fallows in Kalimantan, Indonesia (Weinstock, 1983) (Editor's note: see also article by Belcher in this issue.) suggests that large canes could be grown by small-scale farmers as well.

In assessing opportunities and constraints to rattan harvesting and cultivation, policy-makers must consider the following key questions.

- What is the most reliable and cost-efficient way of producing large-diameter rattan cane - management of wild populations, or intensive cultivation by small farmers or in large plantations?
- What are the ecological effects associated with these different approaches?
- What economic costs and benefits are associated with managing wild populations versus cultivating rattan in plantations?
- What implications do these differing approaches have on the distribution of social and economic costs and benefits?

Is managed harvesting possible?

Although Indonesia has attempted to manage its forest resources, albeit with limited success (Barr, 2000; Peluso, 1996; Sunderlin, 1999), the country has made few efforts to regulate and manage rattan cane harvesting. In some areas of Indonesia and elsewhere in Southeast Asia, rattan exploitation exemplifies what can occur under unregulated, open-access resource extraction conditions. Since the 1970s, wild rattan supplies have drastically declined because of logging, forest conversion, overharvesting and forest fires. Even selective timber harvesting is likely to have adverse effects on rattan resources because of incidental mortality during felling and skidding and the widespread collection of rattan and other NWFPs by loggers. Some premier, large-diameter species such as *Calamus manan*, a solitary rattan that does not reproduce vegetatively, are now nearly extinct in the wild (Dransfield and Manokaran, 1994).

Considered in this light, the loss of rattan resources may simply reflect the political and economic choices of the state and private industrial élite groups to ignore customary resource tenure and forest management practices among local ethnic minorities in the rush to exploit timber or convert forests to agricultural plantations. The "legal" destruction of wild and cultivated rattan through commercial logging and for plantation agriculture is well documented among the Dayak of Kalimantan (Fried,

2000; Belsky, 1992) and has led to the loss of traditional rattan production and management systems that had operated for generations. Such smallholder rattan agroforestry systems appear to have been economically viable, compatible with community economic, social and cultural well-being and capable of producing large quantities of cane reliably and perhaps sustainably (Mayer, 1989; Dransfield, 1988; Godoy and Feaw, 1988; Weinstock, 1983).

Given this history, is managed harvesting of wild rattan possible? And, if so, by whom and under what property rights arrangements? Throughout Southeast Asia there is sufficient evidence to suggest that NWFPs, including rattan, have been successfully managed as a common property resource by traditional forest-dwelling peoples for centuries (Lynch and Talbott, 1995; Peluso and Padoch, 1996). In general, common property resource management may succeed where groups are relatively small and stable; where resource management perspectives and issues of access and control are shared; and where enforcement is simple and inexpensive (Ostrom, 1990). However, historic common property resource management systems have been suppressed or usurped by colonial and post-colonial authorities in Indonesia and other Southeast Asian countries (Peluso, 1996). Consequently, communal management of wild rattan now faces tremendous institutional challenges in many regions.

Economic and social costs and benefits of rattan harvesting and cultivation

The potential ecological effects associated with *C. zollingeri* cane harvesting need to be considered in light of the likely alternative land use practices. It is also important to ask how resident people would secure their livelihoods if rattan harvesting were effectively prohibited. It is likely that the loss of rattan resources would exacerbate pressures to convert forests to agricultural use. In Central Sulawesi, as in much of the tropical world, domestic and international market forces make it lucrative to cultivate export cash crops such as oil-palm, cocoa and coffee (Collier, Mountjoy and Nigh, 1994; Sunderlin, 1999). When weighed against forest conversion to agriculture, the potential ecological effects associated with rattan harvesting appear relatively benign.

A narrow consideration of economic costs and benefits suggests that returns from rattan gathering and cultivation compare poorly with those from perennial cash crops. In addition, coffee and cocoa begin to yield four and three years after planting, respectively, while large-diameter rattan is not likely to produce cane in less than 12 to 15 years. However, it is important to remember that rattan remains a primary or secondary source of cash income for tens of thousands of forest-dwelling people throughout Southeast Asia (DeBeer and McDermott, 1989) and is an important source of emergency income for thousands more (Siebert and Belsky, 1985). Furthermore, rattan cultivation by smallholders, either in swidden fallows or as an intercrop in traditional agroforestry systems, may provide important socio-economic and environmental benefits that are ignored in narrow cost-benefit analyses. Foremost among these benefits are:

- reduced economic risk because of less dependence on volatile coffee and cocoa markets;
- the potential to increase total returns;
- reduced insect and disease infestation rates that may result from greater species and structural diversity;
- the maintenance of high levels of biological diversity and thus at least partial compatibility with bio- diversity conservation objectives.

Farmers and rattan collectors in the case study region expressed interest in intercropping rattan in rustic coffee and cocoa agroforests. On-farm trials involving *C. zollingeri* yielded 96 percent survival rates and excellent growth 18 months after transplanting (Siebert, 2000).

Given the relatively low financial returns from wild rattan harvesting and the long period of yield deferral in the cultivation of large-diameter canes, whether by small farmers or on large estates, significant private investment in rattan management or cultivation is unlikely without subsidies (state, international or non-governmental). Taylor and Zabin (2000) argue that support of such forms of community resource management should be viewed not as a subsidy, but rather as a payment for the goods and services provided by intact forests (e.g. carbon sequestration, functional watersheds and biodiversity conservation). Directed external funding of this sort could provide sufficient financial incentive for small farmers and rattan collectors to cultivate and manage rattan.

A* Calamus zollingeri *seedling transplanted in a rustic coffee farm; rattan intercropped with cash crops may provide important socio-economic and environmental benefits, and on-farm trials have given excellent survival and growth results - S.F. SIEBERT

DISCUSSION AND CONCLUSIONS

Declining supplies and strong market demand suggest that rattan resources, particularly large-diameter canes, will become increasingly scarce. Two general approaches could be pursued to increase rattan supplies: management of wild populations and/or smallholder or estate cultivation. Both strategies entail significant challenges, particularly regarding the unfavourable financial returns (narrowly calculated) of rattan in comparison with cash crop alternatives. The two approaches could also have profoundly different effects on different sectors of society, particularly as concerns smallholder versus estate cultivation.

Efforts to manage wild rattan or to cultivate rattan in small farms or plantations should concentrate on the following areas:

- The focus should be on large-diameter, furniture-quality, clustering and coppicing species (i.e. those that produce multiple canes and sprout new canes when cut). Promising species include *C. zollingeri*, *Calamus subinermis* and *Calamus merrillii*.
- Rigorous and standardized monitoring protocols need to be established and utilized. Widespread adoption of standardized monitoring protocols will help elucidate long-term ecological and social effects associated with rattan

harvesting and cultivation and will provide information that can be used to modify and adapt management systems within the context of dynamic, unpredictable and often chaotic ecological, social, economic and political environments.
- The social and economic costs and benefits and their distribution among different sectors of society need to be carefully considered, particularly to ensure that those most dependent on rattan resources benefit from future investments and have less need to convert protected and production forests to farms.

Both managed harvesting of wild rattan and rattan cultivation are likely to require significant long-term financial assistance, as well as technical and marketing support. It is essential that the amount and type of support complement the institutional capabilities of local resource managers (i.e. resident people). Policy-makers should pay particular attention to providing small farmers and rattan collectors with adequate economic incentives, particularly *vis-à-vis* perennial cash crop alternatives, and to developing secure, stable and enforceable resource management institutions and property rights. Private, state and international support for rattan management and cultivation may be justified as compensation for the public benefits provided by natural forests and diverse agro-ecosystems and for the loss of historic resources by forest dwellers living in and around forests.

Bibliography

Anderson, A., ed. 1990. *Alternatives to deforestation*. New York, Columbia University Press.

Barr, C. 2000. *Will HPH reform lead to sustainable forest management? Questioning the assumptions of the "sustainable logging" paradigm in Indonesia*. Bogor, Indonesia, CIFOR.

BCN. 1996. *Biodiversity Conservation Network annual report: Asia/Pacific Region*. Washington, DC, World Wide Fund for Nature (WWF), Biodiversity Conservation Network (BCN).

Belsky, J. 1992. *Balancing forest and marine conservation with local livelihoods in Kalimantan and North Sulawesi*. Final report to the Indonesia Natural Resource Management Project. Jakarta, Indonesia, United States Agency for International Development (USAID)/ARD Inc.

CIFOR. 1999. *The world heritage convention as a mechanism for conserving tropical forest biodiversity*. Bogor, Indonesia, Center for International Forestry Research (CIFOR).

Collier, G., Mountjoy, D. & Nigh, R. 1994. Peasant agriculture and global change. *BioScience*, 44: 398-407.

DeBeer, J. & McDermott, M. 1989. *The economic value of non-timber forest products in South-East Asia*. Amsterdam, the Netherlands, Netherlands Committee for the World Conservation Union (IUCN).

Dransfield, J. 1988. Prospects for rattan cultivation. *Advances in Economic Botany,* 6: 90-200.

Dransfield, J. & Manokaran, N., eds. 1994. *Rattans*. PROSEA Handbook No. 6. Bogor, Indonesia, Plant Resources of South-East Asia.

Freese, C. 1997. The "use it or lose it" debate. *In* C. Freese, ed. *Harvesting of wild species*, p. 1-48. Baltimore, Maryland, USA, John Hopkins University

Press.

Fried, S. 2000. Tropical forests forever? A contextual ecology of Bentian rattan agroforestry systems. *In* C. Zerner, ed. *People, plants and justice: the politics of nature conservation*, p. 204-233. New York, Columbia University Press.

Godoy, R. & Feaw, T. 1988. *Smallholder rattan cultivation in southern Borneo, Indonesia*. Cambridge, Massachusetts, USA, Harvard Institute for International Development.

Hegarty, E. & Caballe, G. 1991. Distribution and abundance of vines in forest communities. *In* F. Putz and H. Mooney, eds. *The biology of vines*, p. 313-335. Cambridge, UK, Cambridge University Press.

Kramer, R., van Schaik, C. & Johnson, J., eds. 1997. *Last stand: protected areas and the defense of tropical biodiversity*. Oxford, UK, Oxford University Press.

Lynch, O. & Talbott, K. 1995. *Balancing acts: community-based forest management and national law in Asia and the Pacific*. Washington, DC, World Resources Institute (WRI).

Mayer, J. 1989. Rattan cultivation, family economy, and land use: a case from Pasir, East Kalimantan. In *Forestry and forest products*. GFG Report No. 13. Samarinda, Indonesia, German Forestry Group.

Menon, K. 1989. *The rattan industry: prospects for development*. Jakarta, Indonesia, UN/FAO.

Ostrom, E. 1990. *Governing the commons: the evolution of institutions for collective action*. Cambridge, UK, Cambridge University Press.

Peluso, N. 1996. *Rich forests, poor people: resource control and resistance in Java*. Berkeley, California, USA, University of California Press.

Peluso, N. & Padoch, C. 1996. Changing resource rights in managed forests of West Kalimantan. *In* C. Padoch and N. Padoch, eds. *Borneo in transition: people, forests, conservation and development*. Kuala Lumpur, Malaysia, Oxford University Press.

Rice, R., Gullison, R. & Reid, J. 1997. Can sustainable management save tropical forests? *Scientific American*, 276(4): 44-49.

Schweithelm, J., Wirawan, N., Elliott, J. & Khan, J. 1992. *Sulawesi parks program land use and socio-economic survey: Lore Lindu National Park and Morowali Nature Reserve*. Jakarta, Indonesia, Nature Conservancy.

Siebert, S. 2000. Survival and growth of rattan intercropped with coffee and cacao in the agroforests of Indonesia. *Agroforestry Systems*, 50: 5-102.

Siebert, S. 2001. Nutrient levels in rattan (*Calamus zollingeri*) foliage and cane and implications for harvesting. *Biotropica.* (in press)

Siebert, S. & Belsky, J. 1985. Forest-product trade in a lowland Filipino village. *Economic Botany*, 39: 522-533.

Struhsaker, T. 1998. A biologist's perspective on the role of sustainable harvest in conservation. *Conservation Biology*, 12: 930-932.

Sunderlin, W. 1999. Between danger and opportunity: Indonesia and forests in an era of economic crisis and political change. *Society and Natural Resources*, 12: 559-570.

Taylor, P. & Zabin, C. 2000. Neoliberal reform and sustainable forest management in Quintana Roo, Mexico: rethinking the institutional framework of the Forestry Pilot Plan. *Agriculture and Human Values*, 17: 141-156.

Weinstock, J. 1983. Rattan: ecological balance in a Borneo rainforest swidden. *Economic Botany*, 37: 58-68.

Wong, J. 2000. *The biometrics of non-timber forest product resource assessment: a review of current methodology*. London, Department for International Development (DFID).

Rattan harvesting and replanting regulations in the Philippines: the challenge of managing rattan resources sustainably

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In the Philippines, the utilization of rattan cutting areas is governed through bids, harvesting, annual allowable cuts and the imposition of a special rattan deposit. Individual rattan gatherers, cooperatives, associations, corporations, partnerships, indigenous communities and owners or operators of rattan processing plants are qualified to bid. However, indigenous communities have priority over other applicants in areas within their ancestral domain. Licences have a maximum duration of ten years.

However, the limited tenure of the rattan-cutting licence does not provide an incentive for the licensee to manage the rattan resource sustainably. Neither does the imposition of an allowable cut guarantee a sustainably managed resource. The tendency is to gather as much as possible without regard to the succeeding harvest after the ten-year licence period.

Rattan bundles in the Philippines - CIFOR/1854/B. BELCHER

To remove this constraint, it has been ruled to transfer all rattan-cutting licensees within community-based forest management (CBFM) areas to the jurisdiction and management of CBFM people's organizations or indigenous communities. These communities have a 25-year tenure over the area, which is renewable for another 25 years. The long tenure and the benefits that communities derive are incentives for them to manage the resources sustainably. The new arrangement also permits upland communities to profit from the rattan resources in their areas.

Other measures intended to ensure sustainability are a prescribed annual cut and a replanting requirement for rattan licensees. To ensure replanting, licensees must leave a special deposit for every linear metre gathered - 0.57 pesos (US$0.012) for canes of 2 cm

diameter or more and 0.46 pesos (US$0.010) for canes of less than 2 cm diameter. The licensee may use the deposit to contract the services of private parties or government entities to establish plantations.

However, the special rattan deposit does not guarantee that plantations will be developed within the cutting area or elsewhere unless it is strictly imposed that licences are terminated if planting is not undertaken in any given year. As it is, only limited plantations have been developed with the deposit. In one region, the rattan special deposit collected since 1991 now amounts to more than 25 million pesos (US$530 000), but no plantation has been developed.

A more effective alternative to the rattan special deposit might be to require licensees to submit a plantation development plan, to show that an amount equivalent to one year's expenditure for plantation development has been deposited in a bank and to give evidence that a contract has been entered into with a third party for the development of a plantation. Plantation development should be monitored and no rattan-cutting licensee should be allowed to operate in the succeeding year if the planned plantation has not become operational.

Challenges and constraints in rattan processing and utilization in Asia

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In addition to processing innovations, increased knowledge of structural characteristics and species differences can help enhance future utilization of rattan.

Processing is a key issue for fur-ther development and utilization of rattan. Rattan processing is done at various levels of competence and intensity: as a cottage enterprise, in small and medium-sized factories and by larger companies.

Air seasoning of rattan stems in Kalimantan, Indonesia - W. LIESE

Post-harvest treatments - including drying (seasoning), oil curing, bleaching, deglazing to remove the silicified epidermis and fumigation - are necessary to avoid defects and to increase processing possibilities and market value. The cane quality and the product's value on the local and international markets determine the choice of processing methods.

This article summarizes the progress achieved during the past 20 years and highlights existing gaps and constraints. It includes some observations from laboratory work on structural characteristics of rattan as a material, which may influence future utilization of rattan and the choice of species for commercial processing.

PRIMARY PROCESSING

Curing of rattan bundles in a hot oil bath to

Seasoning

reduce moisture content, Malaysia - W. LIESE

Proper drying of canes is necessary to maintain the high quality of rattan products. The moisture content of fresh stems varies between 130 and 160 percent, with an increase from the base upwards.

Seasoning has to start in the forest. Traditionally, bundles of 20 to 30 cane pieces are kept in erect position against a tree for about a week to drain off the sap and water. The poles are then spread out on the ground in an open yard before delivery to the processing site, where they are placed in a wigwam formation for about two to three weeks so that the moisture content is reduced further to less than 20 percent. During the drying process curved parts can be straightened by placing weights over horizontally stacked poles.

Simple grading of rattan takes place at the level of local village processors - W. LIESE

Harvesting and drying should preferably be done during the dry months to reduce the initial moisture and to speed up air seasoning.

Curing

Curing is the immersion of canes in a hot oil bath to prevent deterioration by reducing the moisture content (Bhat and Dhamodran, 1993; Silitonga, 1989). It is often an integral part of the processing line.

The stems, as fresh as possible, cut to the desired length and bundled, are soaked for a given time in an oil bath. The oil penetrates the cane axially, while radial penetration through the skin is almost nil because of its refractory anatomical structure.

Many investigations have been carried out to determine the best methods for curing. Different combinations of diesel oil, kerosene, palm oil and coconut oil are used, depending on availability, and are applied at varying temperatures between 80 and 150ºC for 10 to 60 minutes; the duration depends on the cane diameter. Differences among species in their responses to treatment have apparently not been established. In general, a treatment with kerosene oil at 100 to 105ºC for 20 to 45 minutes (depending on the stem diameter) appears to be best for improvement of skin colour.

After curing, the stems are drained of excess oil and rubbed with sawdust, coir (coconut husk fibre) or rags to remove the waxy substances and silica deposits on the skin. During the subsequent sun drying, often in a wigwam-like formation, the colour changes from green to ivory-white, the most desirable colour for rattan. After one to three weeks, depending on species and weather conditions, the canes are stored under cover.

Deglazing

In some rattans, especially some *Calamus* species, the outer part of the rattan stem, the epidermis, is heavily encrusted with amorphous silica which hinders processing. In highly silicated species the silica layer must be flaked away (deglazed). This is done by bending the stem, repeating the operation at intervals all along its length.

GRADING

Cleaning of a rattan stem in Malaysia - W. LIESE

The grading of rattan stems is a very important, although still controversial,

step in processing. Grading is crucial to trade and influences producers, processors, exporters and importers, as well as the end users.

The first stage of grading is carried out at the level of local village processors or, on a larger scale, intermediaries or trade centres. The criteria at this stage are dimensions (thickness, length of cane and internodes), hardness and defects. Canes are frequently divided into categories of large and small diameter; 18 mm is the most widely used cutoff. Hardness (related to anatomical characters, differences among species or age of stems) is tested by bending the stem by hand and noting whether it regains its original form quickly or slowly, or breaks. A second stage of grading, mainly aesthetic, is done on the basis of surface colour after processing.

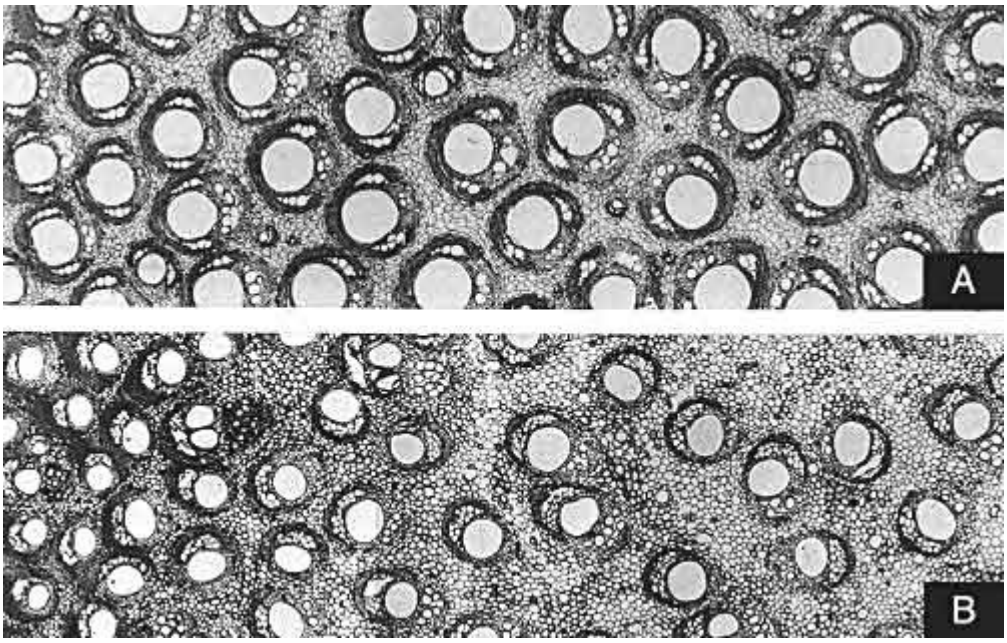
Grading rules and procedures differ widely from country to country. In most producing countries the rattan grading rules are not precisely formulated. They often present confusing terminology and non-standardized grading practices, and consequently allow the production of substandard rattan goods. A certain simplification and unification among countries is necessary for internal and external trade (Bhat, 1996). On the basis of an extended survey, Bhat (1996) proposed model rattan grading rules with a standardized terminology (containing 20 terms), definition of defects (nine terms), methods for clarification, nomenclature of commercial rattan species and grading rules for large- and small-diameter canes and split rattan. The application of general grading rules would benefit trade, assist market standardization and help reduce material wastage.

At the village level, stems are bent and shaped after they are softened by heating with a blowtorch, as shown here in Kalimantan, Indonesia - W. LIESE

SECONDARY PROCESSING

Secondary processing involves peeling, splitting, steaming, bending, dyeing, sanding and finishing. Peeling (removal of the outer layers to obtain the inner core) and splitting are often done by hand with traditional knives or by using simple machines.

Rattan structure can be used to distinguish species suitable for utilization (e.g. a* Calamus *species, A) from less promising species (e.g. a* Plectocomia *species, B) - G. WEINER, W. LIESE



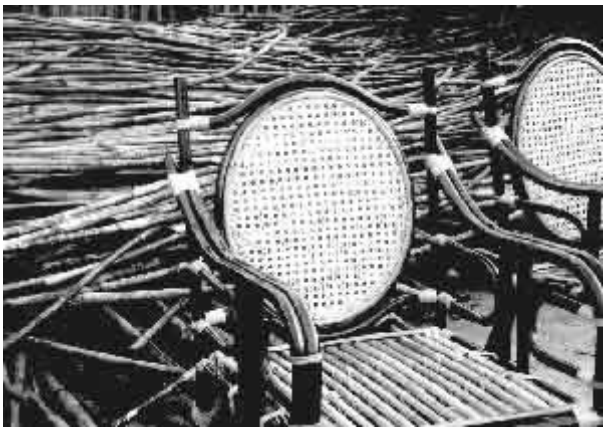
At processing plants, steam chambers are used to soften the stems so that they can be bent; if the rattan is not steamed (because steam facilities are lacking, for example), bending can cause damage to the cane. At the village level, a blowtorch is frequently used to soften the stems for bending and shaping. Sanding and scraping are then required to remove, at least partly, the burn marks left by the blowtorch.

Several measures can be applied to improve surface appearance, which is the main criterion for marketing. Grey-brown canes can be bleached with hydrogen peroxide or other chemicals for a better finish. Discoloured canes (see Box) are often coloured artificially with a wide range of colours; the outer stem layer takes up the colouring liquid quite well. Melamine coating is used for a smooth finish. Fumigation with sulphur dioxide not only sterilizes the canes, but also improves surface quality.

Defects caused by staining and insect attack

Because of its high starch content, rattan is particularly liable to infestation by fungi and insects. Defects resulting from infections by staining fungi and beetle attack can result in severe losses. Fungi cause discoloration of the canes, while beetles cause pinholes or worm holes.

Furniture made from blue-stained poles painted black to hide the defect, Kalimantan, Indonesia - W. LIESE



The most common cause of staining is blue stain fungi which penetrate with their hyphae deep inside the stem, utilizing starch and sugar. It is estimated that about 20 percent of harvested canes become stained.

Fungal invasion can occur within one day of cutting. Staining can be controlled by spraying or soaking in preservative solution, but prophylactic treatment is seldom applied within 24 hours as required because of difficulties posed by harvesting procedures, storage and transport. In addition, the danger of environmental pollution and regulations against the use of chemicals, where these exist, restrict the application of chemical preservatives. Canes arriving at the processing site for air seasoning are often already infested.

Stained canes are often coloured to hide the defect. Through intensive marketing, furniture in various colours has become fashionable. However, heavily stained material cannot be used for furniture since its bending strength is reduced; it is often utilized for baskets and other perishable products, or even as fuel.

Poles can also be discoloured by surface moulds if transported or stored under humid conditions. Unlike blue stain, this discoloration is only superficial and can be wiped off. Nevertheless, the surface shine is reduced (Kumar, 1993; Mohanan, 1993).

At moisture levels of more than 20 percent, decay fungi can also attack the stem. Such infections are often noticed only at a later stage, when the fruit bodies appear, and they can cause serious structural degradation of rattan in service.

Seasoned poles with a moisture content of 50 to 100 percent are liable to insect attack, mostly by the powder-post beetle. The beetles deposit their eggs in the large pores at the cross ends and the larvae are nourished from the starch content. The presence of light-yellowish powder beneath the poles is an indication of an ongoing infestation. Infested material has to be sterilized or burnt.

For protection against beetles an insecticide has to be applied very early, usually by dipping or soaking. Again the consequences of pollution must be taken into consideration. The availability and legal acceptance of suitable preservatives differ from country to country.

Goods for export can be sterilized in containers at the harbour by an approved agency. If slightly infested material is discovered at debarkation, the choice between fumigation and disposal by burning is at the discretion of the authorities and the buyer.

IMPROVING RATTAN UTILIZATION: OPPORTUNITIES AND CONSTRAINTS

Species differences

Because different rattan species vary significantly in structural and aesthetic properties, the relatively small number of rattan species used is a major limitation. Globally, only about 50 of the 600 known species are utilized commercially; in the Philippines**,** 12 of 68 belong to this category (Tesoro, 1988). Rao, Ramanatha Rao and Williams (1998) have prepared a priority list of 21 *Calamus* species using as criteria cane size, commercial potential, quantities available and properties for processing and utilization.

The silica content varies considerably among species (0.9 to 2.7 percent). For specific products such as ropes and binds, species with low silica content should be selected.

Skin colour is an important criterion. *Calamus caesius* is desirable for high-value products because of its yellowish-cream colour with good lustre. The anatomical base for such an appearance is still unknown.

Structural properties

The processing and utilization of rattans are influenced to a great extent by the structural composition of the stem, which exhibits considerable variation along the stem length. Unlike those of softwoods and hardwoods, the fibres in rattans are still alive, and the fibre walls thicken with age. Accordingly, from the basal to the top internodes, and also from the periphery to the centre of a given internode, the fibre percentage and fibre cell wall thickness decrease, whereas the vessel diameter increases. As a result, the lower stem parts have higher density (and thus strength), whereas the upper parts exhibit higher moisture content and higher volumetric shrinkage. Thus shrinkage and warping tend to be problems when prematurely harvested stems or the upper parts of the stem are used.

The anatomical characteristics of fibre content, cell wall thickness and vessel diameter also vary among species and appear to determine the stiffness and breaking behaviour of rattan both within a stem and among the species (Bhat, Liese and Schmitt, 1990). If the top portion of a stem is integrated as a furniture component, it may break more easily because of its smaller fibre walls. Similarly, certain species with low fibre content, thinner-walled fibres and relatively wide xylem vessels, e.g. *Calamus metzianus*, break easily.

The differences in stem composition among the 13 rattan genera, and even among some species of one genus, have made it possible to develop an identification key for 284 species investigated (Weiner and Liese, 1993). This anatomic diversity is of practical value especially for the identification of processed material, which can be helpful in trade disputes.

Knowledge of rattan anatomy has also been used to identify the structural features that characterize a "commercializable" cane, making it possible to analyse hitherto unused species for their processing potential (Weiner and Liese, 1991). For example, anatomic characterization suggests that rattans in the West African genera *Eremospatha, Laccosperma* and *Oncocalamus* have the same basic structures as the well-used Asian rattans, indicating that they should be suitable for furniture making, for which they have so far not been adequately utilized (Weiner and Liese, 1994).

Availability of raw material

The availability of raw material, especially of the valued species *Calamus manan*, is often defined as the most pressing problem for the furniture industry in the countries of origin, as well as in the main European furniture producing countries such as France, Germany, Italy and the United Kingdom. As the rattan ban has affected the

development of the furniture industry within non-rattan producing countries, other countries such as Myanmar, Viet Nam, the Lao People's Democratic Republic and Papua New Guinea have increased harvesting of canes of varied quality. Much furniture is now designed to require only smaller-diameter canes. Factories cope by using low-grade canes, which are often stained and require colouring. A major rattan company in Germany with large furniture factories in Java, Indonesia, described the raw material shortfall, combined with the market price, as a decisive factor for further production (personal communication). For example, the trader may neglect early grading so that all possible canes can be obtained at a reasonable price.

The shortage of rattan has also led to partial or even total replacement of rattan furniture components by other materials such as plastic. The plastic "original imitation" rattan that is available on the market can be colourful, more economical in price and attractive in design.

Technological issues

Other major problems in rattan utilization are related to production technology, financing and marketing. There are many small rattan processors at the village level, who work with very simple tools, old-fashioned designs and limited skills. Their market access is restricted by the inferior quality of their products (Belcher, 1999).

For primary processing in the field, improved technologies for preservation and seasoning would reduce losses and improve the quality of the canes. Labour-intensive methods and simple low-cost procedures are often applied for peeling, splitting and bending. Technical improvements in the processing industry could increase the value of the products and thus also raw material prices.

RESEARCH NEEDS FOR ENHANCED RATTAN UTILIZATION

Progress has been achieved in the areas of better hand tools and hardware, improved processing technologies and better finishes and colouring. However, structural properties, product relations, protection and waste utilization are still neglected areas of research. Indeed, the following priority needs for bamboo and rattan research were listed a decade ago in a report to the International Development Research Centre (IDRC) (Williams *et al*., 1991) and have hardly changed:

- investigations on the properties of commercial and some neglected species in order to facilitate assessment of the utilization potential of currently non-commercial species;
- means of protecting rattan products with environmentally acceptable preservatives, since rattan is susceptible to biological deterioration;
- improved processing technologies to lead to a greater diversity of products of better quality - especially the development of better surface finishes for a pleasing visual appearance and greater wear resistance;
- diversification of products according to species properties;
- methods of colouring and finishes for rattan for use in furniture making;
- development of panel and wall-cover products;
- studies on waste utilization and waste reduction;
- development of cost-effective designs in keeping with contemporary style;
- development of hand tools and hardware.

Finally, it is important to emphasize the need for marketing studies to identify the demand and determine what the market wants.

Bibliography

Belcher, B. 1999. *The bamboo and rattan sectors in Asia: an analysis of*

production-to-consumption systems. INBAR Working Paper No. 22. Beijing, China, International Network on Bamboo and Rattan (INBAR).

Bhat, K.M. 1996. *Grading rules for rattan - a survey of existing rules and proposals for standardization.* INBAR Working Paper No. 6. New Delhi, India, INBAR.

Bhat, K.M. & Dhamodran, T.K. 1993. Rattan harvesting and processing technology in India: present and future. In *Rattan management and utilization*, p. 233-243. Proceedings of a seminar, Trichur, India, 1992. Peechi, India, Kerala Forest Research Institute.

Bhat, K.M., Liese, W. & Schmitt, U. 1990. Structural variability of vascular bundles and cell wall in rattan stem. *Wood Science and Technology,* 24: 211-224.

Kumar, S. 1993. Protection of canes. In *Rattan management and utilization,* p. 304-308. Proceedings of a seminar, Trichur, India, 1992. Peechi, India, Kerala Forest Research Institute.

Mohanan, C. 1993. Biodeterioration of post-harvest rattans. In *Rattan management and utilization*, p. 266-280. Proceedings of a seminar, Trichur, India, 1992. Peechi, India, Kerala Forest Research Institute.

Rao, A.N., Ramanatha Rao, V. & Williams, J.T. eds. 1998. *Priority species of bamboo and rattan*. Serdang, Malaysia, International Plant Genetic Resources Institute Regional Office for Asia, the Pacific and Oceania (IPGRI-APO).

Silitonga, T. 1989. The effect of several cooking oil compositions on manau (*Calamus manan* Miq.) canes. In *Recent research on rattans*, p. 187-181. Proceedings of the International Rattan Seminar, Chiang Mai, Thailand, 1987. Bangkok, Kasetsart University.

Tesoro, F. 1988. Rattan processing and utilization research in the Philippines. In *Proceedings of the National Symposium on Rattan,* Cebu, the Philippines, p. 41-54.

Weiner, G. & Liese, W. 1991. Anatomical comparison of commercial and non-commercial rattans. In *Proceedings of the National Seminar on Oil Palm Trunk and Other Palmwood Utilization*, Kuala Lumpur, Malaysia, 4-5 March 1991, p. 360-367. Kuala Lumpur, Malaysia, Ministry of Primary Industries.

Weiner, G. & Liese, W. 1993. Generic identification key to rattan palms based on stem anatomical characters. *IAWA J.,* 14: 55-61.

Weiner, G. & Liese, W. 1994. Anatomische Untersuchungen an westafrikanischen Rattanpalmen (Calamoideae). *Flora,* 198: 51-61.

Williams, J.T., Dransfield, J., Ganapathy, P.M., Liese, W., Salleh, M.N. & Sastry, C.B. 1991. *Research needs for bamboo and rattan to the year 2000*. Washington, DC, USA, International Fund for Agricultural Research.

Research on rattan genetic resources conservation and use: the perspective and strategy of the International Plant Genetic Resources Institute

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Ongoing research on the identification, diversity and conservation of rattan genetic resources will help to foster sustainable management and utilization of the species.

Until recently, little research was directed towards biodiversity or genetic resources conservation and genetic improvement of bamboo or rattan. By the early 1990s, however, the urgent need to generate information for the effective conservation and sustainable use of rattan and bamboo was recognized. The International Network on Bamboo and Rattan (INBAR) requested that the International Plant Genetic Resources Institute (IPGRI) take the lead in activities related to research on the genetic resources conservation of these two important non-wood forest products (NWFPs). Thus the INBAR-IPGRI Biodiversity and Conservation Working Group was constituted in 1993. Japan provided the financial assistance to IPGRI to initiate the programme (Ramanatha Rao, Rao and Ouedrago, undated). Research activities on rattan and bamboo are planned and implemented from IPGRI's Regional Office for Asia, the Pacific and Oceania, located in Serdang, Malaysia.

Work on the identification of the genetic resources of rattan and their diversity is expected to assist in maximizing the utilization of the species and thus enhancing conservation for sustainable management. This article provides a synopsis of IPGRI's activities in rattan genetic resources conservation.

The International Plant Genetic Resources Institute

The International Plant Genetic Resources Institute (IPGRI) is one of the 16 centres of the Consultative Group on International Agricultural Research (CGIAR). IPGRI's mission is to encourage, support and undertake activities to improve the management of genetic resources

worldwide so as to help eradicate poverty, increase food security and protect the environment. IPGRI focuses on the conservation and use of plant genetic resources that are important to developing countries and has an explicit commitment to specific crops. IPGRI works in partnership with other organizations, undertakes research and training, and provides scientific and technical advice and information. IPGRI operates in five geographical areas: sub-Saharan Africa; Europe; Central and West Asia; North Africa; and Asia, the Pacific and Oceania.

RATTAN RESOURCES

Rattan palms are found only in the Old World, distributed in equatorial Africa, South Asia, southern China, the Malay Archipelago, Australia and the western Pacific as far as Fiji. The greatest diversity of rattan genera and species is found in Southeast Asia. *Calamus*, with 370 to 400 species, is the largest of the 13 known genera and is distributed throughout the geographic range of rattans (Dransfield and Manokaran, 1993). In Africa, three of the four genera recorded are endemic.

The solitary-cane* Calamus manan*, a priority rattan species for research and development and for genetic resources conservation, in cultivation in Sarawak - J. DRANSFIELD

A unique feature of rattans is the abundance and diversity of species. Sometimes as many as 30 species occur in one locality in what is apparently rather uniform vegetation. However, there could be habitat differences and subtle breeding barriers between species that are not yet understood. In addition, knowledge of the genetic diversity within and between species is still scarce. With the fast depletion of the tropical forests it is imperative to obtain this knowledge for the sustainable management of the remaining rattan resources. For commercially popular solitary-cane species such as *Calamus manan* the problem is more acute, as the rate of regeneration is dependent on seedling survival (in contrast with clustering species such as *Calamus caesius* which feature regeneration through the development of suckers).

RESEARCH OBJECTIVES

IPGRI has formulated the following objectives for rattan (and bamboo) activities:

- to identify priority bamboo and rattan species for conservation and use;
- to assess the diversity of selected bamboo and rattan genetic resources;
- to develop complementary conservation and sustainable use strategies for these resources;
- to establish an information base in the Asia, the Pacific and Oceania region and to strengthen the capacity of national programmes through research and

training.

In the past few years a significant amount of information has been generated, compiled and distributed through IPGRI activities on rattan. Nevertheless, there is still a substantial gap in the information needed for effective conservation of the resource in many countries.

STRATEGY

IPGRI's strategy to ensure effective conservation of rattan genetic resources identified four areas on which to focus the efforts of national research organizations: assessment and inventory; development and implementation of conservation procedures; rates of extraction and human impact; and development of methods for conservation and sustainable use (Ramanatha Rao, Rao and Ouedrago, undated). Not all of the areas identified are of equal importance for all countries in the region; activities are being developed according to the priorities and needs of each country.

Assessment and inventory

In situ conservation actions are required and will take priority while complementary conservation strategies are being developed for the rattan resources. Therefore assessment of the current status of rattan resources is vital for successful *in situ* (and *ex situ*) conservation efforts. Activities in this area include assessment, taking of inventories and analysis of distribution patterns, size of populations, rates of extraction, etc.

Development and implementation of conservation procedures

There is a need to implement different procedures for conservation in order to ensure sustainable management of the rattan genetic resources. This area of research includes development of *in situ* and *ex situ* conservation plans; assessment of seed viability and development of seed storage and *in vitro* conservation protocols; establishment and management of field gene banks; and formulation of guidelines for the safe movement of germplasm.

Rates of extraction and human impact

Some countries are witnessing a long-term detrimental impact from overexploitation of natural rattan resources. There is still a lack of information on the natural regeneration of rattan and on the socio-economic impact of exploitation and conservation. This information is needed in order to establish proper *in situ* (and *ex situ*) measures for sustainable utilization of the resource to ensure that socio-economic benefits are maintained.

Current rattan projects supported by IPGRI

Study	Organization/country
Ongoing	
Distribution and status of rattan in Bardiya district of Nepal	Institute of Foresters, Nepal
Distribution, population status and genetic diversity of *Calamus manan* in Sumatra	Indonesian Institute of Sciences, Research and Development Centre for Biotechnology, Indonesia
Studies on rattans of Dakshina, Kannada and Kodagu districts of Karnataka with particular reference to species diversity, density of population, seed viability and germination	Mangalore University, India
Completed	
Herbarium survey to determine the distribution of certain rattan species in China	Research Institute of Tropical Forestry, Guangzhou, China

Evaluation of *ex situ* and *in situ* conservation of rattan germplasm in China	Research Institute of Tropical Forestry, Guangzhou, China
Genetic assessment of three rattan species	Forest Research Institute Malaysia
Identification of patterns of genetic variation among three selected rattans	Universiti Malaya, Malaysia
Distribution and conservation of bamboo and rattan species in northern Thailand	Chiang Mai University, Thailand
Genetic diversity of *Calamus* species	Royal Forest Department, Thailand
Mapping genetic diversity of rattan in the Western Ghats of India	Ashoka Trust for Research in Ecology and the Environment (ATREE), India
Genetic diversity and conservation of certain rattan species in the Andaman and Nicobar Islands and Western Ghats, South India	Kerala Forest Research Institute, Peechi, India
Estimation of nuclear DNA content of various rattan species	National University of Singapore, Singapore
Distribution, phenology and conditions suitable for seed germination of certain rattans in Viet Nam	Forest Science Institute of Viet Nam
Ecogeographic survey and phenology of rattan in Nepal	Forest Research Centre, Nepal

Development of methods for conservation and sustainable use

Many poor rural people are dependent on NWFPs such as rattan. Conservation efforts should not interfere with extraction and use of the resource for the daily needs and income-generating activities of these people and other forest dwellers. An understanding of forest and forest-fringe dwellers' preferences for rattan extraction, especially when alternative means of livelihood become available, is of significance for sustained efforts to conserve rattan in its natural habitats. Related research activities include assessment of economic gains from extraction of rattan; identification and selection of rattan material that performs well under different environmental conditions and in different ecosystems; and identification and selection of species suitable for cultivation to reduce pressure on naturally occurring stands.

RESEARCH HIGHLIGHTS

IPGRI has undertaken rattan projects with partners in a number of countries in the region (see Table). Some achievements generated by these activities are highlighted in the following sections.

Prioritization of species for genetic resources conservation

The correct identification of rattans is essential in establishing priorities for conservation and use strategies. A good taxonomy also provides the means for reliable transfer of information and for predicting the properties of rattan (Editor's note: see article by Dransfield in this issue). The taxonomic identification of some of the commercial species is still uncertain. In view of the large number of species and their diverse geographical ranges and ecologies, focus has to be given to the conservation of gene pools of more useful species. This has added relevance in that only a small number of the total species are used or have a commercial value.

In 1994, IPGRI together with INBAR published a list of nine priority species based on available information on utilization, cultivation, products and processing, germplasm and genetic resources, and agro-ecology (Williams and Ramanatha Rao, 1994). Acceding to the needs and feedback of the countries in the region, this priority list was later expanded to include 21 species, shown in the Box (Rao, Ramanatha Rao and Williams, 1998). The priority list is a useful guide for countries seeking to focus their research on rattan.

Priority rattan species for research and development

Calamus manan	*Calamus polystachys*
Calamus caesius	*Calamus warburghii*
Calamus trachycoleus	*Calamus zeylanicus*
Calamus sect. podocephalus	*Calamus zollingeri*
Calamus andamanicus	*Calamus palustris and relatives*
Calamus burckianus	*Calamus inermis*
Calamus erinaceus	*Calamus nambariensis*
Calamus foxworthyi	*Calamus deeratus*
Calamus merrillii	*Calamus tetradactylus*
Calamus nagbettai	*Calamus hollrungii and relatives*
Calamus ovoideus	

Source: Rao, Ramanatha Rao and Williams, 1998.

Assessments and inventories

Studies have been carried out on rattan genetic resources and identification of commercially important species in Bangladesh, China, the Western Ghats in India, Indonesia, the Lao Peoples' Democratic Republic, Malaysia, Myanmar, Nepal, the Philippines, Sri Lanka, Thailand and Viet Nam (Rao and Ramanatha Rao, 1999; Vivekanandan, Rao and Ramanatha Rao, 1998; Xu *et al.*, 2000). Data collection activities have helped the countries to quantify the depletion of rattan resources and have assisted in identification of the most suitable areas for conservation. For example, the studies in Viet Nam have shown that taxonomic descriptions and species identification are incomplete for most of the resources, especially those in the central and southern regions of the country. *Calamus platyacanthus*, a large cane similar to *C. manan* of Southeast Asia, was found to extend from Yunnan Province in China to several provinces in Viet Nam.

Patterns of genetic variation

The genetic diversity of rattan has just begun to generate interest among scientists and researchers. Therefore only a few studies are available on the genetic diversity of rattans within and between populations.

Research on three *Calamus* species in the Andaman and Nicobar Islands of India and in Malaysia showed significant phenotypic and genetic variation across species and sites. A study of 13 populations of *Calamus palustris* from seven provinces in Thailand showed that approximately 18 percent of the total diversity resulted from differences among populations. Investigations of genetic diversity in *C. palustris* in Thailand revealed great differences in the form and location of the isozymes (a type of genetic marker) in this species. This result indicated that isozyme analysis alone may be sufficient for assessment of intraspecific genetic diversity in *C. palustris*.

A study in the Western Ghats in India evaluated the status of genetic diversity of rattan in order to construct spatial and temporal patterns of the loss of rattan populations and the genetic resources contained in them. The study identified the presence of 27 species of rattan. Assessment of population genetic variability using *Calamus thwaitesii* as a pilot species showed a lack of population differentiation. Related research on the identification of genetic markers for gender determination in two dioecious species of *Calamus* has just been initiated by the National University of Singapore.

Processes that regulate genetic diversity

A study on socio-economic aspects of the loss of rattan resources in Karnataka, India has just been completed. The objectives were to determine the degree of extraction and economic reliance on the resource at the local and state levels, to identify the social and economic factors responsible for the decline in the resource and to examine the social and economic consequences of that decline. The results

are now being analysed and the study will produce proposals for mitigating the impacts of extraction and land use changes.

Human resource development

One of the constraints to rattan research is a shortage of available skilled personnel. This has been a concern of IPGRI since it started its rattan research. Over the past few years IPGRI has made efforts to promote and assist in training for conservation and sustainable use of rattan resources. Collaboration with INBAR and other organizations has increased the skills of partners carrying out work in this area. Workshops and courses on taxonomy, conservation, ecology, silviculture and molecular approaches in plant population genetics have helped partners in the region to upgrade their research skills.

WHAT LIES AHEAD

Results from the rattan research activities supported by IPGRI in Asia have benefited the countries involved and have also improved national capacity to address the conservation of genetic resources of rattan and national awareness of the importance of doing so. The results obtained are already creating awareness among national research institutes not only in Asia, but also in Africa and Central and South America where rattan species have been introduced.

To ensure the conservation and sustainable use of rattan resources, it is imperative that the practice of unsustainable harvesting should be abandoned and replaced by effective measures of conservation, cultivation and sustainable management which would also help the rural poor in the long term. The work done so far on the identification of available genetic resources in various countries is expected to assist in optimizing the utilization of rattan, including the expansion of the number of species brought under management and cultivation. IPGRI will continue to support studies on the conservation of rattan genetic resources under the four strategic areas identified. It has been and will always be the policy of IPGRI to collaborate with relevant organizations at the national and international levels to bring about more effective sustainable management of rattan resources in order to improve the economic status of rural populations in particular.

Bibliography

Dransfield, J. & Manokaran, N., eds. 1993. *Rattans.* Plant Resources of South-East Asia No. 6. Wageningen, the Netherlands, Pudoc Scientific Publishers.

Ramanatha Rao, V., Rao, A.N. & Ouedrago, A.S. (undated). *Sustainable conservation and use of bamboo and rattan resources: elements of a strategy*. Serdang, Malaysia, IPGRI Regional Office for Asia, the Pacific and Oceania (IPGRI-APO).

Rao, A.N., Ramanatha Rao, V. & Williams, J.T., eds. 1998. *Priority species of bamboo and rattan.* Serdang, Malaysia, IPGRI-APO.

Rao, A.N. & Ramanatha Rao, V., eds. 1999. *Bamboo and rattan genetic resources and use.* Proceedings of the third INBAR-IPGRI Biodiversity, Genetic Resources and Conservation Working Group meeting, Serdang, Malaysia, 24-27 August 1997. Serdang, Malaysia, IPGRI-APO.

Vivekanandan, K., Rao, A.N. & Ramanatha Rao, V., eds. 1998. *Bamboo and rattan genetic resources in certain Asian countries.* Serdang, Malaysia, IPGRI-APO.

Williams, J.T. & Ramanatha Rao, V., eds. 1994. *Priority species of bamboo and rattan.* INBAR Technical Report No. 1. New Delhi, India, INBAR and the International Bureau for Plant Genetic Resources (IBPGR) (now IPGRI).

Xu, H.C., Rao, A.N., Zeng, B.S. & Yin, G.T., eds. 2000. *Research on rattans in China. Conservation, cultivation, distribution, ecology, growth, phenology, silviculture, systematic anatomy and tissue culture.* Serdang, Malaysia, IPGRI-APO.

Recommended actions for rattan development: conclusions of the FAO Expert Consultation on Rattan Development

The 23 experts from 16 countries convened at the Expert Consultation on Rattan Development, held in Rome from 5 to 7 December 2000, concluded that there are a wide variety of potential interventions that could assist the different stakeholder groups in the rattan sector. Raw material producers and smallholders could be assisted with incentives to manage local resources on a more sustainable and productive basis, through the establishment of community forest management practices, long-term concessions, local land-use planning and the provision of resource and/or land tenure rights, in conjunction with approved management plans.

For the rattan industry, needs are particularly great at the artisanal level. Potential interventions that might assist industry include improving entrepreneurship and competitiveness via the establishment of design centres, the training of advisers, improving post-harvest treatment and quality control, market deregulation, improved market information and trade fairs. In addition, given the nature of the resource users and the fact that the industry is generally on a cottage or small scale and frequently employs women, the handicapped and indigenous people, rattan products could become ideal commodities for promotion as rain-forest conservation products.

The meeting identified the following key actions, which should be initiated immediately for greater sustainability of the rattan supply.

Resources

- Intensification of ex situ and in situ conservation efforts in a more coordinated and organized manner among countries in the regions.
- Development of suitable methods for resource assessments, including studies on growth, yield, basic biology and taxonomy of rattan species.
- Improvement of techniques of enrichment planting and management of rattan in degraded forests, and wide dissemination of the available guidelines for rattan planting.

Products

- Research on the properties of commercial species and the potential of underutilized or less-known species.
- Improvement of technologies for reducing post-harvest losses and biological deterioration.
- Introduction of quality grading.

Policies and institutional support

- Awareness raising on the importance of the rattan sector to decision-makers at all levels.
- Institutional strengthening and coordination regarding rattan conservation, management and processing issues, including the promotion of more government and private sector cooperation and coordination to enhance the contribution of rattan for poverty alleviation and economic prosperity.
- Provision of tenure security to rattan gatherers and planters by incorporating them into community-based forest management schemes.
- Introduction of incentive schemes for rattan cultivation to increase the economic benefits for rural households and smallholder plantations in Asia, such as provision of credit and technical assistance for small-scale plantation development, and favourable harvesting and marketing arrangements.
- Market deregulation to benefit rattan collectors and traders (i.e. removal of transport barriers and export restrictions) and support for improved collection and dissemination of market information.
- Strengthening of extension support to local collector organizations on methods for reducing post-harvest losses, improving storage, and others as required.
- Provision of comprehensive training and support to local specialists in rattan producing countries in taxonomy, management and processing, complemented with twinning arrangements among relevant institutions in the regions.

FAO FORESTRY

Experts discuss criteria and indicators

An Expert Consultation was held at FAO headquarters in November 2000 to review and discuss current processes regarding the development and implementation of criteria and indicators for sustainable forest management.

In the light of continuing deforestation and forest degradation in many countries and regions, improved field-level forest management practices are urgently needed. Criteria and indicators, which characterize the environmental, economic, social and cultural dimensions of sustainability, are a useful tool towards this end. Establishment of common or mutually acceptable concepts and terms enables regular assessment of the status and trends in forestry conditions and management. On the basis of information on trends at the national level, and on forecasts for the future based on these, policy and decision-making can be rationalized and action can be adjusted and improved. More than 140 countries are currently involved in one or more international criteria and indicators processes.

The Expert Consultation on Criteria and Indicators for Sustainable Forest Management, held in Rome from 15 to 17 November 2000, was organized by FAO in collaboration with the United Nations Environment Programme (UNEP), the International Tropical Timber Organization (ITTO), the Center for International Forestry Research (CIFOR) and the International Union of Forestry Research Organizations (IUFRO). In attendance were 18 experts in the field of criteria and indicators, representing 14 countries, and resource persons from all of the co-sponsoring organizations, including FAO.

In addition to reviewing recent progress, the expert consultation recognized the need to promote further coordination and cooperation among the processes and institutions involved - at the national level, among countries within processes, among processes, and between processes and initiatives in other sectors. The experts discussed the reasons and possible remedies for the slower progress of some countries in implementing criteria and indicators. They especially stressed the need to encourage countries that are not participants in any criteria and indicators process to become involved.

In support of collaborative efforts, the expert consultation recommended that an international conference on criteria and indicators with broad stakeholder involvement be organized not later than early 2002.

The report of the meeting is available from the Forest Resources Division, FAO Forestry Department, Viale delle Terme di Caracalla, 00100 Rome, Italy.

Global Forest Resources Assessment 2000 results released

The global rate of net forest loss has slowed to 9 million hectares per year, 20 percent lower than the previous figure reported in 1995, according to recently

released results of the Global Forest Resources Assessment 2000 (FRA 2000). FRA 2000, a broad assessment covering a range of forestry subjects and assembling the inputs of technical specialists across the various forestry disciplines, is nearing its completion. The main results, consisting of global data tables by country, global maps of forest cover and ecological zones, and country profiles, were released in January 2001.

The 12 global data tables present types of information that FAO has not published before; they report the forest cover state and change, volume and biomass, extent of plantations, forest fire statistics, management status, removals and non-wood forest products. The tables can be consulted on the Web (www.fao.org/forestry/fo/fra/index.jsp).

Country profiles have been developed for all countries and published on the Web (www.fao.org/forestry/fo/country/nav_world.jsp). These profiles link the results of FRA 2000 with information collected by other Forestry Department activities (e.g. information on products and trade statistics) and with information provided by partners (e.g. legal texts). Currently, more than 10 000 pages are available on line containing texts, maps and statistics for all countries. These pages receive about 1 000 external hits every day.

The current survey is the latest of the global forest assessments by FAO spanning a 50-year period and the first of its kind to be implemented using a uniform global definition of forest. The findings reveal a diverse picture, where some countries still have very high levels of deforestation (mainly conversion of forests to other land uses) while others show significant increases in forest cover through plantations or natural regrowth. The FRA 2000 results indicate that forests are disappearing most rapidly in Africa and Latin America, whereas in Asia the reduction of natural forests is largely compensated by new plantation forests. In Europe and North America the forest area is increasing, according to the survey.

A final report of FRA 2000 results is planned for June 2001, and the assessment results will be the subject of a future issue of *Unasylva*.

"Building Confidence" seminar on certification

FAO, the German Agency for Technical Cooperation (GTZ) and the International Tropical Timber Organization (ITTO) hosted a seminar in Rome on 19 and 20 February to encourage improved dialogue and linkages among organizations that have an interest in forest certification.

Voluntary certification of forest management and labelling of forest products are recognized as potential tools for promoting sustainable forest management. However, opinions differ as to whether the current proliferation of certification and/or labelling schemes is helping or hindering the process. Despite the differences of opinion, there have been increasing calls for efforts to achieve some degree of international comparability and to consider the equivalency of different certification schemes.

The seminar "Building Confidence Among Forest Certification Schemes and their Supporters" was organized in order to improve dialogue and contact, to clarify the positions of the different stakeholder groups, to increase understanding and to initiate a broad-based dialogue for more effective collaboration. It also sought to extend the discussions of earlier meetings to a broader range of stakeholders, especially the developing countries and civil society. A central issue was comparability and equivalence among credible forest certification schemes.

Some 85 stakeholders from 33 countries presented their expectations for certification, discussed current cooperation and efforts towards mutual recognition and assessed the requisites for credible forest certification schemes. Producers

(large and small), companies, trade associations, unions, social and environmental non-governmental organizations, buyers, certification schemes, governments, academics, international organizations and certifiers were represented. The following were some of the issues discussed:

- How can the comparability of certification standards and schemes be improved?
- Is mutual recognition among certification schemes desirable?
- What is the scope for mutual recognition?
- What other mechanisms or actions could be considered for improving certification schemes and their compatibility?
- What are some of the main barriers to building confidence among stakeholders, and how can these barriers be reduced?
- What follow-up action is desirable or possible?

The divergent views on many of these questions reflected the contrasting interests, values and goals of the various groups. The importance of recognizing both similarities and differences if certification is to be made more effective was highlighted. It was clear that the development of mutual trust is an important first step for dialogue and cooperation among the different certification processes.

Developing countries indicated that, while they may not have difficulty in participating in the international dialogue on forest certification, their constraints in achieving improved standards of forest management and in meeting the requirements of some of the certification schemes are frequently overlooked. Small-scale forest owners and forest communities expressed particular concern regarding respect for their rights and views in the certification of their forests and the sharing of any benefits that certification might provide.

The seminar highlighted the fact that there is still a considerable distance to go before the different stakeholders reach real consensus on many issues, and that further work is needed to bridge the divide that exists. Participants agreed that further direct dialogue is desirable among stakeholder groups, at both the national and international levels, and that neutral organizations such as FAO, GTZ and ITTO should continue to facilitate this dialogue.

Committee on Forestry documentation available to the public

As this issue of *Unasylva* went to press, final preparations were under way for the biennial meeting of the Committee on Forestry (COFO), FAO's principal statutory body in the field of forestry. COFO is the Organization's most important vehicle for facilitating dialogue in the forestry sector. It brings together heads of forest services and other senior government officials to identify emerging policy and technical issues, to seek solutions and to advise FAO and others on appropriate action. Other international organizations and, increasingly, non-governmental groups participate in COFO.

Topics on the agenda of the fifteenth session of COFO, 12 to 16 March 2001, include:

- forestry information and knowledge management;
- criteria and indicators of sustainable forest management and implications for certification and trade;
- FAO support to the implementation of the Intergovernmental Panel on Forests/Intergovernmental Forum on Forests (IPF/IFF) proposals for action;
- a review of FAO programmes in the forestry sector;
- results of the Forest Resources Assessment 2000 (FRA 2000);
- the FAO Forestry Department's medium-term plan (2002-2006);
- proposals for a global forest resources assessment;
- key forestry-related issues in the Framework Convention on Climate Change

and the Kyoto Protocol.

Background documents for these presentations are available on the Web at:
www.fao.org/forestry/fo/statbod/cofo/cofo-e.stm

WORLD OF FORESTRY

International Conference on Timber Plantation Development

Many of the world's leading experts on forest plantation development were among the 75 participants from 16 countries and five international organizations that participated in an International Conference on Timber Plantation Development, held from 7 to 9 November 2000 in Manila, the Philippines. The conference was organized jointly by the International Tropical Timber Organization (ITTO), FAO and the Philippines Department of Environment and Natural Resources (DENR).

The conference was organized in order to discuss, share and synthesize lessons learned from various countries from their experiences in developing timber plantations. The specific objectives of the conference were to:

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- disseminate technical information on various timber plantation development technologies;
- provide participants with information on possible investment opportunities in plantation development;
- provide opportunities for representatives from different countries, development organizations and funding institutions to coordinate assistance for the development of plantations;
- discuss issues, problems and constraints in timber plantation development and recommend corresponding policies to address them.

Presentations covered a broad range of topics, including policy matters, financing, incentives, supply and demand scenarios, management issues, long-term productivity and sustainability (including certification and reduced-impact harvesting issues). Although the range of presentations was ambitious, the high quality of the

papers and the presentations ensured that the conference was very useful, particularly for policy-makers dealing with plantation issues.

Among the basic conclusions of the conference was a recognition that successful plantation development is highly dependent on a favourable policy and investment climate coupled with sound technical plantation management. While such a conclusion appears fundamental, there was a remarkable level of debate on such policy matters as liberalization of trade and investment and secure land and resource tenure.

It is expected that proceedings of the conference will be published and disseminated in 2001.

United Nations Forum on Forests: a progress report

The organizational session of the United Nations Forum on Forests (UNFF) and informal consultations on UNFF's multi-year programme of work were held at UN headquarters in New York from 12 to 16 February 2001. The organizational session elected the UNFF Bureau, agreed to the duration of Bureau members' terms (one year), determined the location of the UNFF Secretariat (New York) and set the venues for the forum sessions. The first and fifth substantive sessions of the UNFF will be held in New York, and the three intervening sessions will be held in Geneva, Switzerland, and San José, Costa Rica. The meeting also addressed progress towards the establishment of the Collaborative Partnership on Forests (CPF).

Hosny El Lakany, Assistant Director-General of the FAO Forestry Department, speaking on behalf of the Inter-Agency Task Force on Forests (ITFF), informed delegates of progress towards the establishment of the CPF. It was suggested that the CPF operate as a high-level, informal and manageable body, with membership limited to approximately 12 international forest-related organizations. Other bodies, such as non-governmental organizations (NGOs) and regional organizations, would contribute as appropriate. Participants expressed the hope that it be an action-oriented body that focuses on implementation.

During the informal consultations on the multi-year programme of work, delegates exchanged views on the following programme elements:

- facilitating and promoting implementation;
- monitoring, assessment and reporting;
- enhancing cooperation and policy and programme coordination;
- fostering international and cross-sectoral cooperation;
- fostering a common understanding of sustainable forest management (SFM) and addessing forest policy issues and emerging areas;
- strengthening political commitment.

The informal consultations also addressed the review of the international arrangement on forests to be undertaken in five years.

The first substantive session of UNFF is scheduled for 11 to 22 June 2001 at UN headquarters in New York.

Central African forestry ministers set Yaoundé declaration into action

The First Conference of Ministers in Charge of Forests in Central Africa was held in Yaoundé, Cameroon from 4 to 7 December 2000. The objective was to put into action the Yaoundé Summit Declaration on Forests of 19 March 1999, on the basis of a "Convergence plan" (*Plan de convergence*) prepared by a meeting of forestry experts convened from 26 to 30 September 2000.

Countries present included the following members of the Yaoundé Process:

Cameroon, the Congo, Equatorial Guinea, Chad and the Central African Republic. The Democratic Republic of the Congo was the only absent member of the Yaoundé Process. Angola and Sao Tome and Principe were present as observers. Burundi and Rwanda have expressed interest in joining the Process. Also present were representatives of five bilateral donors (Canada, Germany, France, the Netherlands and the United Kingdom), eight international organizations (including FAO), several international NGOs, and forest industry representatives.

The Convergence Plan constitutes a platform of priority actions for the implementation of the Yaoundé declaration. It addresses:

- assessment of countries' achievements in the implementation of the Yaoundé Summit's resolutions;
- evaluation of subregional programmes and projects;
- harmonization of forestry and fiscal policies;
- transboundary protected areas;
- sustainable management and control of illegal exploitation of forest resources;
- funding mechanisms for the Yaoundé Process;
- mechanisms for monitoring.

Activities and projects integrated in the plan will be translated into a Subregional Priority Action Programme aimed at catalysing subregional cooperation in sustainable forestry development.

For the areas addressed, the Conference of Ministers identified key measures to be adopted at the national level and jointly at the subregional level. Indicators of performance and potential national and international partners were also suggested for each level.

The ministers decided that the Ministerial Conference on Dense and Humid Forest Ecosystems of Central Africa (CEFDHAC), restructured with a clear organizational framework and legal status, would be the most appropriate institution for implementation of the Yaoundé declaration. The involvement of this body would also bring other countries such as Angola, Burundi and Rwanda into the process. It was agreed to commission a study regarding the most appropriate funding mechanism.

South Africa chosen to host Earth Summit 2002

The second Committee of the UN General Assembly on Rio+10 has announced that the conference marking the tenth anniversary of the United Nations Conference on Environment and Development (Rio de Janeiro, Brazil, 1992) will be entitled "World Summit on Sustainable Development". The meeting, which is expected to set the agenda for sustainable development and the environment for the following ten years, will be held in Johannesburg, South Africa in 2002.

South African officials hope that holding this major conference in South Africa will raise the prominence of issues and debates related to forest protection, clean water and other crucial environmental and sustainability issues on African agendas.

The tenth session of the Commission on Sustainable Development (CSD10) will function as the preparatory committee for the World Summit on Sustainable Development. Four preparatory committee sessions will be held: from 30 April to 2 May 2001, in late January 2002 and in mid-March 2002, all in New York; and in mid-May 2002, in Indonesia. This last preparatory session will be at the ministerial level.

BOOKS

Community forestry strategies for sustainable forest management in Africa

Participatory forest management: a strategy for sustainable forest management in Africa. 2000. Proceedings of the International Workshop on Community Forestry in Africa, Banjul, the Gambia, 26-30 April 1999. Rome, FAO.

Community forestry refers to the collective or individual activities and practices regarding trees and forests that are carried out by local communities for the sustainable satisfaction of their wants. This publication presents the proceedings of an international workshop on community forestry in Africa sponsored by FAO and the German Agency for Technical Cooperation (GTZ) in collaboration with the Government of the Gambia. In attendance were 120 participants from 25 African countries representing government forest services, projects, community-based organizations and NGOs in the area of community-based natural resource management.

The proceedings are presented in both English (Part 1) and French (Part 2). They include an overview of the workshop discussions, including strategies and recommendations; 13 case studies presented at the workshop; and ten voluntary case studies submitted for inclusion in the proceedings, presented in their original language only.

The presented case studies illustrate the variety of approaches used in community forestry and cover topics such as the principles, prospects and impacts of community forestry and the villagers' perspectives of forest management. They also provide information on policy and legal bases for community forest management, incentives and land tenure arrangements, the degree of transfer of authority to local communities and different institutional arrangements.

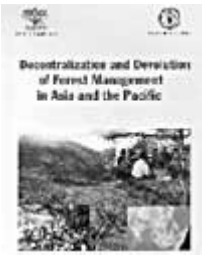
The voluntary case studies discuss the evolution of community-based forest management and experiences gained in the United Republic of Tanzania, Mali, Mozambique, Benin, Uganda, Zambia, and Côte d'Ivoire. The workshop agenda, list of participants, a paper on the Gambian experience, an overview of the field visit and summaries of the working group sessions and panel discussions are also included as annexes.

These proceedings provide an excellent overview of the growing and evolving efforts towards developing and implementing community forestry in Africa. The information shared from all regions of the continent will help others to develop and apply such strategies to management of their own natural resources.

Devolving forest management in Asia

Decentralization and devolution of forest management in Asia and the Pacific. T. Enters, P.B. Durst and M. Victor, eds. 2000. RECOFTC Report No. 18. RAP Publication 2000/1. Bangkok, Thailand, FAO Regional Office for Asia and the Pacific. ISBN 974-7946-02-5.

Governments throughout the Asia and the Pacific region are decentralizing authority and responsibility for resource management as part of efforts towards achieving sustainable forest management and biodiversity conservation goals. Throughout the region, innovative legislation and policies are increasing the power of local governments and communities in managing forest resources. The trend to decentralize is being driven by a range of factors, including efforts to reduce central bureaucracies and cut budgets, a history of less-than-successful government forest management programmes, increased economic liberalization and market orientation, and growing commitment to more equitable forest management.



This publication is based on papers presented at the International Seminar on Decentralization and Devolution of Forest Management in Asia and the Pacific, held 30 November to 4 December 1998 in Davao City, the Philippines. The seminar's main objectives were to review decentralization and devolution experiences in forest management, discuss emerging issues associated with different approaches to forest management, identify and analyse constraints and opportunities, examine gaps between policy and implementation, and explore the expansion of successful pilot efforts.

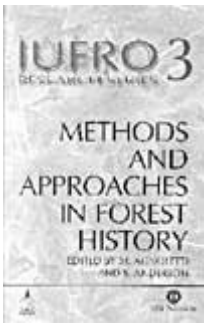
The papers are organized into five main sections. The first deals with the key issues and emerging trends of decentralization and devolution in forest management; it includes a conceptual overview and discusses principles and dilemmas, pluralism and empowerment. The second section discusses the diverse approaches used to achieve the similar objectives of forest management in various countries or regions such as New Zealand, China, the Lao People's Democratic Republic, Viet Nam and West Africa. Institutional adaptation and dealing with change is the topic of the third section, which provides specific examples from Indonesia, Thailand and other Southeast Asian countries. The fourth section explores the role of community-based enterprises and monitoring as well as the relationship between people and protected areas in a discussion focused on forest conservation. The final section presents the Philippine experience as a case study on the process of decentralization.

This publication will assist those in charge of devising and carrying out forest management policies better to understand the key issues and challenges that underlie effective implementation of decentralized forest management.

Social science research into tropical resource dynamics and conservation

> *Tropical forest resource dynamics and conservation: from local to global issues.* K.F. Wiersum. 2000. Tropical Resource Management Papers No. 33. Wageningen, the Netherlands, Wageningen University.

This publication is a compilation of recent and ongoing research by social scientists in the Netherlands on the conservation and management of tropical forests.



The articles are divided into four sections representing the dominant fields of social science research on tropical forests. The introductory section discusses recent trends in social science research of tropical forests and the increased interest in this field, particularly within the Netherlands. It describes various theoretical perspectives such as the actor-oriented approach, common property resource management, legal pluralism, political ecology, induced innovations and conflict negotiation.

The second section presents two articles examining human perspectives on forests. An investigation of Bulu forest tenure and the 1994 Cameroon Forest Law illustrates how management and exploitation rights for forest resources are conceptualized. The other article discusses the use of storytelling as a new tool for expressing local and supralocal environmental views.

The third section contains three papers regarding land-use processes at the forest fringe. The first discusses different approaches used to assess the transformation of rain forests into domestic landscapes, with examples of pioneer shifting cultivators in the Philippines and Indonesia. The other two papers include a historical view of the cultural and social aspects of variable resource use in the highlands of Papua New Guinea, and a historical examination of changes in land use in an Indian region in Chiapas, Mexico.

The final section explores forest conservation in the context of political and economic processes through comparison of the activities and experiences of four countries, namely Senegal, Ecuador, Costa Rica and Sierra Leone.

Companion publications on forest history

Forest history: international studies on socioeconomic and forest ecosystem change. M. Agnoletti and S. Anderson, eds. 2000. IUFRO Research Series No. 2. Oxford, UK, CABI Publishing.
ISBN 0-85199-414-9.

Methods and approaches in forest history. M. Agnoletti and S. Anderson, eds. 2000. IUFRO Research Series No. 3. Oxford, UK, CABI Publishing.
ISBN 0-85199-420-2.

These two books together present edited and revised versions of more than 50 papers selected from those presented at a major conference on history and forest resources, held in Florence, Italy in 1998. The conference was organized by the Italian Academy of Forestry Science and the working group on forest history of the International Union of Forestry Research Organizations (IUFRO). One of the most important achievements of the conference was to bring together scientists from different research fields and different cultural backgrounds, stimulating an interdisciplinary approach to forest history.

As a whole, the papers present detailed analyses of the interrelationships between forest ecosystems and socio-economic development from countries around the world. Main economic and social factors, techniques and local practices, as well as legal and political aspects related to forest changes are discussed, according to the latest achievements in forest history research.