Regional Conference on Sustainable Development of Rattan in Asia

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Application of Production and Utilization Technologies for Rattan Sustainable Development in the ASEAN Member-Countries [PPD 51/02 Rev. 1 (I)]

ITTO

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1 Welcome Remarks

Delivered by Dr. Celso P. Diaz, Director, Ecosystems Research and Development Bureau (ERDB), Department of Environment and Natural Resources (DENR), and Overall Project Coordinator of the ITTO-Project, "Application of Production and Utilization Technologies for Rattan Sustainable Development in the ASEAN Member Countries"

Director Diaz welcomed the participants and guests to the conference. He acknowledged the presence of distinguished guests, namely: Honorable Elisea G. Gozun, Secretary of the Department of Environment and Natural Resources (DENR), Dr. Emmanuel Ze Meka, Assistant Director of the International Tropical Timber Organization (ITTO), and Undersecretary Florentino Tesoro of the Department of Science and Technology (DOST).

He expressed gratitude for the interest that the ASEAN member-countries have shown their full support and cooperation in implementing the project and organizing this conference. He added that while they are blessed with bountiful rattan resources, they have come to realize the value and importance of rattan, which for several past decades was considered a minor forest product. Now that the production of timber from many parts of the globe is declining, rattan in terms of utilization and function, is now considered, one of the most important nontimber forest products, perhaps next to timber in some Asian tropical countries.

He recalled that the development of the pre-project proposal was principally anchored on the results of the FAO Expert Consultation on Rattan Development held in Rome, Italy on December 2000 where the focus of the meeting was the development of rattan sector worldwide with particular emphasis on Asia where the bulk of rattan supply is found. During that consultation, Dr. Florentino Tesoro, then Director of Forest Products Research and Development Institute (FPRDI), and now the Undersecretary represented the Philippines for Field Operations, Department of Science and Technology. Upon his return from that conference, he enjoined the ERDB and FPRDI to prepare a joint project that will investigate the application of production and utilization technologies of rattan resources in the ASEAN region.

Director Diaz informed that with the support and endorsement of the Philippine representatives to ITTO headed by former DENR Undersecretary Ricardo M. Umali and Director Romeo Acosta of the Forest Management Bureau (FMB), the ITTO finally approved the proposal for funding with a duration of one year effective April 2003. The Ecosystems Research and Development Bureau (ERDB) was designated as the implementing agency and the Forest Products Research and Development Institute (FPRDI) as the collaborator of the project. This one-year project has two-fold objectives: (1) to conduct a sustainable analysis of the rattan commodity and the socioeconomic, production, harvesting, processing, utilization, and market dimension of rattan in local communities in the ASEAN member-countries, and (2) to determine the future actions needed to enhance ASEAN Regional cooperation through collaborative research in rattan development.

He noted that the implementation of the ITTO Pre-Project is an ASEAN-wide endeavor that covers Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Thailand, Vietnam, and the Philippines. Furthermore, this project recognizes the fact that it is in most ASEAN countries where rattan products and its by-products are manufactured in small- to large-scale industries. Thus, there is a critical need for rattan raw materials for these industries to survive.

Director Diaz emphasized that in this 2-day conference, it is expected that the participating ASEAN countries will present the current state of the production and utilization technologies of rattan resources in their respective countries. Discussions would also identify the gaps on research and development (R and D) that each country should address so that in the long term, the ASEAN member-countries could attain the level of sustainability of rattan resources that is appropriate for their respective economies.

Finally, Director Diaz was positive that the workshop participants will fully attain the objectives of this conference, trusting the ASEAN's spirit of firmness and resolve, friendship and cooperation.

2 Message from ITTO Representative

Delivered by Dr. Emmanuel Ze Meka, Assistant Director, International Tropical Timber Organization (ITTO)

Dr. Ze Meka expressed gratitude to the conference organizers for giving him the opportunity to address the participants and guests of the conference. He conveyed warm greetings in behalf of Dr. Manoel Sobral Filho, Executive Director of ITTO, who was unable to attend the conference because of previous commitments.

Dr. Ze Meka shared that today's population is living in a rapidly changing world, which calls for swift adaptations by individuals and nations. However, we should not confuse speed with haste. Rather, aim to make speedy progress through a well-thought-out and well-planned process that would take them towards well-targeted objectives in a fast but secure fashion. Unnecessary haste, on the other hand, should be avoided, because of the very many perils that lurk ahead.

Dr. Ze Meka noted that in particular, we are living in an era of globalization, which in many aspects looks like a retreat from the generous sentiments of compassion and solidarity, while competitiveness – where the strongest countries have a decisive advantage – is becoming the rule of the game. In this context, developing countries have to be more creative and determined and make the best use of their own unique sets of natural and human resources. Some natural resources are specific to certain areas; rattan, for example, is only found in tropical and subtropical areas and it is in these tropical and subtropical countries where the greatest experience in the management and use of rattan can be found.

Many developing countries certainly have tremendous natural resources and yet still underdeveloped and a large fraction of their population still lives in a critical state of poverty. The challenge for such countries is to make these resources attractive and available to global markets to generate revenues that contribute to development. The input of appropriate technology is essential. Technologies can be tapped from available sources; they can also be generated through research and they can be disseminated through demonstration and training. Appropriate technologies are needed to process and add value to natural resources and to make the resulting products attractive to the markets. Then, marketing skills are needed to ensure a successful introduction of products to the markets, and to get a good price. One aspect that is often neglected but is worth mentioning in this context of international trade is the need to take into account and to monitor the evolving changes in environmental standards that can sometimes, and increasingly, represent serious barriers to export markets.

Dr. Ze Meka posed the question: Is the rattan economy worth mentioning in the context of globalization? The rattan furniture trade has developed tremendously in the past years. International Network of Bamboo and Rattan (INBAR) underscores that "trade in rattan has burgeoned into a multi-million dollar industry". The value of exports of rattan from Indonesia, for example, has increased 250-fold in 17 years. The rise has been 75-fold in the Philippines in 15 years, 23-fold in 9 years in Thailand and 12-fold in 8 years in Malaysia. The global trade of rattan products is estimated by INBAR to be in the range of USD 4 billion and the domestic trade USD 2.5 billion. These figures show the importance of the rattan economy, which has become, in terms of export value, almost 40% of the trade of primary tropical timber products covered by ITTO, which is around USD 10 billion, or 80% of the banana trade value, which is around USD 5 billion.

Dr. Ze Meka stated that the importance of rattan is therefore far from negligible and amply justifies their reference to the global economy. It also justifies the importance given by ITTO to assisting its member-countries to improve their capabilities in managing, processing and marketing of rattan resources. Many projects towards that end have been implemented in China, Thailand, Indonesia, and the Philippines. The following three projects indicate the type of assistance ITTO is providing to member-countries in this field.

In Thailand, project PD 24/00 Rev.1 (I) "Promotion of Sustainable Utilization of Rattan from Plantation in Thailand" is developing and disseminating knowledge and technologies to promote the sustainable management and efficient utilization of rattan by establishing two demonstration plots: one in Sakon Nakhon province for the harvesting and utilization of rattan shoots, and one in Krabi province for the sustainable management of rattan shoots and canes.

In Indonesia, project PD 108/01 Rev.3 (I) "Development of Sustainable Rattan Production and Utilization through Participation of Rattan Small Holders and Industry in Indonesia" is helping in the development of a competitive rattan industry from sustainable sources to provide multiple benefits to the communities. The project is focused on developing cultivation, harvesting, grading, and processing systems, and on product design, diversification and marketing. This project is organizing a national forum on sustainable rattan development in Central Java next week.

In China, project 100/01 Rev.3 (I) "Capacity Building for the Development of a Sustainable Rattan Sector in China Based on Plantation Sources" is facilitating capacity-building for the development of a sustainable rattan sector in China through the establishment of demonstration plots for the management of rattan plantations and implementation of training workshops on management and utilization of rattan. Three demonstration plots will be established in Guandong, Guanxi, and Hainan provinces.

Dr. Ze Meka informed that ITTO is also pooling efforts with other international organizations, such as INBAR and FAO, to promote the conservation and the sustainable use of rattan resources. The current cooperation of ITTO and INBAR in the field of bamboo and rattan statistics and the international expert consultation on rattan organized by FAO in cooperation with ITTO, INBAR and other relevant organizations and institutions in December 2000 are good examples of such efforts. He added that they are pleased to note that this regional Conference sponsored by ITTO is one of the major follow-up actions to the recommendations of that expert consultation.

However, the importance of rattan as an internationally traded commodity is not the only rationale for ITTO's interest in and support for the rattan economy. One of the core objectives of ITTO is the sustainable management of tropical forests, which, in the tropics, encompasses rattan resources. The sustainable management of tropical forests can succeed only if all available resources are managed in a comprehensive manner and valued at their maximum potential. This would increase the overall value of the forest, making sustainable forest management a more competitive land use option for local communities and the countries concerned.

The sustainable use of rattan resources can play a critical role in this context. Indeed, using rattan is well known in local communities and is part of their culture and tradition because they use this for many purposes in their day-to-day lives, although, very often, the products are not of a standard that can satisfy the international trade. Improved techniques for managing, processing and marketing of rattan resources can help bring about new development opportunities for employment, income generation, and technology transfer. This would be most effective if done through the strengthening of community organizations that will facilitate the management of available resources, the transfer of technology and the marketing of products.

Dr. Ze Meka stressed that the critical word at this juncture is "sustainability". Many ASEAN countries were once major producers and exporters of tropical timber. Because of deforestation, mainly due to forest fires and forestland conversion to other uses, and unsustainable timber harvesting, certain countries have now tremendously reduced, or even stopped timber harvesting. Some have become net importers of tropical timber in order to supply their local timber industry. Thailand banned logging in natural forests in 1989 and Sri Lanka did likewise in 1990. The logging of virgin forests was banned in the Philippines in 1991, Vietnam imposed a partial ban in 1997, and Cambodia placed a moratorium on timber harvesting in 2000. The scaling down of timber production, which was a driving force of economic development in many parts of these countries, had a substantial impact on local communities and national economies. The quest for sustainability is therefore a must and should be pursued through a comprehensive analysis and planning of all stages of the rattan economy, from resource management to processing of products and marketing, and should include the establishment of flourishing rattan cottage industries.

Dr. Ze Meka stated that the national reports that will be presented at this Conference will highlight the status of rattan resources and their utilization in the relevant countries. Some national reports will probably show that the success of rattan products in international markets has put a serious strain on the resource base and many countries are already facing difficulties in supplying their expanding rattan industries.

Thailand, for example, now spends more than USD 3 million annually to import rattan canes. As the supply from natural forests dwindles, the industry will have no other option than to invest in rattan plantation establishment. It is recognized that this is not an easy task and many experiences have failed. But some other experiences, in particular in countries such as Malaysia, where large-scale commercial plantations have been established in Sabah, Sarawak and Peninsular Malaysia, are inspiring examples, although more research is still needed in that field. Establishing new plantations should be complemented by the conservation and rational management of existing natural resources. In this connection, they should seek particularly to develop sustainable harvesting regimes and to pursue research on lesser-used rattan species to promote their inclusion in the rattan economy.

Dr. Ze Meka shared that the ITTO pre-project conference has been implemented with a lot of dedication. He congratulated the DENR and the staff involved for the success of these pre-project activities. He added that ITTO is supporting many projects and pre-projects in the Philippines, particularly in the field of forest industry. ITTO is very proud and satisfied with the way these projects are being implemented. The quality of the questionnaires that have been developed to collect information on rattan at the country level and the profiles of national consultants and contact points who were selected for this exercise and are participating in this meeting guarantee that the discussions would be productive during the two-day conference.

3 Keynote Address

Hon. Elisea G. Gozun, Secretary, Department of Environment and Natural Resources (DENR)

Secretary Gozun welcomed participants from Vietnam, Brunei Darussalam, Myanmar, Cambodia, Indonesia, Lao PDR, and Philippines to conference. She added that their presence is an indication of their commitment to enhance collaboration among ASEAN countries to bring rattan resources under sustainable management. She then thanked the organizers for inviting her to grace this Regional Conference on Sustainable Development of Rattan in Asia.

Secretary Gozun informed that in the past, only timber was recognized as the forest product with high economic value. Rattan was then considered as a minor forest product. However, due to the variety of its uses, especially as a raw material for furniture and handicrafts, rattan has widened its importance and now ranks second to timber and has flourished into a multibillion dollar industry. In 1997, ITTO estimated that rattan trade worldwide was valued at USD 6.5 billion annually with Asia leading the production and export of rattan and rattan products.

Secretary Gozun presented an overview of the statistics on export values of rattan which amount to 250-fold for Indonesia in 17 years; 75-fold in the Philippines for over 15 years, 23-fold over 9 years in Thailand, and 12-fold over 8 years in Malaysia. With regards to the Philippines, among the 68 or so rattan species, about 10 are considered commercially important. Common to the Philippines are *Calamus, Daemonorops, Korthalsia, and Plectomia*. Philippine rattan exports for the last 10 years reached USD 44.567 million in 2001, with forest charges from rattan amounted to PhP 8.71 million.

She noted that rattan is socially significant because it provides sustainable income to some of the most disadvantaged segments of the society, including communities living in the uplands. Furniture manufacturing remains relatively labor-intensive with the furniture manufacturers employing about 481,500 direct workers and 300,000 subcontractors. Studies estimate that 32% are employed in the rattan industry. This translates into 154,080 direct employees and 96,000 indirect workers. Assuming that each worker has a household size of five, approximately 1.25 million are dependent on the rattan furniture industry.

Secretary Gozun posed a challenge to the participant-researchers, that they must not be contented with these employment figures alone. Rather, they must continue to increase access to livelihood through the rattan industry. To do this, several issues on rattan must be addressed. One is the unsustainable management of its natural habitat, over-harvesting and deforestation, which threaten the rattan industry. Other issues include the need for more plantation development, the low priority in forest conservation policies, and limited research and development programs.

She commended the Ecosystems Research and Development Bureau (ERDB) for spearheading the development and implementation of this rattan pre-project. She also thanked ITTO for continuing their support to DENR's projects. She hoped that this project would aim to assess the socio-economic acceptability, financial and market feasibility of rattan production and utilization technologies in the ASEAN member-countries. For several months, Philippine focal persons from the pre-project discussed the country reports of their ASEAN counterparts. The issues and concerns raised in those reports would further be discussed in this conference.

Secretary Gozun expressed hope that this pre-project will be transformed into a full-blown research and development program with the ITTO continuing its support. She looks forward to further assistance because while the research and development will focus on rattan, this climbing vine needs to have a nurse tree for its growth and development. Thus, trees are important elements for the survival of rattan. Hence, this project will provide an opportunity to address deforestation as well.

Rattan is also an important commodity within protected areas. In view of the prohibition of the cutting of trees, rattan can thrive in the protection forests and can serve as a viable livelihood source for the host communities. The adoption of the community-based approach not only provides additional income, but also fosters a harmonious co-existence of people and forests. In addition, the proposed research and development program will foster a stronger ASEAN bloc due to the enhanced "South-South" cooperation. Countries that have high rattan production may provide the raw material needs of countries specializing in rattan processing and manufacture. The result is efficiency, as countries will capitalize on their strengths. This is the theory of comparative advantage.

Secretary Gozun noted that she would like to further see an improvement in the marketing of our rattan furniture and handicrafts. She encouraged participants to find means to improve the technology of rattan processing to conform to the demands of the market in terms of design and structure. Such move would give them competitive advantage.

She remarked that the challenge for the participants during the two-day conference is to work together to attain comparative and competitive advantages for the ASEAN member-countries in the rattan industry. They should make rattan, once considered as a minor forest product, a major commodity that provides not only economic stability, but also promotes ecological soundness and social development.

Finally, Secretary Gozun expressed hope that the conference would be a success and she looks forward to the implementation of the inputs agreed upon and discussed. She wished the foreign guests and participants a pleasant stay in the Philippines.

4 Presentation of Workshop Participants

Dr. Aida Lapis, Project Leader-Management, ITTO

Dr. Aida Lapis introduced the participants, guests, and resource persons to the Regional Conference on Sustainable Development of Rattan in Asia. She acknowledged the presence of eminent guests, Hon. Elisea G. Gozun, Secretary of the Department of Environment and Natural Resources (DENR), Philippines, and Dr. Emmanuel Ze Meka, Assistant Director of the International Tropical Timber Organization (ITTO).

Dr. Lapis also welcomed the country representatives from Brunei Darussalam, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, and Vietnam.

Present were resource persons Dr. Florentino Tesoro, Undersecretary for Regional Operations, Department of Science and Technology (DOST), Philippines, and Dr. C. Renuka from the Kerala Forest Research Institute, India.

She presented contact persons and staff of the "Application of Production and Utilization Technologies for the Sustainable Rattan Development in the ASEAN Member Countries" project, headed by Director Celso P. Diaz, overall project coordinator and Director of the Ecosystems Research and Development Bureau (ERDB).

Dr. Lapis also acknowledged the presence of scientists from Thailand, as well as guests from the College of Forestry and Natural Resources University of the Philippines, Los Baños Laguna (UPLBCFNR), and Forest Products Research and Development Institute (FPRDI). *(See Annex 1: Directory of Participants)*

5 Technical Presentation: Sustainable Rattan Management and Utilization in Southeast Asia

Presented by Dr. Florentino Tesoro, Undersecretary, Field Operations, Department of Science and Technology (DOST)

Dr. Tesoro informed that an estimated 700 million people or more are engaged in the collection, processing, and trade of rattan and rattan products worldwide. In some villages, rattan cultivation and trade is often a secondary source of income. However, with limited efforts to develop rattan plantations, the natural rattan resources started to dwindle. This was further aggravated by the decrease in the natural habitat of rattan due to widespread logging.

Because of such phenomenon, there is an urgent need for conservation and generation of the rattan resources. This involves taxonomic identification of species, inventory of resources, establishment of germplasm and gene banks, plantation development and establishment of rattan gardens. In addition, further studies need to be conducted to increase the productivity of rattan. This involves expanding the number of species used by determining potentials of lesser-utilized species, improving harvesting techniques to reduce wastage, and improving processing techniques to achieve the desired quality required by consumers.

Dr. Tesoro informed that their research showed that at varying degrees, all ASEAN member-countries are undertaking conservation and sustainable management measures for rattan resources. Hence, further work needs to be done to enhance these efforts under cooperative alliances among the countries with technical and possibly financial assistance from donor countries augmented by resources within individual countries. *(See Annex 2 Sustainable Rattan Management and Utilization in Southeast Asia)*

6 Technical Presentation: Challenges and Prospects on Rattan Research and Development: The Asian Region Scenario

Presented by Dr. C. Renuka, Scientist, Kerala Forest Institute (KFRI), India

Dr. Renuka reported that Southeast Asia is the largest producer and exporter of rattan and rattan products globally. Aside from its contribution to the thriving export market, rattan production remains one of the livelihood sources of forest-based communities, thus contributing significantly to subsistence of the local people. She added that approximately 90% of the raw material used for commercial purposes is still obtained from natural forests. Only a very small portion is obtained from the plantations. Because of this, many rattan species, since preferentially sought and extracted, have become rare in the wild.

Dr. Renuka added that in general, shortage of cane is definitely felt in the Asian region. At the same time markets in the consumer countries seems to be steadily growing. Present protection systems are not sufficient to meet the demand for sustainable utilization. The challenge therefore, is to come up with strategies to increase rattan supply, with special attention to large-diameter canes and commercially utilized species. There is also a need to involve the local communities and capacitate them to sustainably cultivate and manage their rattan resources to meet the economic and ecological demands of rattan production. *(See Annex 3 Challenges and Prospects on Rattan Research and Development: The Asian Region Scenario)*

Open Forum:

- Dr. Armando Palijon, from the University of the Philippines Los Baños (UPLB) noted that reports showed several gaps in both the production and research aspects of rattan and the results of the studies seem to imply that there is not enough technologies present for the rattan industry sector. He further inquired if the project will focus on developing new technologies for rattan production and use, or will it focus on application of available technologies to boost the rattan industry sector.
- Dr. Florentino Tesoro informed that while several technologies have been developed for the production of rattan, these are not enough to improve the production and processing techniques of rattan. Further studies should be made on reducing the incidence of staining fungi infestation because this reduces the cane quality and results to wastage. This is especially significant since transport of harvested products is becoming burdensome as harvesting areas for rattan are slowly becoming distant over time. Since gathering areas are slowly moving further, usually, gatherers are forced to leave some of their harvested rattan in the area. This can deteriorate the canes since they become prone to staining and infestation from beetles. Therefore, there is a need for more research on prophylactic treatments and better drying procedures to avoid such problems.
- Dr. C. Renuka added that further research should also be done to enhance silvicultural techniques in rattan production. To be able to find means to enhance rattan production and growth of more shoots, it is important to obtain pertinent information regarding the lifespan and growth of different species, under different conditions.
- Dr. Florentino Tesoro suggested that the components of the regional project could include research on identification of rattan species through the formation of a network of taxonomists (both local and foreign), and research on germplasm and seed banks through exchange of information on seedling propagation and exchange of sample species to serve as input to the seed bank.
- Dr. C. Renuka remarked that if they plan to develop a germplasm and seed bank, they should consider the policies and regulations present in each member-country regarding the transport of seedlings from other countries.
- Director Celso Diaz informed that there are many existing technologies on rattan production developed through research in several countries. However, they would have to look into implementing, testing, and further developing these technologies so that these could be applied by people at the grassroots level.
- Dr. Florentino Tesoro remarked that more researchers are becoming cognizant of their intellectual property rights. This would have to be further discussed through a mutual agreement with researchers so that there is sharing of research findings. One initiative is to involve these researchers in an ASEAN regional project so that research findings could be shared and concepts are tested and applied.
- Mr. U Win Myint from Myanmar inquired what were the technical management initiatives undertaken necessary to promote sustainable harvesting of rattan.
- Dr. Florentino Tesoro informed that for the technical aspect, further research should be made on sustainable harvesting techniques for rattan. Most gatherers experience difficulty pulling the canes that they sometimes resort to cutting the tree. For the management aspect, the Philippines has come up with policies to encourage the sustainable harvest of NTFPs in forest areas. One such initiative is imposition of an annual allowable cut, where the permit-holder is allocated an allowable volume of resources to be harvested annually. However, it is difficult to monitor these permits, whether the holders are indeed cutting within their allocated quota, and whether they are doing so within their allowable area for harvest. The annual allowable cut is based on the number of resources inventoried in the area, and the growth capability of such species. Therefore, the concept of community-based forest management is feasible because the security of tenure serves as an incentive for community members to manage their resources in a sustainable manner.
- Mr. Bambang Wiyono from Indonesia inquired how does the 40% wastage in harvesting of rattan incurred.

- Dr. Florentino Tesoro replied that the 40% wastage incurred from harvesting rattan is due to several factors. One factor is the infection of the harvested canes by staining fungi. In addition, canes, which are not dried properly, are susceptible to beetles and borers. One initiative to counteract such problem is to dip canes in chemical solutions, or to boil them in oil. Another factor is the harvesting of undersized canes. These canes shrink in size when they are dried, and are therefore not feasible for marketing. Wastage also occurs during processing when rattan is split, and when canes are not softened enough during the bending process (usually occurs when a blowtorch is used). The estimated wastage incurred during processing is about 30% to 40%. However, there is a company in Bulacan, Philippines, which utilizes rattan waste for cement-bonded boards.
- Dr. Raja Barizan from Malaysia inquired if the rosette stage is dependent on genetic conditions or on light conditions to increase growth and achieve its desired height and diameter.
- Dr. C. Renuka explained that during the rosette stage (grass stage), it is important to determine how to increase the basal diameter so that the rattan reaches its desired height and diameter.
- Dr. Rungnapar Pattanavibool from Thailand shared that in south Thailand, they have compared the growth of rattan canes from the natural forest and from the plantation areas. It was observed that the growth rate of rattan in plantation areas is much faster compared to rattan in natural forest because the former provides sufficient light supply. Hence, rattan grows well if it receives sufficient light, compared to the stunted growth of rattan in shaded areas.
- Dr. C. Renuka noted that it is important to conduct extensive research on the behavior of different species of rattan under different conditions (e.g., light, soil, water) to determine the environment needed for each species to reach their desired height and diameter.

7 Presentation of Country Reports

Each country representative reported the status of rattan production and use in their respective country. The country reports are attached as annexes.

- Brunei Darussalam by Mr. Joffre Bin Haji Ali Ahmad *(Annex 4.1)*
- Indonesia by Mr. Bambang Wiyono *(Annex 4.2)*
- Lao PDR by Mr. Southone Ketphanh *(Annex 4.3)*
- Myanmar by Mr. U Win Myint *(Annex 4.4)*
- Malaysia by Dr. Raja Barizan Raja Sulaiman *(Annex 4.5)*
- Philippine by Director Celso Diaz and Forester Mario Ramos *(Annex 4.6)*
- Thailand by Dr. Chudchawan Sutthisrisilapa *(Annex 4.7)*
- Vietnam by Ms. Do Thi Ngoc Bich *(Annex 4.8)*
- Cambodia by Forester Maura Dimayuga (for Mr. Lic Vuthy) *(Annex 4.9)*

Following the reports, an open forum followed for participants to provide comments and clarify some points:

7.1 Comments and clarification on the Indonesia Country Report

- *Facilitator:* **Are there studies or recommendations in Indonesia to organize farmers for the conduct of the market study referred to gatherers of rattan or farmers planting rattan in their farms?**
- *Mr. Bambang Wiyono:* The conduct of the market study aims to organize both rattan gatherers and rattan planters.

- *Dr. Rungnapar Pattanavibool:* **Since rattan plantations have long been established in Indonesia (as early as 1850), can you recommend sites, which demonstrate sustainable rattan production for study visits?**
- *Mr. Bambang Wiyono:* The best sites to visit and observe rattan plantations are located in Central Kalimantan. In addition, rattan-processing factories are also found in South Kalimantan.

- *Dr. Armando Palijon:* There is discrepancy in the Indonesian report and presentation. It stated that gatherers collect 3.10-meter to 4.10-meter long rattan canes, but the manufacturers prefer 5.0-meter to 6.0-meter long rattan canes.
- *Forester George Santos:* The length requirement of rattan manufacturers in Indonesia is between 3.2 meters to 6.0 meters, depending on the diameter. The report may have missed indicating this information.

- *Dr. Armando Palijon:* **The Indonesia report explained that after harvesting, the rattan is left in the forest for two weeks to dry. A similar method is also done in the Philippines but it is applied to harvesting of bamboo. Are there further treatments done on the harvested rattan to prevent infestation of staining fungi during the two-week period?**
- *Forester George Santos:* The local people treat the rattan in flowing water to facilitate the cleaning of the cane. This indigenous strategy also enables one to maximize the length of the cane. However, further studies done on this method showed that the cane becomes more susceptible to fungi when they are treated in running water.

- *Dr. Armando Palijon:* **Is inventory conducted before re-stocking of logged over forests to determine if re-planting is necessary or if regeneration is sufficient to meet the desired quantity of rattan? He shared that this inventory is crucial to decide further intervention needed to be done in the area to meet the needed quantity of rattan for production. It may be that assisting natural regeneration would be enough to sustain the production in the area.**

- *Dr. Mercedes Garcia:* **What are the known medicinal values or uses of rattan fruits?**
- *Forester Santos:* Extract from the fleshy part of the fruit is used to stop hemorrhage. In addition, the fleshy part is known to cure diarrhea.

7.2 Comments and clarification on the Lao PDR Country Report

- *Mr. Southone Ketphanh:* **The length required by manufacturers for the processing of rattan is between 4.5 meters to 5 meters long. Is this requirement similar to other countries?**
- *The country representatives:* The length requirement by rattan manufacturers in their respective areas: Thailand- 4.5 meters, Malaysia- 3.5 meters (for large diameter canes) and 9 meters (for small diameter canes), Myanmar-3.4 meters, Cambodia 5 meters (for large diameter canes) and 3 meters (for small diameter canes).

7.3 Comments and clarification on the Myanmar Country Report

- *Director Celso Diaz:* **Is the analysis of the annual allowable cut (AAC) considered long-term production goals? One criterion for sustainability is the balance of production and meeting the demands over time. Hence, further analysis should be done on the extent of the AAC, whether this is related to the production goals of the country.**
- *Dr. Armando Palijon:* Myanmar report included *Flagellaria* as part of the rattan species. He further informed that *Flagellaria* is not rattan specie.
- *Mr. U Win Myint:* We need taxonomic support in identifying some rattan species. We have collected several species but these have been identified using their local names, not their scientific names.
- *Dr. Armando Palijon:* Myanmar report showed that harvesting of rattan is conducted year-round. He added that the season of harvesting is an important consideration in rattan production because the changing seasons may have a relationship with the susceptibility of rattan to diseases. Hence, there is a need to conduct further studies to determine which season is favorable to the harvesting of rattan.
- *Mr. U Win Myint:* Ideally, the harvesting of rattan should be done during the dry season. However, since there is a huge demand for rattan that has to be met by Myanmar, the harvesting of rattan is done all year round.

- *Director Celso Diaz:* A set of guidelines should be set for the inventory of rattan. In the Philippines, research has been done on the inventory design. However, it would be good to discuss a common set of standards that would be used by the ASEAN countries regarding the proper way of conducting inventory of rattan species.

7.4 Comments and clarification on the Malaysia Country Report

- *Mr. U Win Myint:* **The Malaysian paper described research on intercropping rattan with rubber trees. How many percent of the rubber plantation area was intercropped with rattan and whether it was more economically feasible to intercrop both species?**
- *Dr. Raja Barizan*: If one decides to intercrop rattan with rubber trees, the rubber becomes the secondary crop because there would be less latex (rubber) produced from the trees due to the growth of the rattan climbing the tree.
- *Dr. Armando Palijon:* The Malaysian study also experimented intercropping rattan with *Acacia mangium*. He added that since the report showed the acacia becomes susceptible to breakage after 5 years, the wounds inflicted in the tree could make it more susceptible to fungi and diseases.
- *Dr. Raja Barizan:* We did not consider the trees as the main crop; they merely served as "supplement" to the rattan.
- *Dr. Emmanuel Ze Meka:* It is important to conduct financial analysis if one wants to intercrop rattan with plantation species. The financial assessment could determine which species could be intercropped with rattan that would yield economically feasible results. The study could also serve as basis to advocate rattan production as a main source of income for communities living in forest areas.
- *Dr. Raja Barizan:* We have conducted financial analysis which is included in their manual, and which was used as basis for them to intercrop rattan with rubber.
- *Dr. Mercedes Garcia:* A research program could be initiated to test the intercropping of fast-growing species with solitary rattan species, rather than clustering-type rattan species. Solitary rattan species do not dominate trees and the analysis of the economic benefits from intercropping them with fast-growing species could yield better results.

7.5 Comments and clarification on the Thailand Country Report

- *Mr. Bambang Wiyono:* **How do other countries combat illegal trading and smuggling of natural resources?**
- *Director Celso Diaz:* Illegal trade and smuggling of forest products is a critical issue in the Philippines. While policies and regulations are in place, there is an apparent lack of effort to monitor the implementation of such policies. Hence, there is a need to obtain the support of local communities, through the community forestry programme, to help combat illegal activities, within their forest areas. The security of tenure being given to these local communities provides them with enough incentive to sustainably manage and protect their forest products, which includes rattan.
- *Dr. Chudchawan Sutthisrisilapa:* Thailand shares borders with Myanmar, Lao PDR, and Cambodia. Government officials have difficulty in monitoring these boundaries that are surrounded with vast forestlands. Hence, the country experiences transboundary issues, which include illegal trade and smuggling of forest products. One strategy initiated by the government is to promote environmental awareness to local communities for them to be informed of the importance of protecting their natural resources. Furthermore, the government also launched the program One TUMBON-One Product (OTOP) Project, which promotes local communities to produce by themselves their own unique product using their own resources as a means for income-generation. The program focuses on helping the communities manufacture their products. In addition, it provides assistance for communities to maintain and conserve their natural resources through the use of indigenous knowledge and techniques.
  - *Dr. Aida Lapis:* Countries in the Indo-China region recognize the seriousness of illegal trade and other transboundary issues. We could do further research on these issues to come up with unified policies that would put an end to illegal acts and smuggling.

- *Director Celso Diaz:* **Thai government provides financial support to local farmers for reforestation. Are the farmers required to repay the government after the 10-year project period?**
- *Dr. Chudchawan Sutthisrisilapa:* During the thinning process, the income gained from selling the harvested wood would be paid to the government. However, the funds are used by the government to help the farmers develop their rattan plantation.

- *Mr. U Win Myint:* **Does the reforestation project provides tenure for the farmers after the 10-year project period?**
- *Dr. Chudchawan Sutthisrisilapa:* The land used for reforestation is owned by the government. Since the budget is limited for the 10-year project period, the farmers are not given tenure. However, the government provides free rattan seedlings to the farmers, as well as technical assistance for them to develop rattan production as their means of income.
- *Dr. Armando Palijon*: The DENR-ERDS conducted a study to demonstrate production and utilization technology packages for rattan. This was conducted in Taminla, Iloilo, Philippines and the results of this study could yield pertinent information regarding the application of techniques to improve rattan production and utilization, which could be disseminated to local communities for their adoption.

- *Dr. Mercedes Garcia:* **Does the Thailand research obtained information on the medicinal value of rattan shoots? Further research should be done on these claims because it could serve as the basis for promoting rattan as a potential source of income from its medical value.**
- *Dr. Chudchawan Sutthisrisilapa:* We have done extensive research on the medicinal value of rattan shoots. However, during the implementation of the ITTO project, we would document experiences from villagers regarding the therapeutic claims of rattan and use this as basis for further research on the matter.

7.6 Comments and clarification on the Philippine Country Report

- *Mr. U Win Myint:* The Philippine report showed that for 2002, the annual allowable cut for rattan amounted to 58,749 l m, and yet the production capacity only amounted to 66,281 l m. Hence, the allowable cut granted was too high compared to the production capacity of the rattan producers.
- *Dr. Aida Lapis:* The rattan producers did not consume their allowed quota of 58,749 l m for 2002, which resulted to a lower production capacity. There may be factors other than capacity to use that caused this discrepancy. What is important is that the harvest was lower than the allowed volume therefore well within the sustainable level.
- *Dr. Emmanuel Ze Meka:* The Philippine report showed that the total volume of rattan per hectare in the country was estimated to be 2,059.4 l m (as reported by the Philippine-German Forest Resources Project). However, if we consider the figures reported for old growth forest (1,363.1 l m/ha) and for residual forest (696.3 l m/ha), the amount does not add up to the total volume reported.
- *Director Diaz:* We will review the figures to confirm the correct volumes.

8 Results of the plenary discussions on Technology Needs and Prioritization for Rattan Production, Processing, and Utilization

Each country participant filled up a matrix, which contained technology needs and priorities for rattan production, processing, and utilization on a per-country basis *(Annex 5.1and Annex 5.2)*. The matrix was discussed at the plenary so that participants could identify priority research needs on rattan development that could be implemented at the ASEAN-level as a component of the ITTO project.

The discussions also included identifying strategies to enhance ASEAN regional cooperation for the implementation of the project.

The following is a summary of the plenary discussion of day 1 and day 2 for the proposed activities/ components of the Rattan Sustainable Development Project. (*Annex 6)*

8.1 Resource Inventory (Taxonomy and extent of natural stand and plantation)

- Field guides are needed by Philippines, Myanmar, Cambodia, Vietnam, Indonesia, and Thailand. Existing field guides from other ASEAN countries will be made as reference. (Malaysia has a completed field guide). An expert from Kew Garden is needed to guide and validate the contents of the field guides.
- Currently, a draft checklist is available which was done by the ARCBC, but further verification is needed from all countries to check if all species have been included. This could be an ASEAN-wide activity.
- Rattan inventory designs are available from Malaysia and Philippines. These can be the initial basis for developing standard ASEAN Inventory Design. Myanmar, Thailand, and the Philippines agreed to jointly come up with a proposed standard, and validate it in their own countries. The results from the three countries will be disseminated as a draft for discussion among the ASEAN countries.
- The standard inventory design will include standard nomenclature-local names and scientific names. The inventory activity can be an on-the-job capacity-building for local botanists/ taxonomists supervised by experts in the field. (e.g., training on specimen collection, supervised field identification and verification). (Myanmar needs training on conduct of inventory).
- The standard inventory design should include ecology and population dynamics for various plantation objectives (for shoots, cane or fruit) Data could be used to project desired volumes of harvestable rattan.
- There is a need to establish the practice of conducting inventory before restocking especially in logged over area. The inventory will confirm if assisted regeneration or restocking is the appropriate post-harvest activity. All countries are enjoined to promote this practice.

8.2 Nursery activities (Propagation, seedling care and maintenance)

- To further develop the technology, the Philippines will focus on a study using chemical induction to break the phase of grass stage that may hasten growth of rattan. Results will be shared with the other ASEAN countries.
- Research and development for rattan orchard establishment where male and female species will be identified through molecular technique using isozyme and DNA analysis. This study will be specific to solitary species. A comparative analysis will be done to determine which technique is appropriate. The Philippines will take the initiative.
- A study on developing the regeneration system:
  For natural stand- the "seed-rattan" method of regeneration to sustain production.
  For plantation- clustering /solitary system in time with rotation of support trees.
  The Philippines, Cambodia, Myanmar, Vietnam, Indonesia, and Thailand will participate in these studies.
- Study to apply proven germination techniques on lesser-used species.
  Philippines signified interest.
- Study on phenology and reproductive biology for rattan. Countries interested are Vietnam, Indonesia, Cambodia, and Lao PDR. Thailand is interested for other species.
- Study on potential/lesser used species (anatomical, physiological, chemical analysis) Countries interested are Myanmar, Indonesia, the Philippines.

8.3 Plantation Establishment (site requirement, site preparation, out-planting, maintenance and protection)

- Study on ecophysiological site characterization which includes light and water with a program to test intercropping with rattan will be participated in by Brunei, Thailand, Lao PDR, and the Philippines.

- Study and documentation of a Comparative Analysis of Intercropping Rattan with Other Tree Species with rattan as the primary crop. Similar results of intercropping of rattan with host trees and field trials with other species will be compiled. Thailand signified to do trials with other untried species.
- An assessment study of silvicultural requirements (to link production with utilization) of commercially potential underutilized rattan species.
- An ex-situ conservation to establish germ plasm and seed banks, this includes setting up of rules and policies similar to biodiversity guidelines.
- Study on harvesting cycle/economic rotation, harvesting intensity of other rattan species. The Philippines, Vietnam, Malaysia, Indonesia, Lao PDR, and Thailand will do growth and yield trials on plantation establishment. Myanmar however, will focus on the growth and yield trials for natural stand.
- An analysis of demand versus annual allowable cut is needed to determine sustainable levels of resource supply and demand. (Formula for determinants affecting demand/supply can be used for deciding the annual allowable cut). Countries participating are Myanmar, the Philippines, Malaysia, and Vietnam.
- Develop planting technology for edible shoots and cane.

8.4 Harvesting system and Grading Standards

- Develop a technology for waste reduction during harvesting and alternative use of rattan waste products in forest, cane production. Post-harvest technology to reduce shrinkage of the immature portion of harvested cane. Countries participating are Indonesia, Vietnam, Malaysia, the Philippines, Myanmar, and Thailand.
- Develop appropriate tool for harvesting small and large diameter canes. Indigenous good practices can be documented and studied for its appropriateness.
- Develop and adopt an ASEAN grading standard. India's grading system can be shared and made as basis. International standards applicable to rattan will also be a basis. Countries interested are Malaysia, the Philippines, and Indonesia.
- Study on the right season/timing of harvest to reduce susceptibility to insect destruction or staining.

8.5 Post-harvest activities

- Comparative study on preservation practices used by other ASEAN countries. Organically based wood preservatives can be tested for rattan.
  Countries interested are Indonesia, Malaysia, Myanmar, Thailand, the Philippines, and Vietnam.
- Application of existing technology training on Kiln drying for rattan. Myanmar and Vietnam are interested.
- Improved product design based on market demands for rattan. Countries interested to participate are Malaysia, Cambodia, and the Philippines.
- Sharing of technology on mechanized weaving. Lao PDR and the Philippines are interested.
- Develop improved bleaching technologies that are environment-friendly.
  Myanmar, Malaysia, Vietnam, the Philippines, Indonesia, and Thailand are interested.
- Develop new preservation technologies at depot.

8.6 Socioeconomic aspects

- Study on socioeconomic aspects of rattan including financial analysis, indigenous knowledge system, gender roles, computation of its contribution to carbon sequestration. Participating countries are Thailand, the Philippines, Brunei, Cambodia, Myanmar, Malaysia, Vietnam, Indonesia, and Lao PDR.
- Study of consumption patterns and market preferences.
- Review the market chain to determine what is economically viable for the farmers. Indonesia and Lao PDR are interested.

8.7 Strengthening the ASEAN collaboration through a network:

A proposal to establish an ASEAN Network referred by Resource Persons was discussed. The following could be managed by the ASEAN Network:

- An ASEAN database on rattan can be set up to facilitate access to information. For countries with national herbaria, a section for rattan should be set up. For other countries, a national herbarium should be established, and this could be initiated by a rattan herbarium. The ASEAN database should house a common taxonomy data. The database would facilitate sharing of information and accessing data by the countries.
- An ASEAN system of exchanging materials through a seed bank and germplasm bank. This could be explored, with consideration to existing policies and conditions of each participating country.
- Initiate the establishment of an ASEAN certification for sustainable resource management and fair trade practices pertaining to rattan.
- Establish an ASEAN rattan forum that would discuss and share policies that constrain, complement or support implementation of rattan projects. e.g., transboundary issues.
- Coordinate, compile documents for sharing e.g., dissemination of information through RIC electronic bulletin using the FRIM website. Malaysia is calling for sufficient contributions from each member-countries. Likewise an electronic discussion group can be established to share rattan related developments.

It was agreed that this document will be disseminated to the member-countries for further prioritization. Brunei and Cambodia will have to discuss with their respective agency heads to firm up interest to participate in the different abovementioned researches.

9 Dialogue with Dr. Emmanuel Ze Meka, ITTO Assistant Director

The following points were raised during the conference:

- Dr. Emmanuel Ze Meka commended the participants for their contributions to the discussions. He stated that he has learned a lot from the experiences of each ASEAN member-country. The discussions were also comprehensive and could serve as basis for the development of a project proposal. However, they should bear in mind that the project cannot solve all the problems discussed. National efforts are still needed to improve rattan production and utilization.

- Dr. Ze Meka noted that the discussions covered all aspects from management to marketing. However, for the second phase of the project, they should prioritize ASEAN-level urgent concerns that would highlight impacts of the rattan industry on poverty alleviation at the community-level. Hence, the project should highlight the involvement of local communities because they would benefit from the outputs and findings of the project.

- Dr. Ze Meka indicated that the next step would be for ERDB to compile all information into a project proposal according to the ITTO format. A commitment from the ASEAN member-countries to participate in the proposed project should be solicited.

- Dr. Ze Meka informed that the timeframe of the project phase is around 3 to 5 years with an estimated budget of USD 300,000 to USD 600,000. However, the proposal could also be submitted to the common fund for more funding since it contains features such as poverty alleviation, regional partnership, and participation of local communities.

- Each country representative confirmed that the full project should still be headed by the Philippines. They expressed their appreciation on behalf of their country to the management and staff of the ITTO pre-project. They said that the current system of coordinating with each country through the office of ERDB, is working well and that, they look forward to have the same arrangements once a full project is approved by ITTO.

- Dr. Aida Lapis informed that they would ask each ASEAN member-country to prioritize the concerns that they presented during this workshop, and categorize them into "high" and "low" priority. She added that this information should be submitted to their office as soon as possible so that they can facilitate the packaging of the project proposal. She added that the matrix presented during this workshop would be sent back to each country for their feedback.

- Director Celso Diaz added that they will conduct consultations and discussions prior to the drafting of the project proposals. He requested each country to provide their office immediate feedback in case some inputs for the proposal are needed.

10 Impression from the Participants

Mr. Southone Ketphanh, from Lao PDR thanked Dr. Emmanuel Ze Meka and ITTO for their support in the development of rattan production in the ASEAN region. He also thanked the organizers of the workshop and the project staff for giving the ASEAN member-country representatives the opportunity to share their experiences and update each other on the plight of rattan in their country. He noted that the project staff have been very consistent in providing technical support and coordination during the implementation of their pre-project activities. He is also happy to note each country's willingness to adopt the techniques and concepts presented, and their willingness to strengthen cooperation and collaboration for the ASEAN region. He expressed hope that together, they would focus on poverty alleviation because poverty is a prevalent problem among ASEAN countries.

Mr. Joffre Bin Haji Ali Ahmad, from Brunei Darussalam expressed gratitude to ITTO for their willingness to support the rattan project. He also thanked the project staff for organizing this conference. He shared that the discussions were meaningful because he gained a lot of new insights from co-ASEAN member countries. However, there is still much to be done regarding the plight of rattan production and utilization in Brunei, especially in the area of plantation establishment. He hopes that ITTO would decide to continue its support to the project in order for each ASEAN country, to sustainably manage and develop their rattan resources.

11 Closing Remarks

Delivered by Ms. Florence Soriano, Director, Forest Products Research and Development Institute (FPRDI)

Director Soriano commended the participants for their contributions during the workshop. She noted that during the two-day discussion on the status of rattan production and utilization, they have indeed highlighted the rationale for the project proposal titled "Application of Production and Utilization Technologies for Rattan Sustainable Development in the ASEAN Member Countries", which was submitted initially to the ITTO in 2002. She added that the proposal sounded-off the findings of the Experts Consultation on Rattan Development that was held in Rome in December 2000. The findings showed that rattan is a very important resource in the ASEAN region and it has affected peoples' lives economically, socio-culturally and ecologically. Industries drawing on rattan as a raw material are overexploiting the resource and efforts to replenish the supply have been inadequate. Hence, the proposal focused on a five-year plan on research and development (R and D) and science and technology interventions towards the sustainability of the rattan resource base and the industries that draw from it in the ASEAN region.

Director Soriano shared that ITTO was receptive of the proposal as the project would contribute largely to the attainment of two of the six goals in the ITTO Yokohama Action Plan for 2002-2006. The two goals are: (1) to promote sustainable management of tropical forest resources, and (2) support activities to secure the tropical timber resource base. In particular, ITTO recognizes that the project would be able to implement the following support actions:

- Assess opportunities for, and promote development of, non-timber forest products and services which can improve the economic attractiveness of maintaining the forest resource base.
- Support the effective enforcement of forest laws and regulations that ensure sustainable forest management and secure the production base.

Director Soriano noted that Dr. Ze Meka stressed the critical word sustainability. Another critical statement is "community involvement", since small and medium enterprises are the economic engines of most developing countries. The ITTO Experts Panel recommended and approved a one-year pre-project in 2002 and based on previous experience, this was to increase the success factor and reduce the perceived risks of embarking on a five-year research and development plan on the application of rattan production and utilization technologies at a regional scope. Through this workshop, they have drawn more specific information and objectives-oriented plans that would strengthen the framework of the proposal.

Director Soriano remarked that she is certain that ERDB and FPRDI have found renewed enthusiasm to revisit the proposal and to integrate the conclusions and recommendations from this workshop in time for submission to ITTO in May this year. She shared that she had, through this workshop, gained more confidence to support the proposal should she be invited again to become part of the Philippine delegation to the next ITTO council meeting.

In behalf of DENR-ERDB and FPRDI-DOST, Director Soriano expressed gratitude to Dr. Emmanuel Ze Meka for his presence during the two-day workshop and thanked him for his patience in conducting their annual steering committee meetings of the three ITTO-supported projects at FPRDI. She added that it was indeed an honor to have him witness their discussions, and his presence during the workshop was very much appreciated. She requested that he convey their sincere thanks and warm regards to Dr. Manoel Sobral Filho, Dr. Hwan Ok Ma and the rest of the ITTO staff.

Director Soriano congratulated the project staff headed by Director Celso Diaz and the project leaders, Dr. Magdalena Giron and Dr. Aida Lapis, as well as the consultants. She remarked that the workshop was indeed successful because not only have they accomplished the objectives of the workshop and pre-project, they have also strengthened the ASEAN network of rattan enthusiasts and experts on which, the success of future projects on rattan largely depend. She hopes that the proposal for a bigger project on rattan for submission to ITTO will be completed soon, and she looks forward for its immediate approval.

To the ASEAN country focal persons, Director Soriano shared that the Filipino counterparts came home with happy memories of hospitality and kindness during their brief visit to each member country. She thanked them for their commitment to the project and congratulated them for their well-prepared presentations.

Finally, Director Soriano encouraged everyone to keep their passion for rattan burning and wished everyone a safe trip home.

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SUSTAINABLE RATTAN MANAGEMENT AND UTILIZATION IN SOUTHEAST ASIA

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I. INTRODUCTION

Rattan comprises about 600 species in 13 genera. It is widely distributed in tropical Asia and the Pacific where 10 genera are endemic. Twenty species in four genera are found in Africa, three of which are endemic[1]. The greatest known diversity of rattan is found in the Malayan peninsula and in the island of Borneo. It has also been estimated that more than 700 million people are engaged in the collection, processing, and trade of rattan and rattan products worldwide. In some villages, rattan cultivation and trade form a significant economic activity of families, often as a secondary source of income.

The trade of raw rattan canes and finished products, basically furniture and handicrafts, peaked in the 1970s and 80s. The increased demands resulted in increased cane harvesting, mostly from wild plants. With very little development of rattan plantations the natural rattan resources started to dwindle. This was aggravated by the decrease in the natural habitat of rattan by widespread logging.

The rapid reduction of wild rattan prompted cane-producing countries to establish plantations, albeit in limited scale. To shore up existing resources some countries such as Indonesia, Malaysia, Thailand and the Philippines banned the export of raw rattan and to a certain extent even semi-finished products. There is apprehension that resources in the natural forest will continue to decline unless these are managed sustainably. This paper attempts to assess the various rattan conservation and sustainable management efforts in Southeast Asian countries. It looks at ***conservation and generation***, ***productivity and efficiency in the use of the resources***, and ***consumption patterns***. It also looks at policies as a crosscutting issue.

II. RESOURCE CONSERVATION AND GENERATION

Conservation and generation of the resources include taxonomic identification of species, inventory of resources, establishment of germplasm and gene banks, plantation development and establishment of rattan gardens. According to Dransfield[2] lack of taxonomic base constrains meaningful research, inventory of resources, and assessment of silvicultural potential of a given species, which are necessary in the sustainable utilization and commercial use of a given species.

Taxonomic identification of species - Table 1 shows the number of identified species and the number of genera found in each of the Southeast Asian countries. Indonesia has the most number of identified species (306 species) in 7 genera followed by Malaysia (106 in 8 genera). It is suspected that in all the countries there are more species than those already identified. There is also a tendency for unidentified species in one country to be described as a new species when it may be well known in another country[3]. This stresses the need for collaborative work in the identification of rattan species especially in Southeast Asia (SEA).

The proper identification of species helps in the correct inventory of rattan resources. Correct identification provides information on the extent of biodiversity of rattan species in a country. It allows the institution of corresponding conservation measures for species that are rare, threatened or endangered species as well as those that of great commercial value and importance. IPGRI[4] has made a list of 21 priority

[1] Sastry, C. 2001. Rattan in the twenty-first century – and overview. Unasylva 205. Vol 52. p3-6.
[2] Dransfield, J. 2001. Taxonomy, biology and ecology of rattan. Unasylva 205. Vol. 52. p11-13, 15-17.
[3] Dransfield, J. 2001. op cit.
[4] IPGRI. International Plant Genetic Resources Institute.

Table 1. Number of rattan species in Southeast Asian countries.

	Genera	Identified Species	Plantation and Garden	Commercial species-%
Brunei	5	80	900 ha	5 to 6
Cambodia		11		
Lao PDR	6	43	150	11 to 26
Malaysia	8	106	41,000	36 to 34
Myanmar	5	35		8 to 23
Philippines	4	64	16,000	12 to 19
Singapore				
Thailand	7	83		
Vietnam	6	30	60,000	5 to 17

Source: Country reports presented during the ITTO international symposium on Jan. 21-23, 2004

species (Annex A) for research and conservation[5]. Proper identification also allows for the proper monitoring of extraction of various species.

Inventory of rattan resources – An important prerequisite in the conservation of any resources is the knowledge of how much one has. In most countries, rattan resources have not undergone inventory. The Philippines undertook a second inventory of forest resources, including rattan resources, starting in 1983 and the results were published in 1988[6]. Since then, there had been changes in the forest cover of the country, from 6.46 million ha in 1988 to 5.64 million ha in 1997. The change in forest cover which has the most telling effect on rattan resources, was the reduction in the area of old growth forest, from 2.99 million ha in 1980 to 0.8 in 2000. Residual forest decreased from 7.26 million ha of residual forest to 2.73 million ha during the same period[7]. There has been no inventory of forest resources undertaken since then.

Most of the countries in SEA have not done inventory of forest resources, including rattan resources, in the last few years. This lack of inventory has resulted in a major gap in understanding of population dynamics and demography of rattan resources. Information on the population structure, distribution, rate of regeneration and number of harvestable stems per ha of each species is essential to understanding of potential sustainability of rattans[8].

Assessment of silvicultural potential – Fruits and seeds often affect conservation of plant resources. In the case of rattan, the fruits are brightly colored and attractive to animals, which are the main agents in dispersing the seeds. Research on seed germination has led researchers how to hasten germination. Rattans have an outer seed coat, the sarcotesta, which if not removed would delay germination[9]. Further studies should be undertaken on phenology, seed technology, vegetative propagation, plantation and nursery techniques, growth, pests and diseases, genetic diversity, ecology, and biotechnology of rattan species. Focus should be given to at-risk species particularly those that are single-stem ones.

Plantations and rattan gardens – An obvious strategy in the sustainable development of rattan resources is the establishment of plantations. One classic example that has existed for more than 100 years is the rattan gardens in Kalimantan. Before a *kaingin* area is put into fallow, the farmers plant rattan, generally *Calamus caesius*. In addition to providing income in the future, the rattan plants serve as a marker that

[5] Hong, L. T., V. Ramanatha Rao and W. Amaral. 2001. Research on rattan genetic resources conservation and use: the perspective and strategy of the International Plant Genetic Resources Institute. Unasylva 205. Vol. 52, p. 52-56.
[6] Forest Management Bureau. 1988. Natural Forest Resources of the Philippines. Philippine-German Forest Resources Inventory Project.
[7] Forest Management Bureau. 2001. Philippine Forestry Statistics.
[8] Dransfield, J. op cit.
[9] Dransfield, J. op cit.

the area is occupied. *C. caesius* is a suckering species and may have as many as 70 to 100 stems. The harvest peaks in 24 to 30 years. Rattan gardens serves as a safety net for the farmers. When they need cash they harvest some stems for sale[10].

Rattan plantation development efforts of SEA countries are shown in Table 1. Brunei has undertaken trial planting to assess field performance of some species. About 10,000 ha have been identified in 1995 for plantation development but only 900 ha have been planted. In Indonesia, about 118,800 ha of rattan plantations have been developed in addition to rattan gardens in rice *swidden* systems. In Lao PDR, trail planting has been done and villagers have been trained on planting techniques. More than 50 planters have areas of about 100 ha in at least 5 provinces[11].

Similarly, about 10,000 ha of rattan plantation have been established in Sabah, using mostly *C. caesius* and *C. trachycoleous* by the Sabah Forest Development Authority (SAFODA). Another 31,000 ha of plantations were developed in peninsular Malaysia of which about 7,000 ha was interplanted in rubber plantations[12].

A serious attempt to develop rattan plantations under *Paraserianthes falcataria* and bagras (*Eucalyptus deglupta*) tree plantations was reported at the Paper Industries Corporation of the Philippines (PICOP) amounting to about 4,000 ha[13]. There has also been reported small hold plantations in agroforestry farms in several parts of the country. Government's efforts at rattan plantation establishment were undertaken under a national project on community-based forest development. About 7,000 ha have been reported established[14].

Thailand has an extension program on rattan plantation development. Plantations for shoots have also been established which has inspired the development of similar plantations in Lao PDR. Enrichment planting of natural forests has also been reported[15].

In Vietnam, about 60,000 ha of rattan plantations in dipterocarp forests were reported established. In addition, there are also rattan-gardens being developed[16].

Germplasm and gene banks – Another important effort at rattan conservations is the development of germplasm and gene banks. A major effort aimed at building a conservation network for at least the most important commercial species and at the same time provide rattan plantation developers materials and techniques for better cultivation practices is well on its way in Malaysia[17]. This project has established large living collections of bulks, families and provenances that are available at the Forest Research Institute of Malaysia (FRIM), Forest Resources Center (FRC-Malaysia), and Innoprise Corporation Sdn Bhd (ICSB–Malaysia).

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[10] Belcher, B. 2001. Rattan cultivation and livelihoods: the changing scenario in Kalimantan. Unasylva. Vol. 52. p. 27-34.
[11] Evans, T. 2001. Development of rattan for edible shoots in the Lao People's Republic. Unasylva 205 Vol. 52. p. 35.
[12] Abdul Razak Mohd Ali and R. S. Raja Barizan. 2001. Intercropping rattan with rubber and other crops. Unasylva 205. Vol. 52. p. 9.
[13] Formoso, G. R. 1988. Economics of rattan plantation development. Proceedings of the National Symposium/ Workshop pm Rattam/ Cebu City. June 1-3, 1988.
[14] Tesoro, F. 2000. Rattan resources of the Philippines, their extent, production, utilization and issues on resource development. Paper presented during the FAO International Rattan Consultation in Rome. Dec. 2000.
[15] Thailand Country Report 2004. ITTO Regional conference on sustainable development of rattan in Asia. Jan 21-23, 2004. Ermita, Manila, Philippines.
[16] Vietnam Country Report 2004. ITTO Regional conference on sustainable development of rattan in Asia. Jan 21-23, 2004. Ermita, Manila, Philippines.
[17] Bacilieri, R. 1999. Rattan/Genetic improvement and silviciulture/SE Asia. (A project sponsored by CIRAD-Foret, International Center for Research in Agronomy and Development, Forestry Department in collaboration with the Malaysian Forestry Research Center, the Forestry Department of Sabah, the Forest Research Institute of Malaysia, the Innoprise Corporation Sdn Bhd, and the Royal Botanic Gardens in Kew and in Wakehurst).

ICSB has established 33 genetic trials covering 478 different genetic origins of 4 major commercial species. Living collections of 23 other species have been established in an arboretum. FRC has established a network of progeny and provenance trials that include 160 genetic origins of *C. subinermis* and has added 6 new species to the living collection. FRIM has established several progeny trials with *C. manan* and *C. palustris*, established 16 species in the arboretum and managed the genetic resources of other species. Altogether, these collections are considered among the largest in the region and constitute an appropriate genetic base for any future improvement program.

Several countries have likewise established gene banks. In Indonesia more than 20 species have been planted at the Bogor Botanical Gardens[18]. Lao PDR has also established a germplasm garden in Naunxuang province starting with 8 species[19]. In the Philippines, the Ecosystems Research and Development Bureau (ERDB) has established a gene bank at its experimental forest in Los Banos, Laguna consisting of 45 species and in Malaybalay, Bukidnon consisting of 25 species. There are no gene banks as such in Vietnam, however, there are 10 national parks and 53 special-use forests where genetic stocks of several rattan species can be conserved[20]. Accordingly, there are many conservation and development projects in buffer zones involving rattan and other Non-Wood Forest Products (NWFP)[21]

III. PRODUCTIVITY – INCREASING EFFICIENCY IN THE USE OF THE RESOURCE

This section takes a look at efforts in (a) expanding the number of species utilized, (b) improvement of harvesting techniques and (c) improvement of processing techniques.

Expansion of the number of species utilized - It has been estimated that only 20% of known rattans are of any commercial importance[22]. This means that worldwide about 120 species are of commercial value. The selective exploitation of a limited number of species in a given country puts great stress on the resources of these species. Increasing the number of commercial species literally increases the resource base and reduces pressure on the currently commercial ones. Table 1 shows the number of species that are of any commercial value in some countries in SEA. The percentage of utilized species vis-à-vis identified rattan species in the various countries varies from 6% to 34% with Malaysia having the highest percentage.

Most if not all of the countries are undertaking research in the properties and uses of still unutilized or less utilized species. Investigation of anatomical, physical and mechanical properties facilitates the assessment of unutilized or less utilized species for commercial purposes[23]. The processing and use of rattans are influenced to a great degree by the structural composition of the stem, which exhibits considerable variation along the stem length. It has been demonstrated that the lower stem has higher density and thus higher strength properties than the upper parts of the stem. The upper stem also has higher moisture content (MC) and higher percentage shrinkage thus warping is a problem when premature upper stems are harvested and utilized[24].

[18] Country Report for Indonesia. 2004. ITTO Regional conference on sustainable development of rattan in Asia. Jan 21-23, 2004. Ermita, Manila, Philippines.
[19] Country Report for Lao PDR. 2004. ITTO Regional conference on sustainable development of rattan in Asia. Jan 21-23, 2004. Ermita, Manila, Philippines.
[20] Country Report for Vietnam.2004. ITTO Regional conference on sustainable development of rattan in Asia. Jan 21-23, 2004. Ermita, Manila, Philippines.
[21] Evans, T. 2002. The status of the rattan sectors in Lao People's Democratic Republic, Viet Nam and Cambodia – with emphasis on cane supply. Rattan Current research issues and prospects for conservation and sustainable development. FAO Expert Consultation on Rattan Development. FAO, Rome, Italy.
[22] Sunderland, T. C. H. 1998. The rattans of Rio Muni, Equatorial Guinea: utilisation, biology and distribution. Report for European Union Project No. 6 ACP-EG020, Projector Conservacion y Utilizacion Racional de los Ecosistemas Forestales de Guinea Ecuatorial (CUREF).
[23] Liese, W. 2001. challenges and constraints in rattan processing and utilization in Asia. Unasylva. 205. Vol. 52, p. 46-51.
[24] Liese, W. 2001. op cit.

In the Philippines, 7 lesser-utilized species and 3 commercial species were studied with the aim of discovering which of the former have commercial potential. Based on the evaluation of physical and mechanical properties, four lesser-used species were found as promising substitute for some commercial species. In the small diameter class, *C. javensis* may be used in place of *C. caesius*, and *C. diendehorstii* var. *exulans* for *C. usitatus*. In the bigger diameter class, *C. grandifolius* and *C. marqinatus* may be used instead of *C. merrillii* and *C. ornatus* var. *philippinensis* for structural components of furniture[25].

Improved harvesting techniques - The most common method of harvesting is to cut the stem at the base and pull it down. With the upper part of the stem securely anchored by the spines pulling down the stem is difficult. Often the collector cuts the stem within his reach, often leaving a large segment of the stem. In some cases if the rattan is anchored on small trees, the trees are cut to get as much rattan stem as possible. Some harvesting practices result in tremendous wastes and have aggravated the supply. In Africa, all stems in a cluster are often cut, even those that are immature[26].

Improved harvesting techniques especially those that allow the collector to harvest the entire mature length of the stem would improve the sustainability of rattan resources. Collectors in Indonesia have tried a winch to pull down the stem. However, moving the winch from one harvesting area to another has proved very inconvenient and the practice has been abandoned. In Indonesia, harvesting wastes are estimated to constitute 30-40% of total harvest.

Improved processing techniques - The contribution of improved processing techniques to sustainability of the supply of rattan lies in the reduction of post harvest losses at the harvesting site, at primary processing and in the factory. It has been estimated that wastes in processing can be as high as 40% of raw materials[27].

Prophylactic treatment with preservative - Collectors harvest as many stems as possible in a given site, bundle these in sizes that can be carried by one man and let the bundle stand against a tree. This allows the sap to ooze out making the individual canes drier and the entire bundle lighter. However, it takes days before the bundles are brought down the mountain and within that period stain fungi could attack the canes. Staining reduces cane quality and if the staining is excessively heavy, the canes may have to be abandoned in the forest.

To prevent the occurrence of staining, prophylactic chemical protection is applied. Trials have been made on dipping of newly cut canes in a preservative solution in the harvesting area. An excavation is made on the ground and plastic material or canvass is spread over and the solution is poured in the excavation[28]. Bringing the preservative solution to the cutting site is inconvenient and there are some adverse environmental implications of the practice if the excess solution is disposed of in the site. Otherwise, the excess solution has to be carried down along with the canes. One technique that could be tried is to apply the preservative on the ends of the canes by spraying.

Drying – A very important primary processing step is to dry the canes as quickly possible. This could start in the forest as soon as the canes are cut and later continued at the depot before these are further processed. Further air drying of the canes is done by making them stand in wigwam formation. Drying prevents fungal and insect attack of the canes thus preventing some post harvest losses.

Bending – Furniture designs often call for the use of curved parts which necessitates bending the materials. In large factories, bending is done after the canes have been subjected to steaming. At smaller factories a blowtorch is used to soften the canes for bending and shaping. The canes are often not soft enough

[25] Palisoc, J. G. and R. A. Natividad. (Undated). Anatomical, physical and mechanical properties of some Philippine rattan. (National Integrated Research on Rattan Subproject III – Utilization Studies on Rattan) Terminal Report. FPRDI.
[26] Sunderland, T. C. H. 2001. Rattan resources and use in West and Central Africa. Unasylva. Vol. 52. p. 18-24.
[27] Country Report for Indonesia. 2004. op cit.
[28] Giron, M., C. Garcia and A. V. Roxas. 1998. Prevention and control of fungal and insect attack on rattan, bamboo, palms, twigs and vines. Pamphlet No. 1 E. FPRDI-ITTO.

and bending them can cause breakage. The blowtorch also leaves burn marks that must be sanded or scraped out.

IV. CONSUMPTION PATTERNS

Consumption patterns often lead to unsustainable raw material supply. Here are some consumption practices that need to be examined in order to improve the sustainability of rattan resources.

Rattan shoot utilization from wild supply – Rattan shoots are a delicacy in some SEA countries. Cutting the shoots for food especially when the plants are still young reduces the supply of the raw materials. In Lao PDR edible shoots are consumed locally and exported to France and the United States and elsewhere[29]. Trade in edible shoots from the wild is large, unquantified and unregulated. The species sought for shoot production, *Daemonorops jenkinsiana,* is not commercially used for cane production and therefore does not affect the raw material supply for furniture production. However, unabated, this would affect the sustainability of the species. Furthermore, valuable cane-producing species are now being targeted for shoot production.

Thailand is also producing rattan shoots for food. In fact Thailand and Lao PDR are competitors in the trade. Trading in rattan shoots can be a lucrative business. In Lao PDR shoots are dried and exported at USD1.0 for 10 pieces of 6 in long shoots. However, to ensure the supply of edible shoots Thailand has established plantations using *C. viminalis, C. siamensis and C. tenuis.* Inspired by the Thailand experience, rattan cultivation for edible shoot production started in the Lao PDR in 1994. It is estimated that more than 50 planters have planted more than 100 ha in at least 5 provinces[30]. Shoots can be collected only a year or so after planting. Other SEA countries are finding rattan shoots a delicacy and unregulated this can be a serious threat to the sustainability of the resources[31].

Edible fruit collection – Another sustainability concern on rattan is the collection of the fruits for food, for dye production and for medicinal purposes[32]. Rattan fruits are sold in many markets in the rural areas in the Philippines. Often these are made into fruits preserves for food. One community in northern Philippines is cultivating *C. manilensis* for its fruits for food. The collection of fruits for food and for other purposes from the wild if widespread can be a threat to the sustainability of rattan. The cultivation of rattan species for its fruits for various purposes can help ease this threat.

Furniture designs using small diameter canes and substitute materials – The use of large diameter canes for structural parts of furniture has led to concentrated collection and utilization of these species. This resulted in near depletion of their supply. The furniture industry has since adapted to this situation by designing furniture parts using smaller diameter canes. This eases a bit the pressure on the large diameter species and paves the way for the expanded use of smaller diameter ones thus expanding the resources for furniture manufacture. Where the design really calls for the use of large diameter rattans, a technology for producing large diameter rattan parts using smaller diameter ones has been developed.

Where there is a dearth of rattan supply, the furniture industry has resorted to the use of substitute materials. Parts made of wood are covered with rattan materials but these types of furniture do not fetch as much price in the international market as those made of genuine rattan parts. Pieces of furniture using a combination of different materials, such as bamboo, coconut wood, and sometimes metal covered with rattan, have been manufactured. One species of climbing palm, *Desmoncus spp.* has stem of sufficient quality to be used as rattan substitute[33].

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[29] Evans, T. 2001. op cit.
[30] Evans, T. 2001. op cit.
[31] Country Report for Malaysia. 2004. ITTO Regional conference on sustainable development of rattan in Asia. Jan 21-23, 2004. Ermita, Manila, Philippines.
[32] Dransfield, J. 2001. op cit.
[33] Dransfield, J. 2001. op cit.

V. POLICIES ON RATTAN

In the 1960s and 70s rattan cutting was largely unregulated. Areas designated for logging were first subjected to rattan cutting prior to actual logging. This practice fed an increasingly expanding rattan furniture and handicraft industries. The expanding markets in Europe, the United States and other parts of the world further increased the harvesting of rattan. The rattan furniture and handicraft industries developed in cane producing countries such as the Philippines, Indonesia, Malaysia and Thailand and competed in the increasing foreign markets. Canes came mostly from wild plants since there were no commercial cane plantations at that time. Raw canes were also exported to supply raw materials to furniture manufacturers without natural supply such as those in Germany, Italy and the United States.

Ban on the export of raw rattan canes - In the middle 1980s, however, the cane producing countries started to realize that their supply was rapidly dwindling. Local furniture manufacturers who began to feel the impacts of dwindling supply agitated for the institution of measures to keep the cane supply within the country. National governments started to ban the export of raw rattan. Thailand banned the export of raw canes as early as 1978[34]. Indonesia followed suit in 1986[35]. The Philippines likewise banned the export raw canes in the late 1980s and Lao PDR adopted the same policy[36]. Thailand banned altogether the harvesting of rattan. In Vietnam, rattan harvesting is prohibited except in buffer zones.

Indonesia also instituted a ban in 1989 on the export of semi-finished rattan products, however this was replaced in 1992 with a prohibitive export tax. A restriction on all foreign and domestic investment in raw rattan processing and semi-finished rattan production as well as foreign investment in finished products manufacturing was also instituted in 1989. This was later relaxed to allow investment in rattan processing outside Java, and finally relaxed in 1995[37].

The ban on the export of raw rattan and on semi-finished products had some negative impacts on the planting of *C. caesius* in home gardens in Kilimantan[38]. The ban on the export of raw rattan improved the supply of canes to local manufacturers but reduced the price of raw rattan. This had a discouraging effect on rattan planters, some of which stopped altogether the planting of rattan whenever they have access to alternative livelihood opportunities, thus future cane supply was put in jeopardy.

Managing the flow of products – Belcher cites an example of how government's desire to control supply of products in foreign markets has backfired at the raw cane supply source[39]. A Joint Marketing Board (ASMINDO) was established in Indonesia to prevent undue competition among *lampit* (a curtain made of rattan using *C. caesius*) exporters. ASMINDO imposed export restriction among its members to manage the supply in an effort to control quality and increase unit price. Export quota was assigned to *lampit* manufacturers. These measures resulted in the severe reduction in the manufacture of and export of *lampit*. The total number of *lampit* factories dropped from 435 in 1987 to only 20 in 1994. The increase in price of the lampit and unstable supply led the main importer, Japan, to look for other suppliers. Japan started importing lampit from China made of bamboo. The industry in China expanded dramatically in 1995 in response to the demand from Japan. As the demand for lampit in Japan dwindled rattan farmers in Indonesia have reduced production of *C. caesius* and in some places stopped planting altogether[40].

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[34] Country Report for Thailand. 2004. ITTO Regional conference on sustainable development of rattan in Asia. Jan 21-23, 2004. Ermita, Manila, Philippines.
[35] Country Report for Indonesia. 2004. op cit.
[36] Country Report for Lao PDR. 2004. op cit.
[37] Belcher, B. 2001. Rattan cultivation and livelihoods: the changing scenario in Kalimantan. Unasylva. Vol. 52. p 27-
[38] Belcher, B. 2001. op cit.
[39] Belcher, B. 2001. op cit.
[40] Belcher, B. 2001. op cit.

Impact of other government policies on rattan sustainability – To ensure the continuous supply of rattan, the Philippines imposed the payment of a deposit for every lineal meter of gathered from the wild. For canes 2 cm and larger in diameter, a deposit of PhP 0.57 (USD 0.012) was collected and PhP 0.46 (USD 0.010) for diameters smaller than 2 cm[41]. The amount was supposed to finance the establishment of rattan plantations.

Another policy of government is that all moneys collected by government agencies and instrumentalities are deposited in the National Treasury. For moneys collected for special purposes, a request is made with the Department of Budget and Management (DBM) for the release of the funds. However, releases by the DBM do not come easily. The sums collected for this purposes have not been utilized for rattan plantation development.

Land tenure and property rights – Lack of secure tenure over the resource has negative impacts on the resource. Rattan gatherers are not keen in adapting sustainable harvesting methods and practices since there is no guarantee that what they leave behind they will be able to harvest later. This is particularly true in open access areas where government does not regulate the cutting of rattan through permits or licensing. SEA governments have adapted certain measures to regulate cutting. In Malaysia a license to harvest from the natural forest is needed and the volume of harvest is registered with the Forestry Department[42]. The Philippines has a similar licensing system. Cutting areas are bided out and annual allowable cuts are imposed. To allow upland dwellers and indigenous people to benefit from rattan resources, rattan-cutting licenses within community-based forest management (CBFM) areas are awarded to people's organizations (POs) operating in the area. The POs have a 25-year tenure over the area renewable for another 25 years[43]. Thailand has banned altogether the cutting of rattan from the natural forest[44].

Use of forestlands for plantations other than rattan – Land use policies have also affected negatively the sustainability of rattan resources. In Indonesia forestlands used by upland dwellers for *swidden* farming and rattan gardens have been planted to oil palms and forest tree plantations[45]. Accordingly, rattan gardens are seen as degraded forests and are targeted for conversion to oil palm or pulp plantations[46]. In the Philippines, the conversion of inadequately stocked forests is allowed under its policy on industrial forest management agreement (IFMA) for tree plantation development. These forests are habitat to rattans and their conversion to forest plantations reduces the rattan biodiversity and its sustainability.

VI. FINDINGS AND RECOMMENDATIONS

All the countries in SEA are undertaking conservation and sustainable management measures for rattan resources, albeit are varying degrees. What needs to be done is to enhance these efforts under cooperative alliances among the countries with technical and possibly financial assistance from donor countries augmented by resources in individual countries.

The review of the various sustainability factors for rattan leads to the following recommendations.

1. Not all of the rattan species in the SEA region have been properly identified. Taxonomy of rattans has been undertaken in individual countries. While these efforts are commendable, the uncritical use of vernacular names has created some confusion. In the classification of rattans

[41] DAO No. 8. Rattan Policy. Department of Environment and Natural Resources.
[42] Country Report for Mayanmar. 2004. op cit.
[43] Tesoro, F. O. 2001. Rattan harvesting and replanting regulations in the Philippines: the challenge of managing rattan resources sustainably. Unasylva 205. Vol. 52. p. 43.
[44] Thailand Country Report 2004. op cit.
[45] Belcher, B. 2001. op cit.
[46] Fried, S. 1995. Writing for their life: Bentian Dayak authors and Indonesian development discourse. Cornell University, Ithaca, New York (Ph.D. dissertation – cited by B. Belcher, 2001. Unasylva 205, Vol. 52 p. 27 to 34)

reference should always be made on their Latin names. Furthermore, citations of specific names should be linked to actual herbarium specimens to allow verification and reproducible research. ***A cooperative undertaking in the identification and classification of rattans should be undertaken among rattan producing countries particularly in SEA.***

2. One constraint in the conservation of rattan resources is the lack of knowledge on the actual extent of the resources especially those in the wild. Forest resources inventory are generally undertaken for timber and rarely if ever rattan and other NWFP are included in the inventory. ***Rattan, bamboo, and other NWFP should be included in the inventory of forest resources. Further, inventory methods for NWFP should be developed.***

3. Many countries have started to establish gene banks. The most extensive in recent years is the initiative under the CIRAD-Foret/Malaysia project. ***A network of gene banks should be established within individual countries and the safe exchange of germplasms should be undertaken under strict guidelines agreed upon by all participating countries.***

4. Sustainable management of rattan resources can only succeed if there is sufficient knowledge of their various characteristics and properties. ***Further studies should be undertaken on phenology, seed technology, vegetative propagation, plantation and nursery techniques, growth, pests and diseases, genetic diversity, ecology, and biotechnology of rattan species. Focus should be given to at-risk species particularly those that are single-stem ones.***

5. Shoots (rattan hearts) and fruits are collected for food, medicine and other uses. Widespread collection of these materials from wild plants affects negatively the supply of the materials. ***Development of plantations for shoots and for fruits as has already been done in some countries should be encouraged.***

6. About 30-40% is of the stem is wasted during harvesting. This is brought about by the fact that it is difficult to pull down the rattan stem because of the presence of spines that allow the stem to hang on to support trees. ***Better portable mechanical devices should be developed to pull down the entire stem without damaging the rattan stem nor the support trees.***

7. Post harvest losses start immediately after the stems are cut and bundled. These losses result from staining of the stems, which still contain high moisture content. Attempts have been made to apply prophylactic chemical treatment on the stems. Disposal of these toxic chemicals can cause some environmental problems. ***A method of chemical protection of newly harvested canes should be developed without generating environmental problems.***

8. About 40% of raw materials are wasted during the actual product manufacturing processes. ***Improved processing such as the application of low cost bending technology, finishing methods, and drying methods should be developed for rattan.***

9. Only about 20% of the 600 or so species of rattan are of commercial use. Extraction of canes from the wild concentrate on these species thus putting pressure on the sustainability of these species. ***To reduce the pressure on the commercial species, the properties and uses of hitherto unutilized or lesser-used species should be undertaken. Furthermore, the use of small diameter rattan for structural purposes in furniture manufacture should be studied to expand uses of these materials and reduce pressure on larger diameter ones.***

10. There is a growing competition for forestlands for various plantation development purposes that even those traditionally used by upland dwellers and indigenous peoples have been awarded to plantation developers. This has destroyed rattan gardens and the natural habitats of rattans. ***Land use policies should recognize and respect traditional and existing land uses specially if they affect the economic well being of upland dwellers and indigenous people.***

11. Community-based management of forestlands and resources is gaining ground in SEA as a strategy for forest management in contrast to the traditional large corporate forest resources management. In some countries the tenure of communities over forestlands and resources stretches over 25 years renewable for another 25 years. The security of tenure over the resources including rattan resources allows the people to adopt long-term strategies that lead to sustainable management of resources. ***Where applicable and beneficial community-based management of forest resources should be adapted as a strategy for sustainable management of rattan and other forest resources in SEA.***

12. Rattan plantation development whether through small-hold areas or large plantations is a viable option in conserving the natural rattan resources. ***However, the various technical aspects such as seed storage and germination, nursery techniques, pest and diseases, out-planting and maintenance should be worked out for the different commercial species as well as lesser-utilized species. Furthermore, the use of biotechnology for production of planting materials should be developed to make it cost-competitive with seedlings from seeds.***

13. The adoption of trade barriers such as the export quota system, and high export tariff of semi-finished products has proved detrimental to the growing of rattan as these depressed foreign markets or forced foreign markets to look for other product sources. The outcome is reduced rattan plantation development because they reduced the benefits to rattan farmers. ***Before such policies are adopted, their economic impacts on rattan farmers especially the smallholders should be deeply examined. Other government policies that inhibit/constrain rattan plantation development should be examined with the end in view of amending them or instituting more supportive policies.***

Annex A

Rattan priority species for research and development

Calamus manna

Calamus caesius

Calamus trachycoleus

Calamus sect. podocephalas

Calamus andamanicus

Calamus burekianus

Calamus erinaceus

Calamus foxworthyi

Calamus merrillii

Calamus nugbettai

Calamus ovoideus

Calamus warburghii

Calamus zeylanicus

Calamus zollingeri

Calamus palustries and relatives

Calamus inermis

Calamus namburiensis

Calamus deeratus

Calamus tetradactylus

Calamus hollrungii and relatives

Calamus polystachys

Source: Rao, A. N., V. Ramanatha Rao and J. T. Williams, 1998

Challenges and Prospects on Rattan Research and Development
The Asian Region Scenario

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I. INTRODUCTION

Rattan is by far the most important nonwood forest product in international trading. World wide, over 700 million people trade in or use rattan for a variety of purposes (Sastry, 2002). However, South East Asia is the largest producer and exporter of rattan and rattan products globally. Indonesia supply over 90% of the world's commercial rattans (Dransfield and Manokaran, 1993). In Asia the output of the rattan furniture industry represents well over 25% of all furniture industry output (Johnson, 1997). Apart from forming the basis of a thriving export market, rattans contribute significantly to the subsistence economics of forest - based communities.

Approximately ninety percent of the raw material used for commercial purposes is still obtained from natural forests. Only a very small portion is obtained from the plantations. Many species, since preferentially sought and extracted, have become rare in the wild.

II. CHALLENGES AND PROSPECTS

The current state of knowledge is summarized in Table 1. A number of issues, connected with the rattan resource, harvesting and trade require attention and action.

1. Rattan resources

   Despite the commercial importance of rattan, basic knowledge of the resource is somewhat limited and the rattan flora of many Asian countries remains poorly known. Knowledge of biodiversity at the level of genes, species and ecosystem are necessary for strategic planning of their conservation and sustainable use. 'Hot spots' for genetic diversity should be pinpointed and conserved. Genetic diversity studies are required to determine the size of the population for ex situ conservation.

   Molecular genetic studies leading to phylogenetic analysis will help to sort out many existing taxonomic problems. A data base should be prepared and updated periodically.

2. Rattan ecology and population biology

   A major gap in the knowledge of rattans is an understanding of population dynamics and demography. The knowledge of the population structure, distribution, rate of regeneration, and the number of harvestable stems per hectare etc. of each species is essential and forms the basis of an understanding of potential sustainability.

3. Light and water requirements

   Rattans are found in a wide range of forest and soil types. The light and water requirements also vary. In many places the germinated seedlings will remain for long periods with out further growth till they get sufficient light, for example, by a tree fall. Knowledge of the optimum light and water requirements is essential for establishing plantations of the desired species.

4. Seed germination and early growth

   The seeds of some species take a long time to germinate; it may vary from two to twelve months. The seedlings also remain in the 'rosette' stage for at least three years. Certain methods like soaking of seeds or stratification help to reduce the germination time but no method has been found out yet to reduce the rosette stage.

5. Growth rate

   Studies on growth rates are scanty (Manokaran, 1982,1983; Renuka and Rugmini, 1996) which will help in the selection of species for plantation.

6. Harvest and management

   Harvest intensity and rotation should be based on long term assessment of growth rates and regeneration.

Table 1. Current status of knowledge in various Asian countries

Area	Taxonomic knowledge	Taxonomic manual	Status of resource	Inventory	Propagation technique	Tissue Culture method	Cultivation/ Plantation	Processing and value addition technology	Socio-economics	Conservation	Grading and certification	Policy and legal frame work
India	Good	Exists	Depleted	Not done	Available	Standardized for certain species	Forest dept. have raised large scale plantations	Oil curing and prophylactic methods standardised	Available only for the state of Kerala	Not sufficient	Guidelines for grading formulated	Steps initiated
China	Good	Exists	Depleted	Not done	Available	Standardized for certain species	Large scale cultivation exists	Data not available	Data not available	Not sufficient	Not started	Data not available
Bangladesh	Poor	Exists, but there is likely to be many more taxa	Data not available	Not done	Data not available	Not developed	Data not available	Not developed	Data not available	Not sufficient	Not started	Data not available
Nepal	Poor	Not available	Small diameter cane plenty, Large ones scarce	Not done	Available	Not developed	No large scale cultivation	Not developed	Data not available	Not sufficient	Not started	Data not available
Sri Lanka	Good	Exists	Depleted	Not done	Available	Not developed	No large scale cultivation	Not developed	Available, but not in detail	Not sufficient	Not started	Data not available
Cambodia	Poor	Field guide	Depleted	Not done	Standar-dized	Not developed	No large scale plantation	Not developed	Data not available	Not sufficient	Not started	Data not available

Table 1. Current status of knowledge in various Asian countries *(continuation)*.

Area	Taxonomic knowledge	Taxonomic manual	Status of resource	Inventory	Propagation technique	Tissue culture method	Cultivation/ Plantation	Processing and value addition technology	Socio Economics	Conservation	Grading and certification	Policy and legal frame work
Indonesia	Good	Local floras for all regions	Stock Available	Available for certain areas	Standardized	Standardized for certain spp.	Large scale plantation exists	Well developed	Data available	Not sufficient	Not started	Data not available
Laos	Good	Field guide	Data not available	Not done	Standardized	Not developed	Large scale plantation exists for producing edible shoots	Not developed	Data not available	Not sufficient	Not started	Data not available
Malaysia	Good	Exists	Stock Available	Not done	Standardized	Standardized for certain spp	Large scale plantation exists	Well developed	Data available	Not sufficient	Not started	Data not available
Myanmar	Poor	Not available	Data not available	Not done	Data not available	Not developed	Data not available	Not developed		Not known	Not started	Data not available
Philippines	Good	Checklist	Stock Available	Done in 1988	Standardized	Standardized for certain spp	Large scale plantation exists	Well developed	Data available	Not sufficient	Not started	Data not available
Thailand	Good	Only Popular palm books	Available	Not done		Not developed	Small scale plantations	Developed	Data not available	Not sufficient	Not started	Data not available
Vietnam	Good	Field guide	Depleted	Not done	Standardized	Not developed	No large scale plantation	Not developed	Data not available	Not sufficient	Not started	Data not available

Many communities in Asia have benefited from harvesting of rattans. But the local scarcity caused by uncontrolled harvesting is denying the people of their income. Rattan cultivation controlled by local communities have proved to be a good system in Indonesia and Nepal (Connelly,1985; Paudel,1997; Weinstock, 1983). A major problem faced by rattan processors is wastage during harvesting and processing and due to insect and fungal attack. The loss due to wastage is estimated to be at least 30 percent. Preservation is often a neglected area of cane utilization.

7. Grading

The grading of rattan stems is a most important step in processing. It is a crucial step in trading and will affect the producers, processors, exporters, importers and also the end users. Grading rules were outlined by Bhat (1996). The application of grading rules would lead to advantages in the trade, in market, standardization and less material wastage (Liese, 2002).

8. Technology

Even though some of Southeast Asian countries have developed low cost automation and mechanization in the industrial sector, in most of the Asian countries, rattan processing is still at a small industrial level. Skilled workers are few in many countries. Some governments provide incentives by way of supportive policies and loans. When compared to Southeast Asian countries, the rattan products of South Asian countries are of low market value. Hence, value addition by means of better processing and manufacturing techniques is needed.

9. Law and Policies

Extraction of rattans needs permission from the forest department. Government policies must be changed so as to support rattan plantation development. This involves providing tenurial security to rattan gatherers and planters, credit and technical assistance for plantation development, harvesting and marketing.

10. Certification

To date, forest management certification has focused on timber products, although some attention is now being given to NTFPs. Certification may be able to create incentives for improved management and might help to ensure that products meet standards for ecological sustainability and social responsibility.

11. Ethnobotanical studies

In majority of the Asian countries ethnobotanical aspect is not well documented. Selection of local cultivars has been made by local people. More studies are required to determine the local uses of rattan on a global basis.

12. Transfer of technology

There is still a great deal to be done to transfer technologies already developed in the Asian countries, e.g., Indonesia, Nepal, and Myanmar. Republic of Korea has not much progressed in processing technology.

III. CONCLUSIONS

In general shortage of cane is definitely felt in the Asian region. At the same time, markets in the consumer-countries seems to be steadily growing. Present protection systems are not sufficient to meet the demand for a sustainable use. There has been little or no monitoring or management of wild rattan harvesting and virtually nothing is known about the population biology and the ecological effects associated with extraction.

Declining supplies and strong market demand suggest that rattan resources will become increasingly scarce, particularly for large- diameter canes. 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 unfavorable financial returns of rattan in comparison to other cash crops (Siebert, 2002).

Successful rattan cultivation and management will require local people's participation in all aspects of the enterprise.

In order to increase the rattan supplies, all the lacunae pointed out earlier have to be taken care of. More efforts should be directed to produce large diameter rattans since they are the major furniture frame material.

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COUNTRY STATUS REPORT ON RATTAN INDUSTRY OF BRUNEI DARUSSALAM

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I. INTRODUCTION

Brunei Darussalam lies in the northwestern coast of Borneo Island, fronting the South China Sea, sandwiched between the Malaysian States of Sabah in the north and Sarawak in the south and southeast portion. Geographically, it is situated between longitudes 114°23' and 115°23' East, and latitudes 4°00' and 5°05' North. It lies 443 km north of the equator and has a total land area of 5,765 sq km (576,500 ha). It has a total coastline of 130 km. The country is divided into two separate land areas by a strip of land belonging to the State of Sarawak (Malaysia) which runs northwards along the Limbang River into Brunei Bay. The larger western part of the country is divided into three Administrative Districts, namely: (1) Brunei-Muara; (2) Tutong; and (3) Belait, while the smaller separate eastern part consists of only a single district, the District of Temburong (Dransfield, J. 1997).

Although, in terms of land area, the country is literally small, but in terms of the existence of natural resources, per capita/per unit area, it is richly endowed. Oil and gas are the mainstays of the national economy. More than 78% of the total land area of the country is still under full forest cover. About 100,000 ha of these forested areas are close-canopy pristine forests, and mostly are classified as protection and conservation reserves, which are no-touch forests. Furthermore, within the relatively small total land area of the country, seven major forest types, which are characteristics of Borneo Island, are well-represented and some of them are still in their virgin or pristine condition, namely; (1) Mangrove Forest; (2) Freshwater Swamp Forest; (3) Peat Swamp Forest; (4) Kerangas (Tropical Heath) Forest; (5) Mixed Dipterocarp Forest; (6) Montane Forest; and (7) Beach Forest (Traces left). In these various types of forests a diverse species of rattan flora are found.

II. RATTAN RESOURCES

1. *Extent of Natural Stands, Species, Location, and Volume*

Uniquely, confined within a small total land area (particularly the forested areas) of Brunei Darussalam, 80 different species of rattan have been recorded. Most of these species are found elsewhere in Borneo, particularly in eastern Sarawak; uniquely, two species, *Calamus temburongii* and *Calamus maiadum* are indigenous and found only in Brunei. So far from any standpoint, this is a very rich and varied rattan flora (Dransfield, J. 1997).

Different species of rattan, singly or in association, are found in abundance, in certain niches within the various forest types, as described by Dransfield, J. (1997), which are as follows:

a) *Along the Coastal Areas*

In these sites, the forest cover has been heavily disturbed and the vegetative composition much altered.

Along the coastal main Bandar Seri Begawan-Kuala Belait Road, one species, *Daemonorops longispatha*, is particularly abundant, which is easily identified or recognized by its conspicuous coarse, densely spiny yellow brown sheaths and large untidy leaves. It can be spotted from a fast vehicle. In some areas, *Korthalsia ferox* and *Daemonorops fissa* are conspicuous. It is also the habitat of *Calamus erinaceous*, which is rare in Brunei, although it is one of the commonest coastal rattan species in Borneo.

b) In Lowland Dipterocarp Forests

In this forest type, the greatest concentration of various species of rattan, numbering about 50 species is found in various habitats within said type of forest. In valley bottoms, *Retispatha dumetosa*, *Calamus convallium* and *Daemonorops didymophylla* prominent. On the slopes, *Daemonorops periacantha* and *Daemonorops longipes* are found. On ridge tops, the characteristic species is the *Calamus laevigatus* var. *mucronatus.*

c) In Kerangas (Tropical Heath) Forest

This forest type has an unusual distinct rattan flora, with many of the twenty or so rattan species that have been recorded in this forest type being confined to it. One of the distinctive and most striking is the *Daemonorops oblata*, a moderately robust species with unusually large fruit. The species *Pogonotium divaricatum* is also found in this habitat. Some species, like *Calamus lambirensis* which is associated with Kerangas forest, also occurs in the lowland dipterocarp forest, and the species *Plectocomia mulleri*, abundantly growing in Kerangas, is also found at the margins of the peat swamp forest and on ridge tops in the hills.

a. In Empran Forest

This is a riverine alluvial forest subject to seasonal flooding. The most common and abundant species found in this habitat are: *Calamus axillaris*, *Daemonorops fissa* and *Korthalsia flagellaris.*

b. In Peat Swamp Forest

The characteristic rattan species found in this habitat are *Korthalsia flagellaris* and *Plectocomiopsis triquetra*. The species, *Korthalsia paucijuga*, exclusive to this habitat in Sarawak and Kalimantan, has not yet been recorded in the great peat swamps of Belait District where it might be expected to occur.

c. In the Hills and Montane Forests of Temburong District

In the lower elevations, the rattan species usually found in lowland dipterocarps forests, in the Western Districts of the country, also occur in this habitat. However, as you go higher to elevations of more than 900 m above sea level, which is beyond the growing range of the lowland species, the rattan species of genus *Pogonotium* is sometimes present. While the rattan flora of montane forests comprises of a few species of *Calamus*, such as *Calamus kiakii, C. javensis, C. marginatus, Daemonorops asteracantha, D. longistipes, Plectocomia mulleri and Plectocomia elongata* var. *elongata,* are found growing in the area.

2. Number of Taxonomically Recognized Rattan Species

So far, as mentioned by Dransfield, J. (1997), there are about 80 species of rattan that have been recorded in Brunei Darussalam, and the dry botanical specimens of each of these species have already been collected and well-preserved in the National Herbarium (BRUN) at the Brunei Forestry Centre, in the Sungai Liang, Belait District. A CD-ROM of interactive key on Brunei rattan was also produced. The rattan species are listed as follows:

B.1 Genus : KORTHALSIA Bl.

Species:

(1) *K. rigida* Bl.
(2) *K. debilis* Bl.
(3) *K. ferox* Becc.
(4) *K. flagellaris* Miq.
(5) *K. jala* J. Dransf.
(6) *K. echinometra* Becc.
(7) *K. rostrata* Bl.
(8) *K. furtadoana* J. Dransf.
(9) *K. hispida* Becc.

B.2 Genus : DAEMONOROPS Bl.

Species:

(1) *D. fissa* Bl.
(2) *D. didymophylla* Becc.
(3) *D. maculata* J. Dransf.
(4) *D. oxycarpa* Becc.
(5) *D. korthalsii* Bl.
(6) *D. longistipes* Burret
(7) *D. microstachys* Becc.
(8) *D. cristata* Becc.
(9) *D. collarifera* Becc.
(10) *D. atra* J. Dransf.
(11) *D. scapigera* Becc.
(12) *D. asteracantha* Becc.
(13) *D. formicaria* Becc.
(14) *D. sabut* Becc.
(15) *D. oblata* J. Dransf.
(16) *D. sparsiflora* Becc.
(17) *D. longipes* (Griff.) Mart.
(18) *D. periacantha* Miq.
(19) *D. longispatha* Becc.
(20) *D. ruptilis* Becc. var. *ruptilis.*
(21) *D. ruptilis* Becc. var. *acaulescens* J. Dransf.
(22) *D. ingens* J. Dransf.

B.3 Genus : CALAMUS L.

Species:

(1) *C. erinaceus* (Becc.) J. Dransf.
(2) *C. optimus* Becc.
(3) *C. axillaries* Becc.
(4) *C. laevigatus* Mart. var. *laevigatus*
(5) *C. laevigatus* Mart. var. *mucronatus* (Becc.) J. Dransf.
(6) *C. kiahii* Furtado
(7) *C. oxleyanus* T. and B. ex Miq. var.*oxleyanus.*
(8) *C. pogonacanthus* Becc. ex H. Winkl.
(9) *C. semoi* Becc.
(10) *C. sarawakensis* Becc.
(11) *C. hispidulus* Becc.
(12) *C. pilosellus* Becc.
(13) *C. conirostris* Becc.
(14) *C. leloi* J. Dransf.
(15) *C. convallium* J. Dransf.
(16) *C. gonospermus* Becc.

B.3 Genus : CALAMUS L. *(continuation)*
Species:
(17) *C. nanodendron* J. Dransf.
(18) *C. myriacanthus* Becc.
(19) *C. acanthochlamys* J. Dransf.
(20) *C. temburongii* J. Dransf.
(21) *C. maiadum* J. Dransf.
(22) *C. ashtonii* J. Dransf.
(23) *C. paspalanthus* Becc.
(24) *C. blumei* Becc.
(25) *C. flabellatus* Becc.
(26) *C. javensis* Bl.
(27) *C. amplijugus* J. Dransf.
(28) *C. ormatus* Bl. var.*ornatus.*
(29) *C. scipionum* Lour.
(30) *C. divaricatus* Becc. var. *divaricatus.*
(31) *C. zonatus* Becc.
(32) *C. muricatus* Becc.
(33) *C. lambirensis* J. Dransf.
(34) *C. ruvidus* Becc.
(35) *C. comptus* J. Dransf.
(36) *C. marginatus* (Bl.) Mart.
(37) *C. sordidus* J. Dransf.
(38) *C. praetermissus* J. Dransf.
(39) *C. diepenhorstii* Miq. var. *diepenhorstii.*

B.4 Genus : POGONOTIUM J. Dransf.
Species:
(1) *P. divaruvatum* J. Dransf.

B.5 Genus : CERATOLOBUS Bl.
Species:
(1) C. subangulatus (Miq.) Becc.
(2) C. discolor Becc.
(3) C. concolour Bl.

B.6 Genus : RETISPATHA J. Dransf.
Species:
(1) *R. dumetosa* J. Dransf.

B.7 Genus : PLECTOCOMIOPSIS Becc.
Species:
(1) *P. geminiflora* (Griff.) Becc.
(2) *P. mira* J. Dransf.
(3) *P. triquetra* (Becc.) J. Dransf.

B.8 Genus: PLECTOCOMIA Mart. ex Bl.
Species:
(1) *P. mulleri* Bl.
(2) *P. elongata* Mart. ex Bl. var. *elongata*

3. *Economically and Commercially Important Rattan Species (Scientific and Local names)*

Dransfield, J. (1997) mentioned that of the 80 rattan species recorded in Brunei Darussalam, less than five species are of commercial value, and that none of these commercially significant species occurs in much abundance. Among these species, to mention a few are:

Calamus optimus

Calamus ornatus var. *ornatus*

Calamus scipionum

However, during our interview with indigenous village folks, who, in one way or another, were engaged in handicraft making, they mentioned or declared that there were about 10 local species of rattan in the wild that they utilized in the making of rattan handicraft.

Dransfield, J. (1997) indicated that "there are insufficient quantities of naturally occurring elite quality canes in Brunei Darussalam to support a rattan industry, and that if a rattan industry is to be further developed, then it will have to be based on commercial rattan plantation. The industry has never been fully developed in Brunei. Rattans are still of considerable importance to local people as a source of fiber for basket weaving, matting and general tying purposes".

III. PRODUCTION AND RESOURCE MANAGEMENT

1. *Nursery Activities*

a) Propagation

All the propagules produced from the nursery of the Forestry Department were raised sexually from seeds. The seed sources were local collections and importations.

b) Seed Sowing (Ramos and Lau, 1992)

The outer pericarp of the rattan fruit and the sarcotesta have to be removed before the seed is sown, otherwise the result will be a low germination rate (Manokaran, 1978).

Rattan seed separation may be done by means of soaking in water for 3 days to 5 days and then macerating or rubbing off the pericarp and sarcotesta. In the Forestry Nursery, the separation is done simply by rubbing against a wire screen and maceration in water.

Some treatments are ofterntimes done to enhance rattan germination. These include soaking the seeds in hot water (50°C to 60°C) for a day; or in running water for 3 days; washing with sulphuric acid for 3 min to 5 min (Xu, 1987); and scarification, nicking, or slicing through the embryo cover in such a way that the embryo is not damaged.

In the Central Forestry Nursery in Sg. Liang, cleaned rattan seeds are immediately sown. This is to maximize germination as in time, the seeds lose viability although they are placed under cold storage, and even with controlled temperature and humidity.

The germination beds in the Forestry Nursery are provided with overhead canopy covered with sarloin netting (50% to 75% sunlight off). The germination medium is a mixture of topsoil and fine sawdust.

Large seeds (e.g., those of *Rotan Jelayan*) are sown in shallow drills. Smaller seeds (e.g., *Rotan Irit, Rotan Sega*) are broadcast evenly. The sown seeds are covered with a thin layer of fine sawdust; a protective mulch of rough sawdust is also placed on top; and then watered.

From experience, as early as 4 days to as late as 6 weeks, the seeds germinate. The germination is hastened by adequate moisture and provided the seeds are truly mature. Germination rates in the Forestry Nursery range between 70% and 90%.

c) <u>*Seed Lifting and Potting*</u> (Lifted from Ramos and Lau, 1992)

When the germinants are 3 cm to 5 cm long, or after 2 mo to 3 mo from sowing, with initial opening of 2 to 3 leaves, they are carefully lifted from the germination bed, and potted in 8 cm x 12 cm black plastic bags.

The potting medium consists of sifted topsoil, fine sawdust, some organic matter (e.g., compost), and a pinch (10 g to 15 g) of commercial fertilizer (15:15:15). A mulch of rough sawdust is then spread on top of the soil.

d) <u>*Seedling Care and Maintenance*</u> (Ramos and Lau, 1992)

The newly-potted rattan seedlings are immediately brought to the recovery shed, which is also canopied with sarloin netting. For the next 9 mo to 12 mo, the seedlings are given proper care and maintenance including watering (twice a day), shading, fertilizing (10 g to 15 g NPK/plant/ 3 mo, and foliar fertilizer spray and urea fertilizer as required), weeding, and pest and disease prevention and control. Unhealthy leaves are pruned off and undesirable seedlings are altogether culled out. The nursery also conducts regular growth and health monitoring of all rattan seedlings.

After 9 mo to 12 mo stay in the nursery, the rattan seedlings, now 25 cm to 30 cm in height, with 3 to 5 developed leaves, are ready for outplanting in the field.

By this time, the cost of seedling production including seeds price would be approximately BD 2.50/seedling.

The plantable seedlings are then transported by truck to the planting site.

2. *Plantation Establishment*

The Forestry Department of Brunei Darussalam had embarked on rattan plantation development programme and maintained it since 1987. It was motivated by the lucrative returns on investments projected for rattans grown in large-scale plantations, and coupled with the prospect of encouraging and promoting the development of new rattan-based industry and the establishment of associated downstream processing plants, which could usher the widening of the economic-base of the country.

By the mid 1990, a total of about 900 ha of rattan plantation had been established, listed down as follows:

<u>Location</u>	<u>Species Net Area (ha)</u>
1. Andulau Forest Reserve (Logged-over Forest) Rotan Manau *(Calamus manan)* Rotan Jelayan *(Calamus mirrillii* Becc.*)* Rotan Sega (*Calamus caesius* Blume*)*	90

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2. Labi Hills Forest Reserve Rotan Manau *(Calamus manan)* Rotan Jelayan *(Calamus mirrillii* Becc.*)* Rotan Sega *(Calamus caesius* Blume*)*	333
3. Ladan Hill Forest Reserve Rotan Manau *(Calamu manan)* Rotan Jelayan *(Calamus mirrillii* Becc.*)* Rotan Sega *(Calamus caesius* Blume*)*	77
4. Interplanting in Established Timber Plantation Sites (Same species as above)	400
GRAND TOTAL	*900*

However, since 1997, the rattan plantation development operations were indefinitely suspended/ stopped, due to some perceived unfavorable factors pertaining to the growth performances of the species planted.

a. *Site Requirement / Characteristics*

The original preferred sites for rattan plantation development were the logged-over areas within the forest reserves (for security of tenure) with YEAL (Year Elapsed After Logging) of 10 yr and over. Ideally, it should be in the secondary forest of low to noncommercial significance. However, since most of the secondary forests are situated in State lands, where the security of tenure, in terms of land-use is uncertain, the Department decided to concentrate rattan plantation development in the former areas.

From the mid 90's onward, when the planted trees in the established timber plantation areas had attained some height dominance, the Department ventured into interplanting rattan in said areas, to increase the potential economic value of land/unit area. The scheme adopted was to plant single-stem/cane rattan special with cutting rotations matching with that of the planted timber species. At harvest time or at the end of the cutting rotation, the mature rattan should be harvested first to avoid unnecessary damages on the rattan canes should the timber species be harvested first. Under this method of rattan plantation development, the Forestry Department has interplanted a total of 400 ha.

b. *Site Preparation*

a) *In the Logged-over Forest*

The method used in the logged-over forest is the stripline system. The planting strips are spaced at 20 m apart and the width of each strip is 5 m. The planting arrangement and alignment along the planting strip is quincunx, that is, five seedlings of rattan are outplanted in a rectangular pattern, in which four seedlings are planted one at each corner, while the fifth seedling is planted at the center of the rectangle. There are three planting lines along each planting strip. The two outlying lines are each 1 m away from the edges of the planting strip, and 1.5 m apart from the center planting line. Each planting spot, along each line and along each planting strip, is marked with wooden stakes. The planting density/ha is about 495 seedlings/ha.

The site preparation involves the total clearing of all vegetations (trees, bushes/brushes, climbers), except for commercially known timber species (of large pole and over in size), along the 5 m wide stripline. The spacing distance between planting strips is 20 m. The buffer zones of undisturbed forest cover in-between planting strips is 15 m wide. The debris from clear-cutting or total clearing of the planting strips is placed and piled in the buffer zones to rot in due time. No burning of debris is done.

b) <u>In Interplanting Sites</u>

In the established timber plantation sites, only one planting line for rattan planting is laid out in-between (center line) and along the rows of planted trees. Since the understory of the established timber plantation is more or less clear of heavy underbrush, clearing of the planting line and the planting spots along the line is not much work, except in blank areas, where the underbrush is quite thick.

c. <u>Outplanting</u>

In both planting sites described above, the method or procedure of outplanting is the same. The propagules used are nursery-raised potted seedlings of selected rattan species. Seedlings to be outplanted should not be less than 30 cm in height and hardened for a month or two before they are issued and transported to the planting sites. Where the planting sites are accessible by roads, land transport vehicles are used. In areas which are only reached through navigable rivers, a combination of land and water transport facilities is used. Seedlings are delivered up to the accessible road points and navigable rivers. From the roadsides, or river banks, the seedlings are manually carried to the planting sites using customized flat board-lined backpacks to minimize or preclude unnecessary damages to the potted seedlings. Those seedlings which could not be transported immediately to the planting sites are placed under temporary netting-covered storage sheds at any convenient areas by or near the delivery points.

Once in the planting sites, each seedling is carefully de-potted of its plastic bag to preclude the breaking and disintegration of the earthballed soil around the root system while setting it into the planting hole. The planting hole is dug about 4 cm to 5 cm deeper than the height of the earthballed root system, and at least 4 cm wider than the diameter of the earthball. These allowances will give sufficient space around the sides and bottom of the seedlings for soil backfill. Before putting the seedling into the planting hole, the bottom of the hole should first be backfilled with a layer of top soil of about 3 cm thick. Then, the de-potted seedling is carefully placed on top and in the center. It should be done in such a manner that the top surface (top end) of the earthball is about 1 cm lower than the ground surface. Then, the sides of the earthball is completely backfilled with loose soil and heeled-in to compact it and set the seedling firmly in the planting hole/spot.

Each outplanted seedling is applied with complete fertilizer (12N:12P:17K and 2Mg.+TE) at a dosage of 100 g, placed 30 cm away from the stem-base in 4 holes dug around the planted seedling, approximately following the 4 cardinal directions. Each hole contains 25 g of the said fertilizer and backfilled with soil.

d. <u>Maintenance and Protection</u>

Complete weeding and brushing *cum* round weeding of each outplanted seedling along each planting strip is done 1 yr after outplanting and thereafter, every 6 mo, until the surviving outplanted rattans begin to develop their canes. Replanting of mortalities is done during the first maintenance pass.

In strategic locations, along roadsides and river banks, and other sites, signboards are installed indicating the existence of rattan plantation in said areas. These will keep the public aware of the existence of established rattan plantations and discourage illegal entry and destruction of the planted areas. In addition thereto, the Forest Rangers of the Department are advised to include the established plantations in their regular patrol beats.

The Forest Officer-in-charge of the plantation and the personnel under him constantly monitor the plantation sites to ensure sturdy growth and development of the outplanted seedlings, as well as to detect any pest and disease infestations, and if ever there are, immediate preventive, remedial and control measures are undertaken.

e. Harvesting System/Methods (tools, extraction techniques, clear or selective cutting)

The traditional method of harvesting rattan canes is done by means of cutting the base of the stem at the most convenient height and then pulling down the cane up to the point where it could no longer be pulled. Then, using the ordinary parang (large-bladed knives), the cane is cut at the reachable point, regardless of whether the upper ends are still utilizable or not. Usually, only the mature canes in the clumps are extracted. No large scale harvesting operation is undertaken in the country. Only village people, either singly or in a family group of two or three do the harvesting to meet their own local needs, and to a very limited way, sell out some on ad hoc basis.

f. Grading Standards

So far, Brunei has not developed nor adopted any grading standards for rattan products, because of the fact that there is no established and stable rattan-based industry in the country. Today, it is almost nonexistent.

Nevertheless, the traditional method of grading is usually based on the type of species of known commercial value; the diameter size of the cane for such species; and the straightness of the cane; and its length.

g. Transporting and Hauling (from harvesting/cutting site to buying station)

In the past, when there was still some demand for rattan canes, the raw canes were manually carried to the roadsides. In some cases, *kerbau* (water buffalos) were used. From the roadsides, the prospective buyers transported the products, using land vehicles, to the processing plants. Nowadays, such activity is nonexistent.

h. Post-harvest Activities (sorting, grading, cane treatment (chemical/ nonchemical)

Rough sorting and grading of harvested canes are initially done by the gatherers themselves in the field, based on species, size, straightness and smoothness of the canes, before they are brought to the accessible points of the roads, for pick-up by the purchasers. Once delivered to the factory sites, they are further sorted based on the same criteria, but on a more stringent process to meet the required standards for processing.

On cane treatment, in the past, some furniture makers sprayed chemicals to control and/or prevent blue-staining fungi attacks on the canes, much specially, the big-sized canes. However, the most common practices were just air-drying and sun-drying the canes before they were used.

IV. PROCESSING AND UTILIZATION

1. Major Products and Uses

Primary canes. Large-sized canes are usually used as the main material to form and constitute the main-frame of a furniture piece. Some products, whether chairs, tables and other furniture pieces, are purely and entirely made of solid canes. In chairs, the back-rests and seat potions are just padded with seat cushions. In tables, they are with glass tops or plywood/board tops. Small-sized canes are used for bracings. In some handicrafts, they are used as main-frames.

The processing of these canes involves air-drying to the appropriate moisture content, scraping rough surface areas and overall outer layers, and straightening. The rough edges at the internodes are scraped clean with knives and then the whole cane is sanded to complete the smoothening.

2. Secondary (splits, wickers, core)

The small-sized canes of appropriate rattan species are the ones usually the ones being split. The canes, of any required/customized and/or standard lengths, are first scraped-clean of rough surfaces, especially at the internodal joints and sanded-smooth before they are manually split and/or passed through a mechanically devised rattan-splitter. The indigenous village folks do not use sand paper to clean the rattan cane epidermis. They just patiently sponge-clean them. Split rattan are normally used for tying or securing firmly together the solid-cane main-frames and bracings and for decorative lacings of arm-rests and other exposed front-parts of any furniture pieces. Some are used for weaving the back-rests and seat portions plaiting. Villagers use them for weaving baskets, mats and various items of handicrafts.

a. Finished (furniture, baskets, and other handcrafts)

The rattan finished products include furniture items, such as chairs, tables, cabinets and dividers; various shapes and sizes of baskets and the locally made rattan back pack, locally known as *bakul*; and various items of handicrafts, such as hand-fans, mats, canes, picture frames, jewel boxes, vanity cases and handbags, clothes hangers, flower bases, lamp shades, *etc.*

b. Others (dyes, foods, medicines, utensils)

Young terminal shoots (locally called *umbut*) of certain species of rattan (e.g., Jelayan: *Calamus merrilli* Becc., *Manau: Calamus manan*) and locally sold in *Tamu* or open markets are eaten as vegetable. So far, there is no known use of rattan for making dye and for medicine. Some solid canes are used as tool handles; walking sticks; some items of utensils are sieves/strainers, brushes, dough rollers, hot-plate mats, pestles, and fruit trays.

V. METHODS OF IMPROVING RATTAN PRODUCTS

1. Chemical/NonChemical treatments/biological

Raw canes are usually sprayed with or dipped in chemical solution (name of chemical not known) for the prevention, control and remedial measures against blue-staining fungi attacks. Finished furniture pieces are painted, shellacked or varnished, for beauty and durability. The most common non-chemical treatment is merely air-drying of canes. There is no known biological treatment ever adopted.

2. *Processing Technologies (sanding, bleaching, drying, bending, preservation, and finishing)*

Sanding of canes is usually done manually. No bleaching is undertaken. Air-drying and sun-drying are the most commonly used methods. While being air-dried, the canes are stacked-piled in a more or less vertical or inclined position. Bending is done manually using a mechanical device. Canes to be bent are first fire-heated at the bend-point. Once the right bend is attained, the bended piece is tied to maintain its bent position for sometime, until the bend becomes permanent.

Preservation of raw materials is done by chemical spray or steeping and by air-drying. While for finished products, it is done by painting and varnishing as aforementioned.

a. *Grading Standards*

Since the rattan industry has not flourished no grading standard has ever been developed and adopted. Grading is done by ocular inspection and verification based on species, quality, size and length and straightness and roundness or cylindricality, of the rattan canes.

b. *Packaging*

As rattan raw materials are for local processing and that all finished products are only for domestic consumption, no special packaging or crating technique was developed and adopted.

MARKET AND SOCIOECONOMICS

a) *Participants In The Rattan Sector*

The rattan industry in the country is at a standstill and is considered a closed-shop. People's preferences have shifted to imported products which are of much better qualities and designs/ motifs and finesse.

However, in the past, the participants in the rattan sector were as indicated in the table below:

Item	Exporter	Trader	Manufacturer	Plantation Grower	Gatherer
1. a. Years in Operation b. Location	N.A.	N.A.	Several years In all the 3 districts of Brunei	Forestry Department (Government)	Village people
2. Size	N.A.	N.A	S.M.E	900 ha	Few family members
3. Volume of production (l.m)	N.A.	N.A	4 to 5 local manufacturers	Government	Few family members
4. Ownership	N.A.	N.A.	Private enterprise/ companies	Government	Family funds
5. Investment	N.A.	N.A	S.M.E (with capital investments of BD 25,000 and over)	RKN budget (BD 2,000/ha)	Small family funds

Item	Exporter	Trader	Manufacturer	Plantation Grower	Gatherer
6. a. Types of Rattan Handled b. Distribution Systems	N.A.	N.A.	Solid and split rattan Domestic: manufacturers are themselves traders	*C.manan* *C.caesius* *C.merillii* N.A.	Local big- and small-sized rattans. Direct sale to purchasers /buyers
7. Type of Market	N.A.	N.A.	Local/domestic market (retail)	N.A.	Local/domes-tic market (Retail)
8. Other source/s of Income.	N.A.	N.A.	Other furniture products.	N.A.	Farm produce.
9. Membership in Association	N.A.	N.A.	Local business association	N.A.	Nonmember
10. Labor/Wages	N.A.	N.A.	Based on government standards	N.A.	Family affair

Legend: N.A.: Not applicable

b) *Indigenous Knowledge System*

a. *Indigenous People (Descriptions)*

The indigenous people, locally known as *Orang Kampong*, who are known to be involved in the native handicraft industry, are the Ibans, Muruts, and Dusuns. The Ibans were originally natives of Sarawak, Malaysia, who long, long time ago had migrated and settled in the interiors and highlands of Brunei Darussalam. Though they are considered as Bruneians today, the majority of them still possess Red Identification Cards, classifying them as Permanent Residents (Stateless People). Similarly, the Muruts, who are mostly settled in the Temburong District of the country, were originally natives of Sabah, Malaysia, who migrated and settled in the lowlands. They are considered as Bruneians and are issued Yellow Identification Cards as citizens of Brunei. On the other hand the Dusuns are originally natives of Brunei occupying the lowlands of the country. Some of them had inter-married with Chinese, thus are of mixed-blood/race. Like the Muruts, they are farmers. The Ibans are mostly hunters.

Although the young generations are educated and are gainfully employed in government agencies, as well as in private companies, some of them, specially the older ones, prefer to stay in the interior villages (Kampong), staying in the "long-houses". A long-house is a barracks type of structure, usually on stilts, with 12 up to as many as 20 independent doors/apartments, connected to each other and forming one structure. Each door is occupied by one family. The long-house has a common porch, where they hold their social/cultural gatherings and/or celebrations, and also serve as their work-place for handicrafts weaving/making and other light handiworks. The occupants of a long-house, depending on the number of doors, could be as many as 80 to over 100 people.

b. *Participation in the Rattan Industry*

The participation of the abovementioned indigenous people is in the following areas of operations:

- As raw rattan canes gatherer from the natural stands.
- Domestic traders (small-scale) of raw rattan products.
- Handicrafts manufacturer and trader (domestic)
- To some extent, as furniture maker.
- From interviews conducted, some are rattan planters.

c. *Indigenous Practices and Belief*

So far, there are no known beliefs or folklore associated with rattans. However, the indigenous people put some value and importance to rattans, as the source of raw materials for handicrafts manufacture and other household items, including furnitures and fixtures.

Pertaining to indigenous practices and methods, they are described as follows:

Gathering raw canes from the wild. The gatherers identify, and select the mature cane of the desired species. Then, using traditional manual method, they cut the base of stem and pull down the cane as far as it could be possibly pulled then cut the upper end of the cane at the reachable point.

It appears that once they get an order from the customer or buyers, they immediately know what species of rattan to use and where to look for them in the forest. The gatherers usually go out in pairs, for safety reasons. It takes a day to look for and gather the raw rattans required. If the volume of the order is quite big, it will take them several days to gather the required raw canes.

Curing and Cleaning Raw Canes. The gathered raw canes are hauled to the long-house manually. Then, they are sorted by species and size. Each cane is cleared of rough edges, especially at the internodes. After that the cane's epidermis is thoroughly sponge-cleaned. No sandpaper is used in order to maintain the smooth surface and the natural sheen of the cane skin. Once thoroughly cleaned, they are sun or air dried to the desired moisture content.

Splitting and Stripping Rattans. Splitting of rattan canes is done manually, of which they are highly skilled. The split rattans are then scraped roughly of their piths or cores with sharp knives. Then, they are passed through a locally devised pith or core scraper, which has several slots of different sizes, for fine-scraping to final thickness of the rattan strips/skins.

To get the desired widths of the rattan strips/skins, they use a locally devised implement/tool, made of empty flat sardine can, which is punched with holes of various sizes. For any desired width, the rattan strips are passed through the appropriate hole of a given size/diameter, entering through the exit point of the punched hole and then carefully pulled through the entry point producing a uniformed-sized rattan skin/strip.

Types, designs, and weaving of rattan products. The types of products are determined by the buyers but the designs and weaving patterns are decided by indigenous village folks. Nowadays, production is mainly based on order.

Place of assembly and handicraft manufacture. The assembly and manufacturing site is the long-house. The weavers do their work in the common porch. Usually, the one incharge of the manufacturing process is either the Ketua Kampung (Village Chief) and/or his wife.

c) *Trade Practices*

Trading or selling of finished products is usually done in the long-house. Once the finished products (ordered) are finished, the *Ketua Kampung* or his representative will inform the buyers and the latter gets the products from the long-house. In some instances, the former delivers the finished products to the buyers. Payment is made upon delivery.

In some cases, excess finished products are personally sold by the village people during *Tamu* or market day. Some are sold to retail stores in commercial centers. They are paid cash for the products sold. There is no consignment basis of trading and/or bartering. In some instances, local and foreign tourists who visit the long-houses buy handicraft products directly from the Kampong folks.

As earlier mentioned, mass production of rattan products is only done on a per order basis, and it will take the local folks months to meet the order. Two years ago, when the 5-star Empire Hotel was about the operate, handicraft items, such as laundry baskets, trash baskets, toiletry trays, fruit trays etc., were ordered from the indigenous people in the Kampong, numbering a few hundred to a few thousand pieces per item of handicraft products. Based on the interview conducted, the village folk were able to comply and meet the order within a period of several months of production/manufacture.

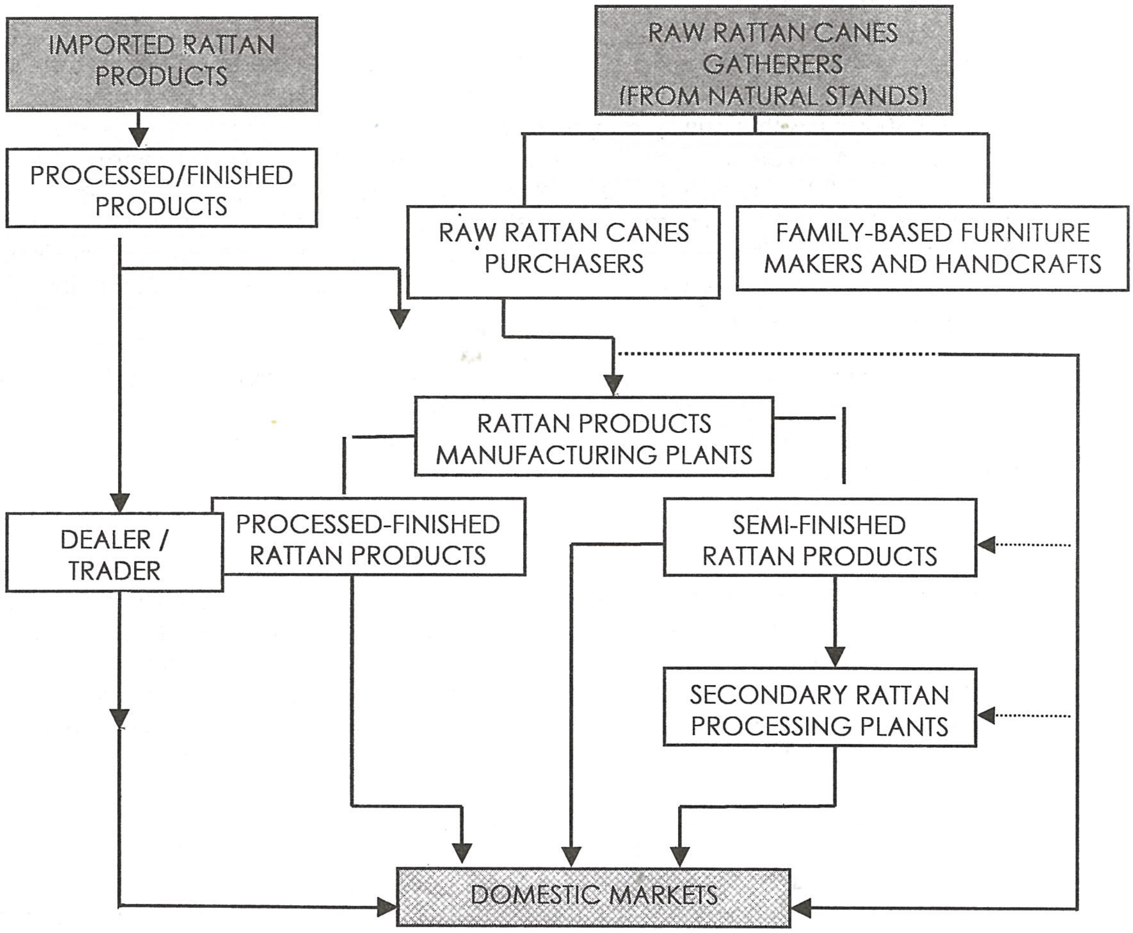
d) Contribution of Rattan to the National Economy (GDP)

The contribution of the rattan sector to the National Economy is very minimal and almost insignificant. The entire forestry sector contribution to GDP is only 0.20% (see enclosed data on National GDP contributions as in Appendix 2).

e) Market Channels

(describe the marketing system/flow of the rattan raw materials, semi-finished and finished products including handicrafts and furniture, diagrammatic presentation of the flow)

The market system/flow is presented by the following diagrammatic illustration.



f) Prices (product type and quality, price of rattan raw materials, semifinished products traders and manufacturers level by type and quality/grading standards)

Presently, local manufacturing of rattan furniture's is non-existent. People's preferences have shifted to imported finished rattan products of much better quality and finesse. However, in the past, when locally made rattan products were available in the local market, the qualities and workmanships of which were not of international standards, the prices-range (for some items) were as follows:

a. For an 8-pc sala set, the price ranged from BD 250 to BD 500; (USD 147 to USD 295);
b. For upright cabinet, e.g., a book case/stand the price range/pc, depending on size, is BD 30 to BD 50; (USD 18 to USD 30);
c. For woven products, such as baskets and handbags, and backpacks, depending on shape, size and quality of finish, could range from a low BD 1 to BD 2 (USD 0.60 to USD 1.18/item) to as high as BD 15 to BD 20/pc (USD 8.80 to USD 11.80/pc).
d. For raw canes, based on species, size (diameter), and length in meters, the price/bundle or kg, and pc, varies (no data available).

g) Financial Feasibility of Rattan Plantations, Trading, Manufacturing (small, medium, and large scales)

On Rattan Plantation

Based on the feasibility study conducted in 1989 by Ramos, the projected returns on investments were high and lucrative. The study showed that for large cane rattan plantation, covering and area of 2,5000 ha with a cutting rotation of 15 yr; with a discount rate of 6%; and with a project duration of 40 years; the estimated economic NPV (Net Present Value) was BD 49,392,000.00, the IRR (internal Rate of Return) was 12.92%, and the BCR (Benefit Cost Ratio) was 1.94. These figures nevertheless should be updated since the estimates were computed 14 yr ago. The cost incurred for the factors of production, like labor, materials (fertilizers, planting stocks, chemicals, etc.) and interest rates must be adjusted to reflect the impacts of inflation and other market forces.

It was envisioned, based on the optimistic projections of the study, that the successful development and establishment of commercial scale rattan plantations, would in turn, encourage and spur the development of new processing and associated industries, which will augment to and enhance the economic diversification programme of the country.

On Trading

Trading of rattan-based products, destined for domestic consumption as well as for exports was projected to be bright and promising. The international (export markets) demands for rattan furnitures and related products are still considerably high up to the present time. In the domestic market, rattan furnitures which are mostly imported from the neighbouring countries, of high quality good and fine finish and unique designs, which command high price (quite expensive – BD 3,000 to BD 5,000), are also preferred by the more affluent Bruneians.

Small-, Medium-, and Large-Scale Manufacturers

At the time when the rattan-based industry was still flourishing in Brunei, there were several large-scale rattan furniture manufacturers and quite a number of small and medium entrepreneurs engaged in the industry. Today, they have concentrated on trading imported rattan products in addition to the other non-rattan products they manufacture, import and trade. However, on the "Low-Key" level, and seemingly unnoticed and/or taken for granted, the handicraft industry undertaken by the indigenous village folks is still thriving until today, though production is intermittent which is based on special orders by specific clients.

VII. POLICY AND LEGISLATION

1. Forest Charges

Under the provisions of the Forestry Act, Chapter 46 of the Laws of Brunei, the royalty charge for rattan canes (First Schedule: Class II), is BD 0.85/100 kg, if taken under Form I License. If taken under Form III License, the charge is BD 1.00/mensem (mo).

Form I license/permit is issued to logging concessions, for timber harvesting, especially in the production forest reserves. Form II and Form III are license/permits issued to private individuals or associations, to extract forest products (either timber or minor forest products) in a limited volume or number for personal use or consumption only, which are usually taken from state land forests.

2. Allowable Cut (policies regulating harvest)

Rattan canes gatherer should apply and secure a Form I or Form III License before he or she can gather rattan canes in the wild. The control mechanism on regulating harvest, as specified in the license are: specified species to gather; when and where to pay royalty charges; place of examination of the harvested products; locality where to harvest; dates of issue and expiry. The quantity of rattan canes to gather is not specified.

a. *Policies Related To:*

1. Controlling or Regulating Internal and/or External Trade of Rattan.

The local rattan industry has already ceased its processing operations. The rattan-based products traded/marketed locally are imported items. They are subjected to import taxes but there is no limit set to importation. The Forestry Department issues the import permit. There is no export of locally made rattan furnitures and fixtures.

2. Controlling of Regulating Access To Rattan Raw Materials/Products

The control/regulating mechanism instituted by the Government is by the issuance of permit/ license to gather raw rattan canes from the forests, under a Form I or Form III license.

Gathering or harvesting rattan products without permit/license is illegal and anyone caught doing so, could be prosecuted under the provisions of the Forestry Act. Nowadays, since the local rattan industry had faltered, village people, for their own consumption, in a very limited scale, are tolerated to have access to raw rattan products in the wild.

Furthermore, since there is no longer any market for raw rattan materials, both domestic and export market outlets, harvesting/ utilization pressure on raw rattan materials has eased and to great extent, has ceased.

3. Biological Protection and Genetic Conservation

So far, there is no human intervention nor manipulation made on the biological protection and genetic conservation of the existing rattan resources in the country. The mere fact, that harvesting pressure has eased, the biological protection and genetic conservation rattan resources in the country, under natural processes, will be ensured and secure.

4. Controlling or Regulating Domestic/Foreign Access to Technologies (Production/Utilization)

On production technologies, the Forestry Department has more access and has the full control. However, on access to utilization technologies, the private sector is more knowledgeable. Since the rattan industry in the country is in its "maiden stage" and by force of circumstance, has ceased to operate any further, before it has fully blossomed, the production and utilization technologies adopted, in addition to the traditional domestic methods, are all patterned upon existing foreign technologies.

5. Development of Rattan Plantation on Government and/or Private Lands

So far, in Brunei Darussalam, only the Government has embarked on rattan plantation development on government lands. No private entity has ever engaged in rattan plantation development on private lands. However, from information gathered through interviews of indigenous village folks, we learned that one person, an Iban, 30 years ago, had planted Sega rattan species nearby his village, at his own initiative. From said "backyard" plantings he had twice harvested rattan canes for weaving handicraft products.

6. Other Related Policies

The essence of the National Forestry Policy stresses the need and the duty/responsibility of all the citizens to sustainably manage and develop the natural resources of the country for the greatest good of the greatest number of Bruneians through time continuum.

VIII. INSTITUTION CAPABILITY AND LINKAGES (Inter- and Intra-)

A. Academe

The Forestry Department has in its organization a Timber Plantation Section, under the Forest Development Division, which is responsible for rattan plantation development. It is headed by a qualified and experienced Forestry Graduate. It is more than capable to undertake rattan plantation development and associated work.

As to linkages, the Department has mutual arrangement and cooperation with the University of Brunei Darussalam, especially on the aspect of botanical specimen collection and identification.

B. Government

The Forestry Department, cooperates and coordinates with the Department of museums, under the Ministry of Culture, Youth and Sports, concerning the implementation of the Wildlife Protection Act and Antiquities and Treasure Trove Act, in areas within the Forestry Department's project sites, which are also covered by the said Acts.

On forest protection, the Department coordinates and cooperates with the Royal Brunei Police and Army; on forest fires, with the Fire Department; on pest and diseases, with the Department of Agriculture; on land tenure and land-use, with the Lands Department and the Town and Country Planning Unit of the Ministry of Development.

C. Nongovernment Organization

To some extent, the Forestry Department has some contacts with Nature Society of Brunei. Presently, NGO's do not yet play prominent roles in influencing national policies formulations and decision-making processes of government institutions.

D. International Linkages

On an ad hoc and informal basis, the Forestry Department confers and interacts with some countries within the Region, especially those, which are actively involved in rattan industry development. So far, attendance to conferences/seminars, such as this sponsored by ITTO, by invitation, is the Departments' means of access to international linkage.

Matrix 1. **Issues and Concerns confronting the rattan industry and recommended solutions and Research and Development (R & D) strategies to address concerns.**

Issue/Concern	Recommended Solution	R and D Strategy to Address Them
1. Production	1. More rattan species is utilized. 2. Higher utilization efficiency. 3. Identify / Locate natural sources. 4. Encourage indigenous village folks to do small-scale "backyard" planting of ration.	1. Identify other rattan species of commercial value. 2. Appropriate Harvesting / Extraction methods. 3. Conduct rattan resources inventory. 4. Species-Site matching; production and management technologies
2. Protection	1. Pest Diseases Control. 2. Illegal extraction / destruction.	1. Identify rattan pests and diseases; control measures. 2. Surveillance and prosecution; information campaign.
3. Marketing	1. Revive domestic rattan industry. 2. Improve quality and workmanship of local finished products. 3. Promote use of local products.	1. Importation Control on certain rattan products. 2.Trainings / capability building /strengthening; Quality control standards. 3. Market survey and info-drive and product promotion.
4. Information Systems.	1. Advertise locally produced rattan products.	1. Through mass media (e.g., TV, Radio, Papers); product show and exhibition, and/or trade fairs.
5. Administrative a. Policy implementation b. Linkage c. Tenurial system	Forestry Department must have an assertive role on product promotion. National and International linkages be developed, promoted and sustained. Security of Tenure for lands developed into rattan plantation.	Review license/permit award system. Promote private and Public sector linkages; with NGO and Academe. To be declared as permanent forest reserve, where harvesting can be undertaken under sustained forest management system.
6. Indigenous Village Folk Handicraft Industry	Government to do product promotion; Government to provide subsidy and incentives; Market expansion; identification and registration of individuals or group of indigenous village folks who are genuinely engaged in the industry;.	Quality control; skill and technology improvement; product designs; Client/market-product orientation.

Matrix 2. **Strengths, Weaknesses, Opportunities, Threats in the Rattan Industry.**

Item	Strength	Weakness	Opportunity	Threat
1. Production of Raw Materials.	Abundant Natural Rattan Resources.	Only few species of rattan are identified of commercial value; Lack of resource inventory data.	The Natural Forests are still vast and intact.	Unfavorable markets.
2. Marketing a. Raw Materials. b. Finished Product.	Potential domestic market. Good farm to market roads Available locally.	Low to nil demand in locally produced rattan products. Presence of imported goods. Only few species identified with commercial value. Poor product quality.	Potential Demand for rattan products is present. More than 80 species are found in the country. Modern design and better craftsmanship. Assessable from neighboring countries.	Presence of imported goods. Available resources in neighboring countries. Most quality products offered by ASEAN Countries.
3. Utilization / Manufacturing	Available technology and existence of several manufacturing / processing plants.	Local product processing has diminished due to low demand.	Potential local market demand for rattan products is good and can be expanded to foreign market.	Domestic rattan products manufacture will be totally neglected.
4. Policy	Existence of broad government policy.	Not specific to rattan resource.	Possible review of existing policy.	Out-dated policy.
5. Information systems	Existence of mass-media; linkages with the academe and private organization.	Lack of impetus and less aggressive approach.	Receptive public. Local product promotion.	Diminished public understanding and cooperation.
6. Institutions	Existence of both government and private institutions involved in the industry.	Lack of coordination. Individual/Respective mandates and objectives may post as constraints.	The institutions are willing participants to proper cooperation and coordination.	Enthusiasm to cooperate and condensate may wane.
7.Indigenous people Industry	Light-scale indigenous people handicraft industry still exists. Quality of products is relatively good.	Handicraft products not aggressively promoted. No market survey made; Client/market-orientation is inadequate.	Indigenous people are willing participants. Local technology can still be improved.	Interest and enthusiasm of indigenous people may wane. Local technology may be lost or relegated.

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Present Status of Sustainable Rattan Production and Utilization in Indonesia (Indonesian Country Report)

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Non-Wood Forest Products, FORDA, Indonesia

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I. INTRODUCTION

Indonesia has long been well known as the biggest rattan exporting country in the world. Since the 1980s, Indonesia has been dominating rattan supply by sharing 80% of the total world trade. Industry in Indonesia plays a significant contributory role on both the national economy and people's livelihoods, particularly of those who are living adjacent to the forest. To the economic sector, rattan industry contributed more than USD 300 million annually in foreign exchange in 1998 and 1999 (National Statistics Bureau, 2000). For the local people, rattan provides not only various benefits for subsistence needs, such as materials for housing and household utensils, medicines as well as food, but also cash income. More than a million of people currently are involved in rattan-based activities such as natural collecting, cultivating, processing, trading and marketing.

Statistics recorded suggests that around 312 rattan species grow in 9.37 M ha distributed throughout the forests of Indonesia. However, only 53 rattan species have been recognized and economically known in rural areas as well as in market. Most of the species belong to the small -diameter class (diameter less than 18 mm). The most important small-diameter species is rotan Sega (*Calamus caecius*) and the big-diameter species are rotan Manau (*Calamus manan*), rotan batang (*Calamus zollingeri*), and rotan Semambu (*Calamus scipionum*). The value of rattan depends on the species' properties which in turn determine how it is utilized, such as for frame of chairs usually made of big-diameter rattan, and traditional carpet materials from small-diameter rattan.

Based on the 1995 inventory, the potential production of rattan in Indonesia is predicted at about 415 thousand tons. This production potential is derived from both natural rattan collection and cultivated rattan.

This paper details the present situation of Indonesian rattan.

II. RATTAN RESOURCES

A. Rattan Plantation

The first rattan cultivation was conducted in the year 1850 and noted as a pioneering effort, located in the countryside of Mengkatip near the town of Buntok and an area around Dadahup Kapuas in province of Central Kalimantan. The first step is preparing strips on the field all the way in the direction of West-East, where the strip was as wide as 2 m. Further , on each of the strip, the holes were made at distances of 6 m to 8 m. Moreover, natural seedlings growing in the surroundings were pulled out and then planted in the holes.

In Palembang-Sumatra, rattan cultivation was started in 1905. Cultivation at that moment was only done by looking after rattan which grew freely in the forest.

Plantations of rotan irit (*Calamus trachycoleus*) and rotan taman (*Calamus caesius)* in local communities around the forest in Central Kalimantan are estimated at around 70,000 ha. In this province, the harvestable rotan irit (*Calamus trachycoleus*), which is highly adaptable to wet conditions, is estimated at around 5,659 kg/ha, while rotan taman (*Calamus caesius*) is about 4,317 kg/ha. With the planting space of 5 m x 8 m, rattan can be obtained as much as 250 clump/ha, where each clump yields 18 stems so that each hectare can contain 4,488 stems (Consultant Report. 2001). At East Kalimantan, one of the centers for rattan production in Indonesia, Saragih (2000) estimated that the total area of rattan plantation could reach 240,000 ha in the area of PT Perhutani, PT Inhutani and Estate enterprises.

The species that are generally planted are those with small diameter as they need very little maintenance. Some rattan plantations have species of high commercial value, cover sega (*Calamus caesius*), pulut merah (*Calamus flabelloides)* and pulut putih (*Calamus penicillatus*). Moreover, there is also rattan plantation in South Kalimantan, in the Buntok Regency. The people in this Regency cultivate rattan under a social forestry scheme. Further, in the Pasaman Regency, West Sumatra, people cultivate rattan, *Calamus manan*, in a 15-yr old rubber plantation, where the rattan could be harvested when the rubber trees reach the age of 25 yr to 30 yr (Sumarna, 1995).

Perum Perhutani, Indonesian Forest Enterprise has developed rattan plantation in production and natural forests in Java, reaching 22,000 ha. Rattan species that have been planted include manau (*C. manan* Miq.), sega (*C. caesius*) and some local rattans like seel (*D. melanochaetes*), cacing (*C. cilliaris*), lilin (*C. javensis*) and others. PT Inhutani, Indonesian Forest Corporation, has been cultivating rotan manau and sega in around 2,000 ha in Berau Regency. The company also plans to develop rattan plantation, manau and sega batu (*C. diepenhorstii* Miq), around 30,000 ha, at a planting rate of 100 ha/yr, in logged-over areas which have been abandoned. Manau has been planted under a dipterocarp forest, and further can be harvested at the age of 10 yr to 15 yr old. Details of the area of rattan plantation are shown in Table 1.

Table 1. Location and the area of rattan plantations.

No.	**Province**	**Scientific name**	**Local name**	**Area** (ha)
1.	West Sumatera	*C. manan, C. caesius*	Manau, sega	10
2.	Riau	*C. manna*	Manau	30
3.	Central Kalimantan	*C. manan, C. caesius, C. trachycoleus*	Manau, sega ,irit	70,000
4.	East Kalimantan	*C. manan, C. caesius, C. trachycoleus*	Manau, sega, irit	11,000
5.	South Kalimantan	*C. caesius, C. trachycoleus*	Sega, irit	200
6.	Menado	*C. inops, D. robustus, C. caesius*	Tohiti, batang, irit	30
7.	Kendari	*C. inpos*	Tohiti	120
8.	Java	*C. manan, C. caesius, C. trachycoleus*	Manau, sega ,irit	37,412
			Total	118,802

Source: Nasendi, 1996; Janumiro, 2001

B. *Rattan Natural Stand*

Natural rattan is still the biggest supplier of raw materials. Based on the rattan inventory conducted by the Department of Forestry in 1995, the forest area where rattan grows naturally is about 1.2 million ha with the production potency of such rattan equal to 415 thousand t/yr (Sukardi, 2000). There are about 312 rattan species in Indonesia, which are either large-diameter (>18 mm) or small-diameter (<18 mm), of both commercial and noncommercial value (Mogea, 2000). Some large-diameter rattans have been recognized well in the world trade such as manau (*Calamus manan*), batang (*Calamus zollingeri*) and semambu (*Calamus scipionum).* These rattans are spread over almost all of Indonesia.

Tables 2. Source of natural rattan product according to province.

No.	Province	Area (ha)	Production Potency (ton)
13.	East Kalimantan	17,256,000	70,000
15.	Centra Sulawesi	3,572,663	18,000
20.	Irian Jaya	850,000	-
14.	South Sulawesi	789,568	240,000
18.	Maluku	657,000	-
10.	West Kalimantan	600,000	92,000
4.	West Sumatera	429,000	-
3.	Jambi	400,000	6,900
9.	Jawa	376,282	-
5.	Riau	345,000	3,000
7.	South Sumatera	341,000	5,000
6.	Bengkulu	300,000	23,000
8.	Lampung	251,000	24,000
1.	DI Aceh	165,000	45,00
17.	Sout East Sulawesi	144,000	97,000
16.	North Sulawesi	78,900	6,000
19.	Nusa Tenggara	67,000	36,000
12.	Central Kalimantan	64,527	24,000
2.	North Sumatera	23,000	-
11.	South Kalimantan	11,000	7,000
	TOTAL	26,720,940	615,900

Source: Nasendi (1994)

According to Nasendi (1994) cited by Saragih (1996), the biggest rattan production areas are Aceh, Bengkulu and Lampung province in Sumatra; East Kalimantan, West and Central Kalimantan province in Kalimantan; South-East Sulawesi, South Sulawesi and Central Sulawesi province in Sulawesi and also West Nusa Tenggara. The details of rattan areas and their frequency in the natural forest are presented in Table 2 and the location of such rattan is shown in the Figure 1.

C. *Recognized and Economically Important Rattan*

The number of rattan species which have been known in Indonesia are around 312, but the one which have been identified to be used locally and commercially in various forms is only around 53 species (Table 3). Meanwhile, rattans that economically have high commercial value are about 28 species (Tables 4).

Tables 3. Known rattan botanically in Indonesia.

No.	Local Name	Botanic name	Region
1.	1. Manau	*Calamus manan* Miq	Sumatera, Kalimantan
2.	2. Tohiti	*Calamus inops*	Sulawesi, Maluku
3.	3. Batang 1	*Calamus zolingeri*	Sulawesi
4.	4. Batang 2	*Daemonorops robustus*	Sulawesi
5.	5. Semambu	*Calamus scipionum*	Sumatera Kalimantan
6.	6. Sega	*Calamus caesius*	Kalimantan
7.	7. Sega batu	*Calamus axillaris*	Sumatera, Kalimantan
8.	8. Sega badak	*Calamus ornatus*	Jawa, Sumatera
9.	9. Irit	*Calamus trachicoleus*	Kalimantan

No.	Local Name	Botanic Name	Region
10.	10.Pulut merah	*Calamus. Inpar*	Kalimantan
11.	11. Pulut putih	*Calamus laevigatus*	Kalimantan
12.	12. Jermasin	*Calamus leijocaulis*	Sulawesi
13.	13. Datu/anduru	*Calamus minahasae*	Sulawesi, Maluku, Irian Jaya
14.	14.Tabu-tabu	*Daemonorops longipes*	Sumatera, Kalimantan
15.	15. Lilin 1	*Calamus javensis*	Jawa, Sumatera, Kalimantan
16.	16. Lilin 2	*Calamus rhomboideus*	Sumatera, Kalimantan
17.	17. Cacing 1	*Calamus cilliaris*	Jawa, Sumatera, Kalimantan
18.	18. Cacing 2	*Calamus viminalis*	Sumatera, Kalimantan
19.	19. Batu	*Calamus filiformis*	Sumatera, Kalimantan
20.	20. Lita	*Daemonorops lamrolepis*	Kalimantan, Sumatera
21.	21. Dahan	Calamus schistoacantus	Sumatera, Kalimantan
22.	22. Umbul	*Calamus symphisipus*	Sulawesi, Maluku
23.	23. Getah	*Korthalsia. Angustifolia*	Sumatera, Kalimantan
24.	24. Sabut/cincin	*Daemonorops sabut*	Sumatera, Kalimantan
25.	25. Jernang	*Daemonorops draco*	Sumatera, Kalimantan
26.	26. Suwai	*Calamus warburgii*	Sulawesi, Maluku, Irian Jaya
27.	27. Seel	*Daemonoropss melanochaetes*	Jawa, Sumatera, Kalimantan
28.	28. Pelah	*Daemonorops rubra*	Jawa, Sumatera, Sulawesi
29.	29. Wilatung	*Daemonorops fussus*	Kalimantan, Sulawesi
30.	30. Balukbuk	*Calamus burkianus*	Jawa, Sumatera
31.	31. Telang	*Calamus polytachys*	Sulawesi, Maluku, Irian Jaya
32.	32. Dahan	*Calamus flagellaris*	Kalimantan, Sulawesi, NTT, NTB
33.	33. Inun	*Calamus scrabidulus*	Sulawesi, Irian Jaya, NTT
34.	34. Bulu	*Korthalsia celebica*	Sulawesi, Maluku, Irian Jaya
35.	35. Semut	*Korthalsia scapighera*	Sulawesi, Maluku, Irian Jaya
36.	36. Tarompu	*Calamus spp*	Sulawesi
37.	37. Lambang	*Calamus spp*	Sulawesi, Maluku, Irian Jaya
38	38. Udang	*Korthalsia echinometra*	Sulawesi, Maluku, Irian Jaya
39.	39. Buyong	*Calamus ornatus*	Jawa, Sumatera, Kalimantan
40.	40. Manau padi	*Calamus marginatus*	Sumatera, Kalimantan
41.	41. Laura	*Calamus didymocarpus*	Sumatera, Kalimantan, Nusa Tenggara
42.	42. Lacak	*Daemonorops crinitus*	Sulawesi, Maluku, Kalimantan
43.	43. Landak	*Daemonorops pericantus*	Kalimantan, Sulawesi, Maluku
44.	44. Buluk	*Calamus hispidulus*	Kalimantan, Sumatera, Nusa Tenggara
No.	Local Name	*Botanic name*	Region
45.	45. Tunggal	*Calamus mucronatus*	Sumatera, Kalimantan
46.	46. Leuleus	*Calamus malnoloma*	Jawa, Sumatera
47.	47. Toli-toli	*Calamus tolitoliensis*	Sulawesi, Maluku, Irian Jaya
48.	48. Rawa	*Calamus tenuis*	Sumatera, Kalimantan
49.	49. Samuli	*Calamus picicarpus*	Kalimantan, Sulawesi (?)
50.	50. Gajah	*Calamus gigantea*	Sumatera, Kalimantan (?)
51.	51. Manau riang	*Calamus axleyanus*	Sumatera, Kalimantan
52.	52. Ronti	*Calamus leptostachys*	Sulawesi, Maluku, Irian Jaya
53.	53. Umbili	*Calamus ahlidurii*	Sulawesi, Maluku
54.	54. Gunung	*Calamus exilis*	Kalimantan, Sulawesi, Nusa Tenggara
55.	55. Raung	*Korthalsia rostrata*	Sulawesi, Maluku
56.	56. Pulut 3	*Ceratolobus subangulatus*	Kalimantan

Source: Ditjen PH, Direktorat Industri Kayu dan Rotan, DJIHPK, Dali dan Sumarna, 1992; Mogea, 2000

Table 4. Highly commercial rattan species in Indonesia.

No.	Local Name	Botanic Name	Region
	Rattan plantation		
1.	Sega	Sega batu/air	Kalimantan
2.	Irit	Sega, taman	Kalimantan
3.	Manau	Irit	Sumatera, Kalimantan, Jawa
4.	Pulut	Manau	Kalimantan
	Natural rattan		
1.	Manau riang	*Calamus ornatus*	Jawa, Sumatera
2.	Manau padi	*Calamus axillaris*	Sumatera, Kalimantan
3.	Pulut merah	*Calamus caesius*	Kalimantan
4.	Pulut putih	*Calamus trachicoleus*	Kalimantan
5.	pulut hijau	*Calamus manan* Miq	Sumatera, Kalimantan, Jawa
6.	Tohiti	*Calamus tumindos*	Kalimantan, Jawa, Sulawesi
7.	Semambu	*Calamus axleyanus*	Sumatera, Kalimantan
8.	buyung	*Calamus marginatus*	Sumatera, Kalimantan
9.	Jermasin	*Calamus inpar*	Kalimantan
10.	Lilin	*Calamus laevigatus*	Kalimantan
11.	Batang	*Calamus spp*	Kalimantan
12.	Seel	*Calamus. Inops*	Sulawesi, Maluku
13.	getah	*Calamus scipionum*	Sumatera Kalimantan
14.	pelah	*Calamus optimus*	Sulawesi
15.	Dahanan	*Calamus leijocaulis*	Sulawesi
16.	Lacak	*Calamus javensis*	Jawa, Sumatera, Kalimantan
17.	Tarompu	*Calamus zolingeri*	Sulawesi
18.	Tunggal	*Daemonorops melanochaetes*	Sulawesi
19.	Dahan	*Daemonorops angostifolia*	Kalimantan, Sulawesi
20	lita	*Daemonorops rubra*	Jawa, Sumatera, Sulawesi
21.	sabutan	*Korthalsia flagellaris*	Kalimantan
22.	andaru	*Calamus crinitus*	Sulawesi, Kalimantan
23.	Tarompu	*Calamus sp*	Sulawesi
24.	Tunggal	*Calamus mucronatus*	Sumatera, Kalimantan
25.	Dahan	*Korthalsia rigida*	Sumatera, Kalimantan
26.	lita	*Daemonorops lamprolepis*	Sumatera
27.	sabutan	*Daemonorops hystrix*	Sumatera
28.	andaru	*Calamus sp*	Sulawesi

Source: Janumiro, 2000

III. PRODUCTION AND RESOURCE MANAGEMENT

A. *Nursery Activities*

Fruits of irit (*Calamus trachicoleus*) and sega (*Calamus caesius*) are taken and collected from natural rattan plants which have a minimum length of 10 m, and from where the fruits have been previously harvested 3 to 4 times. Meanwhile for tohiti (*Calamus inops*), fruits can be taken after rattan reaches 10 yr of age, or when the stems are a minimum 30 m in length, and for batang (*Calamus zollingerrii*) and lambang (*Calamus* Sp) 50 m in length. Gathering of rattan fruits is conducted by climbing the trees or using a bamboo pole to reach the top portion.

Ripe fruits are put in polyethyelene or plastic bag or stored at humid condition for 1 mo to 2 mo, and sprayed with water twice a day. Then the seeds are cleaned and dispersed on the seedbed and sprayed with water 2 times a day.

Another way to clean the seeds is by soaking in the water for 24 hours, after which the seeds are transferred to a transparent plastic bag until they germinate. Germinated seeds are then potted, that is, transferred into plastic bags and placed at the nursery until they are ready to be planted, usually when they are 9 mo to 11 mo old.

B. *Plantation Establishment*

1. *Site requirement /characteristics*

At the cultivation location, the capacity of the trees to be climbed should be paid attention to. At the plantation forest, the age and height of climbed tree stand are determining factors. Climbed trees at 7 yr to 10 yr old with more than 10 m in height and 8 cm to 12 cm in diameter are suitable for rattan cultivation.

Similarly, at the harvested forest area (logged-over area), rattan planters should pay attention to the remaining trees or standing stands, whether of value commercially or non-commercially, whether or not they have trees that have breakeble stems and branches (Sumarna, 1999).

At the rubber plantation, rattan planting can be conducted when the rubber trees are around 15 yr of age, and the rattan can be harvested when the climbed trees reach 25 yr to 30 yr of age. At such a time, the rattan that can be collected would be 3 to 4 stems with 10 m to 14 m in length (clustering species).

2. *Site preparations*

Generally, the location of rattan cultivation can be forest, shrub/coppice area or even tree crop plantation. The location is surveyed to determine its boundary, area that to be cultivated, prohibited areas which may not be opened, road, etc. The location candidate is then worked out to get the optimal illumination condition by clearing stands and plants that bother rattan growth or are of lesser commercial value. The various wild shrubs/coppice around the rattan planting are cleaned. Stands that can be used to support rattans remain, and stands do not have any commercial value are cleared away.

Bamboo sticks or wood called "ajir" are arranged at planting area corresponding to the planting pattern that has been specified. The making of planting holes should be adapted to a planting period early in the rainy season. Hole patterns are made with 20 cm x 20 cm x 20 cm or 30 cm x 30 cm x 30 cm. Moreover, to avoid the possibility of root pest trouble, each hole is given Furadan, a fungicide, with the dose between 20 g to 50 g. During the growing period, fungicide or herbicide is sprayed to protect against the disease and pest. If considered necessary, plant hole can be given basic manure with compost or artificial manure, urea, about 10 g to 20 g/hole + TSP 20 g/ to 25 g/hole.

3. *Out-planting*

Young rattan plants, when around 9 mo to 11 mo are ready to be planted in each hole. The plastic bag is torn, the seedling is put into the plant hole, and the hole is piled up with surface soil and then compacted. Ajiran is stuck and the stem of the seedlings is fastened to the ajir to prevent whiplash caused by the wind so that the rattan can grow straight or as a sign of already being planted. Suggested planting space is around 5 m x 5 m and about 1 m away from creeping tree.

4. *Maintenance and protection*

After 2 mo to 3 mo of cultivation, replanting is conducted to replace a dead plant with another plant of the same age. Then, the light penetration in the area is settled around 60% to 70%, so that plants will grow better, by clipping non-commercial stands. This activity is carried out until plants are 2 yr to 3 yr old. During this period, removal of intruder plants is conducted every 3 mo to 4 mo.

During the growing period until the canes are ready for harvest, it may be necessary to carry out the eradication of disease or pest attacking the rattan crop. Old fronds or leaves are cleared to induce growth in stem length.

C. *Harvesting Systems/Methods and Transporting to Buying Site*

The age of maturity of rattans known is limited to cultivated rattans, among them irit (*Calamus trachicoleus)*, manau (*Calamus manan* Miq), pulut merah (*Calamus inpar)* dan taman (*Calamus caesius)*. Rattans with small diameter like irit and taman are collected at 6 yr to 8 yr of age, while big diameter rattans are collected at 12 yr to 15 yr of age. Usually rattan harvest is conducted using a selective cutting method, wherein only mature rattan is to be taken. Some indicators that rattan is ready to harvest are the thorn and leaf that have broken thorn with black color, and most the stems are unwrapped by green chromatic and frond.

The rattan thorn and leaf are easily cleaned off by beating using the back side of a big knife. The cleaned rattan stem is then cut around 1 m from ground with the knife, axe, or dagger. Trimming at 1 m from the ground is meant to give a chance for the stem base to grow new buds. The next step is to cut the top portion of stem stuck to the climbed tree by using bamboo pole mounted with knife at the top, or climbing all the way up the tree and cutting at the reachable point. Further, the bottom of the rattan stem is pulled out and cut as long as is thought appropriate. At the same time of the rattan stem is being pulled out of the surrounding vegetation, the thorn and frond are removed. This method is used for the harvesting of rattans with small diameter. For the large-diameter rattan, the stem that has been cut is pulled out as long as possible without sweeping off of frond or thorn. The gatherer leaves the rattan canes in the forest for days or weeks and go back there when they know that the fronds, leaves and thorns have become so dry that they are easy to clean off.

The rattan stems are cut to 3.10 m up to 4.10 m in length, then about 10 to 20 stems are bound and transported to the gathering site using boat, as in Central Kalimantan, by carrying on the shoulder as in West Sumatra. At the gathering place, collectors come to buy the rattan. After preprocessing, the rattan is transported to the town by truck or boat.

E. *Post-harvest Activities*

After harvesting or collection, there is usually a simple processing conducted by first trader or collector. In general, the processing activity of big-diameter rattan is a little bit different from the small-diameter one. The processing of the large diameter includes washing, frying, drying, and streamlining, and rattan selection quality. The processing of the small diameter consists of washing, deglazing, whitening, fumigation, draining, book scraping, selection quality and packing.

The cutting of harvested rattan is carried out according to commercial standard in length, usually 5 m to 6 m in length. About 50 to 100 cut rattans are bound and soaked in flowing water for 1 day to 7 days. The objective of this soaking is to make rattan resistant to fungi or any unwanted change in color. After soaking, rattans are cleaned and rubbed with coconut husk or thick sand cloth to eliminate the remaining dirt still present on the stem so that the cane becomes lustrous-looking. Afterwards, deglazing is conducted to eliminate the epidermis and the silica on the surface. The deglazed rattan is then exposed to sunshine for 1 day to 3 days depending on climate and weather or until the color of the cane changes from green to golden yellow. Dried rattans are then straightened and cut according to the required sizes.

IV. PROCESSING AND UTILIZATION

A. *Major products and uses*

The important part of rattan is the mature stem. Principally, from stems can be produced. 3 product groups used internationally; these are primary products, semi-finished products, and finished products.

1. Primary products

The primary products group is comprised of rattan canes not yet cleaned, and not yet preserved, or simply processed but not yet undergone further processes. These products consist of whole rattan, rattan W&S, split rattan and course polished rattan.

Whole rattan (rotan asalan) is any type of rattan cane not yet brushed, not yet cleaned, not yet smoked, and not yet sulphurized. Rattan W&S is rattan that has been cleaned, washed, brushed, fried and smoked. Split rattan is a result of splitting rattan W&S but not yet brushed with a minimal thickness of between 1.4 mm and 2.5 mm. Coarse polished rattan is a rattan W&S on which has been removed the internodes by scraping so that the thickness of the entire cane is almost the same.

The number of the rattan processing enterprisess producing primary products in Indonesia is about 72, spread over Southeast Sulawesi (28 enterprisess), Central Sulawesi (11 enterprises), Sulawesi South (10 enterprises), Sulawesi North (10 enterprises), East Java (4 enterprisess), West Java (3 enterprisess), Banten (2 enterprisess), West Sumatra (2 enterprisess), North Sumatra (1 enterprises), and Central Kalimantan (1 enterprise).

2. Secondary products (splits, wickers, core)

The semifinished products group comprises products of rattan W&S that have been further processed from being primary products. The secondary products include fine polished rattan, skin, separate furniture component, and core.

Fine polished rattan is the result of the peeling process of skin of rattan W&S marked with the cylindrical bar and refinement impression along the bar length. Rattan skin is the result of stripping of rattan W&S with a maximal thickness of 2.3 mm and wide 8 mm along side of skin. The rattan core is the result of forming rattan core having consistent diameter throughout the length of it. There are also separate furniture components that are a result of forming rattan W&S, smooth polished rattan, short circular rattan, eroded book rattan according to selected standard form and design.

The number of the rattan processing Enterprisess that produces semi-finisheds product in Indonesia is around 25 which spread over Southeast Sulawesi (4 enterprisess), Central Sulawesi (2 enterprisess), South Sulawesi (3 enterprisess), North Sulawesi (4 enterprisess), East Java (2 enterprisess), West Java (3 enterprisess), West Sumatra (2 enterprisess), North Sumatra (2 enterprisess), Central Kalimantan (1 enterprises), South Kalimantan (1 enterprises) and NTB (1 enterprises).

3. Finished products (furniture, baskets, and other handicrafts)

The finished products group includes those that are ready for use. Finished products are rattan carpet, Sabrina, any basket, rattan hat, rattan matting, handicraft, furniture components, and furniture.

Rattan floor mat is result of rattan skin or core matting woeven in the form of symmetrical parallelogram sheet. Rattan mat is a skin or core braid in form of symmetrical parallelogram sheet. Any basket is a result of braid of circular rattan, rattan W&S, smooth polished rattan, short circular rattan, eroded book rattan, rattan skin or core in the form of handicraft. Furniture or furniture component is a result of forming furniture or made ready to assemble furniture component. The used raw material covers rattan W&S, smooth polished rattan, short circular rattan, eroded internode rattan, rattan skin or core or matting. Rattan matting is result of matting with skin or core materials and formed accordance with consumer appetite.

The number of the finished products manufacturers in Indonesia is 240 furniture enterprises and 56 matting enterprises which spread over in all Indonesia regions. The furniture enterprises cover West Java (82 enterprises), East Java (60 enterprises), Jogyakarta (25 enterprises), Central Java (22 enterprises), Banten (13 enterprises), North Sumatra (7 enterprises), DKI Jakarta (6 enterprises), Bali (5 enterprises), Kalimantan South (1 enterprise), Moluccas (1 enterprise), Moluccas (1 enterprise) and NAD (1 enterprise). Meanwhile, area that spreads the location of kind of matting enterprises cover East Java (14 enterprises), Kalimantan South (13 enterprises), West Java (12 enterprises), Central Java (6 enterprises), Banten (4 enterprises), North Sumatra (4 enterprises), DKI Jakarta (3 industry), NTB (1 enterprise) and Sulawesi North (1 enterprise).

The rattan enterprises mentioned above are only medium and big scale. Above data are still not yet counted for formal home and non-formal scale industry. As an example, in South Kalimantan there are around 3100 small enterprises. Cirebon are around 850 enterprises, and Central Sulawesi are about 250.

4. Others (e.g., dyes, foods, medicines, utensils)

The rattan shoot is used as vegetable. Rattan fruits and roots are used as traditional medicine, while the fruits' gum is used as colorant material for the ceramic and pharmacy industries. The oleoresin is called dragon blood and is obtained from several rattan species: *Daemonorops draco, D. didymophylla, D. draconcellus, D. malthanensis, D. microcantha* Mart, *and D. branchystachys.*

Small amount of skin waste is used for the fillers of car jock or chair. Generally this waste is thrown out or burned.

Rattan types that have sprouts that can be utilized as vegetable are *D. calapatius, D. melanochaetes* Bl., *D. oblongatus* Bl., *D. Palembanicus* Bl., *D. periacanthus* MIQ, dan *D. rubber* Bl. Rattan sprout is pared, cleaned and boiled till soft. *D. Palembanicus* Bl. yields seeds that are edible, while the *Calamus acidus* Becc kernel is exploited as cookery flavor. Kernels of the *Damonorops* and *Calamus* groups can be used as cure for stomachache.

B. Methods of improving rattan products

Smoking. Smoking basically is oxidizing process using sulphure (gas of SO_2) until the rattan skin becomes yellow and resistant to fungal attack. The result of processing until this phase is referred to as rattan W&S (washed and sulphurized).

To decrease moisture content of the cane quickly as well as to prevent fungal attack, the cane is fried with a mixture of diesel fuel and palm oil (9:1). Frying aims is to remove the wax and silica at the rattan surface easily, so that drying can proceed faster. As a result, the rattan cane becomes more resilient and not brittle, and is brighter.

Drying. The drying of rotan manau (*Calamus manan* Miq) and semambu (*Calamus scipionum* Burr) needs from 22 days to 65 days. Meanwhile, using a dehumidifier, the drying time is 5 days to 8.5 days. Further, the moisture content obtained by using the dehumidifier is lower compared to air drying. Moisture contents range from 10.54% to 11.78% by dehumidifier and from 18.35% until 19.19% by air drying. But the color obtained from air drying is better and glossier compared to from the dehumidifier.

Peeling and Polishing. Peeling and polishing are generally conducted for big rattan so that the stem is more uniform in color and diameter throughout its length. Peeling and polishing rattan manau (*Calamus manan* Miq.), seuti (*Calamus ornatus* Bl.) and nunggal (*Calamus ornatus* Bl.) can be carried out under conditions of wet or dry. Under the wet process, there is a lower yield of peeled and polished rattan, and there are more furry and broken fibers than under the dry process. Manau and nunggal come out as good quality and seuti medium quality, if both are pared in wet process. The cane is peeled and polished under the dry process, manau of nunggal comes out in good quality, whereas seuti is in good class.

Bending. Bending of large-diameter rattan is carried out according to their use. Bending of rattans such as manau (*Calamus manan* Miq), rotan batang (*Daemonorops robusta* Warb) and minong (*Calamus optimus*), that have already been soaked in dimethyl sulfoxide (DMSO) for 8 hours at 82°C can improve an amenity of rattan sagging. At the same concentration level, batang is the hardest to be bent and manau is the easiest to be formed. Rattan stem starts easily to be bent at 15 % concentration and rattan minong at 5 % concentration. The usage of dimethyl sulfoxide facilitates sagging, decreases a level damage of its physics and does not influence its gleam, but it tends to improve elasticity value and decrease in MOE.

Bleaching. The aim of the bleaching is to eliminate silica, lessening oxidation on aromatics structure of lignin and carbohydrate (in hypochlorite potassium). Bleaching of rattan skin of sega (*Calamus caesius* Bl) with soaking in hydrogen peroxide (H_2O_2) at 1% to 7% concentration for 1 hr can improve its degree of whiteness until 48.01%, but strength parallel to the grain decreases somewhat. In industry, bleaching process for finished products is carried out through plunging rattan in a basin containing white chemical at the same time it is brushed with comb. Meanwhile, bleaching process for semi-finished products is by plunging into a basin containing whitener for several seconds or by sprinkling whitener solution on rattan. Whitening used in the bleaching is perhydrol, glass water, NaOH and sulfured smoke.

Preservation. Preservation of rattan is chemical or physical treatment to lengthen shelf life of rattan and to prevent or minimize damage from microorganism attack. Preservation can be done on standing rattan just before being harvested using Buchery methods or just after being harvested using prophylactic method, and after being dried. The preservation methods to use should corresponding to the type of microorganisms attacking rattan.

The usage of pesticide to prevent blue stain on karokok (*C. vivinalis*), seuti (*C. ornatus*), lilin (*Calamus* spp) and irit (*C. trachyodes*) by using preservative of methyllen bisthiosianat 10g/l with concentration 2% and retention 13.7 kg/t at the time of rattan harvesting can improve the rattan protection up to 46 days. Meanwhile, on seuti (*C. ornatus*), pelah (*Daemonorops ruber* Bl), balubuk (*C. burchianus*) irit (*C. trachiocoleus*) and lambang (*Calamus* spp) using 1.5% Enblu preservative can prevent blue stain attack. Cislin preservative with 1.5% concentration can prevent pin hole borer attack by the ambrosia beetle.

Preservation can be conducted on dry rattan, like rattan raw material, semi-finished products and finished products to prevent the attack of pest organisms like the powder-post beetle. Batang, *Daemonorops robusta* Warb, treated with preservative containing 36.8% permetrin at 0.15% concentration and retention 0.08350 kg/ton without or with steaming can totally prevent attack of *Dinoderus minutus* Farb. Seel (*Demonorops melanochaetes* Bl), manau (*Calamus manan* Miq), lambang (*Calamus* spp 1), mandola (*Calamus* spp 2), tohiti (*Calamus inops* Becc) and terumpu (*Calamus* spp 3) preserved with borax can still be attacked by powder-post beetles (*Cryptotermes cynocephalus* Light) with light attacking degree. It is possible that boron compound can be used to prevent the attack by powder-post beetles. It is most likely that seel is most vulnerable to attack and manau is less vulnerable.

Preservative usage of 0.5% permetrin and of methyl bithiosianat on a fresh rattan of mandola (*Calamus* spp) is effective enough to prevent *Dinoderus minutus* attack. Preservation process is conducted by soaking for 2 hr, then the rattan is fried and dried until reaching 17% of moisture content. Preservation using 0.09 ppm permetrin with cold soaking method for 2 hr on dried bubuay (*P. elongata*), seuti (*Calamus ornatus*), and sampang (*Khorthalsia junghunii*) is effective to prevent powder-post beetle attack. Moreover, preservation with 0.25% phoxim and 0.5% Chlorpyrifos is more effective against powder attack of *Dinoderus minutus*.

C. *Grading Standards*

The grading standard that is existing covers whole rattan and rattan W&S. Whole rattan is all types of rattan already being brushed and cleaned, but it is not yet smoked and sulphurized. Rattan W&S is rattan which has been cleaned, washed, brushed, fried and smoked.

The grading of whole rattan is principally based on stem length, light defect, broken knot and heavy defect. Light defect is defect that is caused by hole borer, crack skin, peeled skin, incised skin, and blue stain. Meanwhile heavy defect is defect that is caused by wrinkle, broken knot, and broken. Broken knot is a big hurt and black color on the stem. The requirements of large and small diameter rattan qualities are preented in Tables 5 and 6.

The circular rattans that have been standardized consist of rattan W&S, scraped rattan and peeled circular rattan. The grading of these products is similar to whole rattan, these are stem length, light defect, broken knot and heavy defect. The grading of the quality of rattan W&S, smooth polished rattan and peeled circular rattan is presented in Tables 7.

Table 5. Grading for large diameter rattan quality.

No.	Requisite	Quality			
		I	II	III	IV
1.	Length	≥ 2.5 m	≥ 2.5 m	≥ 2.5 m	≥ 1.0 m
2.	Light defect	≤ 10 %	≤ 25 %	≤ 50 %	≤ 50 %
3	Broken knot	none	≤ 5 %	≤ 10 %	> 10 %
4.	Heavy defect	none	None	none	≤ 10 %

Tabel 6. Grading for small diameter rattan quality.

No.	Requisite	Quality			
		I	II	III	IV
1.	Length	≥ 4.0 m	≥ 4.0 m	≥ 4.0 m	≥ 3.0 m
2.	Light defect	≤ 10 %	≤ 25 %	≤ 50 %	≤ 50 %
3.	Heavy defect	none	None	none	≤ 10 %

Table 7. Gradings for rattan W&S, scraped rattan, and peeled circular rattan qualities.

No.	Requisite	Quality			
		I	II	III	IV
1.	Length	≥ 2.7 m	≥ 2.7 m	≥ 2.7 m	≥ 2.7 m
2.	Light defect	≤ 10 %	≤ 25 %	≤ 50 %	≤ 50 %
3	Broken knot	≤ 10 %	≤ 10 %	≤ 10 %	> 10 %
4.	Heavy defect	None	None	none	≤ 10 %

D. *Packaging (raw and finished products)*

After being sorted based on its diameter and quality level, the rattan canes are bound according to rattan type, quality, and size. The bundles are then weighed and wrapped for shipment. For finished products like furniture or rattan carpet, after wrapping and packing, the products are put into a container van to be exported.

V. Markets and Socioeconomics

A. *Participants in the rattan sector in Each Kalimantan for sega (Calamus caesius).*

Item	Manufacturer / Exporter	Processor (medium or big)	Urban trader	Village trader	Farmer/Owner/ Gatherer
1. a. Years in Operation b. Location	1995 Surabaya, Cirebon dan Jakarta	1995 Surabaya	1995 Java and East Kalimantan	1995 Samarinda	1995 Village/Mahakam
2. Processing step	Final manufacturing	Processing III -Weaving, webbing, and transporting to Cirebon	Processing II - sulphurising, drying II, splitting and transporting to Surabaya	Processing I - cleaning, drying I, sulphurising and transporting to Samarinda	Harvesting, collecting from the field and transporting to the village
3. Types of Rattan handled	Rattan furniture	Processed semi-finished II: Woven mat and plaits	Processed semi-finished I: Peel and core	Processed raw rattan (25% to 40%)	Unprocessed (90% to 100%)
4. Volume	....	10.5 kg 7.5 m^2	10.5 kg 7.5 m^2	25 kg	50 kg
5. Price achieved	....	8.000/m2 3800/kg	2.700/kg 3.800/kg	1250/kg	300/kg
6. Total		168,000	56,850	30,000	15,000
7. Factor at each level	1.4 to 1.6	2.95	1.9	2	-
8. Distribution systems		truck	By ship	By ship	By foot
9. Membership in Association	member	member	No	No	No

Source: modified from Haury, 1995

B. *Contribution of Rattan to the National Economy/GNP*

Rattan is a forest product that brings into the country prime foreign exchange second only to wood. The contribution of rattan products during the last two year increased in terms of export volume, but decreased in export value. Indonesian rattan export in 2001 was equal to 135.805 t with value USD 300,929,134, while export volume in 2002 went up to 139.892 t but with a lower value of USD 291,037,031. This happened due to the decrease of export prices in almost all product type groups.

Table 8. Indonesian rattan export based on product types in 2001-2002.

No.	HS Code	2001		2002	
		Volume (kg)	Value (USD)	Volume (kg)	Value (USD)
1	1401.20.100	19,648,398	10,904,863	15,831,214	9,128,489
2	1401.20.500	719,390	619,621	1,825,008	1,250,321
3	1401.20.600	1,616,351	1,191,490	2,809,350	1,778,055
4	1401.20.700	44,462	46,949	42,918	56,127
5	1401.20.900	96,789	102,013	219,898	182,732
6	4601.20.300	612,985	3,411,457	644,097	3,410,780
7	4602.10.200	20,764,531	53,580,576	20,351,155	46,028,124
8	9401.50.100	64,124,365	165,943,280	68,752,930	164,468,197
9	9401.90.300	855,081	2,522,616	835,989	2,184,618
10	9403.01.100	27,322,701	62,606,269	28,579,899	62,549,588
Total		135,805,053	300,929,134	139,892,458	291,037,031

Sources: Statistical Central Bureau, 2003

Remarks:

1401.20.100 Rattan Mixed, Roughly Rubbed, Unwashed, Smokeed or Sulphured
1401.20.500 Round Rattan, Fine Polished, of A Kind Used Primarily for Planting
1401.20.600 Rattan Cores of A Kind Used Primarily for Planting
1401.20.700 Rattan Bark, of A Kind Used Primarily for Planting
1401.20.900 Rattan Other Than Split, Washed
4601.20.300 Lampit of Rattan
4602.10.200 Basketwork and The Like of Rattan
9401.50.100 Seats Of Rattan
9401.90.300 Parts Seats of Rattans
9403.01.100 Furniture of Rattan

C. *Market Channels*

Rattan in Kalimantan is generally marketed both locally and inter-islands. In local marketing, these rattans are absorbed mainly by large scale enterprises located in South Kalimantan province. Meanwhile, inter-island commerce, they are marketed mostly to some cities in Java island, like Surabaya, Semarang and Cirebon. In the local market, they are generally sold as whole rattan W&S and sliced rattan. for interisland commerce, all of them are sold as whole rattan W&S, both large and small diameter rattans.

The distribution channel of natural rattan starts from farmers/enterprises. The farmer then sells the rattan to the local merchant; later; this merchant sells it to the inter-island merchant. Based on the destination, there are three marketing channels of rattan products: these are marketing to Java island, marketing to rattan carpet enterprises, and marketing to craftsmen. Detail of market channel is as follows:

1. marketing to Java island
   a. Rattan farmer → Green rattan collector/trader → Local trader for rattan W&S → Inter island trader
   b. Rattan farmer → Green rattan collector/trader → Inter island trader
2. marketing to rattan carpet and furniture enterprises
   a. Rattan farmer → Green rattan collector/trader → Local trader for rattan W&S → Furniture or rattan carpet enterprises → retail → Export
   b. Rattan farmer → Green rattan collector/trader → Local trader for rattan W&S → Furniture or rattan carpet enterprises → Export
3. marketing to craftsmen for producing finished products
   a. Rattan farmer → Green rattan collector/trader → Local trader for rattan W&S → rattan craftsmen → rattan products traders → consumer
   b. Rattan farmer → Green rattan collector/trader → Local trader for rattan W&S → rattan craftsmen → rattan products traders → retailer → consumer
   c. Rattan farmer → Green rattan collector/trader → rattan craftsmen → retailer → consumer
   d. Rattan farmer → Green rattan collector/trader → rattan craftsmen → consumer

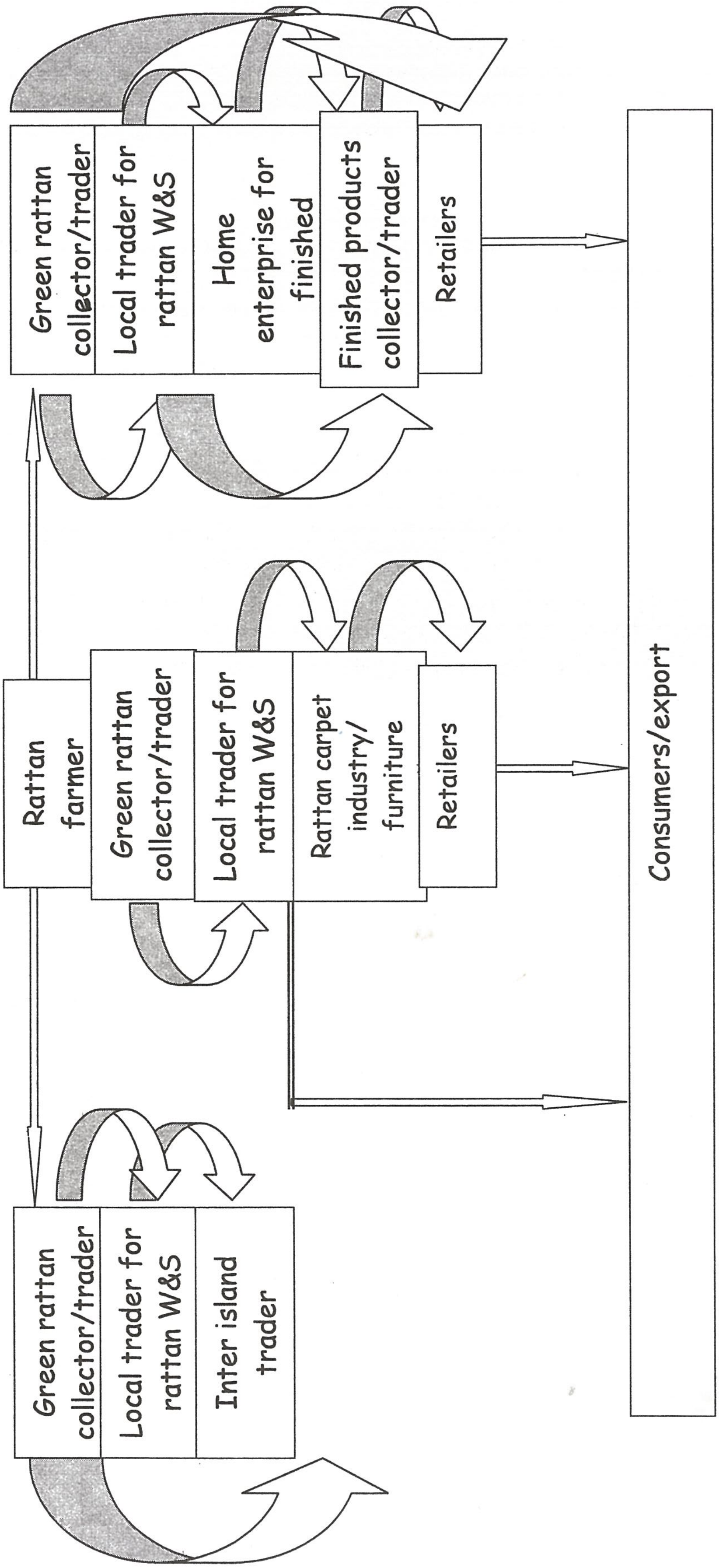

Figure 1. Market channel for rattan products

D. *Prices of various rattan products*

Rattan farmers or collectors usually sell their harvested rattan in the form of green rattan to local or colector trader in the countryside. They sell one ton of rattan around USD 38.9 to USD 44.4 Sometimes rattan is sold in the form of split rattan at USD 4.7/pack, where 1 t of green rattan yields 12 packs and one pack is equal to 1,000 pieces of sliced rattan with length of 2 m to 3 m. Thereby, in the form of slices, each ton of green rattan is sold at USD 56. With a simple processing, rattan farmers or collectors can obtain added value of about USD 11.6/t.

Local traders in the countryside clean and smoke green rattans for 3 nights, and then these are dried. The weight decreases to around 50% to 60% depending on the species. Sega decreases to 50% and pulut diminishes to 60%. Price of sega at this level for one ton is around USD 105.6 to USD 111.1. Local traders sell the product to the subdistrict trader. With further processing, they can obtain added value of USD 13.8/t to USD 16.7/t.

Local traders sell their rattan to traders at the sub-district level. Traders at the sub-district select split rattans based on length and quality. Then, they sell one pack of selected rattans to the rattan carpet makers at USD 4.4 to USD 5.6. From this, they get a profit around USD 4/t to USD 6.7/t. Beside buying split rattan, local traders at the sub-district also buy green rattans. Then, they resmoke green rattan to attain more brightness. After being sorted, resmoked rattan is bound and sent to inter-island traders at Samarinda through rivers. One ton of resmoked rattan is about USD 133.3 to USD 144.4 with the delivery cost of USD 30.6. Each ton rattan that they sell, they get a profit of around USD 13.9 to USD 26.7. Besides that, inter-island traders also buy split rattan. Without any further treatment, they sell these rattans at USD 5.6/pack to rattan carpet enterprises. From selling this product, they get a profit of USD 6.7/t to USD 10.7/t (Gunawan. 2002). Schematically, selling prices and profit level for every marketing level are shown in Figure 2.

Level	Selling price (USD/unit)	Profit (USD)
Rattan farmer gatherer	38.9 to 44.4	
local processor at village	56/t	11.6/t
local collector for green rattan (cleaning and smoking treatment)	105.6/t to 111.1/t	13.9/t to 26.7/t
local trader for split rattan at sub district	60/t to 66.7/t	5.3/t to 6.7/t
local trader for rattan W&S	133.3/t to 144.4/t	27.8/t to 33/t
Finished products craftsman/ enterprises		
- Furniture	0.6/unit to 19.2/unit	0.4/unit to 11.1/unit
- Webbing	0.4/score to 1.1/score	0.2/score to 0.9/score
- Carpet	$3.1/m^2$	$0.7/m^2$

Figure 2. Selling prices and profit level for every marketing level.

Note: A score contains about 20 sheets of webbing. Assumption USD 1 equal to Rp 9000.00.

E. Financial Feasibility of Rattan Plantations and Manufacturing

1. Rattan plantations

The profitability of an irit rattan plantation in small scale, one hectare, has been analyzed. Plant space is around 5 x 5 m and one hectare contains 400 seedlings. Cost analysis and profit for this rattan plantation are as follows.

Table 9. Cost analysis and profit for rattan plantation in one hectare.

No.	Breakdown of expense activity	Cost (USD)
A.	Cultivation and maintenance up ready to be cropped at 7 year old	
1.	Picking natural seedling from forest @ USD 0.1 x 400 seedling	40.0
2.	Cleaning on planting column 1 ha: 10 man day work x USD 0.8	8.0
3.	Making of plant holes, 400 holes x USD 0.05	20.0
4.	Maintenance twice a year for 7 years: 2 x 7 year x 7 man power x USD 0.8	78.4
	Amount	146.4
B.	First harvest at 7 years old with harvest estimation around 400 clump x 16 mature stems per clump, length 20 m = 14.2 ton wet rattan. Cost of harvest, transportation, deglazing, and bleaching: 14.2 ton x USD 27.8	394.8
C.	Total expenditure A and B	541.2
D.	Selling price for wet rattan 14.2 ton x USD 66.7	946.7
E.	Profit for first harvest: D – C	405.5
F.	Profit for second harvest: D – B + increasing in harvest yield 20% - maintenance cost (4 times x 7 man power x USD 1.1)	631.6

Source: Januminro. 2000. Assumption: USD 1 equal to Rp. 9000.00.

To make seedlings available in large numbers, its price can be depressed to USD 0.01/ to USD 0.016/seedling. Based on the analysis carried out by the Ministry of Forestry to develop rattan plantation in large scale, rattan plantation development gives good profit. Financial analysis on rattan plantation in some provinces can be seen in Table 10.

Based on economic activity of rattan plantation development in 5,000 hectares in several provinces, the adequate advantage with IRR above loan rate average is at 12%. Calculation of BCR, comparison between expenditures and earning multiplied with interest rate give a value more than one, meaning that earnings are higher than expenditures.

Table 10. Financial analysis on rattan forest development at some provinces in Indonesia.

No.	Location	Area, ha	NPV x Rp. 1000	Interest rate %	BCR	IRR %
1.	West Sumatra	5000	8.177.097	12	2.32	19.93
2.	South Sumatra	5000	7.378.000	12	2.06	17.40
3.	Central Kalimantan	5000	7.377.942	12	2.06	17.00
4.	East Kalimantan	5000	5.168.511	12	1.56	15.62
5.	Sulawesi tengah	5000	3.106.370	12	1.64	18.76
6.	South-East Sulawesi	5000	1.892.400	12	3.47	13.75

Source: Januminro. 2000

2. <u>*Making furniture*</u>

The process of making furniture is a mixture of mechanical process (rattan trimming and pattern) and working of traditional art (forming rattan finished product manually). In handicraft making, the process covers these steps: rattan trimming in accordance with the size of a model product, forming product model by means of print appliance, cordage, polishing, and drying. Expenses in making furniture are shown in Table 11. Indonesia Bank estimated that a price for one set of furniture around is USD 48. Thereby, in one year, the sale value is about USD 60,000.

Table 11. Financial analysis on furniture processing.

No.	Cost Item	Unit	Cost (USD/Unit)	Total Cost (USD)
1.	Fixed Cost			
	a. Buildings for production	200 m2	22.2	4,440.0
	b. Equipments	Varied	Varied	1,865.0
	c. Electricity, 4000 watt	1.00	2,222.2	2,222.2
	Sub total 1			6,531.7
2.	Operational cost for 1 set furniture			
A.	Raw material			
	a. Semi polished rattan 98/30 mm	6.00 stems	1.3	8.0
	b. Polished rattan 18/20 mm	2.50 stems	0.4	1.04
	c. Core 8/9 mm	1.50 kg	1.3	2.0
	d. Others	Varied	Varied	2.4
	Sub total A			13.8
B	Transportation cost	1.00	0.1	0.1
C	Workers			
	a. Frame processing	1.00	0.8	0.8
	b. Holing and finger manufacturing	1.00	0.4	0.4
	c. Binding	1.00	0.2	0.2
	Sub total C			1.4
Total A+B+C				14.3
The furniture production in 1 yr is about 1250 units				17,857.9

Source: Indonesian Bank

VI. POLICY AND LEGISLATION

A. *Forest charges (by species, volume, FOB market prices).*

Along with the regional autonomy era, a resources royalty provision previously exercised by central government, has now moved to the local government. Based on the information from the field, the provision for rattan collection is around USD 10/t depending on the regional district, which releases the regulation. However, this provision is not subjected to the rattan gatherer, but to the collector.

B. Allowable cut (policies regulating harvest)

In 1989, the Minister of Forestry released a permit of harvesting rights for rattan with the decree No. 208/Kpts-II/1989. However, this decree did not mention any limit to the number of rattan stem that can be harvested. This is important due to the fact that over 90 % of the production is obtained from the natural forest, and the remaining 10 percent being mainly small diameter rattans harvested from plantations.

C. Policies controlling or regulating internal and/or external trade of rattan

Since early 1970 up to year 1980, Indonesia has been known as an exporter country of raw rattan. At this period, raw rattan from Indonesian dominated the international market, but the export value that was obtained by the rattan industry in Indonesia was smaller than that of the other exporter countries, which imported raw rattan, reprocess these and re-export them to Indonesia. Considering this reason, the government in 1979 released a Decree of the Minister of Trade Number 472/Kp/VII/79 concerning a export ban of raw rattan (raw rattan which have been deglazed but not yet cleaned, smoked or sulphurized) throughout Indonesia. This banning was expected to improve job opportunity and foreign exchange through the development of rattan processing enterprises in the country. However, the banning policy did not stimulate an increase in rattan finished products, and raw rattan still dominates Indonesian rattan export. In the middle of the 1980s, the rattan export of Indonesia was gradually dominated by half-finished products, while an export on rattan finished products was not showing any progresses.

Due to the increasing in an export of half finished products threatened natural rattan resources, in 1986 government released a Decree of The Minister of Trade Number 274/Kp/X/86 concerning rattan export chain. This policy decided to prohibit raw rattan export starting 8 October 1986. With this Decree, an export of half finished products increased dramatically. In July 1988 government published a Decree of The Minister of Trade Number 190/Kp/VI/88 that an export of half finished products were totally banned. Since 1989, export value of Indonesian rattan has almost entirely come from finished products. However, this policy and a Decree of The Minister of Trade Number 410/Kp/XII/88 concerning a determination of exporting quota have resulted on a negative impact on rattan enterprises of half-finished products, with some factories closing down,.

The policy of export banning of half-finished products opposes the international agreement contained in the GATT (General Agreements Trade Tariffs) Uruguay rotation which had been ratified by Indonesia. In 1992, this banning policy was changed with stipulating of export taxes on raw rattan and half-finished products to USD 10/ and USD 15/kg (a Decree of Minister for Finance No. 534/KMK.013/1992). In 1997 with a Decree of Minister of Finance No. 554/KMK.01/1997 the export tax on raw rattan and half-finished products became USD 10/kg. The industrial pattern did not change and rattan export was still predominated by rattan finished products.

Along with the reform era and IMF (International Monetary Funds) pressure, Indonesia came out with an LOI (Letter Of Intents), policies on the rattan industry and commerce in Indonesia havebeen liberalized. In the year of 1998, there were published various regulations to give more freedom to the rattan industry. Export taxes turned into ad valorem (based on export check price). Tax rate was specified equal to 30%, and later it decreased to 20% (Decree of Minester of Finance No. 107/KMK.017/1999) and finally only to 10% (Decree of Minister of Finance No. 567/KMK.017/1999) in the following year. Based on the Letter of the Director General of Foreign Trade No. 499/djpln/xii/2002 dated December 31, 2002 that was effective from January 1, 2003 through March 31, 2003. Check price of rattan export (FOB) is presented in Table 12. Thereby, the tax value which must be paid by exporter to government is 10 percentage of rattan product exported volume.

Table 12. Check Prices of Export Commodities (Fob).

HS Code	Type of rattan	Price USD/Kg	HS Code	Type of rattan	Price USD/Kg
1401.20.100	**1. Mixed rattan, roughly rubbed, unwashed, smoked or sulphured** :		1401.20.100	**d. Rotan Tohiti**	
	a. Rotan pulut			(1) Tohiti	1.00
	(1) Pulut Merah	3.00		(2) Telang	1.00
	(2) Pulut Putih	2.00		(3) Batang	1.00
	(3) Lilin	1.00			
	(4) Lacak	1.50			
	(5) Datok	1.95			
1401.20.100	**b. Rotan Sega**	0.80	1401.20.100	**e. Rotan Manau**	2.25
	(1) Sega/Taman	0.80	1401.20.100	**f. Rotan Semambu**	
	(2) Sega Air/Ronti	0.80		1) Semambu	1.00
	(3) Sega Badak	0.88		(2) Tabu/Jelayan	1.00
	(4) Irit/Jahab	0.83		(3) Wilatung	1.00
	(5) Kooboo/ Soft	0.75		(4) Nawi	1.00
	(6) Uitschort			(5) Dahan	1.00
1401.20.100	**c. Rotan Lambang**		1401.20.100	**g. Rattan of other kinds**	1.90
	(1) Lambang	1.00			
	(2) Anduru	1.00			
	(3) Lita	1.00			
	(4) Sabutan	1.00			
	(5) Ampar Tikar	1.00			
	(6) Tarumpu	1.00			
	(7) Jermasin	1.00			
HS Code	**Type of rattan**	**Price USD/Kg**	**HS Code**	**Type of rattan**	**Price USD/Kg**
	2. Rattan, fine			**3. Rattan cores**	
1401.20.500	**polished**	0.90	1401.20.600	a. Umbulu	0.55
1401.20.500	a. Manau	0.70	1401.20.600	b. Fitrit	0.60
1401.20.500	b. Batang	0.75	1401.20.600	c. Hati Rotan Oval	
1401.20.500	c. Tohiti	0.60		Pipih	0.70
1401.20.500	d. Semambu	0.55	1401.20.600	d. Sabutan	0.55
1401.20.500	e. Jelayan/Tabu	0.55	1401.20.600	e. Jermasin	0.55
1401.20.500	f. Tarumpu	0.55	1401.20.600	f. Anduru	0.55
1401.20.500	g. Tanah	0.55			
	h. Manuk				
1401.20.700	**4. Rattan bark**	0.65	1401.20.900	**5. Others**	0.65

D. *Policies controlling or regulating access to rattan raw materials/products*

In the period 1970-1980, Indonesia exported only raw rattan. In 1979 government released a policy through Decree of The Minister of Trade Number 472/Kp/VII/79. By this policy rattan processing industry developed, so that the industry could produce half-finished products. In the year of 1986 government released a Decree of The Minister of Industry and Trade Number 274/ Kp/X/86 concerning rattan commercial export. With this policy, rattan industry was pushed to improve rattan semi-finished product. In July 1988, regulation on rattan industry was published under a decree of Minister of Trade No. 190/Kp/VI/88). The decree mentioned that rattan half-finished products are prohibited to be exported. The existing policy pushed rattan enterprises to produce finished products.

E. *Policies on biological protection and genetic conservation*

There is no policy yet on rattan biological protection and genetic conservation. But in the Decree of Minister Forestry No.148/Kpts-II/1989 concerning rattan concession rights (HPH), a policy on that matter can be seen implicitly in its objective stating that those who hold the rattan concession have to preserve rattan canes and improve production.

VII. INSTITUTIONAL CAPABILITY AND LINKAGES

A. *Academy*

Research on various aspects of rattan has been conducted by Faculty of Forestry from various universities, such as Bogor Agriculture University, Gajah Mada University, Hasanudin University, Mulawarman University Lambung Mangkurat university, etc. But these research activities are not yet integrated properly, because each institution still carry out research on their own without consulting the others. Only at certain times usually these institutions can sit together in seminar to present their research results.

B. *Government*

Some governmental institutions who handle rattan activities include the Ministry of Forestry, Ministry of Industry and Trade, Ministry of Finance, etc. The institutions under Ministry of Forestry handling rattan are Directorate General of Land Rehabilitation and Social Forestry (RLPS), Forestry Research and Development Agency (FORDA), and Directorate General of Forest Utilization (PH). Sub Directorates under RLPS and PH conduct rattan activities in practice, as cultivation, harvesting, technical guide, etc. Meanwhile, FORDA conducts activities on the field of research and development in all aspects. There is also Ministry of Industry and Trade and Ministry of Finance in rattan industry and policy. In the year 2002, one of the institutions under Secretary General of Ministry of Forestry tried to coordinate various institutions in the Ministry of Forestry which involved in rattan activities, besides other commodity of NWFP"s. This activity tried to compile the various results that have been reached and to reralize the possibility of research or study which need to be conducted according to the function and duty from each institution.

C. *Nongovernment organizations*

Society self-supporting institute (LSM) or other organizations in rattan include Indonesian Handicraft Assosiation (ASMINDO), SHK Kaltim, LATIN, Yayasan Dian Tama, etc. ASMINDO focus on the aspects of rattan exporting and industry; while, others focus on the development of rattan cultivation to improve earnings of local society.

In the year 1999-2001, SHK Kaltim had coordinated public discussion of various problems of rattan facing through the internet, but unfortunately the discussion did not continue. Moreover, the conclusion from the discussion is not yet known and distributed, and what stages is required to develop rattan.

D. *International linkages*

Some international institutes that have conducted studies or research on rattan in Indonesia include IDRC, Europe Union, INBAR, CIFOR, etc. IDRC cooperated with FORDA-Ministry of Forestry in the year of 1985-1991 and carried out a rattan project. The European Union working along with Ministry of Forestry in 2000-2001 established a rattan plantation in Bahu Palawa, in Tumbang Hiran and Tumbang Manggo Village in Central Kalimantan. This Institute has also studied a rattan production in Central Kalimantan. In the year of 1992-1994 INBAR worked together with FORDA in constructing a rattan database, and their abstracts can be seen in the website. In addition, CIFOR had also carried out a study on policy impact of rattan in 2000-2002. At the end of their study, their results were communicated through workshops or seminars inviting various parties who handled rattan activities.

VIII. ISSUES, RECOMMENDATIONS R AND D STRATEGIES

A. *Production*

Issues: Production scarcity of raw material
Recommended Solutions: Diversification on species utilization
R & D Strategies to address Issues:

1. Study on harvesting and postharvest handling of non-commercial rattan
2. Study on basic properties of non-commercial rattan
3. Utilization of rattan fruits for dragon's blood production
4. Exploration of rattan plants for food and medicinal production
5. Development of post-harvest handling

B. *Protection*

Issue: Decreasing quality of raw material resources
Recommended Solutions: Requiring postharvest processing near rattan plantation area
R & D Strategies to address Issues:
Development of postharvest handling

C. *Industry*

Issue: decreasing raw materials and producing much rattan waste at Industry
Recommended Solutions: Waste utilization and improving rattan raw material and
R & D Strategies to address Issues:

1. Study on rattan waste as raw material for composite products
2. Study on an estimation of rattan industrial waste
3. Study in rattan products diversification

D. *Market*

Issue: Length of the rattan marketing system leads to the rattan price not remunerative enough
Recommended Solutions: Shortening market chain
R & D Strategies to address Issues:

1. Study on profit margin starting from rattan farmer to large and medium rattan industry
2. Study on profit sharing between rattan farmer and rattan industry
3. Study on determining basic price of rattan at farmer level
4. Marketing price distribution and production flow

E. *Information system*

Issue: lack of marketing information at farmer level
Recommended Solutions: Providing market information at farmer level
R & D Strategies to address Issues:
Establishing information network of rattan marketing at all levels

F. *Policy*

Issue: Illegal trade and lack of sensitivity to the needs of the rattan farmer
Recommended Solutions:

1. Implementation of export tax conducive to the stimulation of an increase in raw material trade in domestic market
2. Provide incentives to rattan farmer

R and D Strategies to address Issues:

1. Study policy impact of increasing export taxes of rattan raw materials on farmer and industry
2. Study the provision of incentives to the rattan farmer for establishing rattan plantation at LOA

G. *Linkage*

Issue: Unharmonious rattan policy among central, government, province and regency
Recommended Solutions: Harmonizing rattan policy at all government level.
R & D Strategies to address Issues: Study a policy on rattan resources and trade at districts

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Matrix 1. Issues and Concerns confronting the rattan industry and recommended solutions and Research and Development (R & D) strategies to address concerns.

Issue/Concern	Recommended Solution	R and D Strategy to Address Issue/Concern
1. Production: a. Scarcity of raw material	1. Diversification on species utilization	1. Study on harvesting and postharvest handling of non commercial rattan 2. Study on basic properties of non commercial rattan 3. Utilization of rattan fruits for dragon's blood production 4. Exploration of rattan plants for food and medicinal production
	2. Using a wise harvesting technique	1. Study on developing a wise harvesting technique 2. Study on estimating rattan harvesting waste
	3. Development of rattan plantation	1. Site matching 2. Study on supporting tree for rattan cultivation 3. Study on rentability comparison of rattan plantations 4. Species and land suitability for nonendemic rattan species
2. Protection on Quality of raw material resources	1. Requiring postharvest processing near rattan plantation	1. Development of postharvest handling
3. Industry a. decreasing in raw material	1. Improving rattan raw material and products quality	1. Grading system of rattan raw material and products
	2. Products diversification	1. Study rattan products diversification
b. rattan waste	1. Waste utilization	1. Study rattan wastes on the possibility of turning them into raw materials for composite products 2. Study on an estimation of rattan industrial waste

Matrix 1. Issues and Concerns confronting the rattan industry and recommended solutions and Research and Development (R & D) strategies to address concerns *(continuation)*.

Issue/Concern	Recommended Solution	R and D Strategy to Address Issue/Concern
4. Marketing Length of an existing of rattan marketing system leads to the rattan price not numerative for the farmers	1. Shortening market chain	1. Study on profit margin starting from rattan farmer to large and medium rattan industry 2. Study on profit sharing between rattan farmer and rattan industry 3. Study on determining basic price of rattan at farmer level 4. Marketing price distribution and production flow
5. Information Systems a. lacks of marketing information at farmer level	1. Providing market information at farmer level	1. Establishing information network of rattan marketing level
6. Administrative a. Policy implementation - Illegal trade	1. Implement export tax condussively to stimulate an increasing in raw material trade in domestic market	1. Study a policy impact of export tax on rattan farmer and industry
- Lack of insentive	1. Provide insentive to rattan farmer	1. Study on providing insentive to the rattan farmer for establishing rattan plantation at LOA
b. Linkages Unharmonious rattan policy among central, government, province and regency	1. Harmonizing rattan policy at all government level.	1. Study a policy on rattan resources and trade at every districts
c. Tenurial system not clear	1. Providing law certainty for both government and society land for rattan establishment at out side or in side forest area.	1. Institutional study on rattan establishment outside or inside forest area.

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Matrix 2. Strengths, weaknesses, opportunities, threats in the Rattan industry.

Item	Strength	Weakness	Opportunity	Threat
1. Production of Raw Materials	• Stability in supplying rattan raw material • Many rattan species to be used in rattan industry • Possessing large number of species and good quality of raw material • Natural rattan plants can be cultivated • Distribution of rattan plants throughout Indonesia	• Scarcity of raw material of commercial rattan • Only few rattan species have been utilized • Weakness in handling harvesting and postharvest activities which lead to decreasing in quality • Most raw materials are coming from natural forest • Lack of gatherer's knowledge on raw materials quality of required market • Not enough capital for farmers to gather natural rattan or to cultivate rattan plant.	• Improving number and rattan species to be utilized. • Development of forest plantation • Developing wise harvesting technique • Highly bargaining position for farmer • Improving prosperity of forest dwellers • Providing scheme credit for the rattan farmers • Improving local earning	• Low in rattan price • Smugglings • Using unwise harvesting technique
2. Marketing a. Raw Materials	• Highly supplying potency of raw material to rattan enterprises • Possessing natural durability and easy to be formed • High demand	• Inequitable rattan price due to long marketing chain • A little of raw material information at local farmer • Highly fluctuation of rattan price at farmer and craftsmen level	• Equitable rattan price • Shortening market chain • Determining basic price of rattan at farmer level • Increasing in earning of local government	• Scarcity of raw material for industry • Illegal trade • Lack of supply in raw materials due to low price

Matrix 2. Strengths, weaknesses, opportunities, Threats in the Rattan industry *(continuation).*

Item	Strength	Weakness	Opportunity	Threat
2. Marketing b. Finished Products	• 90 % of finished products for exporting • Very potential for International market • Various production types and usable product every where • High esthetical value and comfortable	• Weakness of international rattan price information • Weakness of bargaining position at international market • Less innovative of product design	• Extending in market segmentation • Improving main role in international market • Increasing in foreign exchange • Highly probability in innovation of new products	• Limited in market international supply • Increasing in rattan industry competitors in other country
3. Utilization/ Manufacturing	• High availability of industrial number and capacity • High availability of craftsmen • High number of cheap labor • Simply operated equipments	• Low Utility • Less friendly technology process • Conventional equipments and process. • Postharvest processors' low motivation • Low in modification processing	• High opportunity to increase in production volume • Opening on diversify of species utilization of non commercial rattan • Development of rattan product diversification • High opportunity to innovate new product • Opening development on processing technology. • Waste utilization	• Existence of synthetic rattan products • Existence of cheap rattan product from competitor country • Pollution.

Matrix 2. Strengths, weaknesses, opportunities, Threats in the Rattan industry *(continuation)*.

Item	Strength	Weakness	Opportunity	Threat
4. Policy	• Prevention of raw rattan export by high export taxes • No taxes on finished products export • Only the industry that can export rattan finished products	• Less conducive of existing policy to rattan farmer. • Less socialization on released rattan policy to rattan farmers • Weakness to control in rattan policy implementation • Less harmonized and unsynchronized of rattan policy between central government and local government, and among local governments	• Improving to control rattan policy implementation • Improving market chain and administrative policy • Harmonizing and synchronizing rattan policy between central government and local government, and among local governments	• In autonomy era, local governments tend not obey the rattan policy from central government • Rattan traders tend not to obey an existing policy • Local government policy flange to monopolies • Convention policy
5. Information system	• High development on information network	• Rattan resource areas have not yet been reached by information network. • Relatively costly in information network usage	• Opening request of information network development in rattan producing center	• High investment on networking development • No transparency of market actor in providing rattan price information
6. Institutions	• Rattan postharvest and farmer association in some region • Existing of Indonesian handicraft Associations (ASMINDO) • Promotion on finished products by ASMINDO to other country • Availability of many research scientist in rattan activities	• Lack of farmer association at any local government • ASMINDO more accommodating the importance of downstream industry • No institution to conduct rattan activities	• Opening to establish farmer association at all rattan producing center • Possibility in forming special institution to conduct rattan activities	• No motivation of all stake holder to establish rattan association

Country Report on Status of Rattan Production and Utilization in Lao People's Democratic Republic

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I. INTRODUCTION

The Lao People's Democratic Republic (Lao PDR) remains amongst the least developed countries in the world. It has a sparse population with a high proportion of forest. Lao PDR is hindered in its trade options because it is land-locked surrounded by 5 countries: Vietnam in the East, Thailand in the West, China in the North, Cambodia in the South and Myanmar in the North-West. It has a tropical monsoon climate with a prolonged dry season, especially in the lowlands. The specifics of the country's climate, temperature and precipitation are described below:

Climate: rainy season occurs in May to November, intensive rain in August-September and dry season starts in December until April – the hottest month

Temperature: ranges between 17°C to 31°C

Precipitation: ranges from 1500 mm to 2800 mm.

The total land area is 230,800 km^2 with a population estimate of 5.5 million. Annual population growth is 2.5% and has a rural population of 82.9%. Its geographic coordinates are 18 00 N and 105 00 E with a current forest cover estimates of 17 million ha or 47% of the total land area. The six main forest types and their respective areas are:

1. Dry Dipterocarp:	1,206,000 ha
2. Dry evergreen:	1,147,000 ha
3. Mixed deciduous:	8,315,000 ha
4. Coniferous:	132,000 ha
5. Mixed conifer:	280,000 ha
6. Gallery:	88,000 ha
Total:	11,168,000 ha

Sources: MRC/GTZ, 1997.

Globally rattan is seen principally as a cane-producing plant. Nonetheless, in Lao PDR and northeast Thailand rattans also supply great quantities of edible shoot tips. These are consumed locally or exported to Southeast Asian communities in France, United States and elsewhere.

Good rattan taxonomy is crucial since many Asian species differ in quality, abundance, growth rates and other aspects. Without a common, shared system of species names it is almost impossible to discuss the status of the resource or the means to manage it.

District and provincial foresters hold much of the existing knowledge on rattans which are organized according to local species names as used by the villagers. It is understood that the same species can have different local names in different places. Oftentimes, same names are applied to various species in different areas and pairs of species can even swap their local names from one area to the next.

Few species are predominant in the trade at present because of their quality and abundance. The export of unprocessed or "initially processed" cane is forbidden (Prime Minister's Order 14/psl, September 1990). Rattan canes utilization could be classified into two: (1) handicraft processing, and (2) furniture processing. Villages/local communities are involved in the first type while private companies are engaged in the latter. Rattan used by the villagers and furniture companies are different species. Communities use more species than the firms do. Seventy percent of finished products from villages and companies are for exports. Rattan finished products from villages are mostly going to neighboring countries, especially to northeast of Thailand. Manufacturers/workers both in villages and in companies are mostly women and handicapped people. During the weekend, children in villages are enjoined to help their parents in handicraft processing.

Rattan canes pre-processing is simple. In villages, canes are sun-dried and smoked whereas factories boil canes in diesel solutions.

Rattan plantation in Lao PDR focuses merely on species shoot production of edible rattan shoots. This practice, however, is still in small scale and in limited areas. Management and regulation system on rattan harvesting is still weak. Harvesting, marketing and consumption of rattan shoots are widespread throughout the country leading to shortage in cane productions. There is no initiative to establish rattan cane plantation in the country for reasons mentioned earlier. Some communities tried enrichment planting but the results are not satisfactory due to poor monitoring.

II. RATTAN RESOURCES

A. Known rattan species in Lao PDR

With the intensive work of research staff of the Forestry Research Center (FRC) and with the close support of Darwin Initiative (DI), *"A Field Guide to the Rattans of Lao PDR"* was made in year 2001. The results of taxonomy study supported by the United Kingdom Government through the DI showed out of 43 rattan species discovered, 37 are climbing and so produce cane. At least 20 have canes of moderate or high quality. Most others have very short or brittle canes but there are still some species lacking information. In rattan species found, 32 were identified (Table 1) and the rest are still to be studied.

Table 1. Rattan species IN Lao PDR identified by the FRC and DI in 2001.

No	Species	No	Species	No	Species	No	Species
1	*Calamus tenuis*	9	*C. guruba*	17	*C. hypoleucus*	25	*C. plastiacantus*
2	*C. harmandii*	10	*C. gracilis*	18	*C. laoensis*	26	*C. wailing*
3	*C. erectus*	11	*C. henryanus*	19	*C. longisetus*	27	*Daemonorops jenkinsiana*
4	*C. viminalis*	12	*C. solitarius*	20	*C. flagellum*	28	*Korthalsia laciniosa*
5	*C. siamensis*	13	*C. oligostachys*	21	*C. rudentum*	29	*Myrialepis paradoxa*
6	*C. acanthophyllus*	14	*C. tetradactylus*	22	*C. rhabdocladus*	30	*Plectocomiopsis geminiflora*
7	*C. acanthospathus*	15	*C. kingianus*	23	*C. palustris*	31	*Plectocomia pierreana*
8	*C. poilanei*	16	*C. bimaniferus*	24	*C. nambariensis*	32	*P. himalayana*

B. Significance of forest products to the economy

Lao PDR has a poor, predominantly rural population who rely on wild-harvested resources for an important part of their diet (especially after bad harvests) and cash income (Foppes and Ketphanh, 1997 and 2000). Timber harvesting contributed 35% to 40% of export earnings in 1997 (FAO, 1998). This has dropped sharply since the Asian Economic Crisis of 1997 when timber prices collapsed. The trade in other forest products is also substantial (about 2.5% of total export earnings in 1996) and very diverse (Foppes and Ketphanh 1997). Recent estimates suggest that local subsistence uses of NTFPs, taking place outside the cash economy, may be equivalent to a very significant 20% or more of Gross Domestic Product (Foppes and Ketphanh, 2000).

C. Wild sources of rattan cane

Cane production in Lao PDR is entirely from wild stocks. Forest cover was estimated at 110,000 km² in 1989 (FAO, 1998) but may now be closer to 95,000 km² (Duckworth et al. 1999). Deforestation is rapid, but current figures are under reassessment.

Two broad forest types probably hold the main commercial populations of rattans: evergreen or semi-evergreen lowland forests dominated by dipterocarps and evergreen hill forests dominated by Fagaceae and Lauraceae. The total area of forest suitable for rattans is not clearly known, but Berkmüller et al. (1995a) estimated the total area of well-stocked, closed canopy forest as about 22,000 km² in 1989. The area is undoubtedly much lesser now. Since no formal inventories have been made, rattan stocks within these forests are known only in broad, qualitative terms, based mainly on the observations of professional foresters. Generally, rattan stocks are excluded in timber inventories and no formal monitoring is being undertaken.

Forest plantations are not yet abundant in the country and produce almost no rattan cane since wild regeneration is slight and deliberate planting for cane production does not yet occur.

D. Key commercial species

Species of known commercial importance in the Lao People's Democratic Republic are listed in Table 2. The most important large-diameter species is *Calamus poilanei*. Most important small-

Table 2. Rattan species of known or suspected commercial importance in the Lao People's Democratic Republic.

Species	Diameter	Known distribution[1]	Status and regeneration habit (all species clustering unless stated)
Calamus poilanei	Large	C and N, 300 m to 1,300 m	Very heavily harvested throughout. Declining. Solitary stemmed.
C. nambariensis	Medium	Mainly N and parts of C, 1,400 m to 1,800 m	Status unknown. Records remain unconfirmed.
C. platyacanthus	Medium	Mainly N and parts of C, 750 m to 900 m	Status unknown. Records remain unconfirmed.
C. wailong	Medium	Mainly N and parts of C, 350 m to 600 m	Status unknown.
C. viminalis	Medium	Thrt, 100 m to 600 m	Populations in scrub secure, but cane stocks low. Forest populations harvested in N.
C. gracilis	Small	C, southern half of N, 300 m to 750 m	Heavily harvested, Status unknown.
C. solitarius	Small	C, southern half of N, 200 m to 600 m	Heavily harvested. Probably declining. Solitary stemmed.
C. palustris var *cochinchinensis*	Small	Probably thrt, rarer in far N, 100 m to 650 m	Heavily harvested. Status unknown.
C. tetradactylus	Small	Mainly S, 100 m to 600 m	Status unknown.
C. acanthospathus	Small	N, 1800 m	Status unknown.
C. tenuis	Small	Southern half of N, 200 m to 300 m	Heavily used around Vientiane. Survives in scrub, but localized.

[1] From Evans et al. in press
N = North (North of Route 8)
C = Central
S = South (South of Xe Banghiang)
thrt = throughout (following Duckworth et al., 1999)

diameter species include *C. palustris, C. gracilis, C. tetradactylus* and the newly described *C. solitarius* (Evans et al., in press b). The medium-large *C. platyacanthus* (especially important in Viet Nam) also occurs. The list is not yet complete: knowledge is best for central the Lao People's Democratic Republic and the southern half of the north, and fieldwork has been much less extensive in other parts of the country. Several of these species have been identified by INBAR as high-priority species for further research at an international level (Williams and Rao 1994, Anon. 1997).

E. Data on abundance and depletion

There is very little resource information where national government can base its management decisions and policies. Forestry officers and villagers hold much of the data and knowledge on rattan. Recorded or not, they are not available for incorporation into a national-level review.

During the DI project, preliminary studies were conducted on the growth rates of *C. viminalis* and *C. solitarius* but the results of these studies are not yet available for publication. Evans (2000) said quantitative information is only available for *C. poilanei*, and even then, it is very fragmentary.

C. poilanei is the country's elite large-diameter cane. It is single-stemmed and regenerates only from seed after cutting. Thus, it has a poor regeneration capacity like *C. manan* from Malaysia (Dransfield and Manokaran, 1993). Current evidence suggests that heavy harvesting is putting the species at high risk of commercial extinction in the Lao PDR in the foreseeable future. Three Lao species listed as being at global risk of extinction are *C. poilanei, C. harmandii*, and *C. godefroyi.*

The status for other commercial species is unknown. There are extensive forest areas where small-diameter canes have been seriously over-harvested. During a recent socio-economic survey, traders and manufacturers widely reported that lack of raw materials was limiting their businesses and some factories had already closed for this reason (Sengdala *et al.*, 1997). This was partly due to administrative difficulties with permits and poor road access to rattan-bearing forests. Nonetheless, the national picture is likely to be rather better than for *C. poilanei* if only because other species are less valuable (and so less sought after), had higher initial densities and are mostly clustering (i.e. resprout after cutting). They thus persist in harvested areas and have the potential to regenerate more rapidly when pressure eases. One small-diameter species (*C. solitarius*) is solitary-stemmed and, although more abundant than *C. poilanei* even in areas where both have been harvested, it should give some cause for concern. The high-altitude species *C. acanthospathus* apparently tends to produce only one or two stems. This may make it especially vulnerable to over-harvesting in the Lao PDR.

III. PRODUCTION AND RESOURCE MANAGEMENT

Land tenure in the Lao People's Democratic Republic is being restructured. Partial control of forest land is being allocated by the state to some communities. This programme is new and still evolving. The present *de facto* situation is that most forest areas (particularly those very far from villages where they retain rattan stocks) are not under the control of any individual or community. For most non-timber resources (fish, game plants, grazing), the customary land-use regime in remote areas is open access harvesting and with no community ownership of particular areas or resources. Low population pressure, huge forest areas and the cultural preference to avoid conflicts have fostered this. By encouraging unregulated competition between users, open access is one factor which encourages the over-harvesting of rattans.

There are government regulations on rattan harvesting but it is not clear if they are intended to preserve stocks. Sometimes they contribute to resource depletion. For example, harvesting that led to a collapse of *C. poilanei* stocks around Sayphou Phaphet (Annex 4) was done to satisfy official and legal quotas given to a legitimate trader by the provincial authorities. An accurate analysis of the effect of policy and regulations on rattan stocks is not possible because those regulations are rarely publicly available (Enfield et al. 1998). The central government grants total provincial quotas and then each province apportions its allowance to a number of approved manufacturers (Sengdala et al., 1997; Enfield et al. 1998). They subcontract traders who employ villagers to cut the rattan and bring it to a roadhead or up to the concerned villages. The quota specifies a volume, general source or area and is valid for one year. The process of deciding quotas is very unclear to most participants in the supply and marketing chain, and is not open to independent scrutiny (Enfield et al. 1998). Although some regulations mention the need to inventory the wild stocks and assess the effect on future yields at the site this is not thought to be enforced other than by reliance on vague "common knowledge" that certain areas have many rattans (Enfield et al. 1998).

Individuals or communities cannot sell large quantities (i.e., truck-loads) of rattans unless approached by a quota-holding trader. In general this is a restraining influence. However, when a quota-holder does visit, the incentive for all parties is to harvest the greatest volume of rattans possible during the brief window of opportunity. The result is the stripping of commercial rattan species from an area of forest without considering any worthwhile harvest in the following years.

A significant feature of the trade is that the rural collectors are often paid at very low rates for their cane, as is found throughout Asia (Belcher, 1999). This is partly because they have little access to price information, partly because one trader has a monopoly in any particular village and year, and partly because rural people are in a weak position to argue with the politically and financially strong traders. Rattan collectors are often extremely poor and may ask to be paid directly in kinds (e.g., rice) rather than cash.

The export of unprocessed or "initially processed" cane is forbidden (Prime Minister's Order 14/psl, September 1990, cited and reproduced by Enfield et al. 1998). Large recent exports (see Annex 4) may avoid this regulation by being considered "semi-finished".

The above rules refer to non-conservation forests, where the Lao Government appears to be acting on an overriding need to generate income in the short term to support national development despite sacrificing future productivity. The Lao PDR also has a large extent of conservation forests (the Lao term translates simply as "national protected forest" but the preferred English term is National Biodiversity Conservation Area or NBCA). These 18 NBCAs were established in 1993, range from 500 km^2 to over 3,500 km^2 and cover about 10 percent of the country (25,000 km^2), including large areas of all the major forest types (Berkmüller et al., 1995a). The law prohibits commercial harvesting in NBCAs.

There has been no review of how many rattan species occur within the existing protected areas network. There is dearth of data on whether they are properly protected. Nonetheless, judging from experiences with commercially valuable animal species (Duckworth et al. 1999), the system is probably unable to preserve viable populations of those species without political and substantial support from the government.

The above discussion refers to large-scale extraction, in particular of larger diameter canes. Another large but unquantified part of the total harvest is done by many rural inhabitants who make frequent trips to collect and sell small quantities (a few kilos to tens of kilos), especially of smaller diameter canes. Transport is usually by public conveyance or in trucks carrying other goods. These small shipments are often destined for handicraft factories in the larger towns and some portions are going to handicraft villages, although some may eventually be exported. Regulations concerning this trade are rather unclear (Enfield et al. 1998), and they may well vary from province to province. Technically it is illegal to harvest materials from NBCAs and all commercial transactions of rattan should be approved by quotas. However, there is also a contradictory presumption in law that villagers, who have customarily done so, will be allowed to continue harvesting for household subsistence purposes, which is widely interpreted to include small scale-trade (Government of Lao PDR, 1996; Enfield et al. 1998). This makes the diffuse, small-scale trade in rattans a *de facto* legal trade, although confiscation may occur, e.g., if the trade is conducted in a too obvious way. The net impact on rattan populations and productivity is unclear, but is probably significant and deserves further study. The trade is also important to the livelihoods of the people involved (villagers).

The trade in edible rattan shoots from wild plants is large, unquantified and essentially unregulated. *Daemonorops jenkinsianus* thrives in the north in areas of shifting cultivation and appears to be the main source of shoots in 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 (e.g., *C. wailong* in Bokeo Province or *C. poilanei* in Bolikhamxay Province) and this trade is of greater concern.

Edible rattan shoots from plantations: In recent years, late 1990's, villagers of Central Part of the country have been engaged in rattan plantation for shoot production; the species in high-demand is *Calamus tenuis.*

Domestication of rattans in the Lao People's Democratic Republic

Small-scale nursery trials have been made for six or seven species with commercial potential, and a small germplasm collection has been established. Only one or two very small trials have begun of plantations for cane production, but one species (*Calamus tenuis*) has already become a major commercial success in plantations for edible shoot production (Sengdala and Evans, 1998; 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 competitive with rice production and preferring sites where regular flooding would damage most other crops. The techniques were first developed in 1994 (during the technical support from IDRC), but there are now estimated to be over 100 ha planted by over 50 planters in at least five provinces. This new development was inspired by large-scale commercial planting of three species (mainly *C. viminalis* with some *C. siamensis* and *C. tenuis*) in Eastern Thailand which began in 1991 (Jarenrattawong, 1997; Evans and Sengdala, 1999). Parallel to this initiative FRC, with the support from ASEAN Regional Centre for Biodiversity Conservation (ARCBC) in the year 2002-2003, initiated a trial plantation of these three rattans species for shoot production in two different landscapes (flooding and nonflooding sites). The trial aimed to demonstrate to villagers the different opportunities/ feasibility for rattan plantation.

A. Nursery Activities

As mentioned above, rattan plantations in Lao are not in large scale and not yet promoted as other tree plantation species such as teaks, *Eucalyptus*, *Pterocarpus*, rubber trees and so on. Local forest dwellers who used to harvest NTFPs in general and especially rattans (canes and shoots) never practice rattan plantation and even if rattan seeds could be germinated.

With lessons learned from IDRC Project support since 1993-94, the Department of Forestry (DF) had the opportunities to experiment rattan and bamboo nursery. The villagers and the DF's district offices raised their own experimental nurseries. Main activities for tree seedlings nursery were followed except for seed treatment prior to sowing. Five (5) rattan species were used in the study namely *C. poilanei*, *C. tenuis*, *C. viminalis*, *C. siamensis*, and *C. platyacanthusi.* When the seeds are collected at the nurseries or at homes, two alternative preplanting treatments can improve germination percentage and rate of germination. For large quantities, it is easier to soak them in cold water for 7 days to 10 days. Change the water every day to prevent mould. The seedcoat and soft flesh should be removed, either before or after soaking. The second method is only practical for smaller quantities. After removing the seedcoat and flesh, use a sharp pointed knife to remove a small cap which covers the embryo (also called the hilar cover). Take care not to cut the embryo.

Seedbeds are usually used for germination. However, we have found that it is easier for *C. tenuis* to mix the treated seeds with a deep bed of coconut fibers in a bowl and keep them moist and covered in a cool place. Once they have germinated, transplant them into polyethylene bags with a usual size 3/5 x 7 to 4/6 x 10. Soil composition in the plastic bag is 60% of top soil (from the forest), 30% of sand (sandy soil), and 10% of manure (mostly from cow/buffalo). Nurseries should also have a net providing 50% shade. After a month, the net should be removed so the seedlings can develop sunlight tolerance. Water the seedlings thoroughly before transplanting. Remove diseased or dead seedlings and clean the area regularly to prevent weeds from overtopping the seedlings. Once the seedlings have reached 45 days, it useful to add NPK 15:15:15 fertilizer (one soupspoon per 20 L of water every 15 days), and increase this to two spoons when the seedlings are about four months old. Fertilization must be stopped two months before transplanting.

B. Plantation Establishment

B.1. Cane plantation

In Lao PDR, it may be most practical to await an increase in world prices to stimulate the planting and management of rattan for cane production. Even now that rattan canes are good for markets, especially large cane species such as *C. poilanei*, and used in the factories, promotion for cane plantation is still in the air. Meanwhile, the ground could be prepared through capacity building (in biological and participatory research), small-scale planting and management trials, protection of key genetic stocks in NBCA as an on-going dialogue with the Government on the regulation of quotas and land use (Evans, 2000). The reason rattan plantation will be favored in the long run is that they escape most of the difficulties at present. They nonetheless have some significant constraints which have prevented any substantial investment to date (Table 3). There is some scope for further external support to enable the sector to overcome these.

Table 3. Current constraints to the development of rattan cane plantations in the Lao People's Democratic Republic.

Constraint	Current trend	Possible solution
Weak market price	Not improving	International interventions? Wait-and-see approach Reduce costs through improved techniques (especially fast-maturing stock) National subsidies
Limited research capacity	Improving	Further capacity-building support
Limited published research on species found in Lao PDR	Gradually improving	Expanded research programme Increased publication of results from neighboring countries Study visits to those countries
Poor establishment and growth rates for the elite *C. poilanei*	No progress	Focused research Test alternative species (especially clustering ones)
Lack of a governmental extension agency	Proposals in existence	Feed into extension programmes of other organizations or fund rattan-specific programmes.

B.2. Edible shoot plantation

Shoot-producing species are likely to be the focus of activity in the Lao PDR over the next few years. The establishment of plantation for shoot production is mostly carried out by local people. The outlook for expanding edible shoot production is much better than for cane. There is a large domestic market and the country competes only with Thailand in supplying the substantial export market. Furthermore, planting is spreading rapidly without needing special policy support because, unlike cane, shoot producing plantation of *C. tenuis* offer a rapid and proven return on the open market.

To date, these plantations are about 150 ha only. The plantation techniques are quite simple. When the seedlings are 9 mo to 12 mo old, they can be taken out of the nursery and ready to withstand harsher natural conditions. The best time to plant them out is during the raining season when the soil is good and moist. Planting site should be quite rich with a mix of sand and loam. If possible, plantation should be close to water source. This will be good because *C. tenuis* likes to grow in moist areas and it makes watering easier. Clear the area, plough a week before planting and use a spacing of above 0.5 m to 1 m x 2.5 m. When the plantation is already one month, fertilizer application is recommended and manure is a good option. Shoots can be cut approximately eight months after planting (depending on the site and weather). By that time the clumps should have 4 to 5 shoots each. The first cut should be the longest stem; two weeks later you can probably cut again. On the average, a single clump can be harvested up to once per month. With proper irrigation, production is year-round, otherwise production is limited only to seven months (rainy season).

Furthermore, related agencies express the need to enrich the existing forests by introducing NTFPs species especially rattans but the decisions are still hanging. Main reasons of this constraint: no clear demonstration plots, shortage of funding, no clear techniques, and outputs too long in coming.

C. Harvesting System/Methods

The authors would like the outsiders to see that in Lao, local people have the tradition of consuming/eating young shoots of rattans (almost every species). This habit puts rattan in danger of quick depletion, even the shoots of valuable species for furniture have been harvested such as *C. poilanei, C. platyacantus, C. solitarius.*

C.1. Rattan shoots harvesting

Local people have the habit of harvesting young shoots of rattan for their own consumption and for local markets. This is widespread throughout the country. The gatherers look for young rattan plants of about 1 m to 2 m high and then cut the shoots to about 1m long. If for sale, one gatherer can harvest 40 to 50 shoots (large canes) daily and total cost is about USD 4 to USD 4.5. If from small canes, a gatherer can harvest up to 200 shoots daily and total cost is about USD 8 to USD 10. Although small shoots cost higher, they are preferred by consumers to the big shoots.

C.2. Rattan canes harvesting

Traditionally rattan harvesting or collection activities are carried out by villagers residing adjacent to or within the forests on a full-time or part-time basis. In Lao, the main gatherers are the much poorer members of the village or those who experience rice shortage in a year. They are the ones who have lesser control and access in agricultural activities.

In some cases, all family members join in rattan harvesting (father, mother and children). First activity is searching for matured commercial species for usable canes. The traditional harvesting technique is climbing a tree which supports large-diameter canes. The reachable topmost part of the canes will be cut and hauled down. Usually, before cutting the large-diameter rattan, the gatherer estimates the length of merchantable portion. The cane will be cut if more than half of its length can be utilized. The gatherer will climb the tree up to the canopy to cut its leaves, cirri and flagella and then cut upper part of the cane where it could be reached. To get longer cane, some trees will be felled down (but normally it is not allowed). Then the lower part or base of rattan will be cut and will be hauled. The harvested cane will then be cut into desired sizes (usually 5 m long). Normally, one rattan can be cut in 5 to 6 portions. Some other portions which could not be pulled down will be left hanging on the canopy.

For the medium- and small-diameter canes, gatherers also assess their usable length. Like in large canes, gatherers will cut them if the whole or more than 50% of its length can be hauled down. Frequently, the small-diameter cane will be collected entirely.

Gatherers organize themselves into groups of three or four persons or one whole family to have enough capacity to haul down rattan from the canopy. The rattan canes would be shared equally and the members of the group help each other to transport rattan canes from the forest to the village. Usually, gatherers will spend 1 to 3 nights in harvesting. During their stay in the area, they enjoy foods from the forest such as rattan shoots, bushmeat, bamboo shoots, fishes, and others. It was reported that gatherers have strong solidarity and have to help each other in difficult times such as accidents or when tigers or elephants attack them.

All rattan canes are conveyed to the villages or markets using cows or buffalo as an alternative. From this study, it could be seen that in Lao there is only traditional methods in rattan harvesting. There was a suggestion to use elephants in transporting canes but the cost is very high.

D. Grading standards of raw cane

The are about 11 rattan species for commercial purposes. Large portion of these species will be used for handicrafts at villages or communities levels. Four main species are always absorbed by the factories namely *C. poilanei* (large diameter), *C. nambariensis* (medium diameter), and *C. gracilis and C. solitarius* (small diameter). Sometimes the four species are also used by local people but their prices are quite high. The remaining seven species are heavily used by local people for handicrafts.

However, in Lao, good quality rattans go to the factories because their prices are acceptable to the firms. Thus, for quality determination, both the large or medium and small-diameter rattans are simply sorted into two quality classes - good quality with no or few defects and the other is heavily defective.

E. Transporting/hauling

At present most raw rattan canes are obtained from the natural forests where they grow naturally. Different parts of the country have different ways and means of transporting rattan canes out of the forests. Traditionally, bundles of harvested canes are either carried or dragged. The large canes are usually cut into 5 m. long and then grouped in bundles. The small canes are usually carefully rounded. The canes are gathered at temporary collecting sites, such as the edge of forests, forest roads and river banks. In some areas the use of animals as a mean of transportation is still practiced, such as buffalos. In the northern, mountainous areas, horses are sometimes used to carry the rattan bundles out of forests to the villages.

F. Post-harvest activities

For the large- and medium-diameter canes, after hauling down from the canopy, the canes are measured and cut into 4.5 m or 5 m. long according to the order of the factories. Usually after cutting the canes have been lying on the ground but during these time, villagers/ gatherers are advised to stand up the canes to the trees or branches. This is to allow water run off, avoid moisture and fungi, the canes will be more light. For the small-diameter canes, after hauling down, the canes were grouped and rounded, one round is about 25 kg. One gatherer could transport out from the jungle 15 to 20 big canes or about 50 kg of small canes.

Once at the village or at home, gatherers wait for buyers/traders/middle men. Normally, 2 to 3 days or at least 5 days, depending on their appointments, buyers arrive to the village with truck or lorry. To date, there are no problems of grading rattans in the village, as buyers accept the raw materials based on the grades made by the villagers. Large canes are counted and small canes are weighed. After rattans arrive at the village, gatherers expect buyers to come very soon because the weight of small rattan canes is not much reduced from drying up The big canes are still in good shape.

IV. PROCESSING AND UTILIZATION

A. Major products and uses

1. Preliminary treatments (canes)

1.1. Rattan canes in village handicraft

In village handicraft, medium- and small-diameter canes (*Ç. solitarius, C. viminalis, C. palustris*) are used. Villagers do not invest on rattan canes preservation like boiling or other alternatives. They simply dry canes under sunlight or smoke by hanging them above the traditional stove (fuelwood drying).

1.2. Rattan canes in factory

Only large and medium-diameter canes (*C. poilanei and C. platyacanthus)* are boiled in to remove moisture, waxy materials, resins and gums. Boiling is also done to improve color quality, texture and flexibility and to prevent fungal and insect attack. Raw rattans are boiled in diesel solutions. The immersion period ranges from 10 min to 30 min at a temperature of 60° to 150°C. Right after boiling, the canes are either washed with pressurized water or scrubbed with sawdust to remove any remaining dirt and excessive diesel.

After the oil curing and cleaning process, the rattans are air-dried in an open ground by stacking (upright position) them on wooden frames or letting them stand with the support of wooden stands. This process will be for a period of 50 day to 60 days and weekly monitored. Rattans that have been through the preliminary processes will be sorted and graded. The canes are straightened manually or by machine before being tied in bundles of 20 canes to 30 canes for large-diameter or in bundles of 30 kg to 60 kg for small-diameter canes. In the other cases, rattans are just only grouped in hundreds. They are now ready for marketing and prepared for further processing. Sufficient ventilation during storage is necessary to ensure uniform dryness and at the same time to reduce the probability of fungal attack.

2. Secondary (splits, wickers, core)

2.1. Handicraft at community and village level

Preparation and processing of rattan canes (small and medium-diameter size) depends on the purpose of the manufacturers. In this level, rattan canes are split and wicker in different sizes and others are spiraled using suitable bamboo culms as a main core. Splitting and wickering of rattan canes use to be processed by shape knives or by a simple tool generated by local knowledge. Men often do this process while women and children mostly performed handicraft or manufacturing of finished products.

2.2. Factories and Manufactures high level

Rattan poles are selected according to grades and quality of furniture they are intended for. The classes of rattan pole sizes are grouped (Table 4). Rattan poles are normally bent due to vertical storage and natural characteristics. The bent rattan poles are straightened either manually or using pneumatic straightening machines. Straightened rattan poles would ease further processes of making higher quality rattan furniture.

Grading of raw rattan according to species

Selection of raw rattan according to diameter

Boiling in diesel for about 40 minutes

Cleaning of oil cured rattan with pressuring water or saw-dust

Air-drying for at least 30

Bleaching, peeling, coring, air-drying for several days

Storing and Marketing

Figure 1. Processing steps for rattan canes in Lao PDR, the same processes for all diameters.

Before bending into desired shapes, rattan poles are heated so that they become soft and pliable. As shown in Table 4, most of high quality rattans are going to the factory because it has more raw material requirements and has bigger investments to purchase such.

Table 4. Rattan species and their sizes, qualities and areas of uses.

Typical diameter	Species	Quality		Area of use	
		High	Moderate	Factory	Village
Large (≥ 2 cm)	*Calamus poilanei,* *C. rudentum*	X		Xxx	x
	C. laoensis		X	Xx	x
Medium (1-2 cm)	*C. nambariensis* *C. platyacanthus* *C. wailong* *C. viminalis* *C. siamensis* *C. tenuis* *C. godefroyi* *Demonorops jenkinsiana* *Myrialepis paradoxsa* *Plectocomiopsis geminiflora*	X X X	X X X X X X X X	Xx X X Xx Xx	Xx Xx Xx Xx Xx X X Xx x
Small (≤ 1 cm)	*C. acanthospathus* *C. gracilis* *C. solitarius* *C. tetradactylus* *C. palustris*	X X X X X X		Xx	X X Xx X Xx
	C. guruba *C. henryanus* *C. oligostachys* *C.bimaniferus*		X X X X		X X X X

3. Finished Products

Rattan finished products in Lao could be seen in two areas: village/community and factory.

3.1. In village/community level

In general, villagers have their unique styles of making handicraft. But due to quality demand of users and markets competitions, villagers need to improve quality of the products and innovate on design. In many cases, traders or middlemen bring new designs to producers and they could easily apply the new designs. The main products supplied to local and external markets are chairs, food trays of different sizes, baskets and small sizes of containers for fruits, flowers and other souvenirs in different designs.

3.2. In factory scale

In this scale, different products have been introduced. This is due to possible marketing diversity. The large products could be ranked from furniture set down to simple souvenirs. Parallel to the price from the highest to the cheapest: USD 600 down to USD 3, the main rattan finished products can be listed as follows (from the most expensive): (1) Sets of furniture, at least 4 to 5 scales, (2) Sofa, at least 2 to 3 scales, (3) Tables and chairs, different sizes, (4) Book shelves, (5) Beds, (6) Clothes storage and clothes hanger, (7) Cabinet, (8) baskets of different sizes, (9) souvenirs of different sizes.

4. Others (e.g., dyes, foods, medicines, utensils)

As already mentioned, local people in Lao PDR have the tradition of eating young shoots of rattan. Nearly every rattan species are edible except the species that are too bitter and smell bad such as *Myrialepis paradoxa* and *C. guruba*. The most preferred species and in demand in the local markets are *C. tenuis,* all species of *Daemonorops*, and *C. poilanei.*

Cooking methods: the ways of cooking rattan shoots are quite simple. (1) shoots, including leaf sheet, will be put on fire for half-cooking, then (2) peeling off of burning leaf sheet and getting the soft heart. The soft heart of rattan shoots could be made into soup mix with other vegetable and fishes and other ingredients. Or it could be prepared simple by mixing with chili, salt and fish sauce. For longer conservation, the soft heart of rattan could be dried and kept in a plastic bag or bottle. Before eating, the dry rattan will be boiled again and then cooked prior to one's preference.

Fruits of rattan, especially those of *Daemonorops* spp. and some of *Calamus* spp. are eaten. Dry fruits of *Daemonorops* spp. are preferred by Chinese market, around 10 tonnes/year, the end use is not known. In remote areas of Lao, sheets of rattan are used for roofing.

B. Methods of improving rattan products

1. Chemical/Nonchemical treatments/Biological

At the village or household level, rattan canes are dried under sunlight and smoked. After splitting or bending, they are kept in a small stockroom of the family. Since they are engaged in small-scale processing, they store rattan products for a short period of time. The products are being disposed right away due to continuous demands.

Factories boil the raw material in diesel solution before cleaning. Then, they are sun-dried, after which they are stored in a well-ventilated warehouse with a high roof. The warehouse is divided into shelves/sections where different sizes of rattan canes are placed.

2. Processing technologies

Advanced processing techniques are not yet widely used. Raw material seasoning often relies on sun-drying while some use ovens or fumigation in other places. Bleaching and bending using simple tools have been practiced at the villages. Factories are a little bit advanced in processing technologies.

B. Grading standards

Rattan canes are graded based on sizes and physical appearance. Large, medium and small canes are separated. Small rattan canes were usually not separated in different grades, especially rattan canes from farmgates accepted by traders. The large and medium sizes are sometimes bargained by traders at farm gates in order to pay less to farmers. At the factory, large and medium sizes of rattan canes are separated into two grades based on color and straightness.

C. Packaging (raw and finished products)

In the factory, raw materials are grouped according to grades after piling and polishing. Those which will be processed in the factory are put in the shelves. Those which will be sold or exported are wrapped in plastic sheet (100 poles/wrapper).

Finished products are grouped in categories and displayed in the showroom and in the shelves. There is no complex packaging of finished rattan products yet in Lao PDR.

V. MARKETS AND SOCIOECONOMICS

Rattan handicrafts in communities and villages levels are running year-by-year quite successful. 30% of the rattan handicrafts can be absorbed in local markets and other 70% are exported across the Mekong River to the northeastern part of Thailand. 50% of the total incomes (rice, livestock, home garden, labor/ wage) of village gatherers comes from rattan harvesting. Likewise, the same is also observed in the income rates of handicraft manufacturer families. In the rattan handicraft villages, participations of people in the production vary from one group to another (e.g., children or elderly, men or women, and handicapped or not). It must be noted that the gatherer villages and handicraft villages are different and distant from each other. Sometimes, village gatherers produced handicrafts for family consumption only.

Rattan factories supply 30% of the finished products in local markets (household, offices, hotels,). The rest of the products are traded to neighboring countries. Just only these recent years, Lao tried to explore the markets in Japan and in some European countries. The rattan factories have an annual net benefit of about 15% to 20% of total investment. The labor wage averages USD 40/mo to USD 60/mo.

Incomes from rattan processing of the families in village/community level and of the workers in the factory are almost even. The difference is the time spent by each group. Factory employees work eight hours per day. Village/community families have no time limit but they spend their spare time in handicraft processing.

Rattan shoots consumption in Lao generated labor and income for some people. Wild rattan shoots added income to local forest dwellers. Planting of rattan edible shoot helped hundreds of poor families. Even more, some families who are engaged in rattan edible shoot plantation are getting rich.

A. Participants in the rattan sector

Lao PDR is yet to organize data on the different stakeholders in the rattan sector. The identified participants in the sector are exporters, traders, manufacturers (factories and villagers), edible shoot plantation growers and gatherers. However, information on numerous aspects like years in operation (i.e., factories, villagers, plantations), manufacturing area locations, plantation sites, size and capacity (in volume) of manufacturers and others are still wanting. This a good area for rattan study in Lao PDR and hopefully a clear database of various participants in the rattan sector will be generated through such project.

B. Contribution of rattan to the National Economy/GNP

There is no clear figure of rattan contribution to the National Economy/GNP at this time. Large-scale handicrafts and furniture manufacturers throughout the country trade their products directly to neighboring countries. Small traders/factories do the same thing. They report their export goods to local custom after the trade. Only small quantity of finished products exported to Japan and European countries were reported to National Custom.

However, the non-timber forest products (NTFPs) section of central government has recently quoted the export earning from NTFPs is about 2.5% to 4% and the income from rattan was estimated of about 1% of total GDP.

C. Market Channels

The market channels of rattan raw materials and finished products are different from other NTFPs in general. The government policy prohibits the export of rattan raw material. Other NTFPs can be exported as raw material. The market channel for rattan productions is shown below:

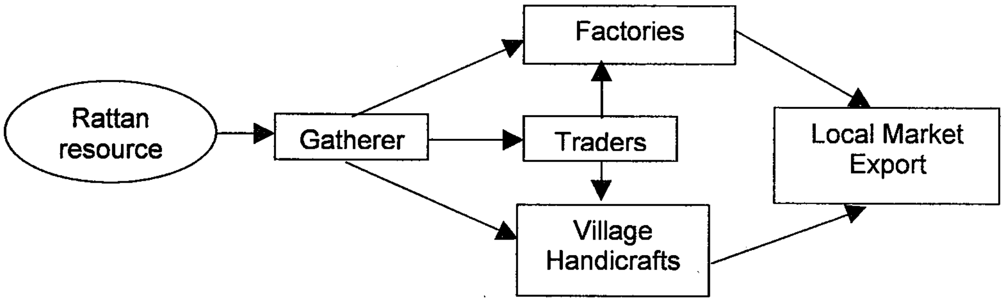

Figure 2. Market channel for rattan production in Lao PDR.

D. Prices

Table 5. Price list of commercial rattan canes for year 2003 in Lao PDR (Source: recent data collection, Sounthone Ketphanh et al).

Species	Length (m)	Grade		Unprocessed (from farm) in USD	Processed (from factory)
Calam us poilanei	5	A		0.8	1
C. poilanei	5		B	0.7	0.9
C. rudemtum	5	A		0.7	0.8
C. rudentum	5		B	0.65	0.7
C. laoensis	5	A		0.7	0.8
C. laoensis			B	0.65	0.7
C. nambariensis	5	A		0.65	0.7
C. nambariensis	5		B	0.65	0.7
Small rattan canes of all species	Dozen of kg	No grade		2.9	3.4

Large rattan canes processed from the factory: after boiling and pilling
Small rattan canes processed from the factory: only after boiling.

E. Financial feasibility of rattan plantations, trading, manufacturing (small, medium, and large scales)

Rattan plantation for cane production is not practiced in Lao PDR. Only rattan plantations for edible shoot productions have been set up and managed since the middle of 1990's up to now. These plantations have been practiced in family scale which are approximately of 1 ha to 4 ha each. The total investment for rattan plantation for shoot production can be calculated as shown below (a farmer case in Vientiane).

For 1 ha: Total investment: USD 352

1. Land preparation:	=	USD 230
2. Seedling: 1100 seedlings x 0.1	=	USD 110
3. Labor planting: 4 persons x 1 day x 3.0	=	USD 12

This investment does not include the cost of the maintenance that will be for at least one year before the first harvest.

A detailed study of financial feasibility of rattan manufacturing and trading in Lao cannot be done right now. The reason is that Lao has never done a rattan resource survey, and there exist no rattan plantations for canes production. All data on annual allowable cut or rattan harvests is based on local knowledge. No investment study for the other NTFPs resources can be made for the same reason. By the existing of rattan factories and rattan manufactures scattered in the main towns of Lao PDR, it could be classified the level of the investments or revolving fund as following:

1. Large factory: USD 200.000
2. Medium factory: USD 80.000
3. Small scale factory: USD 30.000

The revolving fund in the case of family handicraft is about USD 100 to USD 130.

VI. POLICY AND LEGISLATION

Land tenure in Lao PDR is being restructured. Partial control of forest land is being allocated by the state to some communities but this program is new and still evolving.

Nowadays rattan stocks are far from villages and most of the cases, the valuable rattan resources are remaining in the conservation forests at the national or provincial levels. But NTFPs in general and rattans especially are still on open access or at least for local dwellers. There are government regulations on rattan harvesting but it is not clear that they are intended to conserve stocks. Total provincial quotas are granted by the central government and then each province apportions its allowance to a number of approved manufacturers (Sendala et al. Enfield et al. 1998).

Individual or communities cannot sell large quantities (i.e. truck-loads) of rattan unless approached by quota-holding traders.

A. Forest charges (by species, volume, FOB market price)

As for all kinds of NTFPs harvests for commercial purposes, there are many gates to pay as paying contributions and direct taxes. In village level, gatherers will pay 10% of total selling to village community. In district level, the trader will pay 10% of the total price and again trader will pay other 10% to provincial level.

B. Allowable cut (policies regulating harvest)

Lao PDR has 18 provinces, each province has at least one rattan factory from small to large scale. Yearly, the province sends the proposal to the Central Government, the Ministry of Agriculture and Forestry (MAF), asking permission or quota for rattan canes harvesting. The proposal does not mention where to cut but just that the province needs the income. In reality, the factory based in the province has gone to visit different villages and asking the possibility of harvesting rattan for them and then the rattan factory manager has gone to ask quota from the Provincial Agriculture and Forestry Office (PAFO). Officially, MAF grants the quota to the province and the province in turn grants and distributes allowable cuts to their factories.

Table 6. Allowable cut of rattan canes in the country, year 1996-2002

Year	Large diameter	Small diameter
1996-97	500.000	80.000
97-98	385.000	80.000
98-99	780.000	540.000
99-2000	985.000	565.000
00-01	1.050.000	515.000
01-02	1.515.000	533.000
6	5.215.000	2.313.000

The length of large rattan canes was 4.5 m in 1996-2001 but in recent years, the factories have been asking gatherers to provide rattan 5 m long. The length of small diameter is usually 4 m to 5 m.

NB: the medium and small sizes of rattan canes using in the villages/communities and for household uses are not included in this allowable cut.

C. Policies related to:

- *Controlling or regulating internal and/or external trade of rattan*
  As mentioned above, individual or communities cannot sell large quantities (i.e. truck-loads) of rattan unless approached by a quota-holding trader. Rattan canes for export should be in the form of semi- or finished products (Prime Minister's Order 14/psl, September 1990).

- *Controlling or regulating access to rattan raw materials/products*
  Traders or rattan factories managers, after obtaining an official allowable cut, have gone to visit gatherers (villagers) and bargain for the price and number of rattan canes that the traders need. Usually, traders are the staff of the factories. The number of rattan canes from village will be approved by the chief of the village who grant official original provenance. By this process, trader pay 10% tax to the village. And before arriving at the factory, the trader will pay taxes to the District Agriculture and Forestry Office (DAFO) and once again 10% of the original total cost to PAFO.

- *Biological protection and genetic conservation*
  These issues are still less paid attention to by any organizations in Lao PDR. Everybody is aware that rattan resources are depleted year by year but no one has taken any action yet.

- *Controlling or regulating domestic/foreign access to technologies (production/utilization)*
  These issues used to be discussed in the Department of Forestry but no action has been taken yet. The factories have tried to learn or find out the solutions for improving technologies

by themselves. In some cases, the managers of factories have invited outsiders to promote new technologies in rattan processing but this did not prosper.

The government has not enough opportunity to support private sector yet. No proposal to this effect has been prepared.

- *Indigenous knowledge system*
  Most of villagers said that they never think of plantation of rattan for cane production. They don't know how long it will take to harvest the rattan canes and even don't know how to germinate the seeds of rattan. Villagers know that rattan canes are for every people (open access). They know that after cutting the tip of rattan single stem, it will die.

- *Development of rattan on government and/or private lands*
  There is no policy related to development of rattan in either government or private lands.

VII. INSTITUTIONAL CAPACITY AND LINKAGES (INTER- and INTRA-)

A. Academe

There are very few studies concerning rattans in Lao PDR. In 1992-94, IDRC Project organized and supported a study on rattan taxonomy, Germplasm collection, social economy and plantation. In 1995-98, DI collaborated with the FRC for in depth taxonomy study. Because of these two events, Lao PDR could have a Field Guide to the Rattans of Lao PDR. By learning from that two Projects, FRC has produced some leaflets about rattan germination and plantation in local language.

In the Forestry colleges, the curriculum is still weak and not comprehensive yet.

B. Government

On the government side, the only organizations related to rattan research and extension are based in the NTFPs Section of FRC, National Agriculture and Forestry Research Institute (NAFRI). The Department of Forestry (DoF) is concerned about forestry regulation and policy. The DoF studies the possibility of approving rattan allowable cut receiving from the PAFO and then forward to MAF.

C. Nongovernment organizations

In recent years, it seems that many nongovernment organizations concerned with rural development discovered that NTFPs are sources of income for rural people, in which rattans are important. By this opportunity, FRC has played the important role of providing techniques and information. In many cases, FRC offers training and extension to NGO's but the capacity is limited. The need for improving many techniques in rattan is still there.

D. International linkages

The government of Lao PDR and especially FRC which play vital role in R and D should create strong linkages with International Organizations. Up to now, there is no strong networking with others yet. FRC with support from SNV just tried to create national networking. The existing relationships with outsiders in recent years were: RECOFTC in Bangkok, INBAR in Beijing, CIFOR in Indonesia and DI in England, FAO and IUCN. FRC exchanges information about NTFPs with NTFPs Research Center of Vietnam.

Despite of all these linkages of NTFPs R&D in Lao PDR, technology improvements for solving all gaps are still not on the ground.

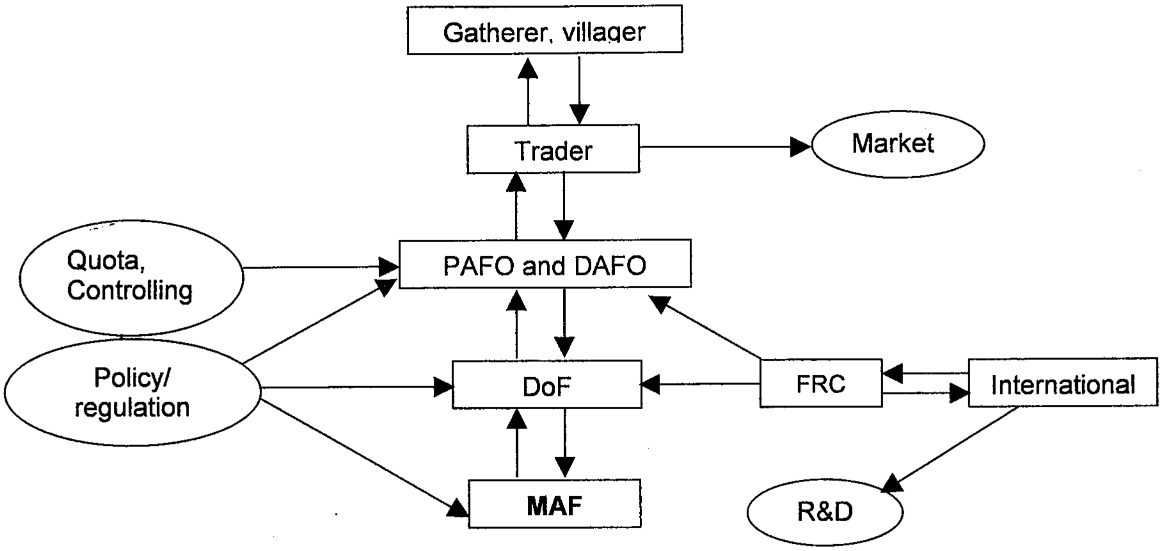

Figure 3. Organizations related to rattan.

VIII. CONCLUSION AND RECOMMENDATIONS

It is certain that the demands for rattan raw materials (rattan canes) are increasing annually. In Lao PDR, the consumption of rattan is focused more on shoots or young tips than canes. This has already caused the decline of the raw material beside other events such as population growth, reduction of habitats/environments of the rattan resources and others. The local knowledge of sustainable harvesting and plantation is still being ignored. The incentive for rattan resource management, assessment, and survey is still weak. The new or suitable techniques for rattan canes preservation and processing are not strong enough as compared to the advances in techniques in other countries.

The main situations of rattan related issues fall under three broad headlines:

Social constraints
- Scarcity of cultural precedents for managing the forests;
- Shortage of trained staff in relevant government agencies; and
- Many gates for taxes

Policy constraints
- Open access to resources;
- Short, erratic quotas allowing (even encouraging) over-harvesting;
- Complex regulatory framework in the forestry sector; and
- Government imperative to maintain its short-term income for fund development.

Economic and biological constraints
- Increasing market access through road expansion and macro-economic changes;
- Intense rural poverty driving rural people to over-harvesting (cane and shoot) for short-term survival;
- Physical difficulty of policing remote and dispersed stocks;
- Long travel times to harvest remaining stocks;
- Low bargaining power of harvesters/gatherers, all sell from farm gates could make more profit for traders,
- Low unit value of wild cane and suspected low annual productivity per hectare,
- Substantial costs of planning, inventory and monitoring; and
- Lack of technical knowledge about the ecology of commercial species.

The prospect of overcoming all of these constraints seems quite poor in major cases, but none of them is technically insurmountable if the likely benefits are considered worthwhile. Specific constraints have been overcome in specific situations in an increasing number of cases (Foppes and Ketphanh, 2000). If widespread progress in this field is to be achieved, three broad approaches are required.

1. *International level.* Support on technical knowledge about the ecology of commercial species; policy change to boost prices. Regulation of world trade (e.g. CITES, ITTO?).
2. *National level.* Enhanced political commitment to sustainable harvesting (e.g., resolution of tenure issues, behavior of consuming tips of valuable rattan cane species, improve quota system and regulation of diffuse trade in small-diameter canes.)
3. *Local level.* Establishment of biological and economically sound pilot schemes.

In Lao PDR, it may be most practical to await an increase in world prices to stimulate the planting and management of rattan for cane production. Meanwhile, the ground could be prepared through capacity building (in biological and participatory social research), small scale planting and management trials, protection of key genetic stocks in NBCAs and an ongoing dialogue with the Government on the regulation of quota and land use.

***Matrix 1.* Issues and concerns confronting the rattan industry and recommended solutions and R and D strategies to address concerns.**

Issue/Concern	Recommended solution	R and D strategy to address them
1. Production	Improve vest in harvesting areas, promote plantation for canes	Improve harvesting tech, plantation demonstration plots, grow rate study
2. Protection	Raise awareness to prevent cutting of tips/shoots of valuable species for food consumption; selection cutting and mother trees conservation	Information and education campaign on the importance of some species in communities; create protection zones
3. Marketing	Sustainable and many markets, Propagation of the products	Market survey
4. Information systems	Network with existing organizations related to rattan productions in Asian countries members	Create networking
5. Administrative a. Policy implementation b. Linkages c. Tenure system	Create regulations on rattan harvest, rattan shoots consumption. Linkage b/w all parties in rattan issues.	Socio-economic survey, set up a rattan partnership.
6. Others, specify: management	Strong management implemented natural resources assessment	Survey and mapping the resource distribution

***Matrix 2.* Strengths, Weaknesses, Opportunities, Threats in the Rattan industry.**

Item	Strength	Weakness	Opportunity	Threat
1. Production of raw materials	Local people still cooperate in harvesting; give information on the existing areas	Vest of raw material from the sources; no plantation yet for cane production	Demonstration for rattan canes plantation; existing of natural forests	Lack of fund and techniques; security in harvest method; custom of eating young shoots.
2. Marketing a. Raw materials b. Finished products	Varieties of rattan canes species	Not enough knowledge on rattan morphology; weak quality study	Raw materials preservation improved, new design of products	Time consumed in hauling canes from forests; real price of raw material.

Matrix 2.* Strengths, Weaknesses, Opportunities, Threats in the Rattan industry *(continuation).

Item	Strength	Weakness	Opportunity	Threat
3. Utilization/ Manufacturing	Preference of all users; local people have some skills in handicrafts.	Few design, only some species used	Raw material preservation, reduce vest, improve handle tools	Price incentive
4. Policy	Allow harvest of rattan; export ban of raw material; check points for NTFPs transportation	Not implemented well	Could be improved	Strong policy implementation
5. Information systems	Existing of information office.	Still weak capacity	Could be improved	Need sometime
6. Institutions	Government organizations in all levels	No clear roles	Could be improve	Need sometime

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Rattan and Rattan Industry in Myanmar

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I. INTRODUCTION

Myanmar, with 67.66 million ha of total land area, stands the second largest among ASEAN countries and the largest in the Southeast Asian continent. The country is situated within a wide range of latitudes 9° 58' to 28° 29' North and longitudes 92° 10' to 101° 10' East. Altitudinal range of topography also varies from sea level in the south to as high as 3,000 m in the north. Such a broad range of geographic and climatic situations allows the nation to possess various ecosystems with diverse flora and fauna.

Endowed with vast tracts of forest covering more than half of the total land area, the country is still rich in natural forest resources. Generally, there are three types of forest products: wood or timber, wood-based value-added products and non-wood forest products (NWFPs). NWFPs have been regarded as minor forest products until recently because wood especially teak and other hardwoods far outweigh others in their contribution to the national economy of Myanmar. Nonetheless, NWFPs are of significant importance to the social and economic aspects of rural life composing more than 70% of the current total population of 53 million. Among the NWFPs, rattan together with bamboo has long been in use only for kitchen utensils and farming implements in the rural society. However, the material owing to its unique properties, has found its way to urban society as prestige handicraft and furniture since one decade or more ago. Nowadays, rattan has become one of the major important export items and gained a leading role among NWFPs. Foreign exchange earnings from rattan and rattan products were recorded at USD 10 million for the year 2002-03 accounting for 5% of the total export value of USD 202.8 million from timber and value added products for the same year.

Myanmar has been far behind in the development of rattan industry within the region and, therefore, there is ample room for development of the industry in the country. Diverse ecosystems and flora of the country are home to Myanmar rattan. Generally rattans grow throughout the country. There are 36 species belonging to five genera so far recorded. More new species are likely to be found. In this regard, further study on its taxonomy and ecology is in urgent need. The number of commercially used species is only about five. It calls for further investigation of new species. About 35% of export value accounted by raw rattan also suggests that much more foreign exchange could be earned by exporting value-added products of rattan converted from the same raw material.

II. RATTAN RESOURCES IN MYANMAR

1. Geography

Myanmar has three distinct seasons, namely rainy season, cold season and dry season, due to the effects of monsoonal climate. Monsoon rain sets in mid-May and continues until end of September. It is followed by the cold season from October to January. Dry season is from February to May. There are four major river systems and three prominent mountain ranges (Yomas in Myanmar) in the country. The Ayeyawady, Chindwin, Sittaung and Thanlwin Rivers form a network of river systems. Mountain ranges are running north-southerly direction and their names are Shan Yomas, Bago Yomas and Rakhine Yomas in the east, the middle and the west of the country respectively. The northernmost part of the country is Kachin hilly region which is foothill of the Himalayas and has some snowcapped mountains. The longest river, Ayeyawady, originates in this region. Myanmar is indeed surrounded by mountain ranges and they are major elements for capturing monsoon rains. Types of forests on the mountain ranges and hilly regions are mostly tropical evergreen, sub tropical evergreen and mixed moist deciduous forests.

2. *Natural Distribution*

Dransfield (2001) reported that the range of rattan habitat extends from sea level to more than 3,000 m elevation, from equatorial rain forests to monsoon savannahs and the foothills of the Himalayas. Throughout their natural range rattan species are found in a wide variety of forest and soil types. In regard to rattan distribution in Myanmar, since there has not been any systematic study, only a very general account of rattan distribution can be given based on the information contained in the forest management plans (working plans in the past) of the forest districts (forest management units) and prevailing limited reports. Forests in Myanmar are generally classified into eight major forest types as shown in **Table 1** and also can be categorized into four major types of vegetation as in **Table 2**. Map showing forest types of Myanmar is provided in **Appendix 1**.

Table 1. Major forest types by area extent.

Sr. no	Type of Forest	Area (,000 ha)	% of Total Forest Area
1 2 3	Tidal Forest Beach and Dune Forest Swamp Forest	1375	4
4	Tropical Evergreen Forest *	5500	16
5	Mixed Deciduous Forest -Moist Upper Mixed Deciduous (MUMD) * -Lower Mixed Deciduous (LMD) * -Dry Upper Mixed Deciduous (DUMD)	11688 1719	34 5
6	Dry Forest	3437	10
7	Deciduous Indaing (*Dipterocarps*) Forest	1718	5
8	Hill and Temperate Evergreen Forest *	8937	26
	Total Forest Area	34374	100

Source: Forestry in Myanmar (2003)
Remarks: Types of forest remarked by * are reported to bear natural rattans according to the Forest Management Plans and reports.

Table 2. Forest area by type of vegetation.

Sr. no	Type of vegetation	Area (,000 ha)	% of Total Forest Area
1	Closed broad-leaved	32,563	94.59
2	Mangrove *	785	2.28
3	Bamboo *	963	2.80
4	Conifers *	113	0.33
	Total	34,424	100.00

Source: Forestry in Myanmar, 2000
Remarks: Natural rattans are not observed in the vegetation types indicated by *.

In general, rattans are widespread throughout Myanmar. It is more abundant in moist forest types than in dryer types. Forest areas where wild rattans have densely grown are known as "cane break" and they are often found in the lowland of moist forests and sometimes in deciduous moist forests. Places such as valley and riverbanks are of more preferences to natural rattans. Altitudinal range of natural habitat is as wide as up to about 1,000 m in hilly regions. It is learned that rattans are not associated with mangrove and bamboo vegetations. Chein Hoe (1972) recorded that Dawe, Upper Chindwin/Myitthar, Myitkyina, Bhamo, West Katha, and Moemeik Forest Districts were the areas where rattans grew in the highest population in the country.

3. *Taxonomy*

Of 13 genera and about 600 species of rattans in the world (Dransfield, 2001), Myanmar has 5 genera so far recorded. There are different schools of thought regarding number of species found in Myanmar. The differences are probably due to subjective opinions and lack of sound taxonomic base. However, 36 rattan species are being recorded in the natural forests of Myanmar (Forestry in Myanmar, 2000). Summaries of genera and species are listed in **Table 3**.

Table 3. Summaries of rattan genera and species

Family	Genera	Number of Species		
		Hundley (1987)	The F D (1987)	Htay Aung et al., (1997)
Palmae (Arecaceae)	*Calamus*	26	25	26
	Daemonorops	1	2	2
	Korthalsia	4	3	3
	Plectocomia	2	2	2
	Plectocomiopsis	2	2	2
	Salacca	2	-	2
Flagellariaceae	*Flagellaria*	1	1	1
Total		38	35	38

The first and foremost comprehensive species classification of rattans in Myanmar appeared in the nomenclature "List of Trees, Shrubs, Herbs and Principal Climbers, etc. Recorded from Burma", Fourth Edition revised by H.G. Hundley in 1987. There has not been any taxonomic study of rattan species afterwards. Rattan species and their occurrence is given by State and Divisions in **Appendix 2**. A map showing States and Divisions of Myanmar is also provided in **Appendix 3**. These are: Calamus 27 species, Daemonorops 2 species, Korthalsia 4 species, Plectocomia 2 species and Plectocomiopsis 2 species under Palmae Family, and a species (Flagellaria indica L.) under different climber family of Flagellaria. Two species from Salacca genus which do not climb, are excluded in the table in order to conform with the classification of rattan genera given by Dransfield (2001) Although Flagellaria indica is not a member of the Palmae family, it is included into the list of canes found in Myanmar (Chein Hoe, 1972; The Forest Department, 1987; and Htay Aung et al., 1997). There still remain some species which are not yet matched with Myanmar name. Likewise, some locally well-known species are not yet identified taxonomically. A list of the latter species appears in **Table 4**.

4. *Commercially important rattan Species*

4.1 *Calamus laetifolius* Roxb (Yamata Kyein)

Yamata Kyein is the most economically sought-after cane in Myanmar and one of the most popular in the export market. It is a powerful climber with more than 100 ft long. It's diameter is about 1 in without sheath. It is a resilient and durable cane with a smooth surface. Diameter does not change much along the length. The length of internodes ranges 9 in to 15 in. It has the best quality as framework in making furniture. This species is similar to Manan from Indonesia and Malaysia (Myint Wai, 1993). It grows in the evergreen forests, moist upper mixed deciduous (MUMD) forest and dry upper mixed deciduous (DUMD) forest in the States of Kayin, Rakhine and Kachin, and the Divisions of Bago, Sagaing and Tanintharyi.

4.2 *Calamus longisetus* Griff (Kabaung Kyein)

Kabaung Kyein is a large-diameter cane with diameter range 1in to 2 in. The stem can reach as long as 300 ft. The cane has slightly tapering along the stem. It is mainly used in furniture making. It is also

Table 4. Locally known but scientifically unidentified yet species.

Sr.no.	Myanmar Name	Genus	Locality (State/ Division)	Size of Diameter
1	Kala Kyein	*Calamus*	Tanintharyi Div.	Medium
2	Khaset Kyein	*Korthalsia*	Kayin St.	M
3	Kyein Me	*N.I*	Tanintharyi Div.	Small
4	Kyein Namaung	*C.*	Tanintharyi, Rakhine St.	Large
5	Kyein Nigyi	*C.*	Tanintharyi, Kayin St.	M
6	Kyein sein	*C.*	Kayah St.	M
7	Kyein Tet	*C.*	Tanintharyi Div.	M
8	Lewa Kyein	*C.*	Moemeik Dist.	M
9	Myauktalwe Kyein	*K.*	Kayin St.	M
10	Myaukchi Kyein	*C.*	Sagaing Div.	S
11	Naukche Kyein	*C.*	Sagaing Div.	M
12	Netkyaw Kyein	*C.*	Sagaing Div.	M
13	Oopwa Kyein	*C.*	Kayin St.	M
14	Sin Kyein	*C.*	Sagaing Div.	Large
15	Toke Kyein	*C.*	Yamethin Dist.	M
16	Wa-Oo Kyein	*C.*	Yemethin Dist.	L
17	Wunthaw Kyein	*C.*	Tanintharyi Div.	S
18	Yethun Kyein	*C.*	Tanintharyi Div.	M

Source: Chein Hoe, 1972; Myint Wai, 1993
Remarks: Size of Diameter >1 in = Large; 0.5 – 1 in = Medium; < .5 in = Small

popular in export market. This species is said to be similar to a species named Batang in Indonesia and Malaysia (Myint Wai, 1993). Kabaung Kyein grows in the Divisions of Ayeyawady, Bago and Sagaing, and Mon State and Kayin State.

4.3 Calamus platyspathus Mart (Kuet-u Kyein)

Kyet-u Kyein is a small-diameter rattan species having a stem as long as 150 ft. Diameter is about 0.3 in. The length of internodes ranges from 5 in to 9 in. Diameter is even along the stem and nodes are smooth. It has supreme quality of durability with good strength and beautiful colour. The colour of skin is white or yolk colour. That is why the name Kyet-u or Chicken egg Kyein is given. It is the most suitable species as splits for making bed and back of chairs where the quality of strength and durability is highly required. The quality was said to be similar to that of Sega for Indonesia and Malaysia (Myint Wai, 1993). Kuet-u Kyein grows in the evergreen forests and moist upper mixed deciduous (MUMD) forests of the States of Rakhine, Kayin, Chin and Kachin and Sagaing Division. Kachin State and Sagaing Division are the major production areas of Kyet-u Kyein.

4.4 Calamus floribundus Griff (Ye Kyein)

Ye Kyein is a small-diameter rattan species. Diameter of the stem generally varies from small to medium size depending on locality. Diameter changes may occur at nodes. Inter-node length ranges 8 in to 15 in. The quality of cane is a little bid soft with low density. So it needs caution in splitting process. The strength of the cane depends on maturity and pretreatments given. Its main use is as splits for weaving in making various household properties and rattan furniture and rattan wares. The production and use of this species are very intense. Of all the species harvested and utilized in 1962, Ye Kyein accounted for 45%. Ye Kyein grows in the lowlands besides streams and river banks. It is found in Rakhine, Kayin, Kachin, and northern Shan States and Ayeyawady and Sagaing Divisions.

4.5 *Calamus guruba Ham* (Kyein Ni)

Kyein Ni is also a small-diameter rattan species. Diameter is about 0.25 in and internode is about 12 in. Stems of over 150 ft long stems have been observed. Because of red hairs and red spikes on the stem, the species is widely known as Kyein Ni, ie. red coloured cane. The species grows on lands not reached by flood. Cane density and strength is superior to Ye Kyein. However, those two species have not been much differentiated in usage and market. So Kyein Ni is as widely used as Ye Kyein. But Kyein Ni is suitable for rafting. Myanma Timber Enterprise (MTE) alone has used Kyein Ni for rafting logs in large quantity about 3 million canes in the past and 1.3 million nowadays. The production of this species was 43% of all the species harvested and about equal to that of Ye Kyein in 1962. Kyein Ni widely grows in the evergreen forests of Rakhine, Kachin and northern Shan States and Tanintharyi and Sagaing Divisions.

III. PRODUCTION, TRADE AND RESOURCE MANAGEMENT

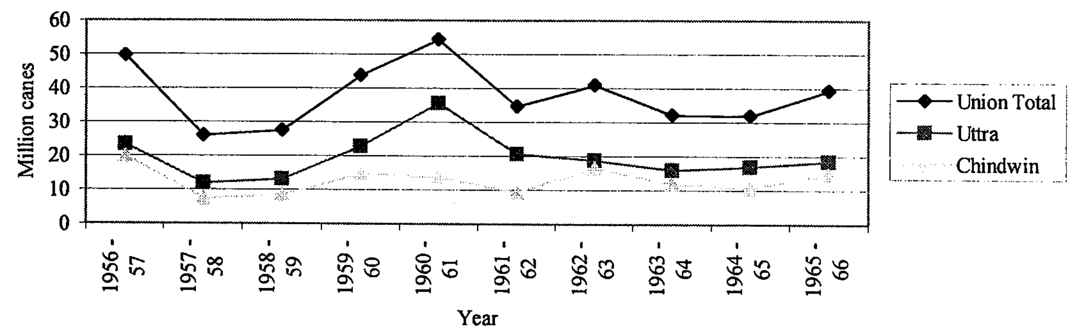
1 . Production

1.1 Production in the Past

Forest divisions in the past were formed based on topographic drainage and intensity of forestry operations. There were six forest divisions formed covering the whole country, namely Hlaing, Sittaung, Coastal, East, Uttra and Chindwin Forest Divisions. The production of rattans from the selected two forest divisions for the period of 1956-57 to 1965-66 is given in **Figure 1** (Chein Hoe, 1972).

The average annual total production was 38 million canes for the period. The Uttra Forest Division was the largest rattan production with an annual average of 19.7 million canes representing 51.7% of the total and the Chindwin Forest Division was the second with an annual average of 12.8 million canes accounting for 33.5% of the total. The Uttra Forest Division consisted of (6) Forest Districts, namely Myitkyina, Bhamo, East Katha, West Katha, Shwebo, and Mandalay/Maymyo. The Chindwin Forest Division comprised (3) Forest Districts, namely Upper Chindwin/Myittha, Chin hills, and Lower Chindwin. The forest districts from those two forest divisions have been reformed mainly into Sagaing Division and Kachin State, partly into Chin State today.

Figure 1. Cane Production in the Past.

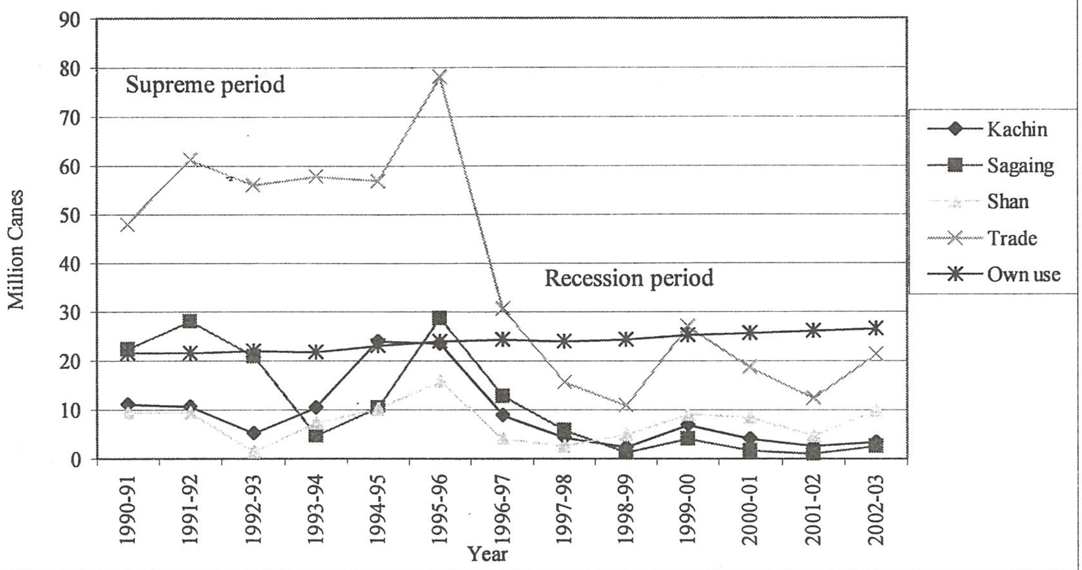


Those production data were based on revenue collected by the Forest Department. The main use among the domestic consumptions of the rattan in those days was for making log-rafts by the State Timber Corporation (Myanma Timber Enterprise-MTE) with an annual consumption of about 3.5 million canes. The domestic consumption by local people was estimated at about 1.2 million canes for 1962-63 (Chein Hoe, 1972). It was learned that Myanma rattans had been at the international trade since then. However, the statistics were not available.

1.2 Production at Present

The productions for trade and domestic use, own use, for the period from 1990-91 to 2002-03 (Planning and Statistic Division, Forest Department, 2003) are provided in **Figure 2**.

Figure 2. Cane Production for Trade and Own Use.



Some selected States and Divisions where rattan production has been intensified are also shown in the figure for comparison. Considering the apparent two opposite trends of production for trade over the time, the period should be divided into two parts, the supreme period (from 1990-91 to 1995-96) and the recession period (from 1996-97 to 2002-03). In the supreme period, the average annual production for trade was 59.7 million canes. At that time, production from Sagaing Division was the highest representing 32.2% of the total trade and Shan State was 15%. However, during the recession period when the annual production for trade has been only 19.6 million canes, Shan State has been the highest productive region representing 32.2% and Sagaing Division has dropped down producing 21.7% of the total trade. But the production rate at 6.3 million canes of Shan State during the recession period is still less than that of the supreme time. Kachin State has kept the second place of productive region accounting for about 24% of total trade throughout the whole period.

Production for domestic use, i.e., own use, was estimated almost constant at an annual average consumption of about 23.8 million canes for the whole period (Planning and Statistic Division, Forest Department, 2003). It is suggested just to add the annual domestic consumption to the production of rattan for trade of a year to get the total rattan production for the same year.

2. Trade

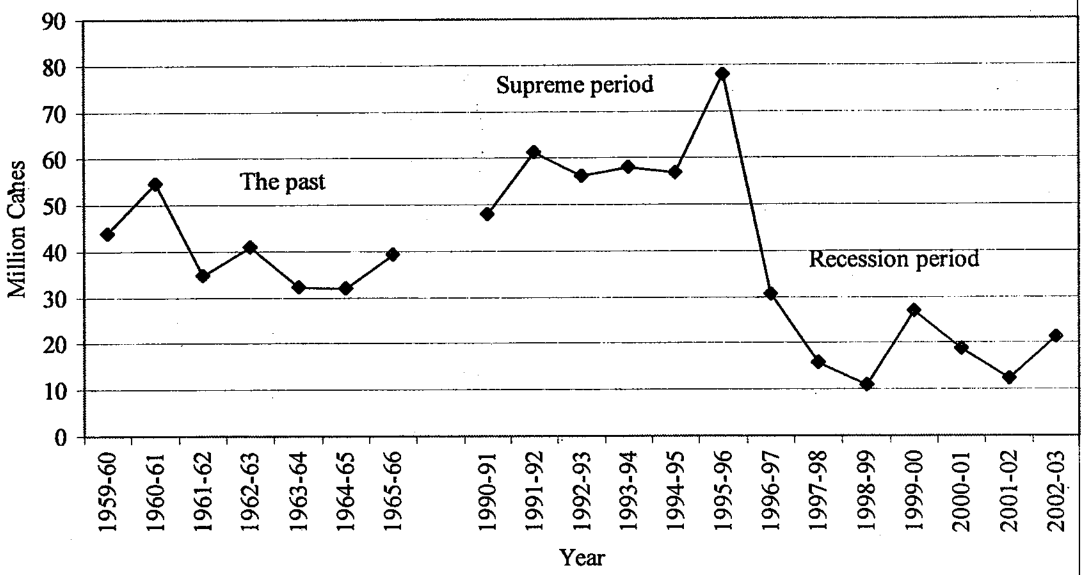
2.1 Development of Rattan Trade in Myanmar

The development of rattan industry in Myanmar has been dwarfed and left far behind in the mainstream of regional rattan industry. The first step towards the regional rattan trade was taken by MTE, under the Ministry of Forestry. It opened rattan purchasing centers in Myitkyina, Kachin State and Tanintharyi Division in 1969-1970 and exported 15 t of canes of 9 different species to Singapore in July 1970. In addition, some rattan wares of handicraft and furniture were also exported to Germany, Hong Kong Karachi, Moritia and Singapore for market exploration (Myint Wai 1993). In 1987, there were some offers made by some companies from Singapore, Hong Kong, Thailand and Japan to buy Myanmar rattan as much as possible. The sought-after species were Yamata (*C. latifolius*), Kabaung (*C. longisetus*), Kyet-u Kyein (*C. platyspathus*). One rattan furniture factory had been established by MTE in Thuwunna, Yangon and was closed in 1995. Record on export of rattan and rattan products during that time were not available.

2.2 Export of rattan

Cane production records for the period of late1960s, 1970s and 1980s were absent. The trend of rattan production for trade covering three periods, the past (1959-60 to 1965-66), the supreme period (1990-91 to 1995-96) and the recession period (1996-97 to 2002-03) is given in **Figure 3**.

Figure 3. Trend of Rattan Production for Trade



During the period from 1990-91 to 1995-96, rattan production for trade gradually increased with annual production of 59.7 million and recorded at 77.96 million in 1995-96. This situation was probably reflected by the impact of regional rattan trade. That period was said to be the boom in rattan industry in the region. In fact, those periods were of seriously getting scarcity of raw material for rapidly developed rattan industries in the region. The seriousness was aggravated in the resource poor countries by the consequent actions of ban on export of raw canes and even semi-processed canes taken by resource rich countries such as Indonesia and Malaysia.

The time was also accidentally coincided with a situation of changing economic policy in Myanmar from centrally planned economy to market oriented one affected since late 1988 (Myanmar Facts and Figures, 2002). At the out set, the interest of newly private individuals and companies was more in trade of raw rattan than producing value-added products. Such a series of events has brought about Myanmar as one of the raw rattan suppliers to the raw starving industries of neighboring countries.

However, a sharp decrease of rattan production in 1996-97 and onwards was observed. This declination of production from the peak of 77.9 million canes in 1995-96 to 30.7 million canes in 1996-97 was probably due to the impact of regional economic crisis that took place in 1997. However, the continuation of low productions has happened until now. The annual production for the past 7 yr was averaged at 19.6 million canes. This production rate is, let alone the maximum production rate during the prime time, still far below average annual production rate of 39.6 million canes in the past, about 40 yr ago. This critical situation might have some underlying causes. One of the causes was likely to be the dwindling rattan resources within Myanmar herself.

2.2 *Export earnings*

Myanmar has practiced market-oriented economy since late 1988. Then border trade has been materialized at border checkpoints with neighboring countries. Selected border trade offices and opening dates are provided in **Table 5**.

Table 5. Border Trade Offices

Sr no.	Border	Office	Opening Date
1	Myanmar-China	Muse	12.1.1991
2	Myanmar- India	Tamu	12.4.1995
3	Myanmar-Bangladesh	Maungdaw	5.9.1995
4	Myanmar-Thailand	Kawthaung	1.6.1996
5	Myanmar-China	Bahmaw	23.8.1998
6	Myanmar-Thailand	Myawady	16.9.1998
7	Myanmar-Thailand	Myeik	1.5.2000
8	Myanmar –China	Lyzar	1.5.2000

Source: Myanmar facts and figures (2002)

Rattan, in the form of raw material was one of the important forest products among export items in border trades. Opening border trades has largely affected the resource base and business of rattan in Myanmar. No statistics on rattan trade across the borders of Myanmar-Thailand and Myanmar-India was available. Records of rattan export to China and Bangladesh through border trades were available. Export values (FOB) of rattan and rattan products through both shipping and border trade are given in **Figure 4**. China is the giant market for raw material making about 99% of export value through border trade and is also accounting for 34.6% of total export value in 2002-03 (**Table 6**).

Figure 4. Export Earnings from Rattans and Rattan Products

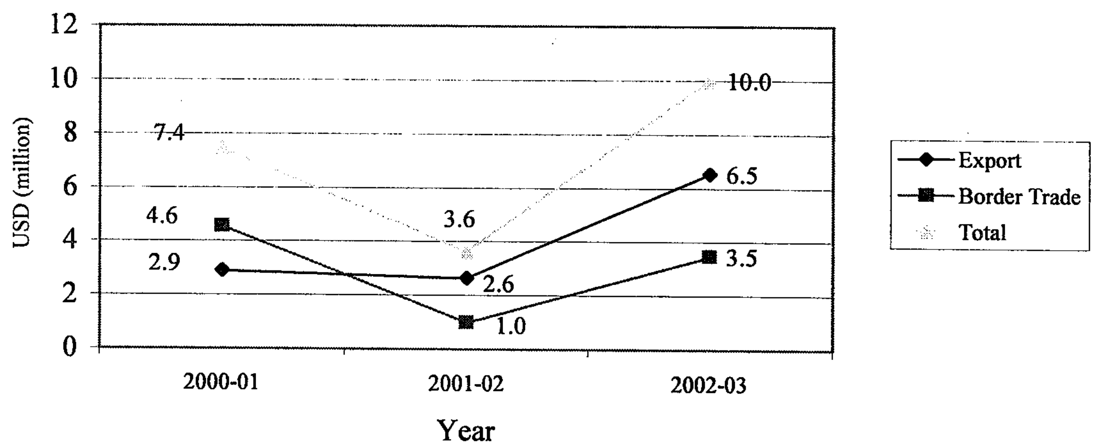


Table 6. Percent Contribution in Total Export Earning by Means of Trade.

Sr no.	Mean of trade	2000-2001	2001-2002	2002-2003
1	Export	38.8	72.9	65.4
2	Border Trade	61.2	27.1	34.6
	Total	100.0	100.0	100.0

2.4 Contribution of Rattan to the National Economy

The significant contribution of the forestry sector to the national economy is given in **Table 7**. The contribution of rattan to the national economy is still not significant.

Table 7. The contribution of Forestry sector to the national economy.

Particulars	1998-99	1999-2000	2000-01
The National Gross Domestic Production (Kyat in Million)	79460	88157	100123
Forestry Sector Gross Domestic Production (Kyat in Million)	802 (1.01%)	839 (0.9%)	867 (0.86)
Forestry exporting earnings in percent of total national export earnings *	17.4 %	17.80 %	-

Source: Statistical Yearbook, 2001.
* Forestry in Myanmar, June 2000.

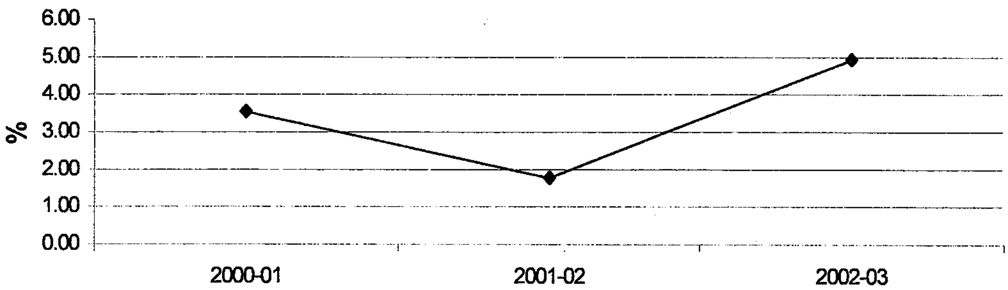
Again export earnings from rattan and value-added products versus timber and value-products are given in **Table 8** and **Figure 5** shows the contribution percent of rattan to timber respectively.

Table 8. Export earnings from rattan and value-added products versus timber and value-added products (Million USD).

Particulars	2000-01	2001-02	2002-03
Timber and value-added products *	208.3	203.6	202.8
Rattan and value-added products	7.4	3.6	10

Source: * Myanmar Timber Enterprise, 2003

Figure 5. FE from rattan and value-added products in % of FE from timber and value-added products



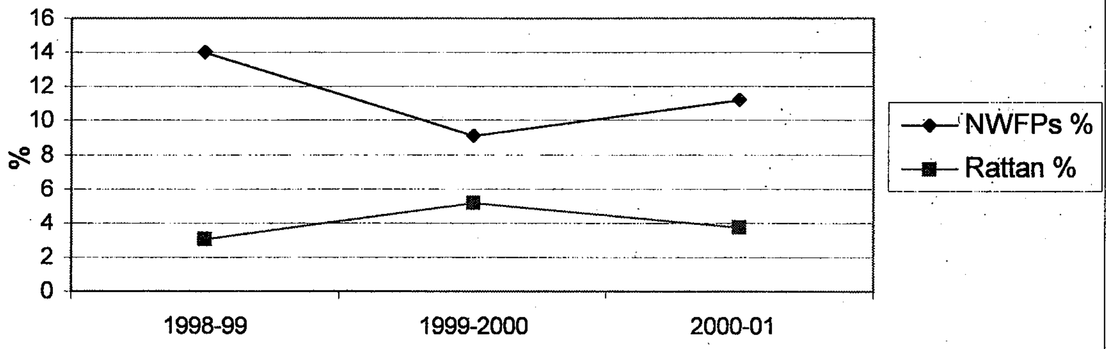
The status of NWFPs and rattan to the overall forest products in terms of revenue values collected for the Forest Department is shown in **Figure 6**.

3. Resource Management

Forest Management Plan is drawn up for each district which is the Forest Management Unit according to forest administration. Management prescriptions are prescribed and production patterns for the plan period of 10 yr are determined. A Special Working Circle, namely "Non-wood Forest Products Working Circles" is formed, based on the significance of production of NWFPs at a FMU. Annual production on NWFPs for each state/division is fixed according to the annual allowable cut (AAC) for NWFPs.

The villagers who are residing in and around the forests are allowed to gather non-wood forest products including rattans for their domestic consumption according to the rights and privileges prescribed in the

Figure 6. Revenues from NWFPs and Rattan as % of total royalties of foest products



Forest Management Plan. But for commercial purpose, it needs license permitted by the Divisional Forest Officer. The Divisional Forest Officer leases licenses within the annual allowable cut. The Divisional Forest Officer has to make records of actual production versus target yearly for the period covered by the plan. Name of reserves and number of canes to be extracted are described in the license. Licensees are allowed to go into the forest when they pay due revenue to the Forest Department.

3.1 Annual Allowable Cut

Chein Hoe (1972) estimated the amount of resources and annual allowable cut (AAC) of rattan by species for the whole country. The AACs were calculated on the assumption that 5 yr harvesting circle was optimum while knowledge on maturity age of rattan was absent. The estimated resource availability and AAC by species were given in **Table 9**.

Table 9. Estimated Resources and Annual Allowable Cuts of rattan Species.

Sr no.	Species		Estimated Resource	Estimated A A C
	Myanmar Name	Scientific Name	Stem (,000)	Stem (,000)
1	Kabaung Kyein	*Calamus. Longisetus* Griff	2,291.3	459.3
2	Kalar Kyein	*C.*	1,600.0	320.0
3	Kyet-u Kyein	*C. platyspathus* Mart	2,000.0	400.0
4	Kyein Kha	*C. viminalis Willd*	3,566.5	722.8
5	Kyein Sein	*C.*	6.0	1.0
6	Kyein Tet	*C.*	100.0	20.0
7	Kyein Ni	*C. guruba* Ham	122,110.0	24,425.0
8	Kyein Nigyi	*C.*	775.0	155.0
9	Kyei Hnamaung	*C.*	5.0	1.0
10	Kyein Bok	*C. myrianthus* Becc	57,600.0	11,520.0
11	Kyein Hpan	*Plectocomia macrostachya* Kz	272.3	74.4
12	Kyein Byu	*C. pseudo-rivalis* Becc	7.5	1.5
13	Kyein Byugalay	*C. helferianus* Kz	23,650.0	4,730.0
14	Khaset Kyein	*C.*	7.0	1.4
15	Lewa Kyein	*C.*	15.0	3.0
16	Myasein Kyein	*C. nitidus* Mart	3,250.0	650.0
17	Myauk Kyein	*Flagellaria indica* L.	2,500.0	500.0
18	Myaukchi Kyein	*C.*	3,300.0	660.0

Table 9. Estimated Resources and Annual Allowable Cuts of rattan Species *(continuation).*

Sr no.	Species		Estimated Resource	Estimated A A C
	Myanmar Name	Scientific Name	Stem (,000)	Stem (,000)
19	Myauktalwe Kyein	*K.orthalsia*	3.0	0.6
20	Netkyaw Kyein	C.	330.0	66.0
21	Naukchi Kyein	C.	30.0	6.0
22	Oopwa Kyein	C.	6.0	1.2
23	Sin Kyein	C.	10.0	2.0
24	Taung Kyein	C. *doriaei* Becc	1,905.0	381.0
25	Thaing Kyein	C. *erectus* Roxb	529.5	109.8
26	Toke Kyein	C.	30.0	6.0
27	Wa-Oo Kyein	C.	20.0	4.0
28	Wabo Kyein	K. *laciniosa* Mart	290.0	58.0
29	Wunthaw Kyein	C.	626.0	125.1
30	Yamata Kyein	C. *latifolius* Roxb	876.2	183.9
31	Ye Kyein	C. *floribundus* Griff	109,191.0	21,838.2
32	Yethun Kyein	C.	2,000.0	400.0
	Union Total		338,902.3	67,826.2

Notes: Unit of AAC mentioned in **Table 9** was assumed as stem or stick. That meant only one stick (the length was not described here) was produced from a stem of rattan.

3.2 Rattan Production Working Circle

Khamti District is bordered by India in the west. The district was formerly composed of the two forest districts, namely Upper Chindwin/Myittha and West Kathar Districts according to the old working plans. About 80% of the total land area, 2.6 million ha, of the district is still covered by closed forests. This area is densely populated by almost all the commercial rattan species. Production of rattan from Khamti Forest District is shown in **Table 10**.

Table 10. Rattan production from Khamti District (million).

District/Division	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
Khamti District	8.8	12.5	2.3	3.8	7.3	15.2
Sagaing Division	22.5	28	20.8	4.8	10.5	28.8
% of the Division	39	45	11	79	70	53

According to the Forest Management Plan of Khamti District (1997), the number of rattans produced from the district was recorded at 15 million for 1995-96 with an annual average production of 7.3 million over the previous 10 yr. It was also noted that the District Forest Department initiated to form a Rattan Production Working Circle in order to be systematic in the extraction under the context of sustainable production of rattan resources. Given the all aspects from management, economic feasibility and resource extent, it was divided into two felling series.

Felling series	Area (ha)	Townships
No. 1	1537229	Homelin, Lashi
No. 2	1733645	Khamti, Lahe

Again, felling series were subdivided into 10 annual coupes of more or less equal area fixing felling circle at 10 yr. According to field experiences, some species such as Kyein Ni *(C. guruba)*, Yamata Kyein *(C. latifolius)*, Taung Kyein *(C. doriaei)*, Kyetsu Kyein (N.I), and Phya Kyein (N.I) are found on the upland where flooding does not occur. These species bear fruits and regenerate from seeds and/or rhizomes at their maturity, from 6 yr to 10 yr. In the case of Ye Kyein *(C. floribundus)* which is abundant in flooded areas in the lowlands, a two-year felling circle is enough for regeneration.

4. Harvesting

4.1 Season

Rattans can be harvested all season in Myanmar. However, some difficulties may exist in drying process and transport in the forest during the rainy season. In the past, rattans were gathered by farmers only for their own use usually and for extra money sometimes. Typical harvesting season was cold season when they were free from farm activities. Nowadays, rattans are harvested all seasons since rattan business has been booming. Rattan gatherers are not only farmers but also other villagers and casual laborers hired by traders. Usually, small-diameter canes are collected during open season but large-diameter canes year round.

4.2 Method and System

The harvesting method of rattans in Myanmar is very conventional. Being climbers, rattans usually hang on the crown layer of the trees in jungle. It requires force to pull it down after cutting the stems. Manpower or animal power is used but great caution is necessary not to break the stem in this case. Animals used are normally cattle and elephant in some cases. Mature rattans are distinguished by presence of dry sheaths or absence of sheaths in lower part of the stem and the color of stem turning from yellowish to dark green. Immature rattan stems, due to their high moisture content, are heavy and shrink when they are dry. Even in a mature rattan, the immature top part of about 6 ft is discarded. The cut-size of a stick in the jungle is 15 ft allowing for extra length for damage in edges during the course of transportation. Although some rattan stems are over 100 ft long, gatherers usually cut at where reachable. The remaining part of the stem that is difficult to be extracted is left and spoiled in the jungle.

While the MTE is buying rattans, rattan gatherers are instructed not to include the following defects in the canes (sticks of rattan) especially of Kabaung Kyein *(C. longisetus)*.

1. Canes with a length of under 4 m or 13 ft
2. Canes with a diameter of under 25 mm
3. Debarked canes
4. Canes with yellow or yellowish skin
5. Canes with cracks
6. Canes stained by mildew
7. Canes spoiled and affected by fungus
8. Canes with holes attacked by insects
9. Canes with uneven length of internodes
10. Canes with large differences in diameter between those of the butt and the tip
11. The twisted and sharply crooked canes
12. Canes from dead and dry rattan plant
13. Canes from immature parts of the rattan plant
14. Canes with wounds from knife
15. Canes with some scars from burning
16. Canes with wounds and scars along the whole length of 13 ft

In addition, the license holders or rattan harvesters must abide by the following regulations.

1. Only when the due royalties are paid to the FD, can the harvesting of rattans be started.
2. Only the rattans growing in the forest reserve described in the license must be harvested.
3. Harvesting must be with a limit of quantity and species as prescribed in the license.

4. Do not harvest rattan that does not meet export quality.
5. Do not harvest small seedlings of and immature rattans to secure regeneration in the future.
6. Do not harvest giant rattans that with high water content and are likely to shrink when they are dry.
7. Do not harvest Leme Kyein (N.I) for their leaves for roofing.
8. Do not harvest rattans those are affected by the defects mentioned above.

Middlemen or traders or sometimes representatives of the licensees or rattan companies hire local rattan gatherers providing credit to them in advance. A team of rattan gatherers headed by a representative may consist of 10 to 25 gatherers for one season. One gatherer can harvest about 30 to 40 large-diameter rattans or 200 to 300 of small-diameter rattans in a day. Some rattan companies open branch offices in some towns where rattans are heavily harvested nearby. Some examples of towns are Belin (Mon State), Gwa (Rakhine State), Myeik, Bokpyin and Tanintharyi (Tanintharyi Division), Monywa and Khamti (Sagaing Division), Bhamo and Myitkyina (Kachin State).

4.3 Transporting

The green rattans that are freshly cut are heavy due to high moisture content. A man can carry on his shoulder only a bundle of about 5 green sticks of Kabaung (C. longisetus), for example. But he may carry about 20 sticks when they become dry. The green rattans sink in water but the dry ones don't. So the green rattans are transported on boats or bamboo rafts in river course and in bullock card on land to their campsite in the forest or sometimes until depots in the town. There, rattans are given pretreatment before they are transported to market or manufacturing places in urban. Trucks or lorries are commonly used in transporting from campsites to markets or factories. Sometimes motorboats are used if a land route is not available.

4.4 Post harvest Activities

At harvesting Site

It is necessary to give preservation treatment to the green rattans soon after they have been cut. Due to inadequate tools and implements in the forest, the following pre-treatments are usually given to the green rattans right in the very harvesting place.

(a) The green rattans are scraped with kitchen knives to remove the spikes, leaves, skin from the stem.
(b) Set erect or lean all the rattans on the forks of trees or on hillside in a position of good ventilation to let the water drain out from them.
(c) Shelters are needed to protect rattans from rains or dews. They are usually covered by waterproof sheet at night.
(d) It is easier to get the crooked or twisted poles to be straight while still with high moisture content. So while some gatherers are harvesting, some have to make the rattans straight. Then rattans are tied in bundles.
(e) Then rattan bundles are carried on shoulders and then in bullock cards till campsite.

At Campsite or Depots

Campsite and depot are temporary sites where to collect and store rattans for a few days before transport it to the market. Campsite is usually at the edge of forest or suitable place and depot is in small town. Sometime canes are spoiled in the camp or depot due to awaiting transport for many days. Thus it is suggested to give further treatments to rattans in the campsite or depot is more effective than do only when they arrive in the town or factory. The following treatments are practiced to obtain the desired quality depending on the market situation.

Skin off and Sun dry Method

The objective of this method is to let moisture out immediately. The canes already skinned off must be placed in perpendicular position. Skinning off is just to take off epidermis from the stem and needs caution not to scrape the flesh. File treated with stone is better than knife as a scraper in this manner. Scraping direction should be along the grain of the cane. Even though this method is cheap in terms of cost, the treated canes are likely to be brittle and thus wasteful in furniture making.

Smoking Method

Make a pile of canes and straw in the arrangement of layer by layer alternately. Then the pile must be paved with mud, leaving small holes, then fire the straw. Because of limited oxygen, the straw will burn slowly, taking time, and thus make the canes dry up gradually. It turns the color of rattans to reddish. This method is suitable for small-diameter canes.

Diesel Cooking Method

This method is the best and mostly practiced in Myanmar. The halves of empty oil drums are used as containers in this method. In order to protect the diesel oil from the flame, the base of the container is paved with mud. The green canes are soaked in the boiling diesel for about 15 min to 30 min depending on their maturity. Thus, the water inside the canes evaporates. The diesel treatment also protects canes from mildews and increase their flexibility. Then the cured rattans are rubbed by sawdust to clean off the remnants of diesel. In this method 50 gal of diesel is needed for 1,000 canes.

Sanding Method

Canes either green ones or cured by diesel can be rubbed with sand in order to increase their quality. By doing so dust and resins stained on the skin are cleaned off. However, caution is needed not to use dirty sand. It is learned that canes carefully rubbed with pure white sand are more attractive in foreign market.

IV. PROCESSING AND UTILIZATION

The knowledge and skills related to production and utilization of NWFPs have been passed on from one generation to another, and thus form traditional forest-related knowledge (TFRK) and culture (Htun, 2001). Rattans are utilized for various purposes for their preferable physical properties such as smooth outer skin, long length and durability and being easy to work with in bending and weaving.

1. Canes

1.1 Rattan Trade

Rattans harvested by gatherers are traded in the form of raw canes in the domestic and export markets. The normal length of a rattan stick (cane) for trade is 13 ft. In domestic market, small-diameter canes are made into bundles, 50 or 100 canes in a bundle, and sold in pieces. According to the new economic policy of the State, the raw canes are allowed for export by private sector. In this case, advertising and sending of samples of rattans are necessary. It is not necessary to send the whole cane as a sample. A sample may be as short as the piece having two nodes. The buyers assess the quality of rattan by examining the length between the two nodes.

1.2 Primary Use

Making ties in teak log-rafts

The conventional ways of timber harvesting in Myanmar has been elephant skidding in the jungle and then rafting along the rivers. The girdled teak logs are floatable in the water. So almost all teak logs are floatable in the water. So almost all teak logs are transported by way of rafting in the rivers at the least cost. It needs a lot of canes to make log rafts and rafting. Ye Kyein (C. floribundus) and Kyein Ni (C. guruba) are commonly used for tying teak logs together. About 3500 sticks of 22.5 ft long canes are needed in making a log-raft consisting of 136 teak logs. In making a halt rafting over 100 ft long canes of medium- or large-diameter species are needed. MTE alone consumed about 3.7 million of sticks while domestic consumption was estimated at 1.2 million sticks in 1962 (Chein Hoe, 1972). The FD of Khamti district also reported in its Forest Management Plan (for the period 1996-97 to 2005-06) that MTE annually collected about 3 million sticks of Kyein Ni (C. guruba) for making log-rafts. However, MTE nowadays reduces rattan consumption down to 1.3 million sticks by introducing steel ropes in the place of rattans. Another reason is that the number of felled teak logs is increasing and more trucks are being used for transportation.

Some Other Uses

The other uses of primary forms are in construction of bridges and houses. Walking sticks, cattle driving sticks, and canes for punishment are also among other uses. Farmers prefer Kyein Kha (C. viminalis) to make cattle driving stick. Some tools and equipment for farming and fishing are usually made up of rattans. The names of rattan species and purposes for which they are utilized are described in **Table 11**.

Table 11. Name of rattan species and their uses.

Purpose	Name of Rattan Species
Teak log rafting (a) Tying logs together	1. Kyein Ni (*C. guruba*) 2. Ye Kyein (*C. floribundus*)
(b) To halt rafting	1. Yamata Kyein (*C. latifolius*) 2. Taung Kyein (*C. doriaei*) 3. Wabo Kyein (*K. laciniosa*) 4. Kabaung Kyein (*C. longisetus*)
Farming and Fishing (tools and equipment)	1. Kabaung Kyein (*C. longisetus*) 2. Kyet-u Kyein (*C. platyspathus*) 3. Kyein Bok (*C. myrianthus*) 4. Wabo Kyein (*K. laciniosa*) 5. Kyein Byugalay (*C. helferianus*) 6. Thaing Kyein (*C. erectus*)
Walking Stick	1. Kyein Kha (*C. viminalis*) 2. Taung Kyein (*C. doriaei*) 3. Yamata Kyein (*C. latifolius*)
Furniture Frame	1. Yamata Kyein (*C. latifolius*) 2. Kabaung Kyein (*C. longisetus*) 3. Ye Kyein (*C. floribundus*)
Cattle Driving Stick	1. Kyein Kha (*C. viminalis*)
Elephant Harmnest	1. Kabaung Kyein (*C. longisetus*) 2. Kyein Hpan (*Plectocomia macrostachya*)
House construction (ropes)	1. Kala Kyein 2. Kyein Sein 3. Kyein Bok (*C. myrianthus*)

2. *Secondary Products*

Some medium- or large-diameter canes of inferior quality are peeled or split into whole cane or cores. Small-diameter canes are processed into splits or sometimes into cores. During processing of rattans prior to making finished products, splitting is the stage that is wasteful. It also requires physical strength. Kyet-u Kyein (*C. platyspathus*) is first class when it comes to meeting the required quality of seat and back for chair. The split forms of Yamata Kyein (*C. latifolius*) and Kala Kyein (N.I.) are suitable for making cane ball. The other large- or small-diameter cane species suitable for splitting in making furniture or handicrafts are as follows.

Splits
1. Kyein Ni
2. Ye Kyein
3. Myasein Kyein
4. Kyein Bok
5. Kyein Byugalay

Cores
1. Kabaung Kyein
2. Yamata Kyein
3. Taung Kyein
4. Tawtanlan Kyein

V. MARKETS AND SOCIOECONOMICS

1. *Participants in the Market Chain*

1.1 Village level

Rattan gatherers may be villagers or farmers when they are free from farm activities, and casual laborers from other places. Normally, villagers and farmers gather rattans from the nearby forests in open season for their own uses and sometimes for selling in the nearest town for extra money. Some rattan companies dispatch delegates to the villages in different regions to collect rattans. Sometimes rattan traders or middlemen bring casual laborers from other places. Company delegates and middlemen may practice two ways in dealing with rattan gatherers. One is paying an advance to the gatherers for their field expenses and their family expenses. It is usually bound with contract and/or trust between each other. Another type of payment is paying cash down for the material extracted. In the second way individual farmers and villagers may have opportunity to join rattan harvesting. After being given pretreatment, the rattans are collected by company men and middlemen and directly transported to the markets and factories in the cities.

1.2 Town level

Farmers or villagers sell raw rattan and sometimes their handmade rattan products in the market of the nearest town. The market size at the town-level is generally small with a small number of rattan shops. Rattan goods can be classified into raw stage, semi-processed products such as cores and ropes, farm implements and some small articles of kitchen utensil. Consumers are mostly farmers from the town and the near villages and carpenters, and town dwellers. As Myanmar is an agricultural country, communities of farmers compose the population of whole townships of considerable size. Farmers buy not only farm implements but also raw rattan and some semi-products to make farming implement by themselves. Carpenters use rattan in making furniture particularly office chair. Office chairs are standardized and used by government offices. Another popular small article of rattan product is a kind of hand basket. It is designed for female office staff and teachers with particular purpose to put in some books, tiffin box, folded umbrella, purse and some small things. Those hand baskets are high-quality products and usually imported from Yangon City. In the scale of commercial trade, some companies open their rattan purchasing centers in town to collect rattans gathered by farmers and villagers from nearby villages.

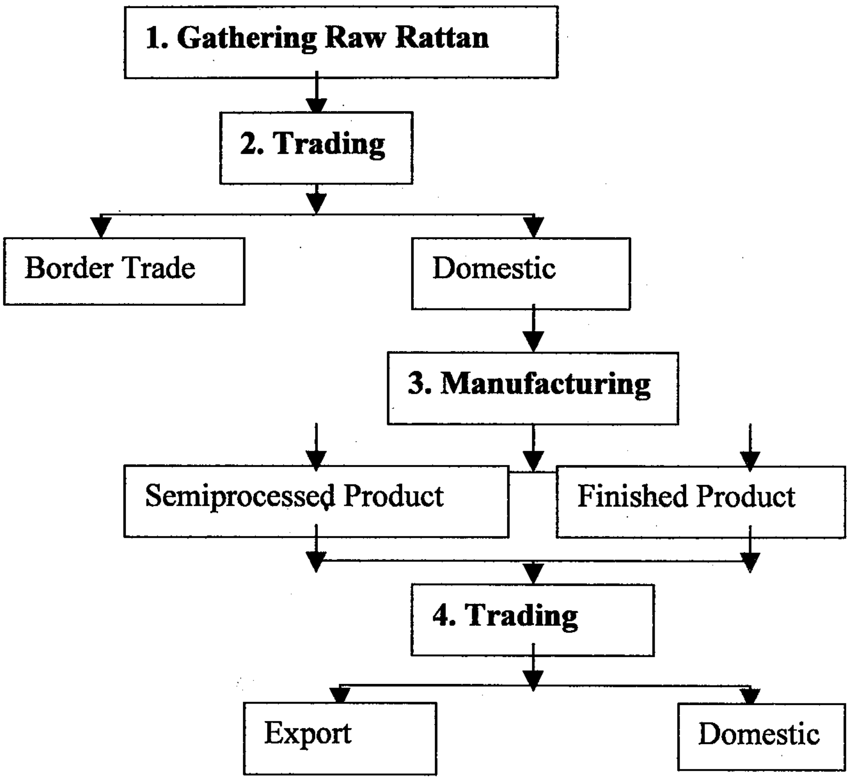
1.3 City Level

Rattan furniture manufacturers, handicrafts, and wholesale markets of raw materials and retail market of rattan products are found in the cities. Yangon and Mandalay cities are primary centers of rattan industry. The wholesale markets are situated in cities such as Yangon, Bago, Pathein, Pyay, Mandalay, Monywa, Bhamo and Myitkyina.

1.4 Rattan Companies

Generally rattan companies are different from each other in nature. Some companies perform the whole process starting from gathering raw material to manufacturing to exporting finished products. They have their own rattan factories. But some are involved only in trading either raw materials or finished products. In the latter case, some small-scale and handicraft entrepreneurs are suppliers of finished products to such companies. **Diagram 1** shows four stages of rattan business where a company might be involved in at least one stage.

Diagram 1. Stages of rattan business



2. Classification of Firms

2.1 Industries

Under the Regional Industrial Co-Ordination and Inspection, Directorate of, Ministry of Industry No. (2), private industries are classified into 3 types: large-scale, medium-scale and small-scale industries. Their specifications are shown in **Table 12**.

Table 12. Identification for Private industries.

Sr no.	Specification	Small-scale Industry	Medium-scale Industry	Large-scale Industry
1	Capitalization (Million Ks)	< 1	1-5	>5
2	Production (Million Ks)	<2.5	2.5-10	>10
3	Machine (Horse Power)	<25	25-50	>50
4	Size of Laborers	<50	50-100	>100

Rattan factories that meet with the above specifications are registered under the Ministry of Industry No. (2). Rattan factories registered so far are given in **Table 13**.

Table 13. Rattan factories registered under the Ministry of Industry No. (2).

Sr no.	Localty	Small-scale factory	Medium-scale factory	Large-scale factory
1	Yangon	-	2	3
2	Mandalay	-	-	3
3	Bago	2	-	-
	Total	2	2	3

All the 3 rattan factories in Mandalay city are semiprocessed products producing enterprises and of major raw material suppliers to other finished products manufacturing enterprises. Rattan factories in Yangon and Bago cities are furniture and/or handicraft manufacturers.

5.2.2 Rattan-based Cottage Enterprises

Another type of small-scale enterprises are at the cottage level, and these are registered under the Cottage Industries Department, Ministry of Cooperative. A cottage enterprise is a small scale production by members of a family or by engaging workers or collectively. This definition covers small-scale businesses that use power less than 3 HP or manpower not exceeding nine workers and handicrafts in which the number of workers is not limited.

The number of rattan cottage businesses so far registered under the Cottage Industries Department is only eight in Yangon City and five in Yekyi, a small town in Ayeyarwady Division. No registration of cottage enterprises is found in other cities and towns. It is believed that some small-scale businesses and many more cottage businesses unregistered yet may exist in other cities and town.

3. *Rattan-Based Cottage Enterprises in Yekyi Township*

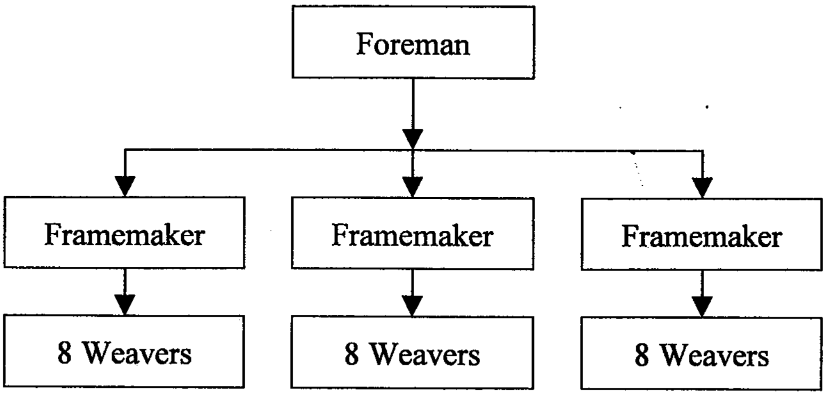
Yekyi is a small town with 2719 households. Population is 10,550 in the town proper and 240,000 for the whole township. Farming and fishing is the traditional lifestyle of the people. The socio-economic status was said to be poor probably due to the inaccessibility and lack of options for livelihood activities. But some rattan companies arrived in Yekyi around 1993 seeking traditional artists for making rattan wares to include it in export items. The art of bamboo-working which has long existed in Yekyi fortunately became the seed of development of the rattan cottage industries in the town.

Companies adapted some residents as their representatives or middlemen. There were about one dozen middlemen in Yekyi and they set their own firms to produce rattan wares. When the business expanded, new small firms appeared, increasing further the supply to the middlemen. In such a way, rattan cottage businesses have mushroomed within a short period since 1996. Now, about 80% households of the town are involved in the industry. Houses sometime with temporary sheds have been changed into rattan cottage enterprises. The industry has expanded into adjacent villages. At present, about 5 rattan companies are active in Yekyi. Of them, two companies are raw material suppliers.

3.1 Structure of a firm

The workforce of a firm ranges from 10 to 50 including family members. There are two types of workers: frame maker and weaver. Frame makers are usually skillful male workers. Weavers are mostly women and young men sometimes. A standard working group has one frame maker and 8 weavers. Generally an average firm has 25 workers in total (**Diagram 2**). Foremen are usually middlemen or owner of a small firm.

Diagram 2. Structure of a working group in rattan cottage industry.



3.2 *<u>Payment</u>*

There are two ways of payment; salary basis and piecework basis. Payment by piecework can benefit skilled workers more than salary basis does. Salary varies from Ks 3500 to Ks 6000 for unskilled weavers, Ks 8000 to Ks 9000 for skilled weavers, and Ks 10000 to Ks 20000 for a frame maker. In the case of piecework basis, other people such as housekeeper, shopkeeper, even office workers and school children, can individually work for pay whenever they can find time.

3.3 *<u>Raw material</u>*

Raw materials for small articles such as rattan wears are semi-processed products; cores and splits. Small-diameter species such as Ye Kyein *(C. floribundus)*, and Kyein Ni *(C. guruba)* are used for producing both splits and cores. Kyet-u Kyein *(C. platyspathus)* is the best for making splits. At the beginning, the rattan firms have to make manually required raw materials themselves. As a tool for making cores, pieces of empty drums are punched to have required diameter size holes on it. To peel and split cane for producing ropes, simple knives were used embedded on a piece of wood. In 1998, some companies in Mandalay installed plants for making cores and splits. Since then, virtually raw materials being consumed in Yekyi have been imported from Mandalay.

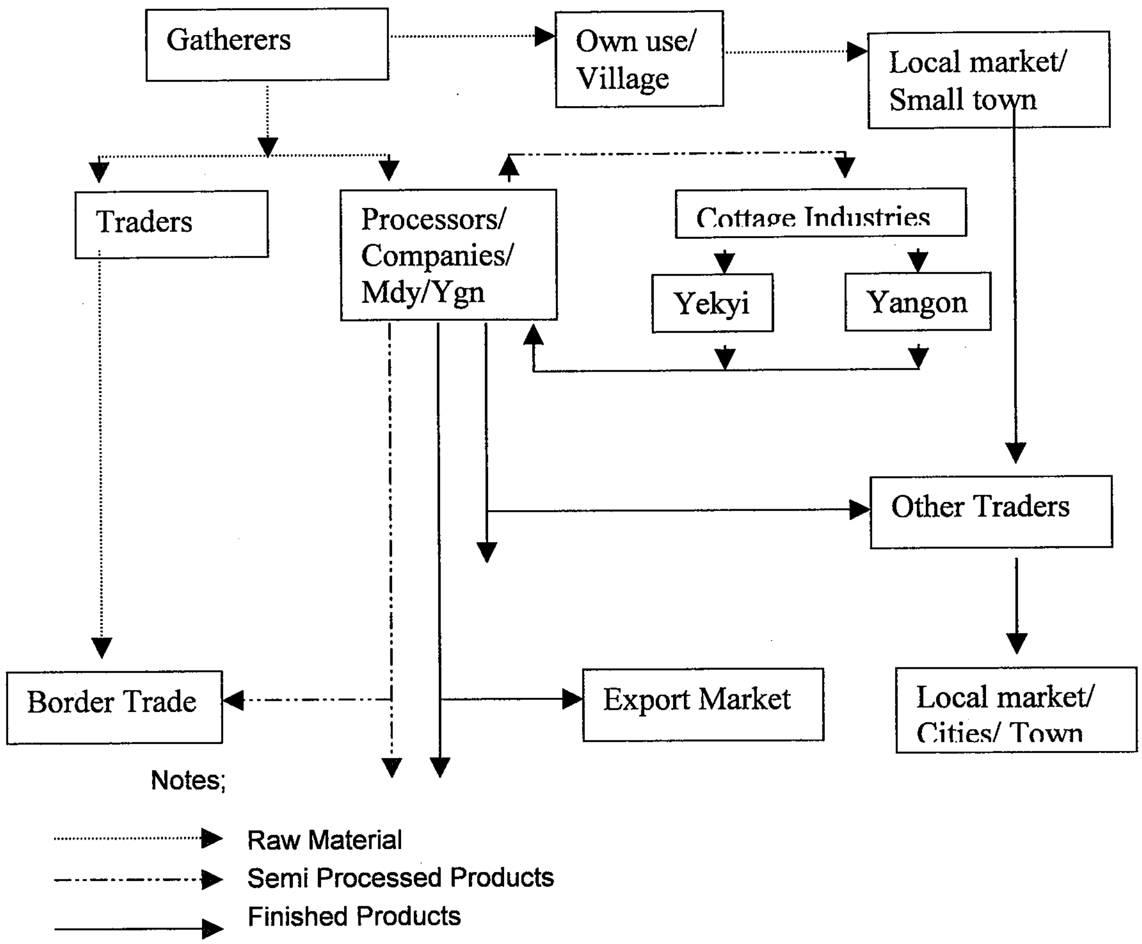
Prices of cores

Cores are traded by number of sticks, usually 100 sticks into a bundle. There are 10 classes in diameter size from 2 mm, the smallest to 20 mm, the largest, with 2 mm interval. But those diameter sizes are locally known as number in sizes. Number 8 and 9 sizes of cores are largely used among other sizes in making rattan wears in Yekyi. Local price of a bundle of number 9 is Ks 12500.

Prices of splits

Splits are traded by weight in the market. There are also several classes of width of splits. They are 1.75 mm in the smallest and 13 mm in the largest. Splits of about 2 vises (3.3 kg) are made into one bundle. Splits made from Kyet-u Kyein *(C.platyspathus)* is the best quality with the highest price, Ks 10000 for one bundle. The prices for splits of other species Ye Kyein and Kyein Ni are Ks 8600 and Ks 7600, respectively. Ye Kyein is the highest in market demand in the form of splits for its fair price and in the form of cores as well for its preferable quality compared to other species.

4. Rattan Product Flow and Channels of Distribution



VI. POLICY AND LEGISLATION

Indeed, systematic forest management widely known as Myanmar Selection System has been practiced in Myanmar for nearly 150 yr. About 100 yr old Forest Act (1902) was also replaced by the Forest Law (1992) and Forest Rules (1995) in the context of changing situations in social, economic and environment. The 1995 Myanmar Forest Policy was also promulgated in line with the forest principles adopted at the UNCED (1992). Following are some selected statements described in Myanmar forest policy pertaining to forest products.

Objectives:

- to increase export quantity of value added forest products
- to encourage in promotion of cottage industries in order to generate job opportunities and extra income to rural community.

Strategies:

- The important role of minor forest products in socioeconomic aspect must be recognized in the priority list of forestry development activities.
- The system of under valuation of forest products must be canceled.
- Export tax must be reduced against increasing export of value added products proportionately to encourage the promotion of forest industries.
- Necessary measures are to be taken step be step in order that all forest products are to become commercial commodities.

The Forest Policy (1995) encompasses possible aspects in protection and sustainability of forest resources, to fulfill the basic needs of the people and enhance the efficiency in resource use, and to raise public awareness and encourage people-participation in forestry activities. However, most of regulations are focusing mainly on premier timber, teak, and other hardwoods for their far outweighed importance in national economy. On the other hand the numerous and diverse items of minor forest product fail to receive particular attention from decision makers. Some sections, under the Forest Law (1992), currently being used for forest products and minor forest products, which are also applied to rattan are as follows.

- Section 17: - Harvesting of any forest product is restricted by permit. With the purpose for own uses, farming and fishing, harvesting minor forest products not exceeding the prescribed quality is allowed without permission.
- Section 18: - While a competitive bidding system is adopted to forest products for commercial production, exemption is due for minor forest products.
- Section 19: - The state/divisional forest officer may grant permission for a term which may extend to one year.
- Section 20; - The Director General of FD may designate a variety of minor forest product, its quantities of which is allowed by the forest officers without a permit and rates of royalty, and penalties for breaching the contract.
- Section 30: - Establishment of wood-based industry with the exception of wood-based cottage industries and furniture industries needs permission from the forest officer empowered for this purpose.

A system of taxation on NWFPs is adopted, by which 25% of the prevailing local market price of each item is collected as royalty on a unit measurement basis. Issuance of tickets and license, permits on face-value is practiced. The former is issued at the forest products check point to levy a tax later is issued when an individual or a private group is given permission for the production of NWFPs from a specified area.

The FD identified size of canes into two types; large-diameter cane (>1 in diameter) and small-diameter cane (<1 in diameter). The designated length for both sizes is 13 ft so that it can be put 3-fold into a 40-ft-long container allowing 1 ft for extra space for shipping. The current rates of tax levied by the FD are Ks 15 for one stick of large-diameter cane (>1 in diameter) and Ks 200 for one hundred sticks of small-diameter cane (< 1 in diameter).

VII. INSTITUTIONAL CAPABILITY AND LINKAGES

The Forest Research Institute (FRI) established in 1983 and the Institute of Forestry in 1992 are the two main institutions under the Forest Department for forestry-related research and higher academy. The first rattan research in Myanmar was initiated by the FRI in 1985. The FRI had established a cane nursery and an experimental plantation on a 3 acre-land under a natural forest at compartment 22, Yezin reserved forest, Pyinmana Township. Then, the FRI presented the following papers at Forestry Research Congresses.

1. "A survey on cane utilization in Burma and testing the methods of propagation", by U Htay Aung and Dr. Nyan Htun (1985-86).
2. "Nursery practice of some species of rattan (1)", by U Maung Maung Lay (2), U Htay Aung and Dr. Nyan Htun (1987-88).
3. "Regeneration of rattan stumps a preliminary survey", by U Htay Aung and Dr. Nyan Htun (1995).
4. Testing the methods of germination rattan species", by U Htay Aung, U Sein Htun and Dr. Nyan Htun (1997).

All of the rattan research papers were focused on initial stages of germination and propagation methods of locally well known species such as: Ye Kyein (C. floribundus), Kyein Kha (C. viminalis), Toke Kyein (C. spp), Leme Kyein(C. erectus), Thaing Kyein (C. erectus), Kyein Hpan (Plectocomia macrostachya). The silvicultural characteristics and growth performance of out planting ones have yet to be monitored.

Research activities currently being undertaken by the FRI in collaboration with the international organizations are as follows;

1. "Promotion of lesser used species" with ITTO;
2. "ASEAN Timber Names and Identification of Wood" with ASEAN Research and Development Expert Group on forest Products;
3. "Joint Botanical Studies" with Smithsonian Institute of the United States;
4. "Bamboo research activities" with International Plant Genetic Resources Institute; and
5. "Neem cultivation and information exchange" sponsored by FAO.

VIII. CONCLUSION

Myanmar still has a large area of forest cover of 34.42 million ha and of which about 76% or 26 million ha is vegetated by moist forests. The moist forests bear varieties of rattan according to reports and forest management plans. Number of rattan species so far recorded in Myanmar is 36 species and there may be some new or unidentified species. Accordingly, systematic study on rattan survey and species classification should be carried out.

On the other hand, the low annual production of 19.6 million canes at present compared to rather stable production rate of about 30 million canes/yr during the period from 1959 to 1965 is probably due to excessive harvesting with annual production of about 60 million canes during 1990 - 1996. This obviously indicated that the problem of rattan resource declination within the currently harvesting areas has already set in since the late 1990s.

The shift of major production areas has been seen. For example, Ayeyawady Division and Bago Division that were once abundant of rattans are facing resource scarcity of rattan. Kachin and Shan States and Sagaing Division have been leading other States/Divisions in rattan production. Meanwhile, rattan can now be harvested only in inaccessible areas, thus generating more harvesting costs and increased price of raw rattan and finished products accordingly.

The trend of export values of rattan furniture and rattan wares is positive, showing market stability in the years 2001-02 and 2001-03, and 2.5-fold increase in 2002-03. This reflects the strong development of rattan industry in the country.

A detailed statement on issues and concerns confronting the Myanmar rattan industry and recommended solutions and research and development (R and D) strategies to address the issues are mentioned in a Matrix form in **Appendix 4**. The second Matrix of SWOT, the strengths, weaknesses, opportunities and threats, in rattan industry of Myanmar is stated in **Appendix 5**.

In conclusion, given the abundance of rattan resource and skilled labor equipped with traditional knowledge about handicraft, the whole rattan industry in Myanmar possesses a bright prospect for development, provided that efforts to increase productivity versus resource conservation supplemented through cultivation are incorporated.

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Country Report on the Status of Rattan Resources and Rattan Industries in Malaysia

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I. INTRODUCTION

Malaysia is located in Southeastern Asia, and is comprised of Peninsular Malaysia, and Sabah and Sarawak at the northern one-third of the island of Borneo. The country borders Indonesia and the South China Sea and South of Vietnam (Figure 1). Geographically, it is co-ordinated between 2° 30 N and 112° 30 E. The total area of Malaysia is 329,750 sq km (328,550 sq km of land and 1,200 sq km of water). Malaysia has a total coastline of 4,675 km in which Peninsular Malaysia covers 2,068 km and Sabah and Sarawak cover 2,607 km.

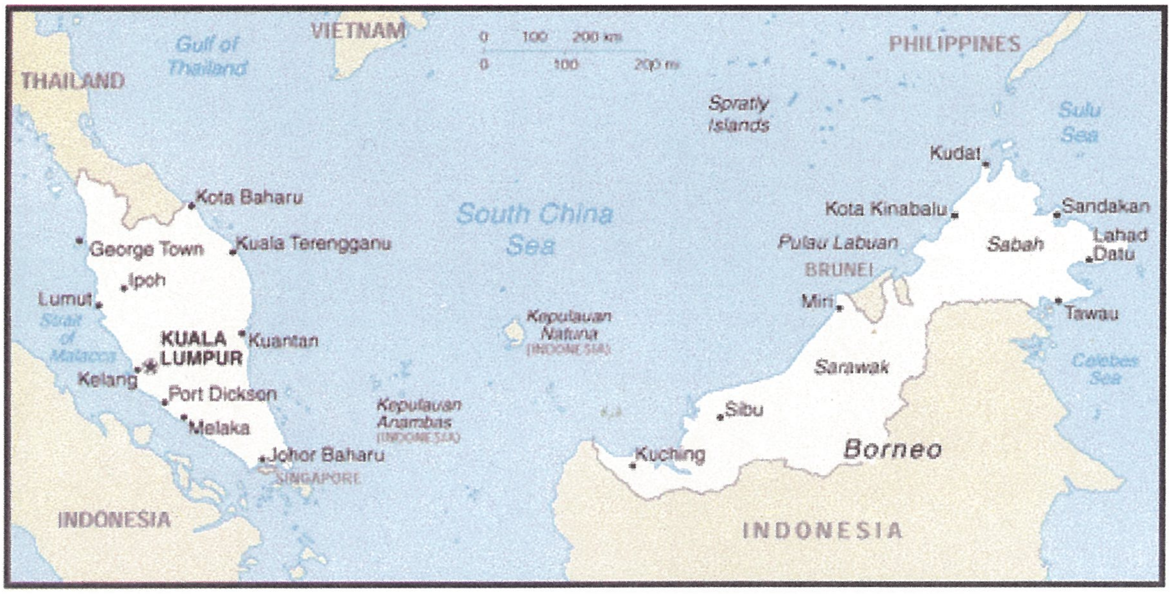


Figure 1. Map of Malaysia (Peninsular Malaysia, Sabah and Sarawak).

The tropical rain forests of Malaysia are comprised of primarily the species-rich lowland and hill dipterocarp forests. The other forest types found are the mangrove, peat swamp forests, limestone forests, heath forests, montane oak forests and montane ericaceous forests. In accordance with the Federal Constitution, forestry is a state matter and the State Governments have complete jurisdiction over their respective forest resources. The Federal Government provides technical advice on forest management and development, undertakes research and education, and promotes industrial development of wood-based industries and trade.

II. RATTAN RESOURCES

Rattan (family Palmae/Arecaceae) is considered to be the most important nonwood forest product in Peninsular Malaysia. The rattans belong to a large subfamily of the palms known as the *Calamoideae* (Uhl and Dransfield 1987). There are about 600 different rattan species belonging to 12 genera found in the world. In P. Malaysia alone there are 106 (8 genera) species found growing naturally

(Dransfield, 1979). However, out of this, only about 30 species are utilized and exploited commercially. In Sarawak, the largest state in Malaysia covering an area of 12.5 million ha, the rattan flora is very diverse. A total of 105 species with 8 genera have been identified (Dransfield, 1992) and a great number of species are endemic to Sarawak. Such richness is partly due to the presence of diverse forest habitats.

The rattan industry in Sarawak is still at the developmental stage. The two government departments currently involved in research and trial plantations of rattan are the Forestry Department and the Agriculture Department. KERESA and Rajang Wood Sendirian Berhad are two private agencies currently involved in rattan plantations. However, some of the areas already planted with rattan are likely to be converted soon to oil palm due to the better economic prospects and higher economic value of oil palm.

About 100 species of rattan are found in Sabah. The Forestry Department of Sabah began small-scale research in rattan cultivation in 1979. Research in this area was also prompted by a growing interest in creating a man-made rattan resource. Subsequently, several public and government organisations embarked on rattan plantations. As of mid-1996, the total area of rattan plantation in Sabah was about 23,157 ha. Innoprise Corporation Sendirian Berhad (ICSB) accounts for almost 43% of the total area planted, followed by the Sabah Forestry Development Authority (SAFODA) for 42%, Jeroco Plantation 8% and Sejati Plantation 7%.

1. Status of the resource in natural forests of Malaysia

Peninsular Malaysia

About half of the rattan species found in Peninsular Malaysia are endemics (Dransfield 1978). Within the Peninsula rattans may be found from sea level to the top of the highest mountain, but there are distinct floristic changes in the rattan flora as a mountain is ascended. Some species occur on a wide range of habitats from lowland, hill slope, and ridge top. Brief notes on the ecology and distribution of each species found in Peninsula are given in the taxonomic account as described in **A Manual of The Rattans of the Malay Peninsula** (Dransfield 1978).

Since 1972, three National Forest Inventories (NFI-1, NFI-2, and NFI-3) have been carried out to assess and determine the status of the various natural forest resources in Peninsular Malaysia. The Third Inventory (NFI-3) was jointly carried out by the Forestry Department Peninsular Malaysia (FDPM) and the Food and Agriculture Organisation (FAO) of the United Nations under the UNDP in 1991-1992 (Chin et al. 1994). Besides estimating the tree stocking, non-wood forest products such as the rattan, bamboo and palm resources were also enumerated.

Table 1a shows the estimated number of rattan clumps present according to forest strata in the Permanent Reserve Forests (PRFs) in Peninsular Malaysia. It is estimated that the total number of rattan plants (irrespective of age) found in the PRFs amounts to around 32.7 million, of which the most abundant (about 37%) are *Korthalsia* species (Table 1b). Of the *Calamus* species, *C. manan* is the most abundant with around 5.9 million (irrespective of age). In terms of distribution according to forest strata, it is found that the forest logged during the period 1971-1980 seem to have the highest number of rattan plants (40.2%).

Table 1b shows that the state of Pahang, which has the largest PFRs, also has the largest rattan resource base (37.2%).

Sarawak

Rattan flora in Sarawak is very diverse and the State possesses one of the richest rattan floras in the world with a total of 106 species in 8 genera (Dransfield 1992). A great number of species are endemic to Sarawak in which *Calamus* is the largest genus with 56 species, *Daemonorops* with 27 species and *Khortalsia* with 16 species. Such richness is partly due to the presence of diverse forest habitats. Major forest types in Sarawak are mangrove forest, peat swamp forest, lowland and hill mixed dipterocarp

Table 1a. Estimated number of rattan clumps according to forest strata and commercial rattan groups in the Permanent Reserved Forests, Peninsular Malaysia based on NFI-3 (in '000 clumps), irrespective of age.

Forest Stratum	Rattan Group							
	Calamus manan	*Calamus Tumidus*	*Calamus caesius*	*Calamus Scipionum*	*Calamus ornatus*	*Korthalsia spp*	Total	% of the Total
Virgin: Superior	578.3	677.9	433.1	110.2	583.7	1,197.1	3,580.3	**10.9**
Virgin: Good	484.4	488.7	168.1	493.1	95.1	2,145.5	3,875.5	**11.9**
Virgin: Moderate	1,017.2	618.1	102.2	855.6	890.7	1,659.7	5,143.5	**15.7**
Virgin: Poor	86.4	107.6	154.4	331.5	22.6	596.5	1,299.0	**4.0**
Logged during 1971-1980	3,011.8	637.1	1,513.1	702.2	3,475.1	3,822.6	13,161.9	**40.2**
Logged during 1961-1970	296.5	507.3	233.9	108.7	378.8	1,676.9	3,202.1	**9.8**
Logged during and before 1960	436.4	190.5	261.2	414.8	165.9	971.1	2,439.9	**7.5**
Total	5,911.0	3,227.2	2,866.6	3,016.1	5,611.9	12,069.4	32,702.2	**100.0**
% of the Total	**18.1**	**9.9**	**8.8**	**9.2**	**17.2**	**36.9**	**100.0**	

Source: Yap and Hasnuddin, 1995.

Table 1b. Estimated number of rattan clumps according to States and commercial rattan groups in the Permanent Reserved Forests, Peninsular Malaysia based on NFI-3 (in '000 clumps) irrespective of age.

State	Rattan Group							
	Calamus manan	*Calamus Tumidus*	*Calamus caesius*	*Calamus Scipionum*	*Calamus ornatus*	*Korthalsia spp*	Total	% of the Total
Johor	443.2	262.8	229.1	278.1	432.0	1,027.2	2,672.4	**8.2**
Kedah	409.9	248.1	231.3	299.7	379.9	1,041.0	2,609.9	**8.0**
Kelantan	724.5	382.1	305.5	359.3	814.7	1,374.8	3,960.9	**12.1**
Melaka	11.6	3.9	5.5	6.3	7.9	23.8	59.0	**0.2**
N. Sembilan	129.2	65.5	69.3	49.1	104.2	271.8	689.1	**2.1**
Pahang	2,288.7	1,247.6	1,087.7	1,046.9	2,022.4	4,460.7	12,154.1	**37.2**
Perak	1,020.1	585.0	469.7	602.1	985.1	2,192.2	5,854.2	**17.9**
Perlis	12.8	7.8	13.1	20.1	11.9	53.2	118.8	**0.4**
Pulau Pinang	10.0	3.4	4.9	9.0	4.5	25.1	56.9	**0.2**
Selangor	164.7	85.3	84.0	48.5	155.1	349.5	887.2	**2.7**
Terengganu	696.2	335.6	366.6	297.1	694.1	1,250.2	3,639.7	**11.1**
Total	**5,991.0**	**3,227**	**2,866.6**	**3,016.1**	**5,611.9**	**12,069.4**	**32,702.2**	**100.0**

Source: Yap and Hasnuddin, 1995.

forests, Kerangas forest (heath forest) and limestone forest. The Kerangas and limestone forests produce a few rare and extraordinary species. Brief notes on the ecology and distribution of each species found in Sarawak are given in the taxonomic account as described in **A Manual of The Rattans of Sarawak** (Dransfield 1992). Rattans found in Sarawak are generally relatively low in grade (*C. oornatus, C. optimus* and *C. scipionum)*, except the small-diameter cane *C. caesius* (Runi 1999).

Sabah

Major forest types in Sabah are similar to the ones in Sarawak: mangrove forest, peat swamp forest, lowland and hill mixed dipterocarp forests, Kerangas forest (heath forest) and limestone forest. Rattan inventory in the natural forest has not been carried out in Sabah. Harvesting canes from the natural forest has been carried out by villagers, who may have their own rules for inventorying rattan. Thus, the rattan resource in Sabah is very poorly known. The most recent documentation of the abundance of the various rattan species is the qualitative description by Dransfield as published in a manual called **The Rattans of Sabah** in 1984. Since then, rattan collection by villagers has intensified, prompted by the strong market demand.

1.1 Choice of rattan species

In Peninsular Malaysia, only 30 species are presently collected and utilised by the rattan industry for a variety of purposes (Table 2a).

Table 2a. List of potentially available rattan species by region.

Species	Vernacular name	Region
Large-diameter (>18mm)		
Calamus manan	Rotan manau	P. Malaysia
C. tumidus	Rotan manau tikus	P. Malaysia
C. palustris	Rotan manau langkawi	P. Malaysia
C. ornatus	Rotan mantang/dok	P. Malaysia/Sabah
C. scipionum	Rotan semambu	P. Malaysia/Sabah/Sarawak
C. peregrinus	Rotan jelayan	P. Malaysia
C. optimus	Rotan sega	Sarawak/Sabah
C. subinermis	Rotan batu	Sabah
Daemonorops grandis	Rotan sendang	P. Malaysia
D. angustifolia	Rotan getah	P. Malaysia
Korthalsia rigida	Rotan dahan	P. Malaysia/Sabah
K. flagellaris	Rotan dahan	P. Malaysia/Sabah/Sarawak
K. laciniosa	Rotan dahan / merah	P. Malaysia
Small-diameter (<18mm)		
C. caesius	Rotan sega	P. Malaysia/Sabah/Sarawak
C. trachycoleus	Rotan irit	Sarawak
C. axillaris	Rotan sega air	P. Malaysia
C. speciosissimus	Rotan sega badak	P. Malaysia
C. insignis	Rotan batu	P. Malaysia
C. laevigatus	Rotan tunggal	P. Malaysia/Sabah/Sarawak
C. densiflorus	Rotan kerai	P. Malaysia
C. diepenhorstii	Rotan kerai hitam	P. Malaysia/Sarawak
C. javensis	Rotan lilin	P. Malaysia/Sabah/Sarawak
D. propinqua	Rotan jernang	P. Malaysia
D. didymophylla	Rotan jernang	P. Malaysia/Sabah/Sarawak
D. micracantha	Rotan jernang miang	P. Malaysia/Sabah/Sarawak

Source: Aminuddin Mohamad (1991)

1.2 Species that are most economically and commercially important

The most important commercial canes come from the genus *Calamus*. The five most important species, in terms of utilisation and cultivation are as below:

***Calamus manan* (Rotan manau)** is the best large-diameter (>18mm) cane and is usually confined to the steep slopes of hill dipterocarp forests. It is abundant at 600 m to 1000 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% of light. It grows well under rubber trees, with growth rates around 0.3 m/yr to 3.0 m/yr (Aminuddin and Nur Supardi 1994).

***Calamus tumidus* (Rotan manau tikus)** is classed under the large-diameter group but the canes are always smaller than *Calamus manan*. The cane is used locally similar to *C. manan*. The habit is solitary, high-climbing, and is common in freshwater swamp forest, peat swamp forest and on alluvial flats.

***Calamus scipionum* (Rotan semambu)** is the widespread lowland species growing up to 200 m altitude. It is found on alluvial soils in flood plains 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 5 to 10 stems per clump and climbing high up to 50 m or more. The growth rate of the cane is slower than that of *C. manan*, about 0.15 m/yr to 1.5 m/yr.

***Calamus caesius* (Rotan sega)** is the best small-diameter (<18mm) cane. It has been used for all types of binding and weaving in the furniture industry, and in the finest basket ware. The habit is clustering with more than 100 stems per cluster and high-climbing, reaching about 100 m or more in length. The species is found in the lowlands such as alluvial flats, freshwater swamps, margins of peat swamp forest to hill slopes at 800 m altitude. The clump tends to be rather close and dense. The advantage is its multiple-stem habit, which allows repeated harvests to be carried out without the need of replanting.

***Calamus trachycoleus* (Rotan irit)** is a small-diameter cane (<18 mm). 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 aerial stem number exponentially. It is found growing on seasonally flooded riverbanks on alluvial clays and margins of peat swamp forests. In general, the canes of this species have shorter internodes, smaller diameter and thinner layer of silica than *C. caesius*. However, there is more demand for irit for weaving purposes because its cane is softer, more pliable and easier to work with. The softness may be a result of its very fast continuous growth under damp to wet conditions. It has a multiple-stem habit as in sega, and needs no replanting.

III. PRODUCTION AND RESOURCE MANAGEMENT

1. *Raising of planting stocks*

Rattan can be propagated from seeds, wildings, suckers or tissue-culture material. Seeds are the most important planting materials for large-scale rattan plantations. They are relatively easy to obtain in large quantities from the established plantations, which are now good sources of seed. However, these plantations were not established using selected seed material. The Forest Department of Peninsular Malaysia has identified the potential seed production areas (SPAs) for the production of high-quality rattan seeds. The PFRs for seed collections are the Bukit Belata F.R. in Selangor, Gallah F.R. in Negeri Sembilan, Raub F.R., Lentang F.R. and Sg. Yu F.R. in Pahang, and Gunung Tebu F.R. in Terengganu.

Small wildings collected from the forest floor can be also used as a source of planting material. However, wildings are not good for large-scale plantations due to their availability only in small quantities and being scattered over a large area in the forest. In the case of clustering species, suckers or stolons can be cut off from the parent plants and transplanted as new plants. The disadvantage of using suckers or stolons as a source of planting material is that they are also difficult to collect and establish as plants.

Tissue culture techniques using embryos or tissue from the shoot apex region have been used in propagating rattan plants. Although planting material developed from micropropagation technique is too costly, a high proportion of the plantlets produced are identical to the original mother plant. Rattan plants can be micropropagated on a large scale. At present some work on the micropropagation through somatic embryogenesis of large cane species, *Calamus manan, C. subinermis* and *C. merrillii,* have been carried out in the Plant Biotechnology Laboratory, Innoprise Corporation/CIRAD-Foret, Tawau, Sabah (Goh, 1988). Somatic embryogenesis technique is a nonsexual developmental process which produces a bipolar embryo from different sources of tissues such as young leaves, roots, ovules, pollen and zygotic embryos. Among the rattan species, *C. merrillii* has demonstrated the best prospects for regeneration via somatic embryogenesis.

Techniques of sowing and raising planting materials have been established and reported by few authors such as Johari and Che Aziz (1983a, 1983b, 1983c), Darus and Aminah (1985), Manokaran (1988) and Tan (1988, 1992). The most practical and successful method of raising rattan seedlings is from seeds. Propagation through vegetative suckers or tissue culture still needs further research to ensure success in producing large number of planting stocks. The following steps are recommended for raising rattan seedlings from seeds in the nursery.

Fruit collection, transportation and storage

Fruits can be purchased from aborigines (orang asli), who have intimate knowledge of the important commercial rattan species. Alternatively, seeds can be obtained from the existing rattan plantations, either established by the private sector or the one established by the forest departments. Only ripe fruits should be collected to ensure high germination rates. Hardness of seed confirms that the seed is mature and good germination rate can be expected. Fruits should be processed as soon as possible after collection to ensure high germination rates. For short-term storage while travelling, the fruits must be kept moist and cool at all times to preserve their viability.

Seed processing

Seed processing involves the breaking and removal of the pericarp and repeated rubbing and washing with water to remove the fleshy sarcotesta. Pericarp can also be removed by rubbing with sawdust or sand. This will expedite the germination of seeds. Soaking the fruits overnight in water would accelerate rotting and removal of sarcotesta. Processed seeds should be dressed with fungicide before sowing (e.g., 1 G thiram to 300 G of seeds).

Seedbed preparation

A seedbed is normally rectangle in shape and should be sited in an east-west direction to shelter the emerging seedlings from strong and direct sunlight. A seedbed should be composed of 7 cm thick layer of sandy loam overlaid with about 3 cm seasoned sawdust.

Seed sowing and after care

Small seeds may be broadcast over the soil about 2.5 cm apart or sown in rows at 5 cm apart and 2.5 cm within row. Seeds are then pressed into the soil until they are shallowly covered. The seeds are then covered with about 5 cm of seasoned sawdust and watered thoroughly. During sowing always keep the germination pore of seeds up, as this will expedite germination. Larger seeds may be spaced at 5 cm x 5 cm. Daily watering is required to ensure seeds are kept moist and cool at all time. Suitable seedbed shade would keep away direct sunshine and minimise impact of heavy rain which might otherwise churn up the seedbed and expose the seeds. Any exposed seeds should be covered up immediately. The seedling is ready for transporting when the seedling leaf is partially expanded.

Potting and after-care

The common potting media used for potting is a mixture of soil and sand with 3:1 ratio. Black plastic bags of 15 cm x 23 cm in size or 20 cm x 25 cm size are normally used for potting depending on how long that the seedlings will be kept in the nursery.

The plastic bag will be wet with water before transplanting the seedlings. A planting hole of sufficient size is dug at the centre to accommodate the root system. After placing the seedling in the hole, the hole is filled up with soil which is then firmed up and watered lightly. Watering should be carried out twice a day, once in the morning and once in the afternoon unless during rainy days. Weeding if required should be carried out just before each monthly round of fertiliser application. A fast release type of fertiliser suitable for application at nursery stage such as NPK (15:15:15) compound granular fertiliser recommended to be applied starting with 5 gm per plastic bag. Foliar fertiliser can be sprayed onto rattan leaves such as Bayfolan (11% N, 8% P_2O_5, 6% K_2O + TE) with 2-3 ml per L water per 100 seedlings. The amount can be increased gradually per bag when the seedlings increase in size and age. Fertilizing should be only carried out one month after transplanting. This to avoid any injury to the roots of the plants.

Pest and disease control

If stringent nursery hygiene is imposed, pest and disease outbreaks on rattan seedlings can be minimised. Attack by small insects can be controlled by insecticides such as Malathion 80% (6 mL/4.5 L of water) and Dicofol (25 mL/4.5 L of water). Spraying fungicides, e.g., 10 G of Methamidophos (50 mL/4.5 L of water) at 2 to 3 weeks interval would help to minimise incidence of leaf blight and leaf spot diseases. Culling of weak and diseased seedlings should be carried out during maintenance. Only healthy and vigorous seedlings should be used for field planting.

2. *Plantation Establishment*

The richest rattan habitats, the lowland dipterocarp forests, are mostly gone. Furthermore, the remaining commercial forest areas are now highly accessible as a result of the construction of logging roads. This has resulted in heavy and unsustainable exploitation of the rattans. In order to maintain the resource, large-scale rattan plantations offer a solution. Land identified as suitable for establishing rattan plantations are logged forests (newly logged or old logged forest) and existing plantations (tree forest, abandoned rubber or commercial rubber and oil palm plantations). Virgin forests with heavy canopy and low light levels on the floor are not recommended for rattan cultivation.

The choice of species for commercial cultivation will have to take into account numerous factors, of which profitability is probably the most important. Another important economic factor is the gestation period. The quality of the cane must be acceptable to the industry either as raw cane, semiprocessed, or finished rattan product. The choice has to be made whether to plant the single- or multiple-stemmed species. This will determine whether it is single or multiple harvests. Sufficient knowledge of the silviculture of the species choice is very crucial.

2.1 Rattan cultivation in natural forests

In Peninsular Malaysia, large-scale cultivation of rattan, especially the most economically important species *C. manan*, has been undertaken since the mid-1980s. Many of the state forestry departments have been carrying out rattan planting in logged-over natural forests using yearly budget allocations from the Silvicultural Cess Fund or Forest Development Fund of each state. By end of 1997, a total of 15,000 ha had been planted with rattan in a number of PRFs throughout the Peninsula (Harnarinder and Chin, 1999). More than 80% of the area was planted with large-diameter cane, *C. manan* only, and the remaining area was planted with the small-diameter canes, *C. caesius* and *C. trachycoleus*. Most of the initial plantings and tending works were carried out using departmental manpower. As the planting intensified in the 1990s, supply of seedlings, planting and tending after planting were contracted out.

a) Field preparation, planting, and maintenance

Lands identified as suitable and recommended for establishing rattan plantations are logged forests (newly logged or old logged forest). Virgin forests, usually rich in timber and with only a few gaps created by tree falls due to lightning and strong winds, are not recommended for rattan cultivation. Moreover, the penetration of light is low.

Group planting of clustering large-diameter cane species such as rotan semambu is not suitable since they will be clumped close together, resulting in poor growth. The planting density for solitary species is usually 500 to 800 seedlings/ha with spacing varying from 6 m x 1 m to 20 m x 2 m. However, clustering species should be planted at a lower density of 300 to 400 seedlings/ha with spacing ranging from 8 m x 2 m to 12 m x 4 m. An important factor that influences the growth and eventually the yield of rattans when planted under logged-over forest is the competition from surrounding trees.

Planting systems

In selecting the planting site for rattan cultivation, one should determine the vegetation present because the rattan seedlings would require sufficient light for good growth at establishment stage and later on they will need aerial support for more light. The support trees will help the rattan stay erect, enhance the growth and produce high-quality canes. Such aerial support can be provided by branches of nearby trees where the rattans can climb up using their climbing organs, cirrus or flagellum. After site selection and site characteristics have been studied, only then can the desired planting system be determined.

There are three methods of planting rattan. Rattan can be either line, group or strip planted.

In line planting rattan seedlings are planted singly per planting point along a planting line.

In group planting more than one seedling is planted per planting point. Three to five seedlings are usually planted at a distance of up to one meter apart.

Strip planting is recommended in old secondary forest so as to reduce damage to the forest. It is suggested that minimal planting density should be at 400 seedlings and 200 seedlings/ha for solitary and clustering species respectively. Based on this planting density, it is recommended that the planting strips and forest trips should be between 5 m to 10 m and 30 m to 40 m, respectively (Figure 2a). The minimum distance between seedlings within the planting line should be 1 m and 2 m for the solitary and clustering species respectively. Trees are felled along the strips and bordered by forest strips, whereby the trees are left undisturbed. To open the canopy, trees need to be thinned allowing a sufficient light to reach the forest floor. This method is practiced by Sejati Plantation in Sabah for small-diameter canes. An optimum of two planting lines per planting strip is sufficient.

In Figure 2b, another example of planting layout for planting rattan under the secondary forest, the recommended planting distance is 3 m x 4.6 m giving a population of 725 plants/ha. A lane 1.8 m wide is cleared of all undergrowths on either side of the planting line, to facilitate field operations. In the case of the clustering or multiple-stemmed species under secondary forest, the recommended planting distance is 6.7 m x 3.4 m with 1.8 m on either side of the planting line cleared of all undergrowth (Figure 2c). The planting density in this planting type is 439 plants/ha.

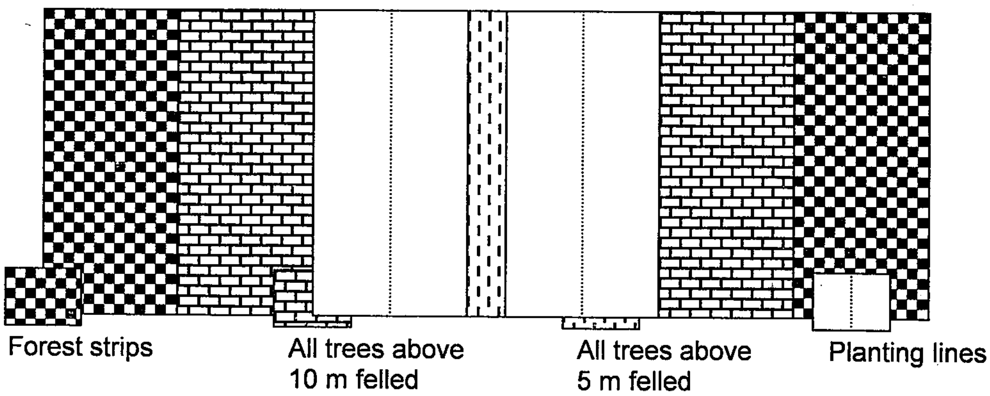


Figure 2a. Strip planting in old logged forest (Nur Supardi & Aminuddin 1992)

Field preparation

Before any field preparation work can be carried out for large-scale planting, the area should be properly surveyed, boundaries demarcated and subdivided into blocks of appropriate size. The blocks may range from 10 ha to 40 ha depending on the size and nature of the land, topography, and planting density. Regular size and shape of the block facilitates field operation and overall project management. Information such as gradient, aspect, and the presence of ridges and rivers can help managers decide the size of planting blocks and the need to construct roads, culverts or bridges. Field preparation involves a number of operations such as underbrushing, lining and line planting clearing, selective felling and cutting of trees. These operations will prepare planting paths for establishing rattan seedlings.

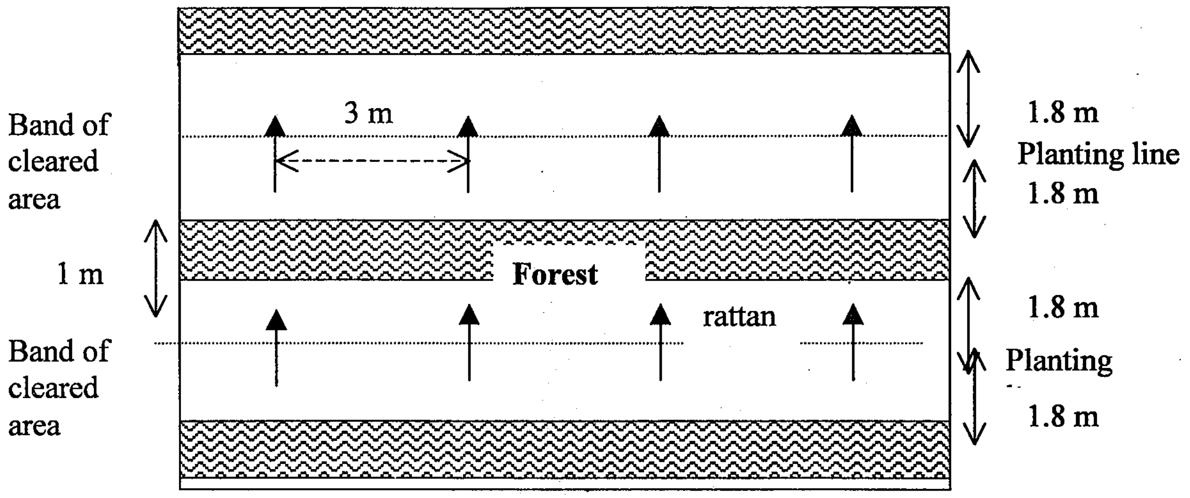


Figure 2b. Line planting layout for solitary-stemmed rattan species under secondary forest (e.g., rotan manau). Planting distance is 4.6 m x 3 m.

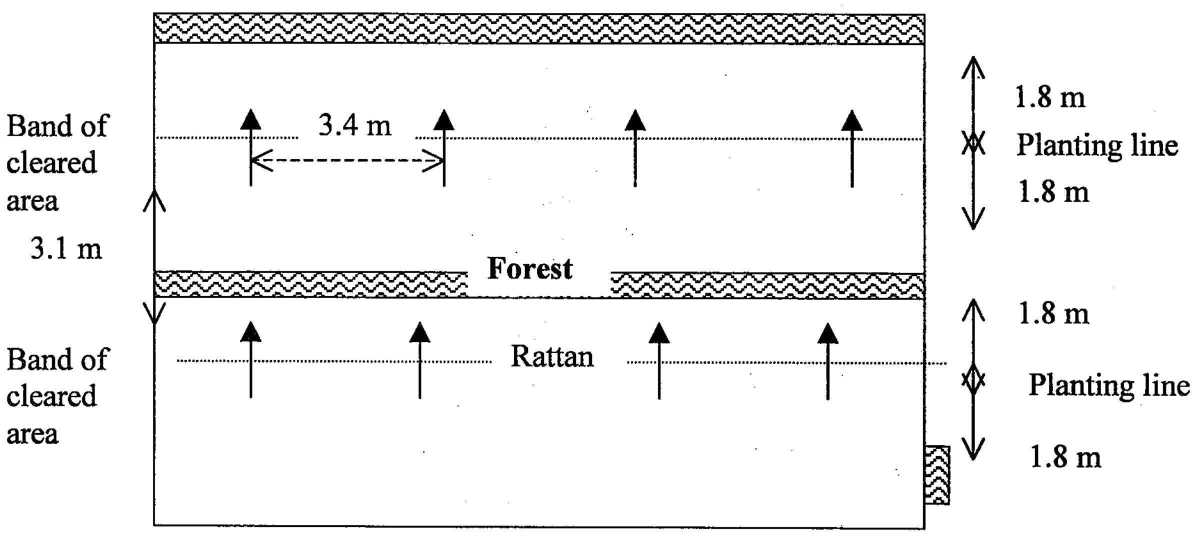


Figure 2c. Line planting layout for multiple-stemmed rattan species under secondary forest (e.g., rotan sega and rotan irit). Planting distance is 6.7 m x 3.4 m.

Construction of roads, drains, canals, bridges and culverts

The existing logging roads should be used and maintained. If new roads need to be constructed, the standard forest roads should be made. In low-lying areas, bridges and culverts need to be well-constructed. A well-maintained network of roads, drains, bridges and culverts is essential in rattan cultivation for the initial development phase and for subsequent maintenance and harvesting operations.

Underbrushing

The operation involves slashing of all undergrowth, creepers and seedlings, young saplings and noncommercially important trees (e.g. *Macaranga* spp) with knives as close to the ground. In a relatively weed-free plantation forest, it may not be necessary to carry out underbrushing at all.

Line planting clearing

For field forest planting, the baseline is determined depending on the direction of the planting line or the terrain. The baseline also serves as pathway for workers to carry seedling during planting and to harvest cane during harvesting. Lining is carried out to mark the planting rows and planting points. Pegs or spikes made of bamboo are inserted at the planting points to assist in aligning the planting distance between points. Planting lines are aligned perpendicular to the baseline. The common practice on undulating and flat areas is to have the planting line in an east-west direction to maximize the benefit of sunlight. On very steep slopes, it is recommended that the planting lines should follow the contour. Therefore, the direction of baseline on steep slopes is along the slope. Along the planting line, the optimal width is between 1.5 m to 2.0 m wide and needs to be cleared as planting path. Trees within the planting path and immediately outside (except those of commercial importance), should be felled and removed if they are found to be obstructing movement of workers for planting rattan, and if they are providing heavy shade. Pruning of tree branches to allow more light, about 50% or more, to reach rattan seedlings along the planting lines may also be necessary. Felling of trees and/or pruning of tree branches require good judgement by experienced workers so that they are neither excessive nor inadequate. The workers should also skilled in identifying the trees so that commercial tree species are conserved. These activities are also quite labour-intensive and tedious. Mechanical felling using small chainsaws is preferred to the application of tree poisons.

b) Field planting

Hardening off and transportation of seedlings

Before planting, rattan seedlings need to be hardened off in the nursery or in the field. A few days or a week before planting, the seedlings should be moved from the nursery shade and placed under direct sunlight in the nursery or transported directly to the planting site. Before the seedlings are transported to the planting site, they need to be watered thoroughly. The seedlings should be transported with ventilated covered vehicle to prevent damage by wind.

Planting operation and fertilizer application

Seedlings should be planted at the onset of the rainy season. A three-man team is required for planting, one for digging the planting hole, one for carrying seedlings, fertilizer and placing the seedling at planting hole, and one for the actual planting. It is a standard practice that the planting holes be at least twice larger than the diameter of the plastic bag and slightly deeper than the height of the bag. The slow-release fertilizer type (e.g., AGROBLEN 16N 8P 9K + 3 mg), 100 G/plant, is recommended to be applied in the planting hole. Fertilization of rattan planted in the logged forest using slow release type should be only done once at planting time.

c) Maintenance

Replanting

Replanting or replacement of dead or unhealthy seedlings should be done in the first three years. This is to ensure that the final stocking of the plantation is at least 60% of the original planted plants.

Weeding

The pathways, borders and planting lines need to be cleaned frequently during the first three years. The frequency of weeding depends on how vigorous the regrowth of weeds is. Weeding of planting line can be done in two ways: by circle or by line weeding. In circle weeding way, the area with a radius of 1 m surrounding the seedlings is cleared. Normally for group planting, circle-weeding is recommended. In line weeding, a strip of area encompassing 1 m distance on both sides of the planting line is cleared. The usual weeding practice is three to four times a year. When rattan plants have established themselves and started to climb it is not necessary to clean the planting line; however, the pathways and baseline need to be cleaned once a year.

Canopy opening

Canopy opening should be done before planting during field planting preparation. However, after a few years, the forest canopy should be manipulated to give 50% light penetration. For this purpose, selected trees should be carefully felled to avoid damage to the young seedlings. The trees can also be poison-girdled using permissible poisons (e.g., Garlon 250). However, the effect of poison-girdling is slow as it takes almost 12 mo for the treated trees to dry and rot.

Thinning

For clustering species (e.g., *Calamus scipionum, C. ornatus, C. merrillii*), some of the stems or suckers need to be thinned to reduce the competition in growth within the clump. This will allow the remaining stems to grow more vigorously.

Table 3a. Estimation cost of establishment rattan plantation in a natural forest in Peninsular Malaysia in 1999. Number of seedling planted/ha is 450.

Activity	Per hectare (RM)
Site preparation	675.00
Seedling cost at RM 3.00/seedling	1,350.00
Seedling transportation cost at RM 1.50/seedling	675.00
Planting at RM 1.50/seedling	675.00
Weeding at RM 0.90/seedling	400.00
Climber cutting at RM 0.90/seedling	400.00
Under brushing at RM 2.00/seedling	1,000.00
Silviculture thinning at RM 2.00/seedling	1,000.00
Total	**6,175.00**

2.2 <u>*Rattan cultivation in forest plantation*</u>

A number of land development agencies, such as Rubber Industry Smallholders Development Authority (RISDA), the Federal Land Development Authority (FELDA) and private companies such as Kurnia Setia, Guthries and Golden Hope Plantations, have also initiated rattan plantations. They have interplanted rattan in rubber and oil palm plantations and small-holdings. In Peninsular Malaysia, about 91 ha of *Pinus caribeae* plantation was interplanted with Rotan manau in Kemasul Forest Plantation, Mentakab, Pahang in 1986. When the cane overtopped the pine trees, either whole trees or branches and shoots, were bent or broken. This shows that the branches of pine trees are not strong enough to support the weight of Rotan manau. In the same area, about 10 ha of *Pinus caribeae* were interplanted with the clustering rattan species, *Calamus caesius,* in the same year. *C. caesius* performed well and vigorously dominated the area. This posed a difficulty for managing the main crop, the pines. It can be concluded that clustering small-diameter cane species is not suitable for interplanting in a commercial plantation pine forest (Raja Barizan and Chong 1999).

In Sabah and Sarawak, a number of public agencies and private companies have actively planted rattan to significantly enlarge the resource base in the country. Commercial planting of *C. caesius* in Sabah was started in the early 1980s. To date the species remains the most important small-diameter cane for planting in Sabah. In 1988, Innoprise Corporation Sendirian Berhad (ICSB), a commercial holding company of Sabah Foundation, started a rattan plantation in Luasong Forestry Centre, about 100 km Northwest of Tawau, Sabah. The objective of this project was to enrich a logged-over forest by line-planting rattans and to provide cash income before the next timber-harvesting cycle. Aside from that project, SAFODA and Sejati Plantation Sendirian Berhad Sabah attempted on their own to plant rattans under *Acacia mangium*. Two species of rattan, *Calamus manan* (a solitary species) and *C. merrillii* (a clustering species from the Philippines), were planted under *A. mangium* on a trial basis at Ulu Tungud, Sabah.

2.3 Rattan interplanting in abandoned or in well-managed rubber plantations

Rattan species is intercropped with rubber (*Hevea brasiliensis*) trees in either well-managed commercial rubber plantations or small-holdings and abandoned or semi-abandoned plantations.

Rattan interplanting in semi-abandoned rubber holding: During 1981/1982, SAFODA of Sabah planted several hundred hectares of rattan, mainly *C. caesius*, under 10 yr or older rubber plantations. The rubber trees were being tapped rather irregularly. In Sarawak, *C. caesius* was interplanted with rubber trees in the semi-abandoned rubber holding along Sungai Sebetan, Seratok. Here, rubber trees were not tapped regularly. The rattan plants were planted haphazardly and were growing irregularly. Thus, rubber trees can undoubtedly be used as support or shade trees for growing rattans successfully, but only abandoned rubber holdings are suitable for multiple-stemmed small-diameter canes such as *C. caesius* and *C. trachycoleus* (Tan, 1992). In this case, rattan will be the main crop while rubber tapping is secondary.

Rattan interplanting in well-managed commercial rubber plantations: The plantation was established similar to the agroforestry concept. This is aimed at increasing the yield of land and supplements the income of smallholders/rural folks. The income is estimated to be more than sufficient to cover the costs of replanting rubber (Salleh and Aminuddin 1986). The survival and the stem growth of Rotan manau planted under rubber trees in plantation were reported better than those planted under forests. The establishment of rattan in rubber plantation is more cost-effective than planting in forest areas. This is because the prevailing conditions in managed rubber plantation are almost ready-made for immediate establishment of rattan seedlings.

Rattan plants are usually planted in the middle of rubber tree rows. The planting distance of rattan under rubber varies according to the rubber spacing. Another approach has been to plant rattan in alternate rows of rubber trees. The other method is to group two to three rattan plants at each planting point. The planting distance between each planting point for group planting is wider than with single planting point. This is to ensure adequate stand planting density (400 plants/ha) and to see that each plant is supported by a rubber tree. From various studies, Rotan manau seedlings require about 60% relative light intensity (RLI) which is considered to be relatively open condition. This suitable light condition can be attained under the rubber trees.

In P. Malaysia, so far only three species have been found to be suitable for growing under rubber: *C. manan* (Rotan manau), *C. scipionum* (Rotan semambu), and *C. palustris* (Rotan manau langkawi). The techniques of planting Rotan manau under rubber have been well developed. Age of rubber trees at inter-cropping and planting densities are also important factors that need to be determined before embarking on planting. Rotan manau is not suitable under old rubber plantation, i.e., more than 10 yr. Four- to seven–yr old rubber trees are the best for intercropping with Rotan manau.

Inter-cropping rattan with rubber appears most feasible. The rattan, however, should be viewed only as supplementary crop. In the planning, the rattan planting should be timed for harvesting when the rubber plantation is coming up for replanting, ca. around 25 yr of age. This will minimise the difficulties encountered during harvesting of rattan, and prevent damage to the rubber tree when the cane is harvested earlier. Longer planting time would mean the canes are allowed to reach maturity and are more suitable for commercial processing. After harvesting, the extra income from the rattan crop will help the management to tide over the non-productive establishment period of the new rubber plantation. Small-scale rubber holders or large rubber estates can adopt the practice. The resource will open up a much bigger opportunity in the downstream processing enterprises.

With inter-cropping of rattan and rubber, there are some management problems – the rattan can hinder the tapping operation. The dense crown of the rattan can prolong the drying of the bole of the rubber trees after a rain. Rattan harvesting can damage the branches of the rubber trees as well.

a). Field preparation, planting, and maintenance

This agroforestry project is aimed at increasing the yield of the same piece of land and the income of rural folk. The planting of rattan in between rows of rubber trees in plantation is initiated to help smallholders use their lands more effectively and to provide supplementary income. The income is estimated to be more than sufficient to cover the costs of replanting rubber. The survival and the stem growth of Rotan manau planted under rubber trees in plantation have been reported to be better than those planted under forests. The establishment of rattan in rubber plantation is more cost-effective than planting in forest areas. This is because prevailing conditions in managed rubber plantation are almost ready-made for immediate establishment of rattan seedlings.

Planting

Planting should be done at the beginning of the rainy season and before the dry season to ensure the high survival of planted plants. Potted seedlings of 8 mo to 12 mo and with 30 cm to 50 cm heights are suitable for planting. The size of planting hole used for planting should be at least twice the diameter of the plastic bag. The depth of the hole should be a few centimeters deeper than the height of the plastic bag. Fertilizer of Christmas Island Rock Phosphate (CIRP), 100 G to 150 G/plant, is normally applied in the planting hole at planting. The plastic bag should then be cut off and the seedling placed in the middle of the planting hole. The hole should then be covered and the soil firmed by foot to ensure that the seedlings are firm in the planting hole. Fertilizer application after planting is necessary in the first three years. The seedlings appear not to respond to fertilizer after this period.

Rattan plants are usually planted in the middle of rubber tree rows. The planting distance of rattan under rubber varies according to the rubber spacing. Another approach has been to plant rattan in alternate rows of rubber trees. One other method is to group two to three rattan plants at each planting point. The planting distance between each planting point for group planting is wider than with single planting point. This is to ensure adequate stand planting density per ha (400 plants/ha) and to see that each plant is supported by a rubber tree.

Three planting systems that are being practiced in Peninsular Malaysia are shown in Figures 3a, 3b and 3c (from Aminuddin and Nur Supardi 1994). In planting system I, depending on the width of rubber planting rows, the rattan seedlings are usually located in the center of the rectangle described by four rubber trees (Figure 3a). This is the quincunx pattern. The planting distance of rattan within the line is equal to the distance of rubber trees and rattan plants are planted in alternate rows of rubber trees. The ratio of planting density between rubber and rattan is 2:1. System II is called a triangle planting system, whereby similar planting distance of rubber trees is used as in system I but with different planting distance for rattan (Figure 3b). The ratio of planting density between rubber and rattan/ha is similar with system I. System III is applied when the rubber trees are planted at wider spacings, usually more than 6 m (Figure 3c). Rattan plants are planted in alternate rows of rubber trees at closer planting distance within the row. Under this planting system, group-planting whereby two to three rattans are planted at each planting point, can be applied. From various studies, rotan manau seedlings require about 50% relative light intensity (RLI) which is considered to be relatively open condition. This suitable light condition can be attained under the rubber trees.

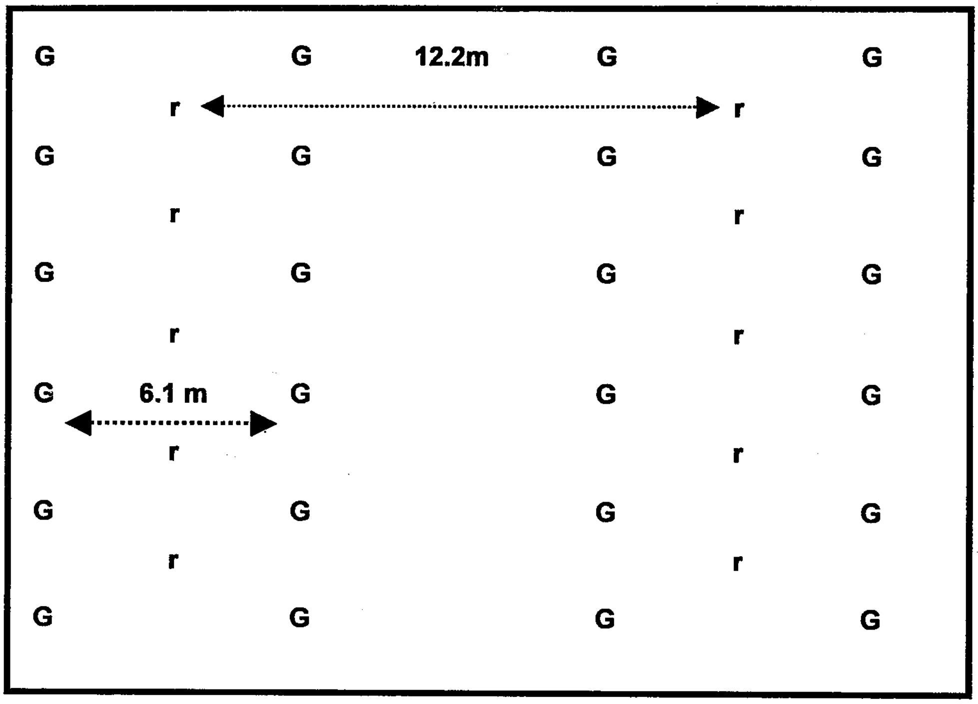


Figure 3a. Planting system I – layout of alternate row rattan planting in rubber plantation. G = rubber tree at spacing 6.1 m x 3.05 m ; r = rattan plant at spacing 12.2 m x 6 m.

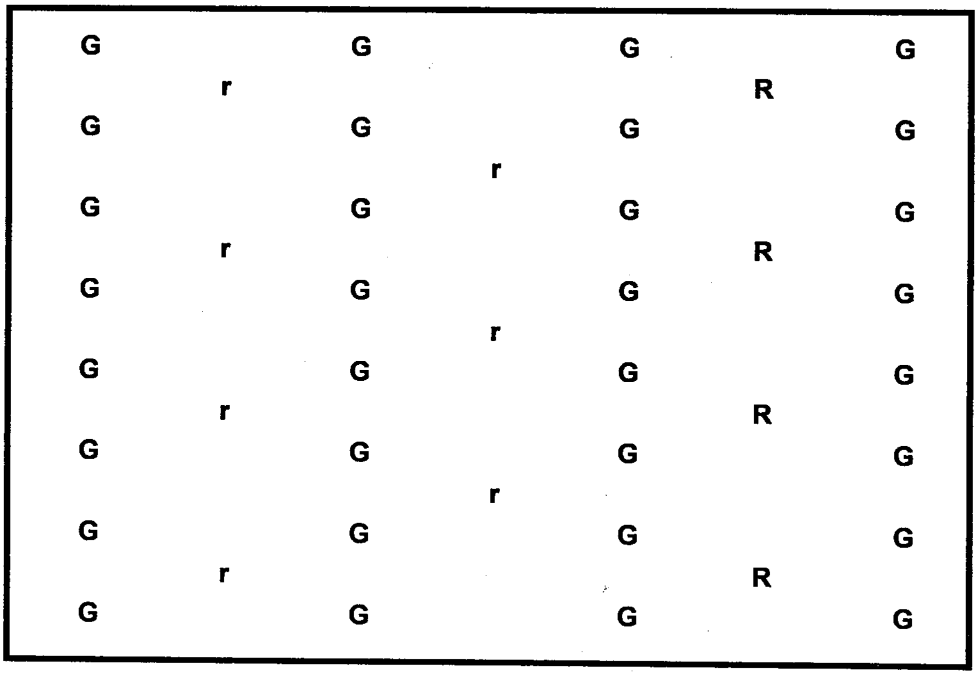


Figure 3b. Planting system II – rattan plants are planted in triangle shape. G = rubber tree at spacing 6.1 m x 3.05 m ; r = rattan plant at spacing 6.1 m x 6.1 m x 6.9 m.

G	R	G	G	r	G
	R			r	
G	R	G	G	r	G
	R			r	
G	R	G	G	r	G
	R			r	
G	R	G	G	r	G
	R			r	
G	R	G	G	r	G
	R			r	
G	R	G	G	r	G

Figure 3c. Planting system III –rattan plants are planted in alternate rows of rubber trees. G = rubber tree at spacing 8.5 m x 3.05 m; r = rattan plant at spacing 17.0 m x 1.5 m.

Of the 106 species of rattan found in Peninsular Malaysia, only three species are found to be suitable for growing under rubber: *C. manan* (rotan manau), *C. scipionum* (rotan semambu), and *C. palustris* (rotan manau langkawi). The techniques of planting using rotan manau are the best developed. Rotan manau is not recommended to be planted in old rubber plantation, i.e., more than 10 yr of age. Four- to seven-year-old rubber is the best for intercropping with rotan manau. After 20 yr, rotan manau can be harvested simultaneously when rubber trees (rubber trees life cycle is 25 yr) need to be replanted.

Maintenance of rattan under rubber

Replacement of dead or unhealthy seedlings should be done in the first three years. The final stocking of the plantation must be at least 60% of the original planted seedlings. During the initial stage after planting, rattan seedlings will remain erect to a certain height before cirri or flagella are produced. In the third year or when the plant is about 1.5 m in height, the seedling will usually develop cirri/flagella. As the stem grows longer, the newly produced cirri/flagella will grow towards taller branches. In order not to create any working hazard to the rubber tappers, drooping cirri should be cut. Dried fronds or those hanging from the stem along the planting lines should be cut to allow better passage to workers. If there are no tree branches or the branches are weak, the rattan will fall abruptly or gradually due to its own weight or through being blown by the wind.

The sprawling rattan plants on the plantation floor will create mobility problems for tappers and obstruct cleaning and weeding activities. Thus, the rattans' climbing organs (cirri/flagella) need to be assisted to climb the nearest available support, in this case rubber trees, in the process of staying erect towards the light. Cleaning and weeding of planting pathways need to be done frequently. This can be done simultaneously with cleaning and weeding of the rubber plantation.

b) Man-day and cost incurred in rattan plantation establishment

Tables 3b and 3c give estimated costs for establishment of rattan plantation in a commercial rubber plantation at the different years by different agencies, Forest Research Institute Malaysia (FRIM) and RISDA. The actual establishment cost for year 2004 is expected much higher than the costs given in this Chapter. This is because the costs of raising seedlings, planting, transportation, fertiliser and insecticide are much higher in 2004 than in 1987 and 1991. However, results given here serve as guidance only.

Table 3b. Estimation cost of establishment rattan plantation in a commercial rubber plantation for 400 plants/ha in 1986.

Activity	Worker	Cost/ha (RM)
Line clearing & canopy opening	-	00.00
Ground preparation for planting (planting hole preparation) at 6 cent/plant	2	25.00
Transportation of seedlings at 10 cents/seedling	2	40.25
Price of seedling (own raised) at 7 cent/seedling	-	25.00
Planting (fertilization is done during planting) at 7 cent/ seedling	4	25.00
Fertilizer cost (170 G/seedling)	-	09.90
Planting tools/equipments	-	20.00
Contingency cost (10% from total cost)	1	29.00
Total	**9**	**174.15**

Table 3c. Estimation cost of establishment rattan plantation in a commercial rubber plantation for 500 plants/ha in 1991.

Activity	Cost/ha (RM)
Line clearing and canopy opening	00.00
Ground preparation for planting (planting hole preparation) at 10 cents/plant	50.00
Transportation of seedlings at 20 cents/seedling	100.00
Price of seedling (purchased from private nursery) at RM 1.00/ seedling	500.00
Planting (fertilization is done during planting) at 15 cents/seedling	75.00
Fertilizer cost (for first year)	75.00
Planting tools/equipments	40.00
Total	**840.00**

c) Suitable rubber clones as support tree

Different clones of rubber probably vary in 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. Tests on the strength of rubber branches showed that the breaking-point diameter for an 8-year-old RRIM 600 clone rubber branch ranged from 3.6 cm to 9.7 cm, when the load of 29.6 kg to 156.6 kg was exerted on it (Aminuddin *et al* 1991). This indicated that rubber branches, particularly RRIM 600, can withstand the weight of rattan of about 2 kg/m length. RRIM 600 clone is suitable for inter-cropping with rattan because it has low branches and is easy for rattans to cling on with their cirri or flagella. Another clone, PB 260, has high and strong branches, is only suitable for supporting mature rattan, but can hold 2 to 4 rattan plants. Clones which are under similar grouping with RRIM 600 are RRIM 712, RRIM 701, PB 255 and PB 217, whilst rubber clones that bear similar characteristics with PB 260 are RRIM 623, RRIM 901, GT 1, PB 235, PM 10. No studies have been done to investigate whether latex production of individual rubber tree is affected by the presence of rattan plants.

2.4 Developing intercropping systems with other crops

Planting rattan under other crops such as oil palm is still under investigation. The growth of 6-yr old *Calamus manan* (Rotan manau) planted under 13 yr old oil palm at Malaysian Palm Oil Board (MPOB) Paka plantation, in Terengganu appeared to be good. The annual height increment was 1.5 m (Nur Supardi and Suboh, unpublished data). However, there were some management problems that have to be solved first. The rattan crown hindered the harvesting of oil palm fruit bunches, resulting in a drop in fruit collections. When the oil palm frond was pruned, the rattan crown fell to the ground, causing shoot damage.

Planting rattan (Rotan manau and Rotan sega) integrated with bamboo is being investigated in FRIM (December 1998; at Bukit Hari), Kepong. Gigantochloa laevis (Buloh beting) was chosen as an alternative support tree for rattan. In this trial, rattan is treated as a main crop. Using bamboo as support tree will ease rattan harvesting later. This integrated planting will also increase the land yield with harvests of bamboo shoots (rebung) from the third year onwards. This study needs to be monitored further before the ability of Buloh beting as a support plant can be established.

3. Product harvesting

3.1 Developing harvesting techniques

Rattan harvesting or rattan collection activities traditionally carried out by villagers residing close to the forests, either on a full time or part time basis. The activities involve walking into the forests in search of mature commercial species for its usable canes. The traditional technique of harvesting climbing large-diameter canes is by cutting the reachable upper-top most part of the canes and hauling it down. Whilst for the small-diameter, the dried canes (the base of cane is cut prior to hauling, at least a day before) are hauled down. Extractions of rattan from natural forests require some skills and this is obtained through experience. In general, the collectors will sell the canes to the middlemen and ultimately to manufacturers.

Harvesting of rattan in Asia generally is under the commission of the forestry department. In Malaysia, harvesting of rattan is administered by the various state forest departments. Before an area of forest reserve or state land is tendered for logging, the area is first tendered for rattan collection. The permit for rattan collection is given to individuals or companies allowing them to collect rattan in the specified area for a duration of one to three years. Rattan harvesters have to pay a royalty for every stick of rattan taken. The royalty rate varies from state to state and from species to species.

At present, rattan harvesting from the wild is being done mainly by the Malay aborigines, the *orang asli*, who are skilled at climbing trees. The canes are sold to middlemen and ultimately to manufacturers. The prime concern here is the loss of the uppermost part of the cane, which can reach up to 50% of the total cane length. It is especially difficult if it is entangled in the surrounding canopy. Improved harvesting methods are needed to reduce this loss. Difficulties in transporting the rattan out of the jungle also affect its final quality. Rattans are susceptible to fungal and insect attack. In order to reduce these attacks, the canes should be processed within a week following cutting.

a) Conventional harvesting method

A harvesting trial using *orang asli* was carried out by FRIM in three 0.4-ha plots at Block D3, compartment 10 of the Sungai Buloh Forest Reserve. Ninety man-days were required for cutting a total of 232 mature Rotan manau/ha (Nur Supardi, unpublished data). On average, a person could harvest, clean and cut between 2 to 7 rattan plants/day. Using this conventional harvesting method, an average of one-third of rattan crowns are left hanging in the forest canopy. In many cases, the cane is difficult to bring down. The collector will normally take the quick route by cutting off the cane using a knife (parang) at any convenient height. This can result in loss of sometimes over 50 % of the usable part. Another problem of harvesting rattan is that it is becoming difficult these days to obtain the services of professional tree climbers. Therefore, there is a need to design a cutter as a mechanical tool for rattan harvesting.

b) Mechanical harvesting methods

Four tools (prototypes A – D) for harvesting rattans have been designed, fabricated and tested in FRIM. Since the harvesting sites are not accessible by vehicles, the tools were designed to be simple to operate and portable. The components have been sourced off the shelf to keep the costs low. Further improvements to the cutting tools are needed before they can be operationalised (Chong et al., 1999).

3.2 *Transportation of canes out of forest*

At present most raw canes are obtained from the natural forests where they grow. Different countries and different parts of the same country have different ways and means of transporting rattan canes out of the forests. Traditionally, bundles of harvested canes are carried if the canes are cut into smaller poles or dragged along forest tracks if the canes are long. The canes are gathered at temporary collecting sites, such as the edge of forests, forest roads and river-banks. In some countries the use of animals as a means of transportation is still practiced, such as buffalos and elephants in Thailand. In Indonesia, horses are sometimes used to carry the rattan bundles out of forests to the villages, where they are sold or stored before transporting to the processing sites.

Transportation by means of river is still practised in Malaysia but only in Sarawak. Bundles of rattan, 50 kg to 60 kg, are tied together to form a raft. The rattan raft is navigated by boat to the collecting sites and the rattans need to be dried immediately when they reach the collection sites. Another means of transportation using rivers is by motorboat. In areas where the site is accessible by logging roads, 4-wheel drive vehicles, trucks or lorries are commonly used for transporting canes.

Soon after the rattan is pulled down, it is cut into desired lengths. The length of cane cut depends upon the species, the diameter size of the rattan, its intended use, the specifications of the buyer, or the convenience of collectors in carrying them out of the forests. Lengths of the cane cut also vary according to the practice in different countries. As practised in Malaysia, the rattans are cut into poles, 3 m lengths for large-diameter, soon after harvesting. And for small-diameter canes, 8 m to 9 m lengths are cut and bent into two and bundled into weights of 60 kg (one picul). Bundles of rattan, 50 kg to 60 kg/bundle depending on the diameter of canes, are loaded on the truck or lorry for delivery to cane processing sites.

3.3 *Post-harvest activities*

Collection: The rattans that have been harvested are normally of mixed species, sizes and qualities. Upon arrival at the processing depots, they are immediately graded according to species and diameter. After processing the canes are immediately graded into different grades, species, and diameter (big canes >18 mm; small-diameter <18 mm). The type of the rattan species, their initial physical condition and diameter, mostly dictates the method used in processing the rattans. The large-diameter rattans are further sorted into five diameter classes, viz. I) 18 mm to 24 mm, ii) 25 mm to 29 mm, iii) 30 mm to 34 mm, iv) 35 mm to 39 mm and v) above 40 mm. For quality determination, both the large- and small-diameter rattans are sorted into two quality classes, viz. i) good quality with no or few defects (good), and ii) heavily defective (inferior).

Boiling: After going through the above preliminary grading, the canes then undergo oil boiling or curing process. After boiling the canes will be sorted and graded again. The canes are straightened manually or by machine before being tied in bundles of 20 to 30 canes for large-diameter or in bundles of 30 kg to 60 kg for small-diameter canes as practiced in Peninsular Malaysia (Razak et al., 2001). They are now ready to be stored, marketed or prepared for further processing. Sufficient ventilation during storing needs to be provided to ensure dryness and at the same time to reduce the probability of fungal attack. The sun-dried canes will be stored in godowns, where they are stacked horizontally in a criss-cross manner in order to facilitate the circulation of air and to prevent discoloration due to dampness. The canes should not be stored vertically as this will bend the canes due to their own weight and this will later cause difficulties in straightening the canes. Before the canes are being transported to their clients, the two ends of the bundle are covered and tied with plastic sheets.

Processing: The details on grading, storing and packaging for transporting the canes have already been discussed in Chapter 4.

Manufacturing: The details of this have been discussed in Chapter 4.

IV. RATTAN PROCESSING AND UTILIZATION

The list of some of the important and popular rattan species used in the rattan industry in Malaysia is shown in Table 4a. The large-diameter canes are mainly for making furniture frames while the small canes are for tying and other parts of furniture.

Table 4a. List of the Malaysian commercial rattan species and their uses.

Species	Local name	Use
Korthalsia spp	Rotan dahan	Rattan strip/split and furniture components
Plectocomic spp	R. mantang	Rattan peel, core, furniture components and walking sticks
Plectocomiopsis geminiflorus	R. giling (R.rilang)	Handicraft items
Myrialepci scortechinii	R. kertong	Handicraft items
Calospatha Scortechinii	R. demuk	The seeds is edible
Daemonorops spp	R. lumpit	The leaves and the stalk can be used for making roof and Handicraft items
D. leptopus	R. bacap	The leaves are used for making cigarettes by the aborigines
D. kunstleri	R. bulu landak	The leaves are used for making roof
D. angustifolia	R. getah	Rattan core and furniture components
D. melanochaetes	R. getah	Rattan core and furniture components
D. grandis	R. sendang	Furniture components
Calamus manan	R. manau	Rattan core, furniture components, walking sticks
C. varidispinus	R. kerai gunung	Rattan core, skin and binding materials
C. longipathus	R. kunyung	The leaves are used for making cigarettes by the aborigines
C. javensis	R. lilin (R.mendon)	Binding materials
C. tumidus	R. manau tikus	Rattan core, furniture components and walking sticks
C. exilis	R. paku	Binding materials
C. caesius	R. sega	Rattan core, skin, furniture components and handicraft
C. axillaries	R. sega air	Rattan core, skin, furniture components and handicraft
C. speciosissimus	R. sega badak (R. semut)	Rattan core, skin, furniture components and handicraft
C. scipionum	R. semambu	Furniture components and walking sticks
C. paspalanthus	R. sirikis	The seeds is edible
C. didymophylla	R. jernang	Rattan strip/split rattan
C. propinqua	R. jernang	Rattan strip/split rattan and the seeds can be used for making dyes
C. micracantha	R. jernang	Rattan strip/split rattan and the seeds can be used for making dyes
C. castaneus	R. cucor	The leaves are use for making roof and the seeds can be used for medical purposes
C. lobbianus	R. cucor kelabu	The seeds is edible
C. erinaceus	R. bakau	Rattan core, skin and rattan strip/split
C. filipendulus (C. insignis)	R. batu	Rattan core, skin and handicraft items
C. ornatus	R. dok	Furniture components
C. perakensis var. *perakensis*	R. duduk	Walking sticks
C. luridus	R. kerai	Rattan core and handicraft items
C. viridispinus	R. kerai gunung	Rattan core, skin, furniture components and handicraft
C. perakensis var. *crassus*	R. tekok gunung	Walking sticks
C. laevigatus	R. tunggal	Rattan core, skin, furniture components and handicraft items
C. balingensis	R. tanah	Rattan core, skin, furniture components and handicraft items

Source: Razak Wahab, Mohd. Tamizi bin Mustafa and Arshad Omar, 2001.

1. Rattan processing mills in Malaysia

Rattan processing commonly refers to any activity involving cooking, drying and processing of rattan into semi-processed products such as peels, cores, splits and skins either manually or by machine. In general, the products can be classified according to whether they are derived from small- or large-diameter canes. Among the products of small-diameter canes are cores, splits, skins and washed sticks which are then used as webbings, weavings, binds, and basketry or furniture components. Large-diameter canes are normally used as natural or debarked furniture frames but they can also be converted into cores and skins.

The trend of rattan processing in Peninsular Malaysia is as reported by Razak et al., 2001. The rattan processing mills in Peninsular Malaysia can roughly be divided into three (3) categories or classes namely; A, B and C. The criteria for classification are:

- Capital investment.
- Size of the mill.
- Production capacity.
- Number of workers employed.
- Type of machines used.

2. Methods of improving rattan products

a) Chemical/Nonchemical treatments/biological

To improve the quality of rattan products, it is essential that the raw canes should have undergone the proper preservative procedures with the use of the right preservative materials. The current practice in Malaysia is to treat the harvested canes within 24 hr after cutting. In order to obtain better treated canes, the canes should be placed in a standing position for drainage of any excess water before it is being soaked in the mixture of preservative chemicals. Up to this time, no biological preservative has been developed yet for the improvement of rattan canes.

b) Processing technologies

The methods used in processing the rattans are mostly dictated by the rattan species, their initial physical condition and their diameter. Figures 4a and 4b show the processing sequence of both large and small-diameter canes.

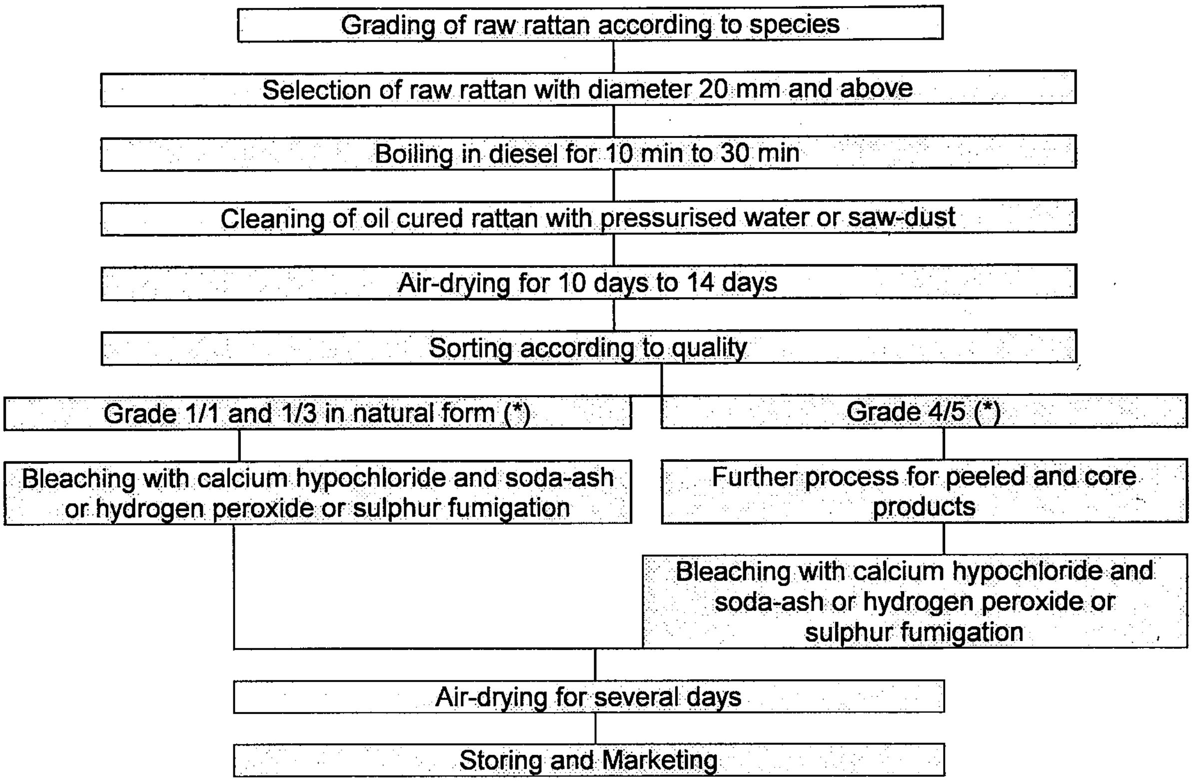
Boiling and curing

In Malaysia raw canes are boiled in order to: i) remove moisture, waxy materials, resins and gums; ii) to improve colour quality, texture and flexibility; and iii) to some extent prevent fungal and insect attacks. The raw rattans are boiled in diesel solutions. The immersion period ranges from 10 min to 30 min at a temperature of 60°C to 150°C. Immediately after boiling, the canes are either washed with pressurised water or scrubbed with sawdust or wiped with rag to remove any remaining dirt and excessive diesel present.

Drying of oil cured rattans

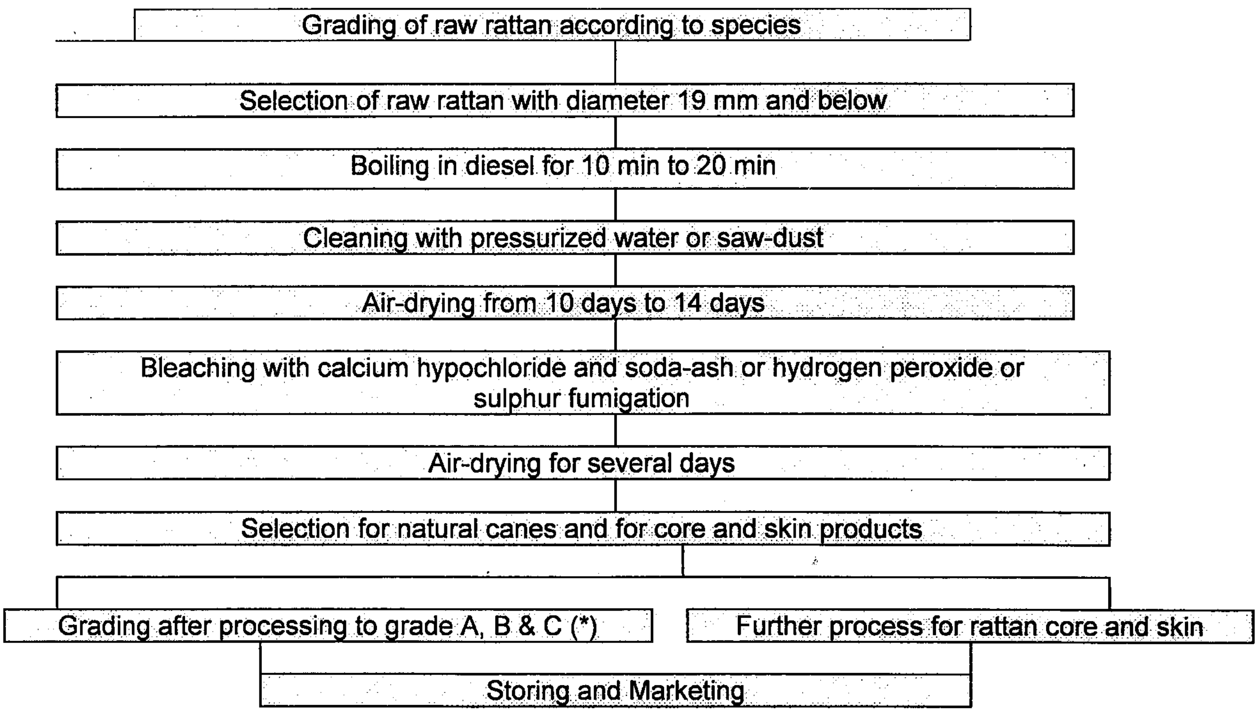
After the oil-curing and cleaning process, the rattans are air-dried in an open ground by leaning them on wooden frames (end racking). Alternatively, the rattans are bundled and loosely tied at one end and placed in a wigwam-like structure with their upper ends in contact with the ground, i.e., inverted. This position helps to accelerate the drying process. Small-diameter rattans of about 6 m long are hung over a wooden stand or spread over a wooden stacker placed on the ground. The drying period of the oil-cured rattans ranges from 10 days to 14 days depending on the species and the weather conditions. On the third to fifth day of drying, the canes are turned over so as to obtain uniform drying. They are considered dry and ready to be transferred to a shed when the stem surfaces turn yellowish, the stem is now lighter in weight and produce a high-pitched sound when beaten on a hard surface or object.

Figure 4a. Processing steps for big diameter canes in Peninsular Malaysia (Source: Razak et al., 2001).



(*) Please refer to Table 4c for descriptions

Figure 4b. Processing steps for small-diameter canes in Peninsular Malaysia (Source: Razak et al., 2001).

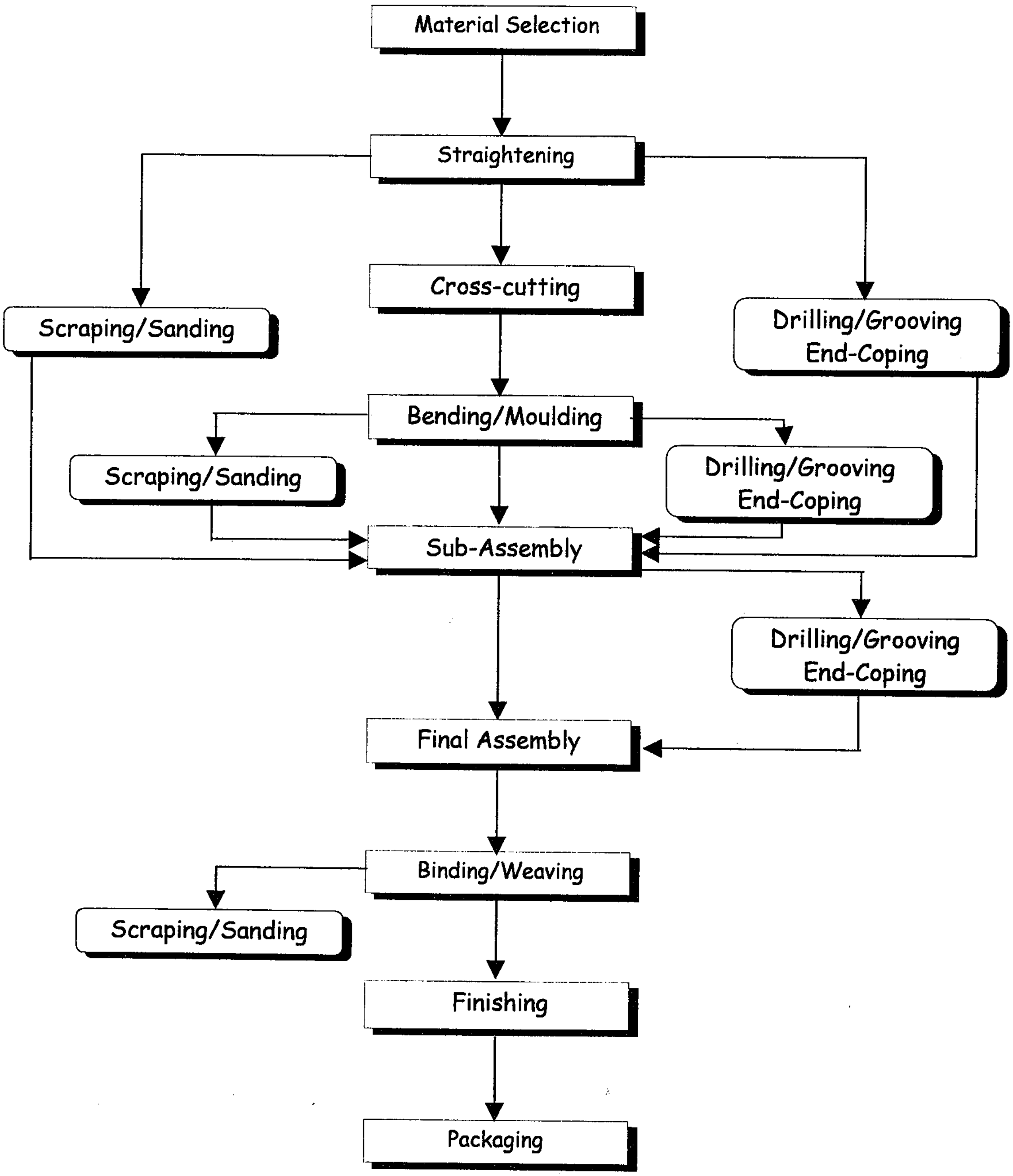


(*) Please refer to Table 4e for description

Sulphur fumigation

Only good-quality large-diameter and peeled rattans undergo the process of sulphur fumigation while those of smaller diameter are scraped with knives or a splitting machine to remove nodes before further processing. The large-diameter rattans are washed and subsequently smoked overnight with sulphur dioxide (SO_2) fumes in an enclosed shed or chamber. Besides providing preservative treatment, this process will also produce greater uniformity in the colour of the rattans.

c) Manufacturing technologies



Generally, rattan furniture manufacturing involves processes as described in Figure 5 (WanTarmeze et al., 2001).

3. *Grading*

General rules in grading the canes of rattan species have been discussed by Bhat (1996). He has divided the grading of canes into three main stages i.e. collection, processing and marketing. Table 4b shows the criteria of canes used for grading at different stages.

Table 4b. Grading criteria used for rattan at different stages (Bhat, 1996).

Stage	Form of canes	Grading criterion
Rattan Collection	Raw canes (after harvesting)	Species or species groups, diameter sizes
Rattan Processing	Semi-processed of round canes (depending on species and countries, the canes are either boiled in a mixture of diesel or coconut oil or just dipped in water and sun-dried or dipped in antistain chemical and fungicides and then sun-dried and stored).	Species or species groups, diameter sizes, stem length, hardness, defect
	Processed canes (canes are processed by bleaching with hydrogen peroxide or fumigation or artificial colouring to improve the cane appearance and are converted into semi-finished products: polished poles, skins or peeled, cores, splits, and binds or ropes).	- Surface colour – whitish, yellowish, creamy (high grade); brownish (lower grade). - Brightness, sheen or glossy (high grade); dull and non-lustrous (lower grade)
Rattan Marketing	Semi-processed and processed canes either in round or in semi-finished products.	- Dimensions (diameter, thickness, length, taper, inter-nodal length). - Colour (brightness or dull) - Hardnes (hard, moderate, soft). - Defects (fungal stains, pinholes, worm holes, bruises, checks)

For grading rattan in Malaysia either for processing or manufacturing, the researchers adopted the definition established by Bhatt (1996). However, no definite grading systems have been imposed by the authorities on rattan processors and manufacturers. The grading systems, which are established by the researchers, are discussed in the following subchapters.

3.1 <u>*Grading standards of raw canes*</u>

Rattans that have been harvested are normally of mixed species, size (diameter and length) and quality. Upon arrival at processing depots, they are immediately segregated, first according to species and then diameter. The poles of rattan are graded to determine the price to be paid to the collectors. It is well recognized that grading of rattan is an important and significant step in the trade.

Grading in rattan is very subjective and grade classes are usually derived from long trading practices established in specific localities, by local communities or even by individual companies. As emphasized by Bhat (1996), to formulate a set of unified grading rules for all stakeholders involved in the rattan sector within a country or in-between countries, is not an easy task. Some countries have formulated grading rules, such as Indonesia and the Philippines, whilst other countries have adopted informal grading rules such as Malaysia and Thailand. Thus, criteria used, number of quality classes or grades developed in grading the canes at all levels of rattan sectors or stages vary, and determinants used for grading are also different.

Treated rattan poles are normally bundled on the basis of diameter and rarely graded on the basis of defects. However, proper grading of the canes into several classes using criteria such as stem diameter, physical appearance, defect due to insect and fungal attacks, will ultimately improve the quality of exported canes. Thus, for quality determination in Malaysia, both the large- and small-diameter rattans are simply sorted into two quality classes (Razak *et al*, 2001), viz. i) good quality with no or few defects (good), and ii) heavily defective (inferior).

Cane selection

Rattan poles are selected according to grades and the quality of furniture they are intended for. The criteria of rattan grading and classification are as shown in Table 4b (Wan Tarmeze *et al*, 2001). Grade 1/1 refers to the highest quality rattan poles with smooth and clear skins. These poles are normally used as main-frame components such as backrests and legs. Grade 1/3 poles are used for the shorter and hidden components such as bracers. The outer skin layers of grade 4/5 poles are normally removed to produce an even whitish and uniformly peeled rattan poles. The peeled rattan poles are then further sorted into two grades, namely grades A and B. In this proposed rattan furniture manufacturing factory model, grade A rattan poles with diametrical sizes of 30 mm to 34 mm (the most popular for furniture making) are used.

Table 4c. Malaysian grading system for round and peeled canes based on outer skin quality and diameter size of the canes.

Cane	Grade	Criterion
Round cane	1/1	No black or brownish spots
	1/3	Little spots
	4/5	Many spots
Cane	Grade	Criterion
Peeled	A	Uniform whitish colour
	B	Some discoloration

Straightening of rattan poles

Rattan poles are normally bent out of shape a little bit due to their inherent properties or to vertical storage. The bent rattan poles are straightened either manually or using pneumatic straightening machines. Straightened rattan poles would ease further processes of making higher quality rattan furniture.

Measurement and cross-cutting

The straightened rattan poles are measured and cut into the desired lengths. Measurements can be made using 1:1 scaled plan.It is better to use pencil for marking the length for easy removal. Measurements and cross-cutting can also be done simultaneously using radial arm-saw with adjustable stoppers.

Bending and moulding

Before bending into the desired shapes, rattan poles are heated so that they become soft and pliable. Heating of rattan poles is normally done in steaming chests for 20 min to 30 min. Sometimes, blowtorches are used to heat the rattan parts that need to be bent. 2-D furniture components are produced using jigs made from wooden blocks and plywood board. The rattan poles are manually bent by pressing them against the wooden block stoppers arranged on the plywood surface of the jig. Clamps of mechanical or pneumatic types are added to the jig to secure the rattan poles inside. The jigs for moulding 3-D components are more complicated with wooden block stoppers (of various shapes) arranged on several plywood boards unparalleled to each other. Bending and moulding, especially for simple 2-D components could also be done using machines. The setting time of simple bends and moulds is about four hours and the time is longer for more complicated shapes.

Drilling, grooving and end-coping

Most rattan furniture components, especially the seat and backrest, are drilled with a series of holes for inserting slates (smaller rattan poles or cores) or grooved for inserting rattan webbing. Depending on the shape of the furniture components, the drilling and grooving are done either prior to or during the assembly process. For the straight components, drilling and grooving are achieved using bench-drill units. For the moulded components, drilling and grooving are done manually using hand drill when the basic frame is assembled. Some ends of the components are cut into half-moon shape using a special drill bit. Half-moon ends could ease the jointing of the components to each other during the assembling process. Furthermore, this method, which is also known as 'coping,' can strengthen the joints.

Binding and weaving

Various types of materials have been used for binding and weaving work. The popular materials are rattan skins, splits and cores. Sometimes, leather and plastic strips are also used. While leather bindings are normally being chosen for the high-end rattan furniture, plastic bindings are gaining popularity especially in rattan chair sets used in Western-style pavement cafes. For this proposed model, rattan splits (without skin) 6 mm wide are used as the binding materials. Some workers prefer to sit on a low stool or even on the floor to do this work, while others like to work at a low bench on which the frame is placed. Whether sitting down or standing up, it is important to ensure a comfortable working condition and that the materials needed are readily available so that the binding time is reduced to a minimum.

Scraping and sanding

Scraping and sanding are the processes to smoothen the surfaces of the components using sandpaper. The works are done at various places in the workflow. It can be after the cross cutting, after bending and moulding, after assembly and during finishing process. After bending, sanding is required to polish rough rattan surface due to the steaming process or to remove the burned marks caused by blowtorch. Scraping is done using hand scraper to remove excessive putty (the paste applied on to fill holes and gaps in rattan frames). Pneumatic hand scraper is also used especially to level down the protruding rattan cores plugged in to hide the screw or nail heads. The sand paper grit sizes are selected based on when the sanding processes are done. Grit size of 220 is for sanding before finishing process. During the finishing processes, grit sizes of 280, 320, and 360 are used. Sanding can be done manually or by machine.

Finishing

Finishing is another important stage to ensure the final quality of furniture. Spray guns powered by compressed air are used for spraying the furniture. Best quality of finishing can be achieved in enclosed spraying rooms equipped with spray booths and proper exhaust system. The workers must wear pieces of proper personal protective equipment (PPE) that conform with the standards imposed by the government.

3.2 <u>*Grading according to trade names*</u>

Grading of canes and rattan products plays a significant role in predetermining the quality of the final intended products. Rattan trade names are developed by rattan traders and the names have little or no association to botanical origin. Trade or commercial names of rattans, usually, are derived either from the locality of which they come from or by their appearance (Table 4d). In Malaysia the canes (poles) are classified into trade names based on their general appearance, distinguishing characteristics, and species groups as shown in Table 4d.

Table 4d. Classification of rattan poles according to trade name.

Country	Trade name	Species groups	General characteristics
Malaysia	Manau	*C. manan*	Glossy, not flexible, creamy colour, thin nodes with diameter of 2.5 cm to 4.5 cm.
	Semambu	*C. scipionum*	White creamy, less flexible, thick nodes with diameter of 2.5 cm to 4.5 cm.
	Sega	*C. caesius*	
	Irit	*C. trachycoleus*	Less glossy, brown colour, thick nodes with diameter of 1.6 cm to 2.5 cm. Grey colour with diameter of 3 cm to 5 cm.
	Dahan	*Khortalsia*	Brown colour

3.3 <u>*Grading according to dimension*</u>

Thickness of the canes can be broadly divided into two categories, large-diameter or big and small-diameter or slender canes. Round large-diameter canes measure from 18 mm to 40 mm and above, round small-diameter canes measure below 18 mm. The demarcation between the two categories used in most countries is 18 mm (Bhat, 1996). Length of the canes varies from 1 m to 8 m and common length applied by most countries are 3 m to 4 m for large-diameter canes. Whilst, small-diameter canes are cut from 4 m to 5 m or 8 m to 9 m and bent into two. Although methods for grading the canes differ from one operator to another and vary with different countries, rattans are generally graded according to diameter and cane qualities. For large-diameter canes, the rattans are further sorted into diameter classes (Tables 4e).

Table 4e. Classification of large size rattan poles or round canes by diameter sizes for different countries.

Country	Grade	Diameter	Length (m)	Criterion
Malaysia	A B C D E	40 mm and above 35 mm to 39 mm 30 mm to 34 mm 25 mm to 29 mm 24 mm to 19mm 18 mm and below	Large-diameter canes, 3 m Small cane, 6 m	

Source: Abd. Latif, 1992, Razak *et al*, 2001, Wan Tarmeze et al., 2001.

Main criteria used in grading the quality of canes are based on physical appearance and weight. In Malaysia, quality of small-diameter canes is based only on appearance as described in Table 4f.

Table 4f. Grading for small-diameter canes.

Country	Grade	Criteria	Source
Malaysia (general grading rules)	1	Yellowish white in colour, smooth surfaces, and with no or few defects on epidermis, outer or inner portion of the stem.	Abd. Latif, 1992
	2	Reddish in colour and with few defects either on epidermis, outer or inner portion of the stem.	
	3	Reddish in colour with heavily defective stem	

3.4 *Grading based on defects*

Defects in large-diameter canes are due to many factors, namely moisture content, handling of cane during collection and transportation, method of boiling, and species characteristics. The harvested canes usually comprise a mixture of various cane length and quality. During the first selection prior to boiling, the canes are segregated into high (no or little defects) and low quality (contain many defects) (Table 4g).

Table 4g. Grading of rattan based on skin appearance and defects.

Country	Grade	Criterion
Malaysia	1	Straight pole, ivory-white or brown or yellow colour, up to 5% allowable defects, mature with no cracks, borer or twists.
	2	Cream colour, 6% to 15% allowable defects within 25 cm distance from either end, mature.
	3	Light brown to reddish, 16% to 25% colour allowable defects like blue stain, worm holes.
	4	Reddish to black, more than 25% allowable surface defects like swollen nodes, blue stain.
	5	Heavy defective and often tender lightweight stem with shrunken portion and cracks.

Source: Abd Latiff, 1992.

3.5 *Grading based on colour*

Colour determination in current grading practices is by visual judgement, although it is known that colour perception differs from person to person. A variation in colour of natural and polished rattans actually depends on rattan species, degree of cooking and blemishes due to fungal attack. In Indonesia, grading rules based on colour uniformity and cane brightness are established for grading the canes. In Malaysia, however, there are no specific grading rules based on colour alone but rather a mixture of different criteria for different rattan products (Abd. Latif 1992). Some of the criteria that can be used as guidelines in classification the species in Peninsular Malaysia are shown in Table 4h. The Malaysian grading system for round canes is mainly based on quality (class) and diameter (size) as shown in Table 4h (Razak et al., 2001).

Table 4h. Malaysian grading system for round canes based on outer skin quality and diameter size of the canes.

Grade	Class	Quality
A	1	No stain or any dark spot
B	2	2 or 3 staining or dark spot
C	3	Plenty of staining or dark spots
Grade	**Size**	**Diameter**
A	1	Diameter 40 mm and above
B	2	Diameter 35 mm to 39 mm
C	3	Diameter 30 mm to 34 mm
D	4	Diameter 25 mm to 29 mm
E	5	Diameter 24 mm and below

Table 4i. Some guidelines in characterisation of commercial rattan species found in Peninsular Malaysia.

Species	Physical characteristic	Diameter (mm)	Length between nodes (cm)	Other feature
Calamus caecius Rotan sega	Colour: Cream yellow Hardness: Very hard Texture: Fine Diameter: Uniform Quality: High	4 to 15	17 to 35	Silica layer crack off when bended. Content: White
C. balingensis Rotan tanah	Colour: Reddish or whitish yellow Hardness: Hard to fairly hard Texture: Fine Diameter: Uniform Quality: High	1.5	12 to 15	Content: White or reddish. Black rings at the nodes.
C. manan Rotan manau	Colour: Cream yellow Hardness: Very hard Texture: Fine Diameter: Uniform Quality: High	15 to 80	15 to 36	Content: Reddish brown. Black rings at the nodes.
C. omatus Rotan mantang /dok	Colour: Cream yellow Hardness: Very hard to hard Texture: Moderately coarse Diameter: Not uniform Quality: Medium	15 to 80	10 to 30	Swollen nodes. Content: White
C. scipionum Rotan semambu	Colour: Reddish brown Hardness: Very hard to hard Texture: Coarse Diameter: Not uniform Quality: Low	15 to 65	20 to 140	The stem is brownish black in colour.
D. augustifolia Rotan getah	Colour: Reddish brown Hardness: Fairly hard Texture: Coarse Diameter: Not uniform Quality: Low	15	Up to 34	Content: Reddish white
Korthalsia spp. Rotan dahan	Colour: Reddish brown Hardness: Hard Texture: Coarse Diameter: Slightly uniform Quality: Low	10 to 35	16 to 33	The stem is reddish in colour and the surface is coarse and fibrous.
C. conirostris Rotan kerai	Colour: Buff Hardness: Hard Texture: Fine Diameter: Slightly uniform Quality: Medium	5 to 15	15 and less	The node is blackish in colour. Content: White with uniform diameter
C. insignis Rotan batu	Colour: Cream yellow Hardness: Very hard Texture: Fine Diameter: Uniform Quality: High	2 to 7	6 to 25	The stem is very hard and strong. Content: White,

Table 4i. Some guidelines in characterisation of commercial rattan species found in Peninsular Malaysia *(continuation)*.

Species	Physical characteristic		Diameter (mm)	Length between nodes (cm)	Other feature
C. tumidus Rotan manau tikus	Colour: Hardness: Texture: Diameter: Quality:	Brownish yellow Hard Fine Slightly uniform Medium	5 to 10	7 to 8	Longitudinal shrinkage appearances very obvious. Black rings at nodes.
C. gibbianns Rotan sega air	Colour: Hardness: Texture: Diameter: Quality:	Whitish yellow to crean yellow Hard to fairly hard Fine to moderately coarse Not uniform Medium	Up to 12	Up to 19	Content: White or brownish
C. omotus Rotan dok	Colour: Hardness: Texture: Diameter: Quality:	Cream yellow Very hard to hard Rough or coarse Not uniform Medium	15 to 80	15 to 25	The stem is light in colour. Content: White
C. javensis Rotan lilin	Colour: Hardness: Texture: Diameter: Quality:	Yellowish brown Hard to fairy hard Moderately coarse Not uniform Medium	3 to 7	10 to 33	The stem surface is smooth and glossy. Content: White
Korthalsia spp. Rotan udang	Colour: Hardness: Texture: Diameter: Quality:	Yellowish brown Hard to fairy hard Moderately coarse Not uniform Medium	5 to 15	Up to 15	Content: Brownish

Source: Razak et al., 2001.

V. MARKET AND SOCIOECONOMICS

1. Rattan marketing and trade

There are always markets for high-quality rattan furniture either locally or abroad. There are various ways in hunting for potential buyers, and display showrooms for products is a first step. Afterwards, advanced information technology, virtual displays, and a website can be exploited toward this end. Many international rattan furniture companies have their own websites and are selling their products through the e-commerce mechanism. Another effective way of marketing is by participating in furniture fairs held by various organisations in the world. Malaysia has been holding her own Malaysia International Furniture Fair (MIFF) annually since early this decade and the effectiveness of the event is manifested in sharp rises of the furniture exports in the last few years. To assist in marketing the products, the Malaysian Timber Industry Board (MTIB), the Trustee Council for Indigenous People (MARA), PKKM and MEXPO were commissioned to collect and disseminate information on markets for Malaysian products. The MNRD organises trade exhibitions to create market opportunities for the entrepreneurs.

Malaysia is fortunate to be endowed with abundant raw materials from its forests. However, the contribution of the rattan-based industry to the country's economy is relatively very small, USD 21.7 million, contrasted to that of the wood-based industry, which generated about USD 0.66 billion in export earning in 1997 (Ministry of Primary Industries, 1998). This is meagre compared to countries like Hong Kong and Singapore, which exported rattan products valued at USD 53 million and USD 23 million, respectively.

We must note that the latter two countries do not have any natural resources of their own. This amount far exceeded Malaysia's export, and something needs to be done in order to upgrade and establish the rattan and rattan-based industries as the main industry in the development of forest product activities. This is in line with the Malaysia Industrial Master Plan (IMP) which calls for a rapid development in the downstream production of the forest-based industry.

1.1 <u>*Prices of canes*</u>

Most rattan mills obtain their canes from contractors/traders. But some of them obtain rattan directly from the forest by arranging their own collecting team. The mode of purchasing rattans can be by ordering in advance or when necessary, purchasing on demand. Rattan mills do face difficulty in acquiring rattan inputs. A survey conducted in 1995 (Poh et al 1995) showed that 72.22% of furniture mills order in advance their rattan inputs whereas only 30.77% among rattan processing mills do. The furniture mills have invested in machinery; thus, their daily production run must continue in order to recover their investment cost. Credit term is the most common mode of payment besides cash for rattan input purchased. The duration of the credit term is 1 mo to 4 mo. To obtain a discount, mills tend to order in bulk lasting at least several months.

The study also showed that about 41% of the mills reported that they are facing difficulty in getting their supplies of rattan. Some of the rattan species being used by the rattan enterprises in Peninsular Malaysia are Rotan manau, Rotan dok/mantang, Rotan sega, Rotan semambu, Rotan air, Rotan tasong/tanah, Rotan jelayan, Rotan batu, Rotan dahan, Rotan assam and Rotan getah. The levels of dificulty in acquiring rattan supplies vary among rattan types. The supply of other rattan types is at the moment not that critical. There are several reasons for the rattan supply difficulties. They include increasing remoteness of rattan resources because of over-harvesting, which raises production costs and eventually selling price (Table 5b), lack of access from the forest to the rattan processing mills, high competition among purchasers for supplies. The misuse of the business mode whereby collectors demand advanced payments has created uncertainties of actual delivery, and most important seasonal supply owing to the rainy seasons and fruit seasons. Since most of the local collectors are aborigines, they tend to shift their activity to collecting fruits such as durian and *Parkia spesiosa* (petai) during durian and petai fruit seasons.

Table 5a. Price list of raw rattan purchased by rattan processing mills in 1992. Conversion rate is USD 1 = RM 2.70

Species	Price/ (RM)
a) Large-diameter cane (price/stick; 3 m length)	
Rotan manau *(Calamus manan)*	4.50
Rotan semambu (*C. scipionum)*	1.40
Rotan mantang/dok (*C. ornatus)*	3.00
Rotan jelayan (*C. peregrinus)*	1.20
Rotan dahan (Korthalsia sp)	0.90
Rotan assam	0.59
Rotan halban	0.50
Rotan getah (*D. angustifolia)*	0.18
b) **Small-diameter cane (price/kg; 6 m length)**	
Rotan sega emas (*Calamus caesius)*	16.00
Rotan tasong/tanah (*C. balingensis)*	2.07
Rotan batu ((*C. insignis)*	2.08
Rotan merah (*C. balingensis)*	1.30
Rotan kerai (*C. luridus)*	1.30
Rotan labuan	1.27
Rotan air/tawar	1.00

Source: Poh et al., 1995

Table 5b. Price list of commercial rattan canes for year 1999 in Peninsular Malaysia. Conversion rate is USD 1 = RM 3.80.

Species	Length (m)	Size (mm)	Grade	Unprocessed USD/stick	ProcessedUS D/stick
Calamus manan (Rotan manau)	3	18 to 24	1/3	0.17	0.43
	3	25 to 29	1/3	0.50	1.00
	3	30 to 34	1/3	0.88	1.60
	3	35 to 39	1/3	0.95	1.85
	3	40 up	1/3	1.14	2.14
	3	18 to 24	4/5	0.17	0.30
	3	25 to 29	4/5	0.45	0.71
	3	30 to 34	4/5	0.86	1.00
	3	35 to 39	4/5	0.90	1.57
	3	40 up	4/5	1.00	1.86
C. ornatus. (Rotan mantang/dok)	3	18 to 24	4/5	0.17	0.30
		25 to 29	4/5	0.34	0.60
		30 to 34	4/5	0.52	0.86
		35 up	4/5	0.52	1.03
Calamus sp.? (Rotan jelayan)	3	18 to 24	4/5	0.17	0.29
		25 to 29	4/5	0.34	0.45
		30 to 34	4/5	0.52	0.64
		35 up	4/5	0.52	0.82
C. scipionum (Rotan semambu)	3	18 to 24	1/3	0.14	0.57
		24 up	1/3	0.20	
			4/5		0.43
Kolthalsia spp. (Rotan dahan)	3	16 to 19	All grade	0.17	0.29
		20 to 23	All grade	0.17	0.37
		24 to 27	All grade	0.21	0.43
		28 up	All grade	0.23	0.51
C. luridus (Rotan kerai)	3	all sizes	All grade	0.06/pc	0.43/kg
C. balingensis (Rotan tanah)	6	all sizes	1/3	11.71/100 pcs	0.66/kg
			4/5	11.71/100 pcs	0.59/kg
C. caesius (Rotan sega)	6	all sizes	All grade	5.14/100 pcs	1.60/kg
C. balingensis (Rotan merah)	6		1/3	4.3/100 pcs	0.57/kg
			4/5	4.3/100 pcs	0.43/kg
C. insignis (Rotan batu)	6		All grade	4.3/100 pcs	0.80/kg
C. javensis (Rotan seni)	6		All grade	4.3/100 pcs	0.95/kg
Manau peeled	3	25 to 26	-	-	1.03
		28 up	-	-	1.23
Strip rattan	2	-	-	0.75/100 pcs	1.43/bundle (100 pieces/ bundles)

Source: Razak et al., 2001

Table 5c. Selling price of rattan skin and rattan core for year 1999 in Peninsular Malaysia. Conversion rate is USD 1 = RM 3.80.

Type of products	Size (mm)	Grade	Selling price (USD)
Skin	2	A	10.78/kg
Skin	6	A	4.85/kg
Skin	6	B	4.41/kg
Skin	6	C	3.74/kg
Core	2 to 6	A	3.14/kg
		B	1.71/kg
Core	7 to 11	A	2.71/kg
		B	1.57/kg
Core	12 up	A	2.51/kg
	12 up	B	1.71/kg

Source: Razak et al., 2001

1.2 Furniture export

Rattan furniture manufacturing industry in Malaysia still needs a lot of research and development efforts in order to maintain its relevance compared with other industries. The industry is dependent on availability of skills and technologies. The rattan furniture manufacturing business can be best run as a small- or medium-scale enterprise (sole proprietorship). It is also suitably operated as a community cooperative business since the villagers can become the workforces. To be successful the industry needs a substantial amount of funding, consistent supply of raw material, and tenured and skilled workforces.

Looking back at history, it can be said that the rattan furniture manufacturing industry in Malaysia has grown significantly only in the last decade. Before that, the Malaysian rattan industry was dominated by the exportation of raw and semi processed rattan materials to other furniture manufacturing countries such as Hong Kong and Singapore. In 1986, these countries, even with no natural resource of rattan, exported USD 19.6 million and USD 8.5 million worth of rattan furniture, respectively. Malaysia, in the same year, exported only a mere USD 2.6 million. Realising these discrepancies, the Malaysian government took a drastic measure by banning the export of raw canes starting from December 1989. Among others, the ban was aimed at encouraging the development of rattan products manufacturing especially of furniture by ensuring a consistent and affordable supply of raw materials. The industry has improved by leaps and bounds. It has contributed to the economy of the country by:

1. generating domestic revenue;
2. contributing towards the foreign currency exchange; and
3. providing job opportunities to the local community.

In 1980, the export value of raw cane and partially processed cane was only worth RM 2.38 million and RM 0.06 million respectively. However, in 1988 the export value for both of the above products increased to RM 7.51 million and RM 1.24 million respectively (Aminuddin and Nur Supardi, 1994). Malaysian cane furnitures are normally exported to developed countries – the majority being to countries like USA, UK, Singapore and Japan. European importers of Malaysian-made cane furniture include Germany, Spain, Denmark, and Belgium.

In 1990, the government of Malaysia only permitted the export of finished or semi-finished cane products including handicrafts. This move by the government was to ensure the continual supply of raw cane material for the local cane industry. As a result, there was a drastic increase in our export commodity due to the increase in the setting up of local cane processing industries. In 1994, our export value had increased to RM 111.6 million (Figure 5). However, between 1995 to 2001 there was a sharp decrease in the export of rattan furniture to RM 69.4 million. Norini (2001) attributed this to instability of the United State economy and the slow recovery of the Japanese economy. Additional factors that directly affect the decline in the rate of export include (Abd Latif, unpublished):

i). the difficulties in obtaining a fixed supply of high quality raw materials,
ii). to maintain competitive raw material prices for the downstream industries, and
iii). malaysian-made rattan products are not as competitive as those made by the philippines and the indonesians in-terms of quality and design.

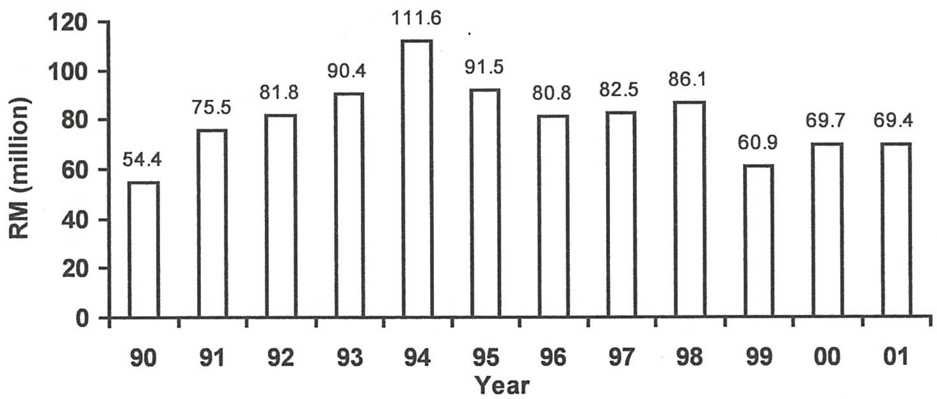
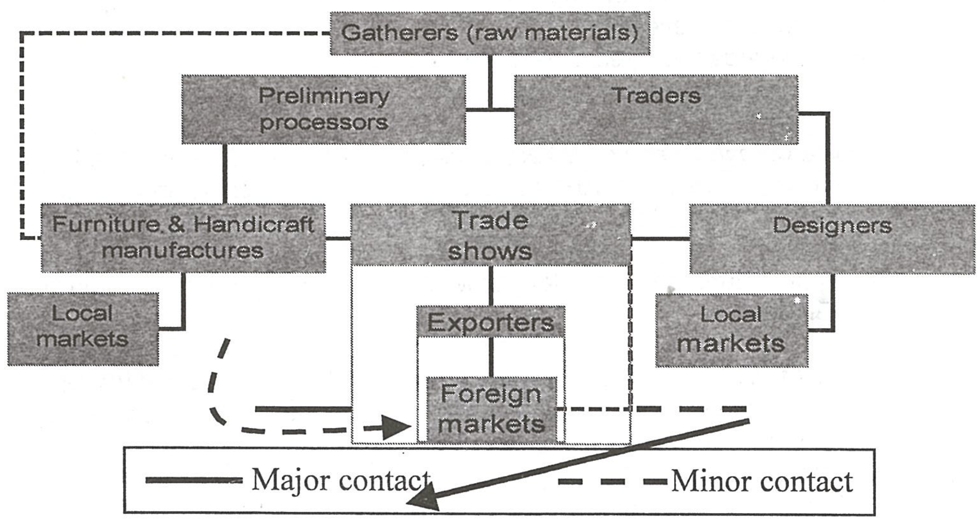


Figure 5. Rattan furniture export to other countries from year 1990 to 2001.
Source: Anon. (1989 – 2002).

2.2 *Marketing flow*

Preliminary processors obtain their inputs directly from rattan gatherers (Figure 6). Majority of the treated canes are supplied to the traders while some are being supplied to furniture and handicraft manufacturers. Traders can either directly obtain their raw materials from the gatherers or purchase the boiled canes from the preliminary processors. The traders are normally involved in supplying semi-finished products to designers and furniture/handicraft manufacturers. Furniture and handicraft manufacturers can sometimes obtain unpolished furniture products from the designers, they will then complete the process for marketing purposes. The designers sometimes participate in trade shows locally and internationally with their latest designs. Manufactures market their products directly to foreign markets if they have foreign contacts or they exhibit their products in trade shows. Alternatively they can sell directly to exporters.

Figure 6. Production to consumption system of rattan industries in Malaysia.



2. *Social aspects: socio and cultural importance for poverty alleviation*

As a means for social development in rural areas, full-time cultivation of small-diameter canes is a good option. It is labour-intensive and offers full employment for the family. Based on family units consisting of four able members, an allocation of seven to ten hectares per family is comparable to growing other crops in a rural development scheme.

a) Input requirements – workforce

The downstream processing of the rattan canes employs a much larger workforce than the growing of the rattan. Finished products of rattan are usually bulky and incur high transportation costs. To minimise cost of transportation and manufacturing the downstream processing is grouped into two processes, namely preliminary and semi-finished products processing, and fully finished products and furniture processing. The former can be located near the site of cultivation and the latter near the point of marketing and the source of a large workforce.

Rattan furniture manufacturing can provide good sources of income to many people, regardless of age, gender, and educational background. Except for the under-aged children, all members of a family can work in the rattan furniture factory. Rattan furniture manufacturing can also be operated as community co-operative business where all the villagers can contribute in terms of financial capital or as employee/ worker.

b) Environmental

Rattan furniture manufacturing does not impose a threat to the environment as significantly as the wood-based manufacturing industries. Nevertheless, one major problem that needs to be looked into is the high wastage of rattan raw material, especially rattan poles, which often become a burden to the environment through open burning and illegal dumping (Wan Tarmeze et al., 2001). Rattan poles are wasted even before the furniture manufacturing process takes place because both ends of the poles supplied are normally rendered unusable by fungal attacks and non-uniform diameter. In some cases about 15 cm in length of each unusable end must be cut and thrown away. At this stage, the wastage rate can be as high as 10% (2.7 m divided by 0.3 m). In terms of money, as much as USD 0.20 is wasted from each pole (10% of USD 2.00 – average price of rattan pole). A productive way of managing the waste is by using it as fuel for the steaming chest.

c) Occupational safety and health

Occupational safety and health problems (due to hazardous working conditions) would come from the usage of hand tools such as nail drivers, staplers and spray guns. Carelessness in operating the tools and accidents cause serious injuries to the workers. Prolonged inhalation of finishing chemicals from spray guns can cause long-term health problems (especially the respiratory system). Therefore, the workers must be made to wear proper personal protective equipment (PPE) while working.

VI. POLICY AND INSTITUTIONAL RELATED ASPECTS FOR THE PROMOTION OF THE RATTAN SECTOR

Malaysia government banned the export of raw canes in 1989. All rattan products, including raw canes, semifinished and finished products could be freely exported from Sabah until 1990. However, in July 1990, export of raw canes was banned. Thus, cane exporters were forced to venture into downstream part of the industry, resulting in a large increase in the export value of rattan products. The rationale of the ban is to conserve the dwindling resource and to derive more added value from the rattan resource for the State. However, this ruling in Sabah is not applicable to canes harvested from plantations, whereby all forms of rattan products can be exported (Sining, 1999).

1. Institutional capability and linkages

It will be ideal for the industry to operate within an industrial zone. Basic infrastructure facilities (as shown in Table 6a) must be made available, without which production output will be hampered. In cases where the facilities are not provided or not in operation, contingency plans are proposed. For instance, water pumps with adequate filtration systems could provide the water needed by the factory from sources such as rivers and wells. In the case of electrical blackouts, generator sets should be made available as the stand-by units.

Table 6a. Basic Facilities for Rattan Furniture Manufacturing Factory.

Facilities	Institution	Contingency Plan
1. Water	Local Department of Water Supply	Water pumps
2. Electricity (3 phase)	Tenaga Nasional (National Power)	Generator set
3. Communication	Telekom Malaysia (Telecommunication service company)	Hand phone
4. Road and easy access for 40 footer containers	Local Authority / Jabatan Kerja Raya (Public Works Dept)	-

a) Research agencies and academic institutions e.g. FRIM, Universities

Various technical agencies such as the Forest Research Institute of Malaysia (FRIM), the Malaysian Timber Industry Board (MTIB), and Standards and Industrial Research Institute of Malaysia (SIRIM), provide technical assistance in production and basic design. They also organise seminars and training courses in management and production. FRIM has a core of experienced researchers able to train the entrepreneurs in the uses of rattan and bamboo.

b) Government (national) e.g., MTIB, Institut Kraf Negara (IKN)

In Table 6b the need for human resource development (HRD) is illustrated. Where the industry is concerned, training of workers is mainly in-house through mentor and apprenticeship system. Realising this, the government agencies mentioned below have developed several HRD training programs. The government through its agencies gives support to the industry in various ways. The Ministry of Trade and Industry (MTI) and the Ministry of National Rural, together with various technical agencies, are directly involved in the development of small-scale enterprises in Peninsular Malaysia.

Table 6b. Training Aspects Supported by Government Agencies.

Training Aspect	Institution	Follow-up Activity
Skill Development	Institut Kraftangan Malaysia (IKN)	In-house training
Marketing	MTIB	Showroom
Research & Development	FRIM	In-house R&D unit

Notes: Kraftangan = Malaysian Handicraft Development Corporation; MTIB = Malaysian Timber Industrial Board; FRIM = Forest Research Institute Malaysia

c) Nongovernment organisations

Financial assistance is extended in the form of loans. Under the program, certain banks provide interest-free loans of between USD 800 to USD 20,000 to qualified operators. In addition, government supported institutions such as the Ministry of Youth and Sports (MYS), the Agricultural Bank, the Development Bank of Malaysia Limited, the Trustee Council for Indigenous People (MARA), and the Malaysian Industry Development Bank also provide financing for small-scale entrepreneurs at below market interest. An owner with assets of less than USD 100,000 and fewer than 50 full-time employees is eligible to apply. Technical aid is extended by providing machinery, technical services and training. Under the village industry assistance program since 1986, the MNRD has provided machinery to set up stories and sometimes even the building itself.

d) International linkages

Most of international agencies' involvement is in providing funds and gathering information related to rattan activities, statistics and research findings. INBAR roles in rattan developments are more on coordinating rattan R and D projects, compiling information, transfer of technologies and exchanged information related to rattan activities. UNDP, FAO and ITTO providing funds for R and D, meetings and conferences.

2. *Policy and Legal*

a) Policy and incentives on establishment of plantation in Peninsular Malaysia

State Forest Departments have been implementing rattan planting programmes since the early 1980s in an effort to replenish the rattan resource in PRFs and also as an activity to rehabilitate the forests. Besides allocation of development funds by State Governments, the Federal Government is also providing financial assistance from the timber export levy to be used for rattan planting and management (Harnarinder and Chin 1999). A sum of RM 17,824,550 has been approved to plant 9,430 ha over a five-year period, from 1998-2002. An additional RM 8,100,400 has been allocated to carry out maintenance and silviculture treatments in 13,832 ha of planted area.

To encourage the private sector's investment in forest plantation development, the government of Malaysia has reviewed the existing fiscal incentives and granted full tax exemption under the pioneer status for ten years and 100% tax exemption under the Investment Tax Allowance (ITA) for five years. These incentives are also applicable for rattan plantation. However, the incentives are still not attractive to the private sector for participating in rattan planting due to the long gestation period.

b) Rattan harvesting regulation

Peninsular Malaysia

According to the National Forestry Act (NFA) 1984, a license is needed to harvest rattan from the Permanent Forest Estate (PFE) and Stateland Forests. Under the provision in the NFA 1984 and its amended version NFA 1994, besides requiring a license, there are also other regulations to be adhered to in rattan production including the payments of premium, royalty, forest development cess, license fee and registration fee for application as a contractor to the State Government. The rattan canes are normally cut and gathered by rattan gatherers. These gatherers generally obtain permits for cutting rattan from the government through the States Forest Department. These permits are renewable annually and are given at 250 acres/permit.

The rate of collection of royalties and the implementation of the licensing procedure varies from state to state. On the average, the royalty rate for *Calamus manan* (large-diameter cane) and *C. caesius* (small-diameter cane) is RM 0.20/m and RM 0.10 per 100/m, respectively (Poh *et al*, 1995). The state of Pahang imposes its license fee based on the size of area applied for, while others impose a flat rate per license. For example, in Pahang, the license for harvesting *Calamus manan* and *C. caesius* is RM 200/ha or parts thereof per license and RM 100 per 400 ha or parts thereof per license for other species. The registration fee is charged as highest at RM 100.00/year to the lowest at RM 20.00 according to the different states.

Although rattan is quite heavily exploited in Sarawak, there is no record of production levels. The main reason is that there is no royalty collected by the State. A permit is required, for which a monthly fee of RM 1.00 is charged for collection of rattan. However, no permit is required if rattan is collected for domestic use. In Sabah, royalty collected from rattan has been lumped under miscellaneous forest revenue and as such it is not possible to gauge the production level. The present royalty rate charged is RM 400/tonne. A permit or a license is required for the extraction of rattan from the forest. The monthly fee is RM 5.00/person.

Sarawak

There is no clear policy on the extraction and import-export of rattan in Sarawak. A licence fee of RM 1.00 per person and per month is charged for its extraction in the Permanent Forest Estate, irrespective of the size of the collected area. No licence is required for collection outside the Permanent Forest Estate (Lee, 1984). Duty charged for forest produce, rattan, is 10% ad valorem (Anon, 1997).

Sabah

Rattan has been considered as a minor forest product, and its sustainable production from the natural forest has not been given due consideration in forest harvesting until recently. The commercial rattans in all accessible forests have been reported to be so depleted to the extent many natural populations have disappeared, and the extremely few mature stems which remain are inadequate to form viable breeding populations, except in totally protected forests such as a national park (Lee and Chia, 1995).

c) Upstream rattan industry

Like any other natural resource-based industry, the consistent supply of raw material is important to ensure the existence of the industry. Over the years, the industry has observed the decline in quantity and quality of the rattans. As a result, the industry is forced to accept inferior quality rattan. Hence, the industry encounters problems in meeting buyers/clients specifications. Cultivation of rattan through proper management is essential to ensure a continuous supply of high-quality raw materials. The government should continue to restrict the export of raw materials to promote rattan enterprises in Malaysia.

Among the constraints identified against the success of the transfer of technology are the capital financing, raw material supply and skilled workforce availability. A medium-sized furniture manufacturing factory requires a sizeable capital investment, and requires financial support from the government in terms of soft loans.

Skilled workers such as master craftsmen are not easy to find and keep. The Philippines has been a well-known source for such workers. Their availability and hiring costs would depend much on the 'foreigner employment policies' imposed by the government of the hiring country. However, it is also interesting to note that while semi-mechanisation (through pneumatic technology) is slowly making its presence, skilled workers are still a much-sought-after commodity in this industry.

Most of the rattan processing mills, especially the smaller ones, are unable to compete in the open market due to high production costs. They market their products through direct selling, wholesalers and retailers besides government contracts and subcontracts. Many do not conduct market surveys to keep abreast of the current popular demand nor display their products in exhibit houses. They rely only on the fluctuating local markets.

VII. RECOMMENDATIONS AND CONCLUSIONS

While the demand for the cane from the industry remains, the supply of the raw material is declining rapidly. Growing rattan in plantations or in mixtures is not as profitable as the traditional crops. The government may have to play a part in the land acquisition or long-term lease of the land to make plantations more attractive. A form of a rural development scheme, like the Federal Land Development Authority (FELDA) scheme for rubber planting in Peninsular Malaysia, can be a good model to start off the industry. But the processing industry will also have to participate in the growing of the resource, if the industry is to have a future in Malaysia.

The rattan processing mills are also facing some difficulties, and immediate solutions and suggestions are needed to improve production out-put both in quality and quantity. Stimulating production through a rural village industry development program is worthwhile. Policy changes are needed, such as granting pioneer status to the new factories to provide financial incentives, i.e. reducing the sales tax on rattan products. A government agency could be responsible for overseeing and monitoring the marketing of raw materials to ensure an adequate supply to local manufacturers.

A product development centre for systematic and co-ordinated research and development is urgently needed. Greater emphasis should be placed on identifying alternative products and their potential markets. Collaboration with various agencies and higher institutions is essential so that trade and technical information can be collected and centralised for dissemination to the industry. Extension of technology to the rural areas should periodically upgrade and improve the traditional skills already in use without sacrificing the quality and originality of the products.

All concerned should undertake concerted efforts as this industry demonstrates good prospects for development. The time has come for the full-scale involvement of the rural people. With government support to foster development of the industry, there is no reason why it should not succeed. Issues, concerns, constraints, strengths, weaknesses, opportunities, and threats confronting the rattan industry are highlighted in Table 7.

Table 7. Issues and Concerns confronting the rattan industry and recommended solutions and Research and Development (R and D) strategies to address concerns.

Issue/Concern	Recommended Solution	R and D Strategy to address them
Production • No assessment on the actual rattan resource from the natural. • Declining supply of mature raw canes from the natural forests. • Long gestation period of mature canes.	• The growing commercial demand for the rattan resource in Peninsular Malaysia warrants the need to formulate appropriate strategies to assess, manage, develop and conserve this valuable non-wood resource.	Some of the strategies include: • continuing the assessment of the rattan resource in natural forests so that forest development and management plans can be drawn up to ensure its sustainability; • replenishing the rattan resource through large-scale cultivation with species of high commercial value in order to sustain the increasing needs of the rattan based industry; • determining the socio-economic contribution and impact of the rattan resource to the rural and urban communities and the rattan industry; • collecting of data on the rattan industry including those pertaining to the demand, supply and utilisation of the rattan resource and employment opportunities.

Table 7. Issues and Concerns confronting the rattan industry and recommended solutions and Research and Development (R and D) strategies to address concerns (*continuation*).

Issue/Concern	Recommended Solution	R and D Strategy to address them
Protection • Develop a sustainable harvesting system. • Develop proper harvesting techniques to reduce the harvesting wastage. • Study the cane properties of less commercial species for the use of industries.	• Improve the systems of harvesting rattan from natural forests. • Improve the harvesting techniques. • Reduce the annual allowable cut of commercial canes. • Promoting the use of less commercial species	
Marketing • The export of Malaysian rattan manufacturing products to the international markets is declining. • Malaysian rattan-based products are less competitive compared to The Philippines and Indonesia.	• In order to be competitive, Malaysian rattan-based products need to be improved on the finishing qualities, design must be up-to date to the customer demands and the price must be competitive through applying cost-effective measures.	• To set up an integrated rattan plantation and rattan manufacturing industrial park as a center of observation of the country industries.
Information Systems • Lots of publication on rattan R&D outputs but in effective dissemination systems of R & D outputs to the target groups.	• Some of the R&D outputs were delivered to the target groups through extension activities by the relevant government agencies.	• Establish friendly database systems on R&D outputs for sharing information, applications and for use as a benchmark for further R&D at national and regional levels. • Transfer the technologies through conducting regular training to the target groups. • Prepared and made available for distribution on the non-technical reports of rattan-based technologies to the target groups.

Table 7. Issues and Concerns confronting the rattan industry and recommended solutions and Research and Development (R and D) strategies to address concerns (*continuation*).

Issue/Concern	Recommended Solution	R and D Strategy to address them
Policy implementation Administrative Tenurial system	• A clear policy on needs to be drawn up to put rattan growing and the rattan trade on a firmer footing. • Sufficient incentives for encouraging the small holders and entrepreneurs whose are already involved in rattan plantation to sustain their plantations. • Conservation rattan resource through enrichment planting in logged over forests. • The government has to formulate a policy where by the manufacturers have to plant rattans for their own need and not depending on the source from natural forests alone. • Ban of raw materials export is still practiced, thus temporarily supporting the demand of material supply for local industries.	• Studies on the improvement of policies, better incentives and better tenurial rights. • Improve the current rattan plantation establishment for better yield.
Linkages	• Relevant government agencies are in place e.g. FRIM & Universities on R&D and transfer tech. • MTIB & IKN on technical & training support. • Forest Department on raw material resources information. • Ministry of Science & Technology on local funding for R&D & transfer technology.	

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Country Report of Production and Utilization of Rattan in the Philippines

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I. Introduction

The Philippines is an archipelago composed of 7,100 islands. It is located between latitudes 5°N and 21°N and longitudes 116°E and 127°E. It is bordered by the Luzon Strait to the North, the Pacific Ocean to the East, the Celebes Sea to the South and the Sulu and South China Sea to the West.

It has a total land area of 30 M ha, 53 percent (15.86 M ha) of which is forest land (Philippine Forestry Statistics 2001). Land is classified as alienable and disposable and forestlands. Forestlands are categorized into classified and unclassified. Classified forestlands account to 14.77 M ha or 93% of the total area. It consists of established forest reserve (3.273 M ha), established timber land (10.228 M ha), national parks, game refuge and bird sanctuaries and wilderness areas (0.893 M ha), military and naval reservations (0.130 M ha), civil reservation (0.166 M ha) and fishponds (0.076 M ha). Unclassified forestland, on the other hand, accounts to 1.089 M ha or 7% of the total area (Philippine Forestry Statistics 2001).

Rattans are spiny climbing palms occurring in the Old World tropics and subtropics. They are distributed in equatorial Africa, the Indian subcontinent, Sri Lanka, the foothills of the Himalayas, southern China through the Malaya archipelago to Australia and the western Pacific as far as Fiji. The greatest diversity of genera and species of rattan is in the western part of Malesia (Dransfield and Manokaran 1994). Malesia is a plant geographical unit comprising of the Federation of Malaysia, Brunei Darussalam, Indonesia, Papua New Guinea and the Philippines.

Rattan belongs to the palm family Palmae or Arecaceae, subfamily Calamoideae and tribe Calameae. It comprises 13 genera distributed to 5 subtribes (Table 1). Although most members of the rattan genera are climbers, some species are short-stemmed or acaulescent undergrowth palms. There are also species of rattan which are short-stemmed and tend to scramble weakly in the undergrowth, while there are species which have stems that are stiff and erect. The stems of rattan can vary from few millimeters to over 10 cm in diameter. If left unharvested, the cane can grow as long as 100 m (Dransfield and Manokaran 1994).

There are two whip-like organs associated with climbing in rattan, the cirrus and the flagella. The cirrus is an extension of the leaf rachis beyond the terminal leaflets, while the flagellum is a sterile inflorescence borne on the leaf sheath near the knee. Both are whip-like and bear groups of short reflexed spines. Inflorescences of rattan are produced singly at the node and can vary greatly in size and overall structure. The fruits are covered with vertical rows of overlapping reflexed scales. Beneath the scales lies the pericarp. The pericarp is usually thin and dry at maturity. The seed is covered with a fleshy outer layer, sarcotesta. In some genera, such *Korthalsia, Laccosperma, Eremospatha* and *Oncocalamaus*, the mesocarp is thick and fleshy at maturity and the seedcoat is dry (Dransfield and Manokaran 1994).

In the Philippines, rattan is comprised of 4 genera, namely: *Calamus, Daemonorops, Korthalsia* and *Plectocomia,* with 66 species (Appendix 1). Of these, only 47 species are endemic. *Calamus* is the largest genus with 45 species, followed by *Daemonorops* with 14 species, *Korthalsia* with 5 species and *Plectocomia* with 2 species (PCARRD 1991).

Rattan occurs throughout the country. There are 31 species of rattan, excluding *Plectocomia,* found in Luzon, 22 in Palawan and 37 in Mindanao. They are widely distributed from sea level in mangrove swamps to an altitude of 2000 m in montane rainforests. However, most species are confined to lowland and mid-elevation forests (PCARRD 1991). Many species of *Calamus* are narrow endemics and are confined to specific islands or mountains. *Daemonorops* species are widely distributed from Luzon to Mindanao, but many species are confined to islands and mountains. Species of the genus *Korthalsia* have a more restricted distribution, 3 species are found only in Palawan, 2 species in Mindanao and 1 species in Polillo island, Luzon and Mindanao. The genera *Plectocomia* are confined to the primary rainforests of Palawan, Leyte and Mindanao (PCARRD 2002).

The most widely distributed of the Philippine rattan species is ditaan (*Daemonorops mollis*). This is followed by tandulang parang (*Calamus usitatis*), which is found in Batanes Island, Babuyan Island, Zambales, Laguna, Quezon, Camarines Norte and Sorsogon. Other widely distributed species are: palasan (*C. merrillii*), which is generally found in the mountain ranges of Sierra Madre, Cordillera, Kitanglad, Isarog, Halcon and Caraballo, and limuran (*C. ornatus* var. *philippinensis*), which is distributed in Luzon, particularly in the mountains of Laguna, Bicol, Quezon, Rizal, Camarines Norte, and Sorsogon.

Rattan is one of the country's most important and valuable non-wood forest products. The rattan industry has been contributing significantly to the country's economy through generation of revenue from forest charges and to generation of foreign exchange, income, and employment.

Table 1. The classification of rattan genera

Family *Palmae (Arecaceae)*

Subfamily *Calamoideae*

Tribe *Calameae*

Subtribe *Ancistrophyllinae*
Lacosperma
Eremospatha

Subtribe *Metroxylinae*
Korthalsia

Subtribe *Calaminae*
Daemonorps
Calamus
Calospatha
Pogonotium
Ceratolobus
Retispatha

Subtribe *Plectocomiinae*
Myrialepsis
Plectocomia
Plectocomiopsis

Subtribe *Oncocalaminae*
Oncocalamus

Source: Dransfield and Manokaran, 1994

II. Rattan Resources

Rattans are naturally found in dipterocarp forests of the Philippines and are widely distributed throughout the country. Some of the mountains and islands found to be rich in rattan are in Luzon, the Sierra Madre range from Cagayan to Quirino and Quezon provinces; the Central Cordillera; the Zambales mountain range; Mt. Isarog in Camarines Sur province, and Mt. Halcon in Mindoro province; in the Visayas, the southern part of Samar province; the central part of Panay islands; and in Mindanao, in the mountains of Agusan, Surigao, Cotabato, Zamboanga and Basilan in Mindanao (PCARRD 2002).

Of the 66 taxonomically recognized rattan species in the Philippines, only 12 species are economically and commercial important (Table 2). Among these species, palasan, limuran, and tumalim are the most demanded species by the furniture and handicraft industries due to their availability and diameter size.

Table 2. Economically and commercially important rattan species

Common Name	Scientific Name
Palasan	*Calamus merrilli* Becc.
Limuran	*C. ornatus* var. *philippinensis* Becc.
Tumalim	*C. mindorensis* Becc.
Panlis	*C. ramulosus* Becc.
Malacca cane	*C. scipionum* Lour.
Lambutan	*C. dimorphacanthus* Becc. var. *halconensis* (Blanco) Baja-Lapis
Arorog	*C. javensis* Blume
kurakling or sika-sika	*C. microsphaerion* Becc.
Tagiktik	*C. filispadix* Becc.
Sika	*C. caesius* Blume
Ditaan	*Daemonorops mollis* (Blanco) Merr.
hiyod or rogman	*D. pedicellaris* Becc.

Source: Baja-Lapis *et al.,* 2003; PCARRD 2002

The Philippine-German Forest Resources Inventory Project, which was completed in 1988, was the only nationwide inventory conducted on rattan resources in the country. Results of the inventory showed that the total volume of rattan per hectare in the country was estimated to be 2,059.4 lm (Table 3). From these figures, 1,363.1 lm/ha and 696.3 lm/ha were found in old-growth forests and residual forests, respectively. In addition, rattans with diameter of 2 cm and above were estimated to be 782.9 lm/ha, while rattans with diameter of less than 2 cm were estimated to be 1,276.5 lm/ha. The inventory also found 69 known rattan species, as opposed to 66 reported by PCARRD (1991), distributed as follows: 48 for Calamus, 14 for Daemonorops, 5 for Korthalsia and 2 for Plectocomia. Likewise, palasan, limuran and tumalim were found to be occurring throughout the country. Palasan was estimated to have a total of 1.36 B lm, while for limuran and tumalim it was estimated to be 1.14 billion lm and 582.9 million lm, respectively. Their combined length of poles with greater than 2 cm in diameter was estimated to be 1.45 B lm, which accounts to 85% of the total resources of this diameter class (Table 4).

No other nationwide inventory on rattan resources has been done after the Philippine-German Forest Resources Inventory Project. The recent inventory of rattan resources was conducted only in selected provinces of the country such as Western Samar, Surigao del Sur, and Aurora, as part of resource survey on nonwood forest products (FPRDI 2002). Results of the inventory showed that in Western Samar, 6 species of rattan were observed in the area with palasan as the most common one with 115.7 lm/ha, followed by limuran and ditaan with 49.14 lm/ha and 27.43 lm/ha, respectively (Table 5). In Surigao del Sur, there were 7 rattan species observed and the most common was limuran with 531.0 lm/ha, followed by olasi with 114.3 lm/ha (Table 6). In Aurora, palasan and limuran were the more common ones with 90.0 lm/ha and 72.0 lm/ha, respectively. It was also observed that the stands were relatively young having an averaged length of only 3 m to 6 m (Table 7).

Table 3. Average rattan occurrence in dipterocarp forests by region and diameter class.

		Diameter Class								
		less than 2 cm			2 cm and above			Total		
Region	Forest Type	N/ha	lm/pole	lm/ha	N/ha	lm/pole	lm/ha	N/ha	lm/pole	lm/ha
1	Old Growth	276.9	5.3	1,476.9	46.5	7.2	333.8	323.4	12.5	1,810.7
	Residual	47.6	4.8	227.4	10.3	3.8	39.5	57.9	8.6	266.9
2	Old Growth	202.6	6.5	1,322.8	76.1	8.2	623.5	278.8	14.7	1,946.3
	Residual	187.2	5.5	1,035.4	45.7	9.0	412.7	232.9	14.5	1,448.1
3	Old Growth	134.5	6.4	859.2	94.3	7.4	699.7	228.8	13.8	1,558.9
	Residual	84.0	4.9	410.9	34.1	6.7	229.1	118.1	11.6	640.0
4	Old Growth	160.6	6.5	1,054.8	43.6	8.9	374.0	204.2	15.4	1,428.8
	Residual	156.1	5.4	843.5	29.4	7.5	219.1	185.5	12.9	1,062.6
5	Old Growth	74.0	4.2	310.6	3.0	9.2	27.6	77.0	13.4	338.2
	Residual	92.1	4.7	431.8	8.1	6.2	50.1	100.2	10.9	481.9
6 and 7	Old Growth	35.1	4.3	152.2	4.4	8.3	36.6	39.5	12.6	188.8
	Residual	49.1	4.0	197.2	15.8	8.2	129.2	64.9	12.2	326.4
8	Old Growth	163.9	4.2	687.4	66.8	7.6	509.5	230.7	11.8	1,196.9
	Residual	95.5	4.4	416.4	25.5	6.6	168.6	121.0	11.0	585.0
9	Old Growth	98.7	6.1	599.0	50.2	7.9	397.2	148.9	14.0	996.2
	Residual	88.8	4.8	422.4	56.9	8.3	470.2	145.7	13.1	892.6
10	Old Growth	0	0	626.0	0	0	1350.0	0	0	1,976.0
	Residual	0	0	420.0	0	0	337.0	0	0	757.0
11	Old Growth	0	0	693.0	0	0	1180.0	0	0	1,873.0
	Residual	0	0	214.0	0	0	212.0	0	0	426.0
12	Old Growth	169.9	6.1	1,037.8	66.9	9.6	642.7	236.8	15.7	1,680.5
	Residual	135.9	4.4	603.9	21.2	8.0	170.2	157.1	12.4	774.1
13	Old Growth									
	Residual									
Phil	Old Growth	146.2	5.5	801.8	50.2	8.2	561.3	196.4	13.7	1,363.1
	Residual	104.0	4.8	474.7	27.4	7.1	221.6	131.4	11.9	696.3

Table 4. Rattan resources of the Philippines, 1988.

Species	Diameter < 2cm (million m)	Diameter > 2cm (million m)	Total (million m)
Apas (*Calamus symphysipus* Mart.)	462.2	57.8	518.0
Ditaan [*Daemonorops mollis* (Blanco) Merr.]	199.1	32.9	232.0
Limuran (*C. ornatus* Blume var. *philippinensis* Becc.)	550.2	591.4	1,141.6
Palasan (*C. merillii* Becc.)	645.2	730.6	1,375.8
Sika (*C. caesius* Blume)	68.6	7.9	76.5
Sumulid (*D. ochrolepis* Becc.)	58.2	16.5	74.7
Tandulang-gubat (*C. microcarpus* Becc.)	340.7	69.7	410.4
Tumalim (*C. mindorensis* Becc.)	451.2	131.7	582.9
Others	92.3	68.3	160.6
Total	2,865.7	1,706.8	4,572.5

Source: DENR, 1988

Table 5. Rattan species found in four-hectare plot at Hinabangan, Western Samar.

Species	Density/ha	Volume/ha (lm)	Average Length (m)	Average Diameter (cm)
Palasan (*Calamus merillii*)	18.5	115.7	6.25	1.87
Limuran (*C. ornatus* var. *philippinensis*)	12.25	49.14	4.01	1.28
Ditaan (*Daemonorops mollis*)	7.0	27.43	3.92	1.06
Panlis (*C. ramulosus*)	5.25	19.40	3.70	1.11
Tandulang-gubat (*C. dimorphacanthus*)	8.25	20.46	2.48	0.93
Tumalim (*C. mindorensis*)	6.0	19.22	2.87	0.98

Source: FPRDI, 2002

Table 6. Rattan species found in two-hectare plot at Lanuza, Surigao del Sur.

Species	Average Diameter (cm)	Average Length (m)	Volume/ha (lm)
Olasi (*Calamus aidae*)	1.6	12.7	114.3
Dalingdingan (*Calamus* sp.)	1.2	4.2	29.4
Tagiktik (*C. filispadix*)	1.6	4.5	27.0
Kadapi (*C. ornatus* var. *philippinensis*	2.5	13.5	531.0
Armog (*C. javensis*)	1.7	5.5	66.0
Bagbag (*Daemonorops affinis*)	1.3	4.2	46.2
Sumulidor (*D. ochrolepis*)	1.2	5.8	52.2

Source: FPRDI, 2002

Table 7. Rattan species found in three-hectare plot at Dilasag, Aurora.

Species	Average Diameter (cm)	Average Length (m)	Volume/ha (lineal meter)
Tumalim (*Calamus mindorensis*)	2.0	4.0	36.0
Palasan (*C.merrilli*)	2.5	6.0	72.0
Limuran (*C. ornatus* var. *Philippinensis*	2.0	5.0	90.0
Ditaan (*Daemonorops mollis*)	1.3	3.0	24.0

Source: FPRDI, 2002

With the growth and expansion of rattan industry in the country, the demand for rattan poles will continuously increase. The Master Plan for Forestry Development (1990) had estimated that the demand for small- and large-diameter rattan poles by year 2000 may reach 437.2 M (Table 10). An increase in growth rate was likewise projected at 8 percent per annum for the years 2010 to 2015 due to the expected new markets, which might have been found and developed (Rivera 1999).

Ninety percent of rattan raw materials comes from the wild or natural stands. These natural stands now face rapid depletion because of rampant timber harvesting, conversion of forest areas into other land uses and the unregulated cutting of rattan which reduces regeneration (Rivera 1999). A clear indication of this is that production of rattan poles has decreased significantly for the last 10 yr (Table 8). From the highest production of 24.8 M lm of unsplit rattan in 1993, it has decreased significantly to only 6.6 M lm in 2002 or a decrease of 73% in production.

Accordingly, there is also a decrease in the number of cutting contracts issued by the government as well as the allowable cut for rattan collection in the last five years. Table 11 shows the number of permittees, area, and allowable cut for 1999 to 2003. The highest number of cutting contracts issued by the DENR was 370 in 2000 with corresponding total allowable cut of 220.5 M lm. In 2003, the number has reduced to only 49 cutting contracts with total allowable cut of only 55.3 M lm.

Table 8. Rattan production from CY 1999 to 2003 (in thousands).

Year	Split Rattan (k)	Unsplit Rattan (lm)
2002	0	6,628
2001	25	8,767
2000	97	32,336
1999	48	15,552
1998	5	10,463
1997	2	19,519
1996	17	24,613
1995	24	17,457
1994	4	19,088
1993	1	24,845
1992	30	22,693

Source: Forestry Statistics

The continuous increase in the demand for rattan poles coupled with the decrease in supply has resulted in importation of raw materials by the industry. In 2001, the country had imported around USD 1.12 M worth of rattan poles, splits and core from countries like China, Hong Kong, Indonesia, and Singapore to supplement the local supply of rattan (Philippine Forestry Statistics PCARRD 2001).

Rattan plantations have also been developed throughout the country to supplement the decreasing supply of raw materials.

The DENR, through its Forestry Sector Project, has developed rattan plantations throughout the country. Table 9 shows the reported areas of rattan plantations developed in different regions of the country. Palasan and limuran were mainly used in these projects due to their importance for the furniture industry (Tesoro 2000). Figures 1 and 2 show photographs of a successful rattan plantation developed by DENR reforestation project in Malasag, Cagayan de Oro City under Region X.

In addition, in 1977, the Ecosystems Research and Development Buraeu of the DENR initiated the cultivation trials of palasan and limuran in Pagbilao, Quezon. At present, about 200 ha are planted with these species (Rivera 1999).

Table 9. Rattan plantations developed under the DENR's Forestry Sector Project.

Region	Area (ha) Under Loan I	Under Loan II
CAR	270	162
1	1470	316
2	90	271
3	421	4
4	650	460
5	284	666
6	250	834
7	110	277
8	400	2283
9	470	1070
10	382	114
11	174	268
12	-	-
13	A	251
ARMM	2	3
Total	4982	6977

Source National Forestation Development Office, DENR

Figures 1 and 2. Rattan plantation developed in Malasag, Cagayan de Oro City.

Table 10. Projected demand for rattan poles on projected value exports, 1990-2015 a/.

Item	1990	1991	1992	1993	1994	1995	2000	2005	2010	2015
Value of Exports (USD '000,000)	163.6	180.0	198.0	215.7	239.5	263.5	336.3b/	429.2	630.6c/	926.6
Rattan Poles (million lm)	212.7	234.0	257.4	283.0	311.4	342.6	437.2	558.0	819.8	1,204.6
Large-diameter Rattan (40% of requirement)	85.1	93.6	103.0	113.2	124.6	137.0	174.4	223.2	327.9	481.8
Small-diameter Rattan (60% of requirement)	127.6	140.4	154.4	169.8	186.8	205.6	262.3	334.8	491.9	722.8

a/ Raw material requirement is based on 1.3 lm of rattan for every USD1.0 sales.
b/ Estimate of annual growth of export value from 1996 to 2005 decreases to 5% annually due to competition from Indonesia
c/ From 2006 to 2015, the estimate of annual growth increases to 8%. It is expected that new markets will have been found and developed

Source: DENR 1990. Master Plan for Forestry Development

Table 11. Permittees, area and allowable cut for different regions in the country for CY 1999 to 2003.

Region	Number of Permittee					Area (ha)					Allowable Cut (lm)				
	Year					Year					Year				
	1999	2000	2001	2002	2003*	1999	2000	2001	2002	2003*	1999	2000	2001	2002	2003*
CAR	12	10	5	3	3	218,660	101,540	48,940	48,940	48,940	13,275,098	893,109	1,533,088	1,533,088	1,533,088
1	0	6	0	0	0	0	19,082	0	0	0	0	899,256	0	0	0
2	16	42	10	9	13	60,019	323,370	83,370	53,370	66,517	8,740,451	13,487,397	3,591,325	3,148,925	3,588,388
3	0	2	0	0	0	0	16,670	0	0	0	0	2,782,181	0	0	0
4	14	102	19	6	4	115,704	1,281,082	141,288	50,988	41,538	6,471,174	32,624,748	7,422,721	2,604,163	2,380,363
5	1	4	2	0	0	4,475	9,419	8,275	0	0	139,000	326,567	187,017	0	0
6	0	1	0	0	0	0	5,000	0	0	0	0	423,912	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	23	0	0	6	0	177,000	0	0	30,850	0	9,088,172	0	0	1,587,618
9	0	33	4	1	0	0	183,419	37,145	12,002	0	0	5,133,025	1,044,913	339,287	0
10	13	15	8	6	7	67,520	76,652	49,452	39,515	44,825	5,393,622	6,163,279	3,722,339	2,966,096	3,652,295
11	78	51	22	6	9	685,598	488,883	329,003	329,003	203,436	77,584,116	69,312,016	51,598,834	41,396,321	37,826,795
12	14	19	1	1	0	125,695	176,853	2,650	2,650	0	9,903,332	21,280,299	825,680	825,680	0
13	47	49	17	9	7	29,6053	2,005,206	289,529	226,154	213,719	28,983,328	26,230,112	11,333,894	5,935,506	4,738,287
ARMM	0	13	0	0	0	0	138,010	0	0	0	0	31,892,087	0	0	0
Total	195	370	88	41	49	1,573,724	5,002,186	989,652	762,622	649,825	150,490,121	220,536,160	81,259,811	58,749,066	55,306,834

* as of March 14 2003; Source: Forest Management Bureau, DENR

The National Development Corporation (NDC) ventured into the first commercial and industrial rattan plantation in Mindanao. The plantation is located within the concessions of Paper Industries Corporation (PICOP) and the Bislig Bay Lumber Company in Surigao del Sur. The total plantation established in a period of eight years (1984-1992) was 5,185 ha (Rivera 1999). The plantation was planted mainly with palasan under bagras (*Eucalyptus deglupta*) and falcata (*Paraserianthes falcataria*) plantations (Tesoro 2002).

The Swedish Match Hillshog Philippines, Inc., in cooperation with the Provident Tree Farms, Inc. (PTFI), likewise, established a 50-ha plantation in Mindoro Island and 150-ha plantation in Talacogon, Agusan del Sur province. Both areas were planted with palasan and limuran (Rivera 1999).

The government encourages and provides incentives for the development of rattan plantations. The incentives include reduced rental fees for the plantation area; reduced forest charges; provision of rattan seedlings to developers at production cost; free technical assistance; and the right to harvest, sell, convey, or dispose of the rattan in any manner the owner sees fit (DENR 1989, as cited by Tesoro 2002).

In Agusan del Sur province, a nine-year rattan plantation was established by Mr. Raul L. Matuguinas. The plantation has an area of 51 ha and is located in Brgy. Baylo, San Luis, Agusan del Sur. The plantation is planted mainly with palasan and tumalim (Figures 3, 4, 5, and 6). Small-scale plantations, e.g., 1 ha to 2 ha, were likewise learned to be established in other parts of Agusan del Sur province.

Figure 3. Portion of 51-ha rattan plantation established by Mr. Matuguinas in San Luis, ADS. The rattan plantation was established under falcata plantation.

Figures 4 and 5. Portion of 51-ha rattan plantation established by Mr. Matuguinas in San Luis, ADS.

Figure 6. A nine-year old rattan planted in 51-ha rattan plantation established by Mr. Matuguinas, in San Luis, ADS.

Table 12 presents the research breakthroughs, technologies and significant information on production of rattan in the country from 1990 to 1998 (PCARRD 2002).

Table 12. Research breakthroughs, technologies, and significant information on rattan, 1990-1998.

Year	Title/Source	Status of Technology
1998	Establishment of rattan genebank in Mindanao and expansion in Mt. Makiling/ERDB	Information for Dissemination
1997	Establishment of a rattan genebank in Mt. Makiling/ERDB	Information for Dissemination
1996	Rattan production under para rubber plantation/DENR-ERDS-Region XII	Technology for Dissemination
1994	Survival and growth development of palasan (*Calamus merillii* Becc.) under different reforestation species/DENR-Region VII	Information for Dissemination
1991	Growth performance of palasan (*C. merillii* Becc.) planted in Pagbilao, Quezon/DENR-Region IV	Information for Dissemination
1990	Supply and demand for rattan by handicraft and furniture industries in the Philippines/ERDB	Information for Dissemination

Source: PCARRD, 2002

III. Production and Resource Management

A. Nursery Activities

1. Propagation of Rattan

Rattan planting stocks can be propagated either through sexual or asexual means. By sexual means, planting stocks are produced from seeds, while by asexual means, planting stocks are produced from suckers, wildlings or other means such as tissue culture.

a. For propagation of rattan through sexual means or by seeds, the following procedures are followed (PCARRD 1991, 1992a):

- Seed Collection

  Collect only ripe rattan fruits from natural stands from October to March. For palasan and limuran, the best season to collect fruits is from October to January. The fruits of rattan turn yellowish when ripe. For palasan, the fruits turn yellow or grayish, while for limuran, yellow orange and black fruit tips.

- Seed Extraction

  The seeds of rattan may be extracted from the fruit by maceration. The fruits are crushed by hands and may be soaked in water for 24 hr to 48 hr, by which time the clean seeds will have settled at the bottom and the fleshy covering floated to the water surface. Likewise, the crushed fruits may also be allowed to rot for 2 days to separate the seeds from the flesh and pericarp. The seeds are then washed to remove the remaining pulp.

- Seed Germination

  To accelerate the germination of the seeds, removal of the hilar cover using a sharp knife or scalpel is recommended. The technique or process has greatly reduced germination time of rattan seeds. For palasan, removal of the hilar cover has reduced germination time from 365 days (1 yr) to 2 days. For limuran, it has reduced from 210 days (7 mo) to 15 days.

  Immediately, sow the seeds in a box lined with sterilized wet jute sack and cover the seeds with the same materials. Place the box under the shade and cover it with plastic sheets to conserve moisture. When the shoots and roots have reached 1 cm to 3 cm long, they are ready for potting. Pottting is done preferably in 13 cm x 15 cm plastic bags with equal mixture of river and top soils.

  The seeds of rattan may also be sown, 5 cm to 10 cm apart, in seedbeds or seedboxes with equal ratio of garden soil and humus and placed under partial shade. Watering should be done twice a day to keep the seeds moist.

  Treatment of seeds with fungicide, e.g., 0.5 lb sodium pentachlorophenate with 3 gal distilled water is also recommended before sowing the seeds to protect them from fungal infection. Likewise, application of gibberellic acid at 100 ppm concentration has also been found to increase shoot and root ratio in limuran.

b. For asexual means, planting stocks may be produced from suckers, wildlings and tissue culture (PCARRD 1991).

   1. Suckers
      Suckers are side shoots or plants growing out of the nodes or base of mature rattan plants. Collection of suckers may be done anytime, but collection during rainy season is recommended. Only suckers 15 cm tall or less and with well-developed root system should be collected.

   2. Wildlings
      Wildlings are seedlings that naturally grow from fallen seeds on forest floor. Only wildings 30 cm tall or less should be collected. Collection must also be done during the rainy season and appropriate digging tools should be used to prevent root damage. If the nursery is far from the collection area or source, cover the roots with soil, moss or banana leaf sheath to prevent drying of wildlings.

3. Tissue Culture
   Tissue culture is a very promising method of mass-producing rattan planting stocks. It is an aseptic way of culturing plant parts, tissues or cells *in vitro* under a germ-free nutritionally and physically controlled environment. The method has been successfully used to propagate various species of rattan such as palasan, limuran, panlis, ditaan, tagiktik, sumulid, lambutan and kumaboi. In addition, tissue-cultured palasan and limuran have been successfully established in nurseries and in the field.

   Likewise, 11 species of *Calamus* and 2 species of *Daemonorops* have been successfully propagated under various media and growth conditions using tissue culture prepared from youngest portion of shoot apex. However, callus induction and growth of different rattan species required different salt concentrations, pH level and additives. The best sugar level for callus growth was found to be 4% and while low auxin level encouraged the differentiation of callus into shoots (Umali-Garcia 1985).

2. Seedling Care and Maintenance (PCARRD 1991, 1992a)

After potting the seedlings, wildlings or suckers, the following activities should be done to ensure healthy growth:

- Keep the seedlings from direct sunlight. Keep them under shaded area or nursery.
- Water the seedlings regularly. Water them twice a day during dry season.
- Fertilizer application at a rate of 4.5 G to 7 G using complete fertilizer (14-14-14 NPK) around the seedlings is recommended. The fertilizer should be applied 1 cm to 2.5 cm around and from the base of the seedlings.
- Before outplanting, harden the seedlings for about 2 mo to 3 mo. This can be done by gradually decreasing the shade and exposing them to sunlight. By this process, the plants can withstand full sunlight stress when they are planted in the field.

Figure 7. Rattan seedlings.

B. Plantation Establishment

1. Site Requirements or Characteristics

Rattan requires the presence of vegetation as shade when young and support as it matures. The area should also be accessible for easier management and supervision.

The following are areas suitable for rattan plantation development (PCARRD 1991; 1992b):

- communal tree farms where other forest tree species of commercial value, with 25 yr to 35 yr of rotation, have been planted from 3 yr to 5 yr earlier to provide the needed shade;
- logged over-areas where there are still standing saplings or other forest tree species;

- developed reforestation projects;
- bushland with considerable stocking of broadleaves, soft-stemmed trees and other shrubs not scheduled for reforestation within the next 10 yr;
- second-growth forests not scheduled for re-logging within the next 10 yr; and
- kaingin areas with fruit-bearing trees or coconuts where shade-loving agricultural crops can be raised simultaneously with rattan.

In addition, if the area to be developed for rattan plantation does not contain enough trees, planting of fast-growing and nitrogen-fixing tree species is recommended.

2. Site Preparation

- Clear the area of grasses, vines shrubs and other unwanted vegetation without disturbing or damaging the host trees. Clearing or underbrushing should be done during the dry season.
- Stake and dig the area with spacing of 2 m x 2 m for solitary-type rattan and 5 m x 5 m for clustering type. Holes must be wide and deep enough to accommodate the soil-balled seedlings. Holes should also be made 1 m away from the nearby trees. A maximum of 400 seedlings should be planted in 1 ha.
- In addition, soil analysis may also be done to determine the site's specific water and fertilizer needs.

3. Outplanting

- Seedlings should be transplanted at the onset of the rainy season to ensure survival.
- Only robust and healthy seedlings should be selected for transplanting. The seedlings should also be at least 15 cm tall and have 4 to 5 leaves.
- Transport the seedlings to the planting site with utmost care and least disturbance.
- Potting medium such as plastic or polyethylene bag should be removed without, as much as possible, breaking the ball of soil before placing each seedling into each hole.
- Plant the seedling such that the root collar is at ground level.

4. Maintenance and Protection

- Ring weeding of a radius of 25 cm to 50 cm around the plant for the first 3 yr is recommended. Ring weeding should be done 3 mo after outplanting and every 4 mo thereafter.
- Application of complete fertilizer (14-14-14 NPK) at the rate of 10 G one month after outplanting and 6 G after every 6 mo for 3 yr.
- Mulching of seedlings to conserve soil moisture is also recommended.
- Replacement of dead seedlings should also be done simultaneously with ring-weeding.

Figures 8 and 9. Newly planted rattan seedlings.

C. Harvesting Systems or Methods

- It usually takes rattan 10 yr to 15 yr to attain maturity and be ready for harvest. The length and diameter of the cane vary depending on species (Table 12). For palasan and limuran, the mature cane can measure from 10 cm to 20 cm long and at least 2 cm in diameter. After 10 yr, only 20 cm long.
- There has been little, if any change, in the technologies used for harvesting rattan canes. Harvesting is usually done by a team of at least two gatherers. One climbs the tree to loosen the "grip" of the long or tall while the other stays on the ground to pull and cut the cane (Kilmer 1994, as cited by Rivera 1999). Rattan cane is usually cut close to the base or 30 cm to 60 cm above the ground using a sharp bolo (PCARRD 1991; The Philippines Recommends for Rattan 1985).
- It is estimated that 30% of the total supply of rattan poles is wasted during harvesting. This is due to traditional methods of harvesting rattan canes wherein the cane forcibly pulled down leaving a substantial merchantable length of the cane in the forest canopy (PCARRD 1991). Likewise, when long canes cannot be pulled down in one piece, the cane is cut so that only the accessible portion is harvested.
- To maximize the volume of rattan harvested, the following steps are recommended (PCARRD 1991):
    - Cut the stem with bolo from 30 cm to 200 cm above the ground.
    - Dislodge the cut cane from the tree from which it is suspended by pulling the stem at its base with strong tugs.
    - If the cane gets stuck in the canopy, climb a neighboring tree to cut the rattan free from its support or use a fishhook or a similar device tied securely to a pole to pull down the cane.
    - As the cane is dragging down from the tree, twist it around the tree trunk carefully to prevent the cane from crashing down to the ground and damaging itself and to remove the thorny leaf sheaths, or remove the thorny leaf sheaths using bolo.
    - Depending on the rattan species, remove the soft and immature (3 m to 4 m) top potion of the cane.
- For rattan licensees, harvesting of rattan is done by rotation cutting. The license area is usually divided into blocks. Each block is then programmed or scheduled for harvesting for a particular year. After harvesting, the block is then replanted with rattan seedlings such that the seedlings as well as the young and immature ones left during harvesting are ready to be harvested at the end of the 10-year cutting rotation.
- In Samar province, harvesting is done all year round, particularly from January to August. Mature rattan canes are harvested based on length of the cane, which should be more than 10 m, absence of defects and the straightness of the cane. Likewise, sharp bolo is the only tool used in harvesting rattan and in cutting the cane into desired length (Baja-Lapis *et al.*, 2003).

Figures 10 and 11. Harvesting of rattan cane.

D. Grading Standards

- Grading of rattan poles is generally practiced by buyers and manufacturers. It is mostly based on cane color, size, quality and general appearance. In Samar, a permittee uses 3 grades, namely: Grade A, B, and C, for evaluating the rattan poles delivered to his stockyard. Grade A

Table 13. Stem diameters of Philippine rattan.

Below 1 cm	
Daemonorops gracilis	
From 1 cm to 2 cm	
Daemonorops gaudichaudii	*C. discolor*
D. curranii	*C. filispadix*
D. pannosus	*C. elmerianus*
D. pedicellaris	*C. caesius*
D. oligolepis	*C. ramulosus*
D. affinis	*C. halconensis*
C. mitis	
Over 2-5 cm	
Korthalsia laciniosa	*C. viridissimus*
K. merrillii	*C. dimorphacanthus*
K. rigida	*C. dimorphacanthus* var. *zambalensis*
K. scaphigeroides	
K. squarrosa	*C.dimorphacanthus* var. *motalbanicus*
Daemonorops margaritae var. *palawanicus*	*C. microcarpus*
D. ochrolepis	*C. siphonospathus*
D. urdanetanus	*C. samian*
D. mollis	*C. vinosus*
Calamus blancoi	*C. megaphyllus*
C. symphysiphus	*C. reyesianus*
C. cumingianus	*C. scipionum*
C. manillensis	*C. mindorensis*
C. moseleyanus	*C. microsphaerion*
Over 5-10 cm or more	
Plectocomia elmeri	
Calamus ornatus var. *philippinensis*	
C. bicolor	
C. merrillii	
C. merrillii var. *nanga*	
C. merrillii var. *merrittianus*	
C. melanorhyncus	
C. multinervu	

Source: The Philippines Recommends for Rattan (1985)

- Grade A is the highest grade wherein poles must be mature, whitish in color and no pinholes. For Grade B, the poles must be mature, whitish in color and only a portion with blemishes, while for grade C, a portion black and brownish in color (Baja-Lapis *et al.,* 2003).

E. Transporting or Hauling

- After harvesting, rattan canes are normally brought to the collection site and bundled. A bundle of rattan contains 20 canes. The bundles are manually brought by the gatherers to the roadside for pick up or transported to the stockyard. In Samar, some permittees use truck to transport the bundles rattan canes from the roadside to the stockyard. In Agusan, some gatherers use motorcycles to transport the canes to the stockyard. Others, particularly those individual gatherers, manually bring the rattan canes to the stockyard.

Figures 12. Manually transporting of bundled rattan poles to stockyard.

Figures 13. Transporting of rattan canes to stockyard.

F. Post-harvest Activities

- In the stockyard, rattan canes undergo various post-harvest activities such as sorting, grading, scraping, drying and cane treatment.
  - Rattan canes are sorted according to diameter and physical attributes (Figures 14 and 15).
  - Scraping of rattan cane is done with the use of sharp knife or bolo. Scraping is done to shorten the drying process of canes, improve adhesion of varnish or polish and to give the canes a smooth finish and uniform diameter (Figure 16) (PCARRD 1991).
  - Rattan canes are dried as soon as possible after harvesting to reduce susceptibility to staining fungi and powder-post beetle attack. Air- or sun-drying is the most common and cheapest way of drying rattan canes (Figure 17). However, this method requires longer period to attain the desired moisture content of canes. (PCARRD 1991). Likewise, air-drying often leads to staining and damage by borers that degrade the quality of the canes (Tesoro 2002). Other methods of drying rattan, which significantly reduce drying time, are kiln drying, tarpaulin canvass drying, and portable demountable drying (PCARRD 1991).
  - Treatment of rattan canes in cutting area or stockyard is seldom practiced due to added cost of preservative treatment. In Samar, however, a rattan licensee treats the canes in boiling water with kerosene and diesel (1:1:1) for 20 min to 30 min to prevent termite attack (Figure 18) (Lapis *et al.*, 2003).
  - Other post-harvest activities done on rattan canes are trimming and straightening of canes (Figure 19).

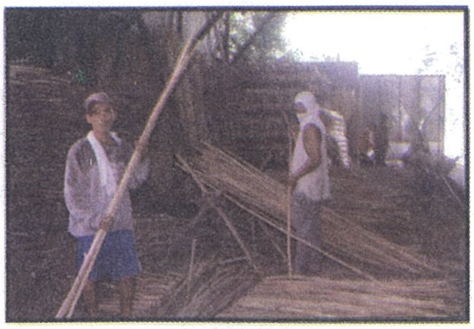


Figure 14. Sorting of rattan canes by diameter classes.

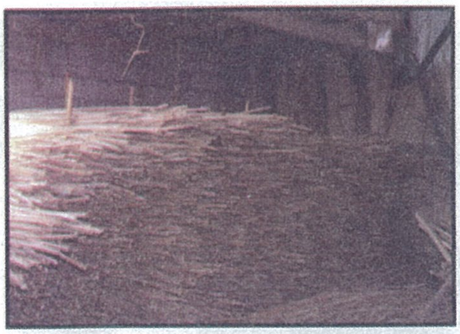


Figure 15. Sorted rattan canes by diameter classes.

Figure 16. Scraping of rattan canes.

Figure 17. Sun drying of rattan canes.

Figure 18. An improvised treating vessel used to treat canes (Photo from Lapis *et al.,* 2003).

Figure 19. Straightening of rattan canes.

IV. Processing and Utilization

A. Major Products and Uses

Rattan products are generally classified as primary (canes), secondary (splits, wicker and core) and finished (e.g., furniture, handicrafts, and baskets). Canes and splits are raw materials that have undergone first stage processing such as scraping, drying, and splitting, while wicker and core are raw materials that have undergone second stage processing (Pabuayon, *et al.*, 1996, as cited by Rivera 1999).

Aside from furniture and handicrafts manufacture, rattans are also used for numerous purposes such as cordage, construction, thatching, and matting. Other uses of rattan include mats, broom handles, carpet beaters, hammocks, walking sticks, fish and animal traps, sun blinds, bird cages, footballs, hats, bags, twines, and toothbrushes. The young shoots of rattan are eaten, while the fruits of some species are edible. The fruits of *Daemonorops* species produce sap called dragon's blood because of its deep maroon color. It is used as dye and medicine (PCARRD 1991; Dransfield and Manokaran 1994).

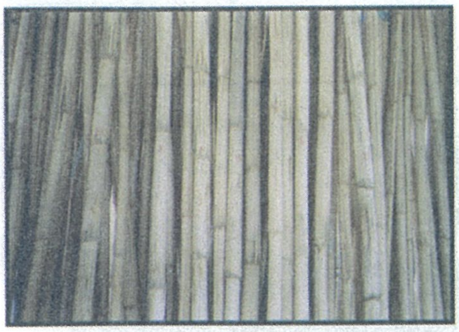


Figure 20. Rattan canes.

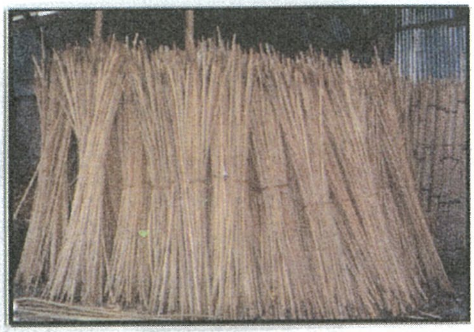


Figure 21. Bundles of dried rattan canes stored in a stockyard in Bayugan, Agusan del Sur.

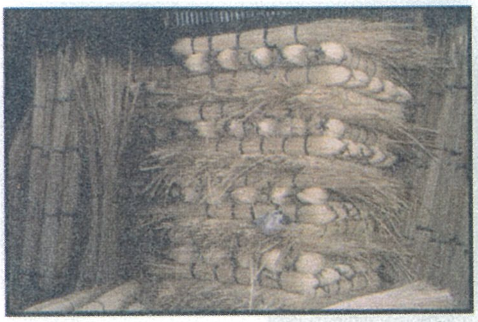


Figure 22. Bundles of rattan splits.

Figure 23. Bundling of rattan cores.

Figure 24. Bundling of rattan wickers.

Figure 25 and 26. Tables and chairs made from rattan (Davao City).

Figure 27. Divider and other products made from rattan.

Figure 28. Sofa made from rattan.

Figure 29. Baskets and other items made from rattan.

B. Methods of Improving Rattan Products

1. Causes of Biodeterioration in Rattan

Fungi and powder-post beetles are 2 main causes of biodeterioration in rattan. Examples of fungi are the molds, wood-staining fungi and wood-destroying or decaying fungi. Molds are found on the surface of rattan and can be easily wiped off, while wood-staining fungi cause discoloration, penetrate deep into the tissues and cannot be scraped off. Examples of molds are *Aspergillus niger, Trichoderma viride* and *Penicillium* sp and for wood-staining fungi, *Ceratocystis* sp and *Botryodiplodia theobromae*. Wood destroying or decaying fungi are capable of disintegrating the cell wall thereby changing the physical and mechanical properties of rattan. Examples are white rot, brown rot and soft rot. For powder-post beetle, the insect that causes damage to rattan is locally known as bukbok. It is a small, black, cylindrical beetle about 3 mm long. The larvae and the adult of bukbok are capable of burrowing inside the tissues and converting them into fine powder. They infest both freshly cut or those in service rattan canes (Giron *et al.,* 1998a).

2. Nonchemical and Chemical Treatment of Rattan

There are two methods of the preventing and controlling fungal and insect attack in rattan: nonchemical or traditional methods and chemical methods. Examples of nonchemical methods are air- or kiln-drying. In air-drying, rattan canes are air-dried under shade, and if sun dried, the materials are not exposed under the intense heat of the sun. Kiln drying, on the other hand, may be used to reduce drying time. For chemical methods, fungicides and insecticides are used to prevent fungal and insect attack, respectively. They are classified as either water-borne or oil-borne preservatives. Water-borne preservatives are chemicals soluble in water and examples are sodium pentachlorophenate (NaPCP), 2-thiocyanomethylthio-benzothiozole (TCMTB) and deltamethrin, while oil-borne preservatives are chemicals only soluble in oil or kerosene such as creosote and NaPCP. Oil-borne preservatives are likewise applied to materials that are in ground contact (Giron *et al.*, 1998a).

The preservatives may be applied to rattan canes through spraying, brushing and dipping or soaking in chemicals for 5 min to 10 min (Giron *et al.*, 1998a). The preservatives may also be applied using pressure processes such as full cell or Bethel and empty cell (Lowry or Rueping method) process. However, these methods are expensive and commonly applied only in commercial treating plants (PCARRD 1985)

Manuals on treatment procedures against fungal and insect attack as well as handling and preparations of fungicides and insecticides for rattan were also prepared (Giron *et al.*, 1998b; Garcia *et al.*, 1998).

3. Processing Technologies

In addition to prevention and control of biodeteriorating agents in rattan, a number of studies have been conducted on the utilization of rattan. The Forest Products Research and Development Institute have been conducting R and D studies on the basic properties as well as products development of rattan in the country. Studies on basic properties of rattan include anatomical, chemical, physical, and mechanical properties, while for utilization processes, studies include drying, bending, bleaching, and finishing.

- **Anatomical Properties of Rattan**

  There have been few studies on the anatomy of rattan in the Philippines. A study on the stem anatomy of 9 species of *Calamus* viz., talola (*C. blancoi* Kunth.), Sika (*C. caesius* Bl.), pangan-panganan (*C. filispadix* Becc.), palasan (*C. merillii* Becc.), sipai (*C. microcarpus* Becc.), padlos (*C. microsphaerion* Becc.), tumalim (*C. mindorensis* Becc.), limuran (*C. ornatus* Bl. ex. Schult. var. *philippinenesis* Becc.) and lokuan (*C. reyesianus* Becc.) aimed at identifying them based on their anatomical characteristics showed that these species have similar pattern of vascular arrangement. The vascular bundle arrangement of all species was found to be very homogenous and cannot be used to segregate the nine species unless associated with other anatomical features such as the width of the cortex, presence or absence of peripheral sclerotic zone and the presence of mucilage canals and raphid sacs in the ground tissue, density of silica inclusions in the sclerenchymatous bundle cap and the presence of tyloses (Palisoc 1983).

  In another study, the frequency of fibrovascular bundle (per mm^2) of kumaboi (*Calamus discolor* Mart.), tandulang-gubat (*C. dimorphacanthus* Becc.), danan (*C. laciniosa* Mart.), douung-douung (*C. cumingianus* Becc.) and kamlis (*C. microcarpus* Becc. var. *diminutus* Becc.) was found to decrease from the dermal portion towards the central portion of the cross section of the pole. No pattern of variation, however, was observed from 2^{nd} to the 50^{th} internode (Alcachupas and Palisoc 1986).

  A study of 7 lesser-used rattan species, viz. tipon-tipon (*Calamus daemonoropoides* E. Fern.), labni (*C. didenhorstii* Miq. var. *exulans* Becc.), uai, (*C. grandiflorus* Becc.), arorog (*C. javensis* Blume), labsikan [*C. marginatus* (Blume) Mart], balanog (*C. simphysiphus* Mart.), bugtong (*C. subinermis* H.A Wendl. ex. Becc.) and 3 commercial species, sika (*C. caesius* Blume), palasan (*C. merrillii* Becc.) and limuran (*C. ornatus* Blume var. *philippinensis* Becc.), observed difference in the structure of the epidermis peripheral zone and central portion of the sample canes. A decrease in fibrovascular bundle frequency and size from the dermal portion towards the central portion of the canes again was observed, however, similar trend was generally observed from the base to the top portion of the pole (Palisoc and Natividad 1991).

- **Chemical Properties of Rattan**

  There was only one study conducted on chemical properties of rattan. Much of the studies conducted on basic properties of rattan were on anatomy and physical and mechanical properties.

Knowledge and understanding of the chemical composition of rattan is an important factor in determining the proper processing techniques and solution to fungal and insect attack in rattan canes.

Proximate chemical analysis of 12 species of rattan, belonging to Genera *Calamus, Daemonorops* and *Korthalsia*, for holocellulose, lignin, alcohol-benzene and hot-water extractives, 1% caustic soda soluble, ash, silica, pentosans and starch content showed that there was a wide variation in the chemical components within and between species. Results also showed that rattan had ½ to ¾ holocellulose and about ¼ lignin content. They were also high in ash and silica, but low in extractives. Hot-water extractives, lignin and solubility in 1% sodium hydroxide appear to be confined mostly in top portion, while holocellulose and silica in butt or basal portion of canes. Starch was high in some species but negligible in other species and it was found to be concentrated in the middle and top portions of the cane. Averages of the proximate chemical composition of rattan species studied are presented in Table 14 (Gonzales 1985).

Table 14. Proximate chemical composition of some species of Philippine rattan.

Property	Range (%)
Holocellulose	52.66 to 70.05
Lignin	16.61 to 33.50
Extractives	
Alcohol-benzene	3.30 to 8.02
Hot-water	2.07 to 10.74
Ash	2.38 to 6.03
Pentosans	18.80 to 27.90
Silica	0.113 to 3.44
1% NaOH Solubility	21.85 to 34.73

- **Physical and Mechanical Properties of Rattan**

A study on the moisture content, specific gravity, static bending, compression parallel to grain, hardness, screw and nail withdrawal of stained and unstained rattan specimens showed that the moisture content increased from the base to top. The base had moisture content of 60% to 75%, while the top portions had 145% to 154% moisture content. In addition, node specimens had higher MC than internode specimens. Specific gravity decreased from base to top. The specific gravity of node also differed from the internodes specimens. The basal nodes and internodes had average SG of 0.61 and 0.68, respectively, while top nodes and internodes had 0.40 and 0.45, respectively. The specific gravity and mechanical properties of the stained rattan poles were lower than the stained samples, except for static bending which did not seem to be affected by staining (Casin 1975, as cited by Tesoro 1987;1988).

Likewise, a study on the moisture content, specific gravity, static bending and compression parallel to grain of 9 noncommercial viz. tipon-tipon (*Calamus daemonorops* E. Fern.), sumulid (*D. ochrolepis* Becc.), sipai, (*C. microcarpus* Becc.), biri (*C. siphonospathus* Mart.), butarak [*C. vidalianus* Becc.), kumaboi (*C. discolor* Mart.), bayabong (*C. manillensis* (Mart.) Wendl.), tandulang parang (*C. usitatuss* Blanco.), and danan (*Korthalsia laciniosa* Mart.) and 4 commercial species of rattan, viz. ditaan (*Daemonorops mollis* (Blanco) Merr.), tagiktik (*C. filispadix* Becc.), lambutan (*C. halconensis* Becc.) and lokuan (*C. reyesianus* Becc.), showed that moisture content and specific gravity of all species likewise increased from the base to the top for both node and internode specimens. The node specimens were also found to have higher MC but lower specific gravity compared to internode specimens. Likewise, the top portions of the canes were observed to have lower strength properties. For the same height level, the nodes showed lower compressive strength than the internodes which may be attributed to lower specific gravity of the nodes. Three of the noncommercial species, *D. ochrolepis* Becc., *C. microcarpus* Becc. and *C. manillensis* (Mart.) Wendl., were found comparable to the commercial species while 5 species, *Calamus daemonorops* E. Fern., *C. siphonospathus* Mart., *C. vidalianus* Becc., *C. usitatus* Blanco., and *Korthalsia laciniosa* Mart., could be used for similar uses of the commercial species but of slightly lower quality (Alcachupas 1985).

Similar results on moisture content and specific gravity were found in a study on the physical and mechanical properties of 3 noncommercial rattan species, i.e., tandulang-gubat (*C. dimorphacanthus* Becc.), douung-douung (*C. cumingianus* Becc.) and kamlis (*C. microcarpus* Becc. var. *diminutus* Becc.) (Alcachupas and Palisoc 1986). The average moisture content increased from the base towards the top with corresponding decrease in specific gravity. Node had also slightly higher moisture content than the internode. Variation in moisture content may be attributed to different elements present in nodes and internodes, while for specific gravity, variation was attributed to the compactness of the vascular bundles at the lower portion of the cane.

In addition, the strength properties of the cane decreased from the base to the top portion of the cane for both dry and green samples. The fiber stress at proportional limit and modulus of elasticity tend to decrease from the base to the top portion which may be attributed to decreasing specific gravity. Unseasoned and dried samples with and without nodes from butt portion had also higher maximum crushing strength than those samples taken from middle and top portions of the cane. The compressive strength of seasoned or dried samples was generally higher than unseasoned or green samples. Internodes had also higher maximum crushing strength than the nodes. The strength properties of three species were comparable to ditaan [*Daemonorops mollis* (Blanco) Merr.] and pangan-panganan (*C. filispadix* Becc.) (Alcachupas and Palisoc 1986).

In another study, the variation in moisture content and specific gravity of 6 noncommercial rattan species, viz. tipon-tipon (*Calamus daemonoropoidess* E. Fern.), labni (*C. didenhorstii* Miq. var. *exulans* Becc.), uai, (*C. grandiflorus* Becc.), arorog (*C. javensis* Blume), labsikan [*C. marginatus* (Blume) Mart], balanog (*C. simphysiphus* Mart.) and three (3) commercial species, sika (*C. caesius* Blume), palasan (*C. merrillii* Becc.) and limuran (*C. ornatus* Blume var. *philippinensis* Becc.) was again found similar from the previous studies. In addition, noncommercial species, except for C. *simphysiphus*, had comparable mean diameter and longitudinal shrinkage with commercial ones. The strength properties of the species likewise followed the variation pattern in specific gravity. Compression parallel to grain and static bending generally decreased from base towards the top portion. Evaluation of the physical and mechanical properties showed that *C. javensis* and *C. didenhorstii* var. *exulans* may be used as substitute for *C. caesius* and *C. usitatus*, while *C. grandiflorus* and *C. marginatus* may be used as substitute of *C. merrillii* and *C. ornatus* var. *philippinensis* for structural components of furniture (Palisoc and Natividad 1991).

- Drying of Rattan

Drying or seasoning of rattan reduces susceptibility to fungi and powder-post beetle attack as well as it prepares the material for further processing particularly finishing. Studies on drying characteristics of rattan have been undertaken as early as 1939. The study involved air-drying of scraped and unscraped poles stacked vertically in the open. Results of the study showed that scraped rattan poles attained a moisture content of 13% from an initial of 120% in only 5 weeks while unscraped rattan poles took 26 weeks to attain an average MC of 22% from 160% (Cortes 1939, as cited by Tesoro 1987; 1988).

A similar study showed that scraped poles attained an average MC of 20% in 8 weeks while unscraped poles attained 23% MC within the same period. Both scraped and unscraped poles, however, were heavily stained at the end of drying period (Casin 1975).

In another study, air-drying of scraped and unscraped rattan poles, 2.13 m long, stacked vertically and horizontally showed that poles stacked vertically had shorter drying time than those poles stacked horizontally. Vertical air drying of scraped poles from green to final moisture content of 14.11% to 17.89% took 8 to 17 weeks, while for the same period, unscraped poles attained a moisture content of 15.76% to 19.52% from initial of 87.62% to 290.43%. Horizontal drying had a drying period of 12 to 20 weeks. Scraped poles attained a moisture content of 16% to 19.70% from initial of 67.19% to 284.16%, while unscraped poles had 16.90% to 21.60% moisture content from initial of 73.0% to 292% (Alcachupas 1985).

Similar results were obtained in air-drying of 6 noncommercial species, viz. tipon-tipon (*Calamus daemonoropoidess* E. Fern.), labni (*C. didenhorstii* Miq. var. *exulans* Becc.), uai, (*C. grandiflorus* Becc.), arorog (*C. javensis* Blume), labsikan [*C. marginatus* (Blume) Mart], balanog (*C. simphysiphus* Mart.) and three (3) commercial species, sika (*C. caesius* Blume), palasan (*C. merrillii* Becc.) and limuran (*C. ornatus* Blume var. *philippinensis* Becc.) of rattan. Scraped poles dried faster than the unscraped ones regardless of size, initial moisture content and stacking position. Likewise, for stacking position, poles stacked in near vertical position dried faster the ones stacked in horizontal position. Poles air-dried at vertical position had final moisture content of 14% to 18% and 16% to 20% for scraped and unscraped, respectively, compared to 16% to 19% and 18% to 21% in scraped and unscraped, respectively, of horizontally air-dried poles. Drying defect in the form of wrinkles or collapse was also observed in the top portion of *C. simphysiphus* (Palisoc and Natividad 1991).

A study on drying of rattan poles using a furnace type dryer showed that scraped and unscraped palasan and limuran poles were able to dry to below 10% MC from an initial of more than 120% MC in just 96 hours (Mabesa and Mabesa 1956). The use of steam-heated kiln was also used to dry rattan poles. The study showed that drying time for scraped poles from 150% to 119% to 4.6% to 14.7% MC was from 1.5 to 10 days (Laxamana 1974).

Portable and low-cost rattan dryers have also been designed, built and tested in FPRDI. Casin (1979) developed a wood-waste fired, low cost furnace type dryer. The hot air is conducted into the kiln by flue pipes, while humidification is through a spray line situated below the flue-pipes. The dryer can reduce the MC of scraped poles from 114% MC to 15% MC in 15 days. A portable-demountable dryer was also developed by Casin in 1985. The dryer is a cone-shape frustum, with 4 m diameter at the base and 0.8 m diameter at the top and 3.8 m high. The ribs of the dryer are made of telescoping aluminum tubes and the structure is covered with tarpaulin. A charcoal drum kiln located at the center of the structure provides heat up to 45°C. The dryer has a capacity of 250 poles. Scraped palasan poles can be dried from 80% MC to 15% MC in 72 hours (Tesoro 1987; 1988).

Figure 30. Drying of rattan poles.

- **Bending of Rattan**

A low-cost, small capacity integrated rattan pole steam conditioning and drying chamber was developed in FPRDI. The system consists of a low-pressure wood and rattan waste fired steam generator, a steaming cylinder and a rattan pole dryer. The heat requirement of the dryer comes from the flue gases from the stack of the steam generator, which supplies steam to the steaming chamber. The system's over-all thermal efficiency was 47.2%

The system was intended for small rattan firms who cannot afford a steam generator and a drying chamber. Likewise, it was developed as an efficient substitute to the use of blow-torch in bending rattan poles (Cuaresma 1987; Tesoro 1987; 1988).

A preliminary study on steam-bending of 2 large-diameter rattan, i.e., uai, (*C. grandiflorus* Becc.) and labsikan [*C. marginatus* (Blume) Mart] at FPRDI showed that air-dried samples can be easily bent into circular and U-shaped furniture components with radii of 200 mm after 15 minutes of steaming at 100°C temperature and atmospheric pressure (Palisoc and Natividad 1991).

Figures 31 and 32. Bending of rattan poles using a jig.

Figure 33. Bent rattan poles.

Figure 34. Steam conditioning chamber used in bending rattan poles.

- Bleaching of Rattan

A study on the bleaching rattan using peroxide and hypochlorite showed that the unstained materials increased in brightness when subjected to bleaching at concentration beyond 1.5% while the stained poles showed slight brightening but the stains were not removed. Using higher concentration of peroxide, the surface appeared bleached but the outline of stain was still visible (Casin 1975).

In a study of the best conditions for bleaching of 4 stained rattan species, viz. palasan (*Calamus merrillii* Becc.) and limuran (*C. ornatus* Blume var. *philippinensis* Becc.), ditaan (*Daemonorops mollis* (Blanco) Merr.] and tagiktik (*C. filispadix* Becc.), using peroxide showed that maximum brightness and removal of fungal stains were attained at bleaching time of 2 hours and temperature of 60°C; 1% hydrogen peroxide concentration and 1:4 ratio of sodium hydroxide to sodium silicate. These conditions likewise did not affect the mechanical properties of rattan particularly maximum crushing strength. A single component bleaching formulation and procedure for removal of fungal stains and blemishes for scraped rattan canes, cores and wickers was also made (Gonzales 1993).

A manual which includes procedure on bleaching rattan poles using hydrogen peroxide with caustic soda and sodium silicate is also being developed in FPRDI (Palisoc *et al.,* 1999).

- **Finishing of Rattan**

A study on the surface enhancement of 4 noncommercial rattan species, i.e, arorog (*C. javensis* Blume), balanog (*C. symphysiphus* Mart.), bugtong (*C. subinermis*) and labsikan [*C. marginatus* (Blume) Mart] using hot oil, kerosene and 1:1 mixture of kerosene and hot oil as pretreatment to finishing application showed that 1:1 kerosene and hot oil mixture was the most effective pretreatment, followed by kerosene and hot oil only. Pretreatment with kerosene had the highest overall performance rating in terms of finishing serviceability based on hot and cold check test. However, the different pretreatment methods had statistically insignificant effect on adhesion property of finish such as nitrocellulose lacquer. The 1:1 mixture of kerosene and hot oil was recommended for the pretreatment of the non-commercial rattan species to minimize fungal stain infection, enhance drying rate and to achieve good finishing adhesion as well as serviceability. Bleaching is necessary for *C. symphysiphus, C. subinermis* and *C. marginatus* to obtain better finishing quality (Palisoc 1996).

A manual on finishing of rattan for furniture and handicraft is also being developed in FPRDI. The manual consists of presentation and brief discussion of some of the factors that affect a good finish, finishing properties, the required finishing equipment and facilities, the good finishing practices, some finishing techniques and finishing systems, procedures on bleaching, remedial measures on finishing problems and some health and safety measures or tips (Palisoc *et al.,* 1999).

Figure 35. Finished rattan furniture.

C. Grading Standards or Classification for Rattan

Rattan poles are graded based on quality and general appearance regardless of size and species (Table 15). These grading rules were issued by the then Ministry of Trade and Industry, now Department of Trade and Industry (DTI), through Commerce Administrative Order No. 6 or Administrative Order No. 103 in 1948 (PCRRD 1985).

At present, modifications have been made and adopted by the rattan industry. The revised grading rules set the limits for allowable percentage of defective area on rattan poles (Table 16). In case the defects are scattered over a wide area of the rattan pole, the grading method is modified according to end product or use (Table 17). These grading rules, including the allowable defective portion, also apply for round cores and wickers except for the minimum length requirement. Splits with skin and flat oval cores (or splits without skin), only three grades are maintained (Table 18) (PCARRD 1985).

For purchasing raw materials, some manufacturing firms of high end products have also adopted certain standards to ensure high quality manufactured products. These standards are shown in Table 19 (Rivera 1999).

Table 15. Grades of Philippine unsplit rattan.

Grade	Specification
Grade A	Mature; white; well seasoned; very slightly blemished and free from fungal discoloration, pinholes, scars, bruises, checks and cracks
Grade B	Mature; white to yellowish; well seasoned; slightly blemished by fungal discoloration; with few pinholes, scars, bruises, checks and cracks
Grade C	Mature; white to yellowish; well seasoned; blemished with slight fungal discoloration; with few pinholes, scars, bruises, checks and cracks
Grade D	Mature; well seasoned; heavily stained; with numerous pinholes, scars, bruises, checks and cracks

Source: PCARRD (1985)

Table 16. Revised grading rules for Philippine unsplit rattan.

Grade Level	Allowable Defective Part	Minimum Clear Pole Length (m)
Grade A	0% to not more than 5% of surface area	3.8
Grade B	6% to not more than 15% of surface area	3.4
Grade C	16% to not more than 25% of surface area	3.0
Grade D	more than 26% of surface area	Below 3.0

Source: PCARRD (1985)

Table 17. Revised grading rules for defective canes based on end-product or use.

Grade	Specification
Grade A	The canes are usable for quality naturally-colored furniture that does not need finishing to remove stains or other physical defects. Defects are sparsely located and hardly noticeable. Defects such as cracks, checks, deep bruises, big pinholes, or worm holes are not allowed.
Grade B	The canes are usable for certain inner components of quality naturally-colored furniture that does not need finishing to remove stains or other physical defects. Defects are moderately scattered. Defects such as cracks, checks, deep bruises, big pinholes, or worm holes are not allowed.
Grade C	The canes are not usable for quality naturally-colored furniture but can be used for stained or painted ones. Defects are less moderately scattered and more pronounced. Slight cracks, bruises, pinholes and checks are acceptable provided they are sparsely located, preferably towards the end portions.
Grade D	The canes are not usable even for stained and colored furniture. Defects are heavily scattered and concentrated. Canes can be used as framework for furniture provided the canes are structurally sound

Source: PCARRD (1985)

Table 18. Grades for split canes, flat oval cores or without skin.

Grade Level	Color	Allowable Defect	Clear Area (m)
First Quality	whitish to light yellowish	5%	3.0
Second Quality	Light cream to cream	15%	3.0
Third Quality	Light brown to brown	5%	3.0

Source: PCARRD (1985)

Table 19. Criteria used by manufacturers in purchasing rattan raw materials.

Species	Criterion	Condition	Allowance
Kalapi (*C. ornatus* var. *philippinensis*)	Size (diameter) 1 1/8" down	• full dry, single scrape • half dry, single scrape • with bolo marks • with skin	flat (no allowance) 1 1/16" 1 1/16" 1 1/16"
	1 3/16"	• full dry, single scrape • half dry, single scrape • with bolo marks • with skin	flat flat 1 1/16" 1 1/16"
	<u>Grade/Class</u> BC Class: Acceptable	• one side black • all sides black • shrinkage (maximum of 1 ft) • about 2 pinholes/ft or maximum of 20/pole	
	D Class: Acceptable	• all sides black • shrinkage (maximum of 2 ft) • pinholes/ft	
	Not Acceptable	• more than 2 ft shrinkage • broken • brittle • twisted • full of pinholes especially if concentrated on nodes	
Palasan (*C. merrillii*)	All Sizes	• full dry, single scrape • half dry, single scrape • with skin, single scrape	flat 1 1/16" 1 1/16"
	<u>Grade/Class</u> ABC Class: Acceptable	• one side black (max. of 2 ft) • all sides black (max. of 1 ft) • shrinkage (maximum of 6 in) • about 20 pinholes/pole	
	Not Acceptable	• more than 6 in shrinkage • broken • brittle • twisted • full of pinholes especially if concentrated on nodes	

Source: Rivera (1988)

V. Markets and SocioEconomics

The rattan industry contributes significantly to the Philippine economy through generation of foreign exchange, income and employment. Rattan ranks second to wood in terms of market share in the total furniture export of the country. From January to October 2003, export of rattan furniture reached USD 44.567 M (BETP 2003). Table 20 presents the export of rattan furniture for the last 10 years (1993-2002). Although the value of total export decreased for the last two years, the contribution of rattan in the economy of the country remains significant. Aside from furniture, in 2001, the country also exported about 20 thousand kg of rattan raw materials in the US and Hong Kong amounting to USD 33 T (Philippine Forestry Statistics 2001). Likewise, for the same year, the revenues generated by the government through forest charges amounted to PhP 8.71 M or around USD 158.32 T at the exchange rate of PhP 55/dollar.

Table 20. Export of rattan furniture, 1993-2002.

Year	Value (Million USD)
2002	96.94
2001	91.98
2000	118.02
1999	112.89
1998	108.26
1997	123.02
1996	119.29
1995	110.69
1994	122.9
1993	114.21

Source: Natividad 2003

Natividad (2003) estimated that the furniture industry consists of about 15,000 establishments employing about 500,000 direct workers and about 300,000 indirect workers or subcontractors.

Rivera (1999) reported, however, that it is difficult to determine the exact number of people involved in the production, marketing, manufacturing and exporting of rattan because of the existence of unregistered and small-scale firms. Table 21 presents, from latest reports, the estimated number of firms and workers in gathering trading, manufacturing and exporting rattan and Table 22 presents the wages received by the workers.

Table 21. Estimated number of firms and workers in rattan gathering, trading, manufacturing and exporting.

Activity/Year	Number of RCC/Firm	Number of Worker
Gathering (2003)	49	-
Trading (Number of Traders Interviewed)		
Raw Materials (1988)	34	-
Manufactured Products		
Furniture (1986-1987)	18	257
Handicrafts (1986-1987)	37	-
Manufacturing		
Furniture (1994)	15,000	15,000
Handicraft (1998)	67	2,169
Exporting (1992)	>200	-

Source: Rivera (1999)

Table 22. Estimated wages received by workers in rattan gathering, trading, manufacturing and exporting.

Activity/Year	Wage (PhP/day)
Gathering (1994)	100 (USD 4.00)
Trading	
Manufactured Products:	
Furniture/Handicrafts (1994)	100 (USD 4.00)
Manufacturing	
Furniture (1986-1987)	Full-time – 51.17
	Part-time – 47.17
	Piecework – 50.00
	Average – 45.50
	Average – 40.50
(1998)	
	Full-time – 40.33
Handicraft (1986-1987)	Piecework – 31.00
	Average – 35.67
(1994)	100 (USD 4.00)
(1998)	299.7

Source: Rivera (1999)

In addition, Table 23 presents the characteristics of the disadvantaged groups in rattan sector, Table 24 presents the characteristics of rattan manufacturing by firm size in Luzon and Cebu for 1986-1987, while Table 25 presents the general characteristics of rattan based handicraft sellers and buyers in Quezon province and Metro Manila. The distribution and characteristics of rattan traders by type of products is shown in Table 26 (Rivera 1999).

Table 23. Characteristics of disadvantaged group in rattan sector.

Particulars	
Number	15,000
Location	rural villages, foothills
Average Age	29
Household size	5
Housing	Temporary/semipermanent
Major occupation	Farming
Land ownership	No legal claims; forest areas
Farm area	2.17 ha (upland)
Farm output	Home use
Cash income/year	PhP 20,642.00
Proportion of income from rattan	16%
Rattan activities	Cutting, hauling, primary processing
Rice yield	1.7 t
Fertilizer use	none to minimal

Source: Aquino 1993, as cited by Rivera 1999

Table 24. Characteristics of rattan manufacturers by firm size in Luzon and Cebu.

Characteristic	Small		Medium		Large		All	
	F	H	F	H	F	H	F	H
Number of Reporting	25	25	7	3	16	14	48	42
Average Age (years)	40	42	44	40	48	38	132	120
Average Years in Business	8	6	17	1	7	4	32	11
Year Established								
1960 and earlier	-	-	3	-	-	-	3	-
1970 – 1975	5	1	-	-	4	3	9	4
1976 – 1980	15	10	2	-	9	1	26	11
1981 – 1987	5	14	2	3	3	10	10	27
Market Outlet								
Domestic	6	25	-	3	-	13	6	41
Export	16	-	7	-	15	-	38	-
Both	3	-	-	-	1	1	4	1
Business Ownership								
Sole Proprietor	14	25	-	3	1	11	15	39
Partnership	1	-	-	-	-	2	1	2
Corporation	10	-	7	-	15	1	32	1
Average Capital (Thousand Pesos)	1,461	99	3,566	120	5,661	228	3,168	138
Membership in Association								
CFIP	12	-	6	-	15	-	33	-
CITEM	1	-	-	-	1	-	2	-
NIPA	1	-	-	-	-	-	1	-
TACIPA	-	3	-	-	-	6	-	9
MHPA	-	19	-	1	-	-	-	20
Others	-	1	-	-	-	1	-	2
None	11	2	1	2	-	7	12	11
Other Sources of Income								
Sale of handicraft products	-	3	1	1	-	-	1	4
Others	2	3	2	-	1	1	5	7
None	23	19	4	2	15	15	42	36

Source: Rivera (1999)

F-Furniture; H-Handicraft; CFIP-Chamber of Furniture Industries in the Philippines; NIPA-NACIDA Integrated Producers Association; CITEM-Center of International Trade Expositions and Missions, Inc.; TACITA-Tayabas Cottage Industry Producers Association; MHAP-Manaoag handicraft Producers Association; Others included Philippine Chamber of Handicraft Industry (PCHI) and NACIDA

Table 25. General characteristics of rattan based handicraft sellers and buyers, Tayabas, Quezon and Metro Manila, 1987.

Characteristic	Number of Market Participant		
	Seller	Buyer	All
Number of Reporting	20		25
Average Age (years)	42		42
Year Established			
1970 – 1975	5	-	5
1976 – 1980	3		5
1981 – 1981	7		10
1986 - 1987	5	-	5
Type of Ownership			
Single Proprietor	19		20
Partnership	-	-	-
Corporation	1		5
Type of Business Management			
Owner	19	5	24
Hired	1	-	1
Average Capital (Thousand Pesos)			
Initial	(n=20)	(n=5)	
Present	41	494	130
	189	1,413	412
Educational Attainment			
Elementary	2		2
High School	6		6
College	2		2
College Graduate	9	5	14
Post-graduate	1		1

Source: Geonzon 1988, as cited by Rivera 1999

Figure 36 shows the five channels in the marketing system of rattan raw materials. The first channel shows the flow of products from the gatherers to the small-scale manufacturers who produce for their local markets. These manufacturers purchase the raw materials from the cutting group leaders or gatherers. They also perform the drying, scraping of canes and manufacture simple products for direct sale to the public. The major part of local manufacture is based on orders placed by consumers before production begins. Channels 2 to 5 are oriented toward the export market although a small portion is channeled to local consumers (Kilmer 1994, as cited by Rivera 1999).

Likewise, Figure 37 shows the marketing system of rattan raw materials in the Philippines as described by Rivera (1988). The system follows a general trend in Asean wherein a permittee hires an authorized representative or contractor, who in turn hires natives or local folks to do the actual harvesting. The canes are then transported to the permittee's stockyard and finally to the middlemen who supply the furniture and handicraft manufacturers (Rivera 1999).

In addition, Figure 38 shows the marketing channels of rattan furniture and handicraft products from raw form into finished form. Raw materials are obtained from concessionaires or traders, which are then sold to furniture handicraft manufacturers or contractors. The finished products are distributed through several channels before reaching the final end-uses (Pabuayaon et al 1988, as cited by Rivera 1999).

Table 26. Distribution and characteristics of rattan traders by type of product handled, Luzon, 1987.

Characteristic	Furniture	Handicraft	All
Number Reporting	18	37	55
Manila	6	15	21
Angeles	9	12	21
Pampanga	3	-	3
Baguio	-	10	10
Average Age (years)	35	36	36
Average Years in Business	5	5	5
Year Established			
1975 – 1980	7	9	16
1981 – 1987	11	28	39
Type of Respondent			
Wholesaler-Retailer	2	3	5
Retailer	15	28	43
Exporter	1	6	7
Type of Ownership			
Single Proprietorship	18	32	50
Corporation	-	5	5
Nature of Operation			
Purchase from source upon order of customer	17	20	37
Maintain a given level of stock	8	27	35
Average Capital (PhP '000)	74	220	172
Membership in Association			
CFIP	1	-	1
PCCI	-	3	3
Others	2	2	4
None	15	32	47
Other Sources of Income			
Selling wood furniture/handicraft and other products made of buri, shell, bamboo and macrame	15	21	36
Others (garments, electric appliances, farming, air-freight forwarding)	3	7	10
None	2	9	11

Source: Pabuayon et al 1988 as cited by Rivera (1999)

Table 27 presents the average monthly retail price of rattan canes by region, species, and diameter class (Philippine Forestry Statistics 2001).

Table 28 presents the computed profit rates (before taxes) of rattan traders and manufacturers in different parts of the country. Profits for traders ranged from –2% to 329% of the total cost/truckload or container van while furniture manufacturers obtained 49% of the total cost compared to the 32% obtained by handicraft manufacturers. Traders of rattan furniture, on the other hand, obtained a higher profit margin than traders of handicraft (Rivera 1988 and Pabuayon *et al* 1988, as cited by Rivera 1999).

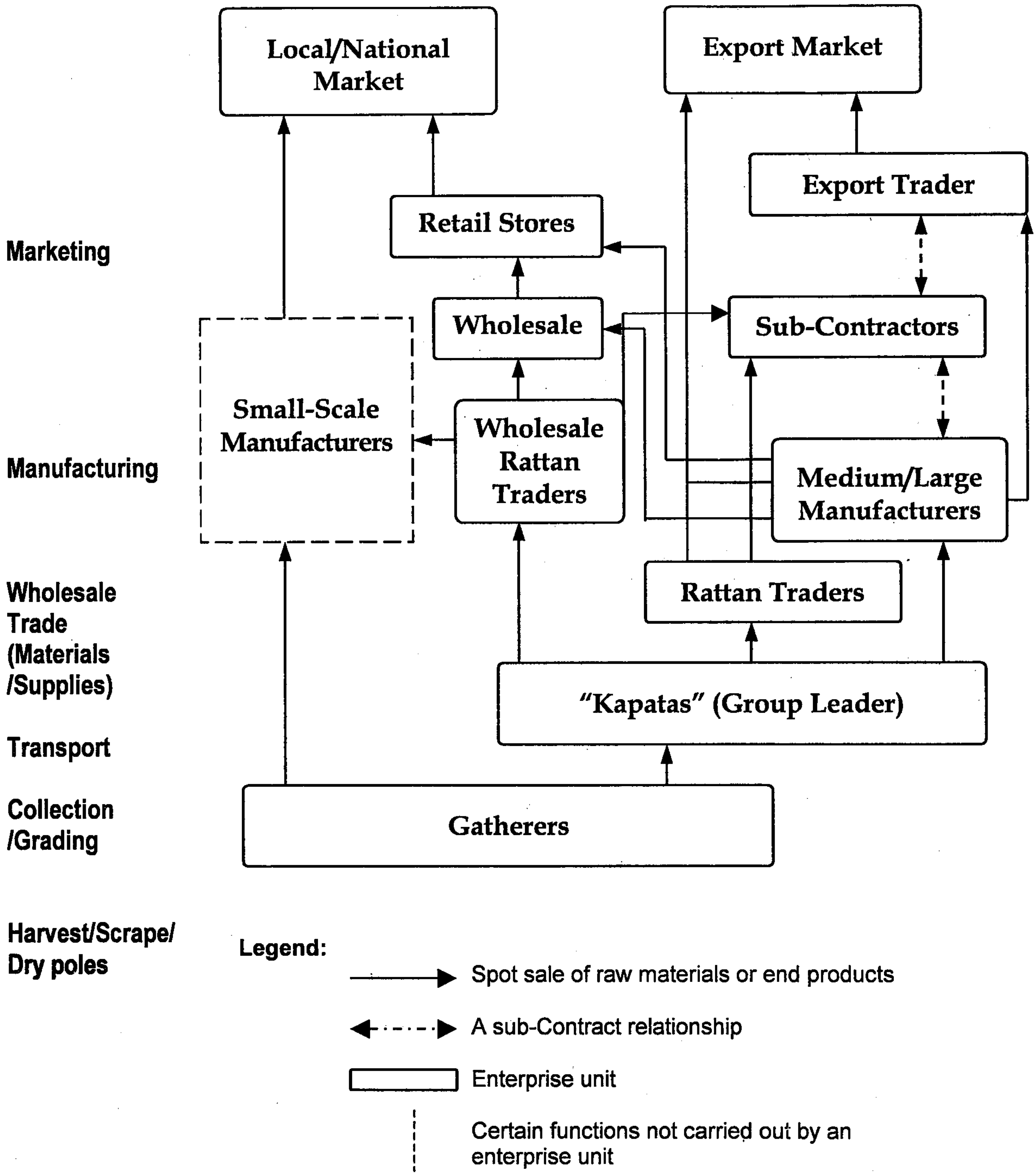
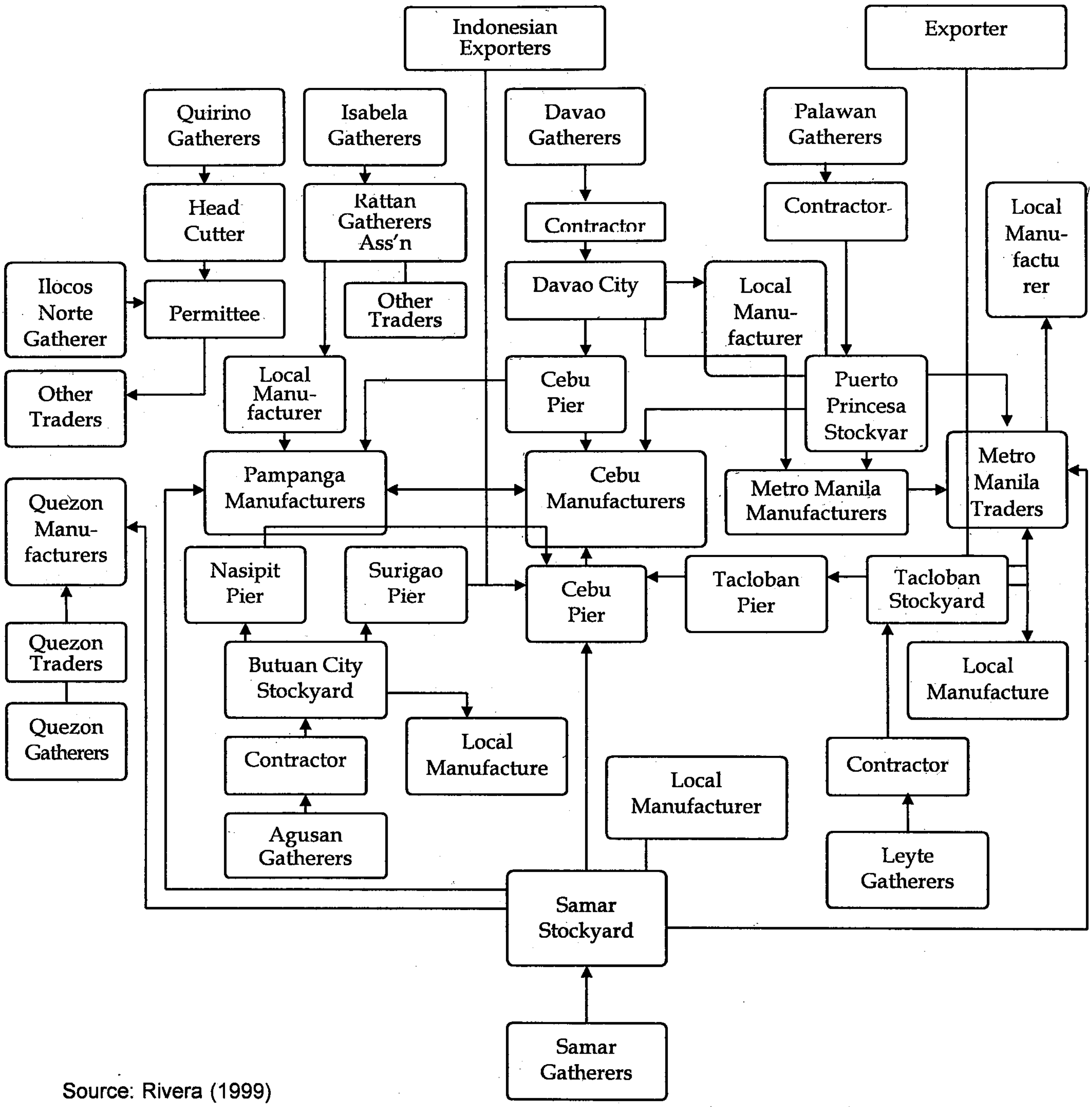
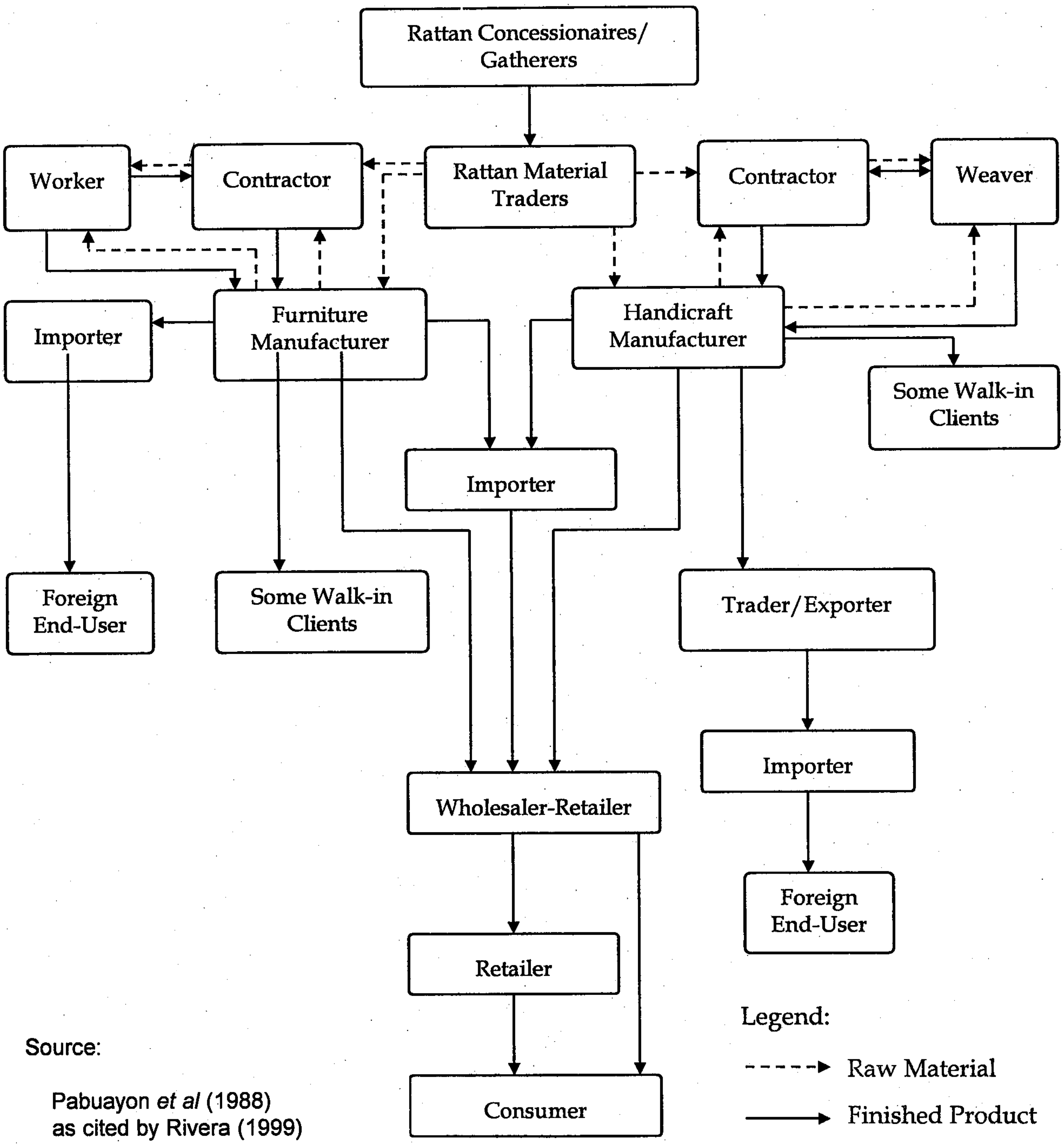


Figure 36. Marketing channel of rattan raw material in the Philippines.



Source: Rivera (1999)

Figure 37. Market flow of rattan raw materials in the Philippines.



Source:

Pabuayon *et al* (1988)
as cited by Rivera (1999)

Figure 38. Flow of rattan material and finished product.


Figures 39 and 40. Loading of rattan canes in container vans to be transported to Cebu City.

Table 27. Average monthly retail price of rattan by species and diameter class.

Species / Region	Average Price (PhP/4 lm pole)	
	2 cm and above	below 2 cm
Kalapi		
Region 3	18.50	6.00
Region 13	16.00	5.00
Limuran		
NCR	13.00	4.00
Region 2	12.00	5.00
Region 4	8.00	5.50
Region 11	18.50	8.50
Region 13	4.00	2.00
Palasan		
Region 3	10.00	7.00
Region 4	8.25	5.25
Region 11	18.50	8.00
Region 13	16.00	6.00
Tumalim		
NCR	11.00	5.00
Region 2	12.00	3.00
Region 4	8.00	5.50
Region 10	23.00	17.30
Region 11	18.50	8.00
Region 13	14.00	4.00

Source: Philippine Forestry Statistics 2001

Table 28. Profits rates (before taxes) of rattan traders and manufacturers.

Species / Region	Profits (PhP) [a/]	% of Total Cost
Traders of rattan canes (1989) [b/]	Per truckload or container van [c/]	
Quirino	163,849	329
Pampanga	3,528	3
Quezon	74,501	161
Palawan	21,004	46
Leyte	53,346	32
Samar	(2,604)	(2)
Agusan	1,944	2
Davao	37,025	7
Manufacturers (1986-87)	Per month operation	
Furniture (Cebu, Manila, Pampanga) [d/]	416,556	49
Handicraft (Pangasinan)	31,340	32
	Per month operation	
Traders of rattan products (1986-87)		
Furniture (Angeles, Pangasinan, Manila)	40,389	73
Handicraft (Baguio, Angeles, Manila)	69,601	52

Source: Rivera 1999

[a/] Exchange rate: USD 1.00=PhP 20.34 (1986-87) and PhP 21.20 (1989)
[b/] Averages for different species (palasan, kalapi, tumalim and limuran) and from different destination within the Philippines
[c/] 12,500 canes/truckload and 9,000 canes/container van
[d/] Major manufacturing centers

VI. Policy and Legislation

The Philippine government has formulated and implemented a number of policies and DENR Administration Orders (DAO) governing the production and utilization of rattans in the country, as well as, their protection and genetic conservation. The government, likewise, provides incentives and credit facilities to help the rattan industry (Baja-Lapis *et al* 2003).

- **Plantation Development and Harvesting**

  - DENR Administrative Order No. 4 (1989)
    Revised regulations governing rattan resources including cutting, gathering, transporting, and disposal, including amendments related to plantation development.

  - DENR Administrative Order No. 4-1 (1989)
    Special provision for the processing of rattan application within area reserved or occupied by cultural communities.

- DENR Administrative Order No. 61 (1990)
  Guidelines in the Determination of Floor Price for Rattan.

- DENR Administrative Order No. 31 (1991)
  Revised Guidelines for Contract Reforestation.

- DENR Administrative Order 315 (1991)
  Encourages establishment of bamboo/rattan plantations.

- DENR Administrative Order No. 39 (1993)
  Rates and Forest Charges Pursuant to Republic Act 7161. An important provision is that charges are levied on the basis of a certificate of minor forest product origin.

- DENR Administrative Order No. 2 (1993)
  Rules and Regulations for the Identification, Delineation and Recognition of Ancestral Land and Domain Claims.

- DENR Administrative Order No. 25 (1993)
  Ancestral Domain Claims guidelines for the recognition and protection of Indigenous Cultural Communitie's rights to enter ancestral lands.

- DENR Administrative Order No. 42 (1991)
  Revised Regulations and Guidelines Governing the Establishment and Development of IFPs.

- DAO 63 (2000)
  New Rates of Forest Charges pursuant to Republic Act No. 7161 and based on the 1999 FOB Market price of forest product.

- **Incentives, Credit, Facilities, Export/Import Regulations**

  - Board of Investments (BOI) credit programmes for starting and developing enterprises. These programmes provide a guaranteed fund for small- and medium-scale enterprises and are offered to small-scale enterprise for agriculture and agroforestry production (based on the Entrepreneurial Development Services Department of the BOI)

  - Amended Rules and Regulations implementing PD 930. Prohibits exportation of raw bamboo and rattan canes, except for scientific or testing purposes, which need export clearance.

  - BOI Credit Programs for Beginning and Developing Enterprises Magna Carta for Exporters (Export Development Act), 1994. Exemption from advanced payments of duties and taxes of exports prior to the opening of the letter of credit, percent duty on importation of machines and equipment and others.

- **Biological Protection and Genetic Conservation**

  - RA 7586 (1992)
    Act providing for the establishment and management of the National Integrated Protected Areas System (NIPAS).

  - DAO 25 (1992)
    The National Integrated Protected Areas System implementing rules and regulations focusing on the twin objectives of biodiversity conservation and sustainable development.

  - PD 1586 (1978)
    Establishment of Environment Impact Statement System (EIS)

- DAO 21 (1992)
  Revision of Rules and Regulation on EIS System

- DAO 96-37 (1996)
  Revising DAO 21 (1992) to further strengthen the implementation of the EIS.

- E.O 247 (1995)
  Prescribing guidelines and establishing a regulatory framework for the prospecting of biological and genetic resources, their by-products and derivations for scientific and commercial purposes, and for other purposes.

- DAO 96-20 (1996)
  Implementing rules and regulation on the prospecting of biological and genetic resources.

Figure 41. Truckloads of confiscated rattan canes impounded in the Regional Office of DENR Region X, Cagayan de Oro City.

VII. Institutional Capability And Linkages

Various government and non-government agencies or entities, state colleges, universities, and international agencies have in one way or the other undertaken research and development activities to encourage and promote the rattan sector.

- **Academe**

  Research activities on rattan are being undertaken by state colleges and universities in coordination with government and private sectors. These include the following:

  - University of the Philippines Los Baños (UPLB)
  - Benguet State University (BSU)
  - Mariano Marcos State University (MMSU)
  - Nueva Viscaya State Institute of Technology (NVSIT)
  - Tarlac College of Agriculture (TCA)
  - Palawan National Agricultural College (PNAC)
  - Panay State Polytechnic College (PSPC)
  - Mindanao State University (MSU)
  - Visayas State College of Agriculture (VISCA)

  Government

  - Cottage Industry and Technology Center (CITC)
    Mandated to encourage and promote the establishment of micro cottage and small enterprises and improve product quality and productivity towards global competitiveness for generating employment and livelihood opportunities.

- Ecosystems Research and Development Bureau (ERDB)
  Ecosystems Research and Development Sectors (ERDS)
  Both under the Department of Environment and Natural Resources (DENR) and support the R and D activities of the forestry sector in the technical socio-economic and marketing aspects of raw materials. ERDB is the research and development arm of the Department of Science and Technology (DOST) on forest production.

- Forest Products Research and Development Institute (FPRDI)
  The research and development arm of the Department of Science and Technology (DOST) on forest products utilization.

- Technology Applications and Promotions Institute (TAPI)
  Under the DOST which is responsible for technology commercialization and promotion.

- Philippine Council for Agriculture, Forestry and Natural Resources and Development (PCARRD)
  Under the DOST which is responsible for R and D evaluation, monitoring providing financial, support and promoting linkages among R and D institutions and individuals.

- Department of Trade and Industry (DTI)
  A major agency which has a number of bureaus and attached agencies which directly affect the rattan industry. It coordinates, promotes, facilitates the country's trade industry and investment activities.

- National Statistical Coordinating Board (NSCB)
  Recognizes and strengthens Philippine Statistical System. Its objective is to achieve the development of an orderly statistical system capable of providing timely, accurate, sufficient and useful data to suit planning, programming of evaluation needs of all sectors of the Philippine economy.

- **Private Sector**

  - Chamber of Furniture Industries of the Philippines
    Group of furniture exporters whose mission is to promote the continued growth of the Philippine furniture industry. It also provides direction to its development efforts. Serves as forum for industry related issues.

  - Philippine Chamber of Handicrafts Industries
    Non-stock, non-profit organization which aims to contribute to the growth of the Philippine handicraft industry by promoting handicrafts in both local and international markets.

  - Philippine Chamber of Commerce and Industries
    An umbrella private sector representative organization with 139 sectoral trade associations which provides trade opportunities and buyer-seller matching services for its members and foreign buyers. It also mounts overseas missions and hosts incoming missions. Some rattan manufacturers-exporters are members of the Chamber.

  - Confederation of Filipino Exporters Foundation
    An industry association composed of private sector exporters. It is a non-stock, non-profit service foundation which seeks to facilitate exporters' access to trade information and technical services towards expanding and diversifying markets. It also aims at organizing Philippine exporters into a persuasive collective advocate for policy and administrative reforms needed to transform the country into a progressive nation. It provides trade opportunities and buyers-sellers matching services and regular publications. It has also a regional network. Some rattan manufacturers are exporters.

- European Chamber of Commerce of the Philippines
  The only European bilateral chamber represented in the Philippines and represents the interest of all European countries as well as those Filipino members. ECCP provides a full range of services including personalized buyer-seller matching and circulation of trade opportunities through the regular publications.

- Chamber of Cottage Industries of the Philippines

- Christmas Décor Producers and Exporters Association of the Philippines

- **International**

  - The International Network for Bamboo and Rattan (INBAR)

  - The International Development Research Centre (IDRC)

  - Food and Agriculture Organization of the United Nations (FAO)

  - International Tropical Timber Association (ITTO)

VIII. Conclusion and Recommendations

The issues and concerns confronting the rattan industries in the Philippines are within the aspects of production, marketing, utilization, protection, policy, administrative and information systems. Most of the issues and concerns identified are on production and administrative aspects. Issues and concerns on rattan production includes plantation development, long period of production, and poor replanting programs. On the administrative aspect, there are weak linkages between government and private sector; inappropriate forest charges; and ineffective polices on the cutting, transporting and monitoring of rattan and rattan activities need to be immediately addressed (Rivera 1999).

The issues and concerns on rattan together with their corresponding recommended solutions and R and D strategies are presented in Table 29.

Table 29. Issues and Concerns, Recommended Solutions and R and D Strategies for the Rattan Sectors.

Issue/Concern	Recommended Solution	R and D Strategy
Production • lack of concerted efforts on rattan plantation development • poor replanting programs if any, by gatherers	• delineation of rattan seed production areas • development of support facilities for producers of raw materials • CBFM approach • gatherers must be encouraged and assisted in developing their replanting programs through CBFM	• plantation establishment of indigenous commercial species of phenotypically superior strains • policy studies
• poaching and illegal harvesting	• CBFM approach	
• long period of production	• adoption of community based forest management and incorporation of rattan with agroforestry development schemes • provision of alternative sources of livelihood	• R and D to determine the maturity age of rattan canes in relation to the physiological properties demanded by then market • pilot testing of livelihood projects
Tenure • inadequate tenurial rights to solicit increased and sustained participation in maintaining productivity of rattan areas	• provision of ancestral domain claims to indigenous people • empowerment of communities	• researches on tenurial rights
Protection • poaching and illegal harvesting • limited/inadequate preservation techniques	• technology development	• R and D efforts on efficient and effective preservation technologies
Utilization • harvesting wastage • high cost of artificial drying facilities	• develop better harvesting methods or techniques • develop new and cheaper drying designs	• R and D studies on improved harvesting and drying of rattan

Table 29. Issues and Concerns, Recommended Solutions and R and D Strategies for the Rattan Sectors *(continuation).*

Marketing • value addition	• community enterprise development • organization of cooperatives/associations	Impact assessment on: • gender • socio-economic parameters • environmental parameters
• dependence of gatherer groups on advance payments from outside traders and purchasing agents	• establishment of a central marketing center in Palawan. It reduces the extent to which gatherers are controlled by individual purchase contracts. Gatherers are more free to work according to their own schedules against longer term contracts with the marketing organization wnile remaining free to sell their canes to other buyers when a more profitable opportunity appears in the short run (Kilmer, 1994)	
Information Systems • unorganized information on rattan resources	• development of computerized resources database system • establishment of a centralized repository of rattan database on production, management, marketing, utilization	• information systems analysis
Administrative • ineffective government policies on the cutting, transporting and monitoring of rattan activities	• assessment of existing policies on - length of canes marketed - allowable cut • assessment of administrative feasibility of policies	• policy studies
• inappropriate forest charges	• updating of forest charges	• resource inventory • economic valuation studies
• weak linkage between government and private sector	• strengthening research and development collaboration among government and private institutions for a holistic approach to rattan production and utilization	

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Appendix 1. Checklist of Philippine Rattan.

Genus	Species	Distribution	Vernacular Name
Calamus	*C. aidea* E. Fern.	Luzon, Samar, Biliran, Dinagat Island Mindanao	ulasi, ulisi, inhian
	C. arugda Becc.	Luzon	quwenlunhuy, arugda
	C. balerensis E. Fern.	Luzon	rituuk
	C. batanensis (Becc.) Baja-Lapis	Batanes	valit
	C. bicolor Becc.	Mindoro	sambunotan, lasi, rasi, obanan
	C. caesius Blume	Palawan	sika
	C. cumingianus	Luzon/Mindanao	Ubut, dowung-dowung
	C. diepenhorstii Miq. var. *exulans* Becc.	Luzon/Palawan and Polilio Island	abuan
	C. dimorphacanthus Becc.	Luzon, Panay	
	var. *dimorphocanthus*		
	var. *montalbanicus* Becc.	Luzon	
	var. *zambalensis* Becc.	Luzon	
	var. *benguetensis*	Luzon	lambutan, umbanan, oban-oban
	var. *halconensis* (Blanco) Baja-Lapis	Luzon, Mindoro Panay, Mindanao	
	C. discolor Mart	Luzon	kumaboi
	var. *discolor*		
	var. *negrosensis* Becc.	Negros, Siargao	
	C. elmerianus Becc.	Luzon, Dinagat, Mindanao	tagiktik, panlis, sababai, samanid
	C. erinaceus (Becc.) Dransf. var. *erinaceus*	Palawan	
	C. filispadix Becc.	Palawan	pangan-panganan, nokut, kangnobnob
	C. foxworthyi Becc.	Palawan	
	C. grandifolius Becc.	Luzon	saba-ong
	C. javensis Blume	Palawan	
	C. jenningsianus Becc.	Mindoro	
	C. malawaliensis J. Dransf.	Palawan	
	C. manillensis (Mart.) H.A. Wendl.	Luzon, Dinagat Island Mindanao	lituku, giwi, lintukan
	C. marginatus (Blume) Mart	Palawan	labsikan
	C. megaphyllus Becc.	Leyte, Mindanao	magbagaki, banakbo
	C. melanorynchus Becc.	Mindanao	dalimban
	C. merrillii Becc. var. *merrillii*	Luzon, Masbate, Palawan, Mindanao	palasan, quwen, babuyan, pasan, nanga, acab-acab
	var. *merrittianus* Becc.	Luzon, Mindoro	
	var. *nanga* Becc.	Mindanao	nanga
	C. meyenianus Becc.	Pangasinan, N. Vizcaya	

Appendix 1. Checklist of Philippine Rattan *(continuation).*

Genus	Species	Distribution	Vernacular Name
Calamus	*C. microcarpus* Becc. var. *microcarpus*	Luzon, Polillo, Mindoro, Leyte, Mindanao	Korayot tandulang-gubat, potian, obanon
	var. *diminutus* Becc.	Luzon	kamlis
	var. *longiocrea* Baja-Lapis	Luzon	cham-may, damayon
	C. microsphaerion Becc. var. *microsphaerion*	Luzon, Culion, Palawan	kulakling, labit, pinpin, siksik, sika-sika
	var. *spinosior* Becc.	Palawan	
	C. mindorensis Becc.	Luzon, Mindoro	tumalim
	C. mitis Becc.	Batanes, Luzon Babuyan	tevdas, matkong
	C. moseleyanus Becc.	Mindanao (Basilan)	sarani
	C. multinervis Becc.	Mindanao (Basilan)	bugtungan, balala, ubli
	C. ornatus Blume var. *philippinensis* Becc.	Luzon (Polillo) Mindoro, Negros, Mindanao	limuran, quwen, gamangan, kalapi
	var. *pulverulentos* E. Fern.	Palawan, Mindoro	managa, borongan
	C. ramulosus Becc.	Luzon	panlis
	C. reyesianus Becc.	Luzon, Mindanao	apas, lukuan
	C. samian Becc.	Luzon, Mindanao	tagsa-on, samian
	C. scipionum Lour.	Palawan	
	C. siphonospatus Mart. var. *siphonospathus*	Luzon	biri, tallawan
	var. dransfieldii Baja-Lapis	Mindanao	pasan-pasan
	var. *farinosus* Becc.	Luzon	
	var. *oligolepis* Becc.	Luzon	sukol
	var. *polylepis* Becc.	Luzon	
	var. *sublevis* Becc.	Luzon, Mindanao	sipay, papakin
	C. spinofolius Becc.	Luzon, Panay, Mindanao	kurakling
	C. trispermus Becc.	Luzon	
	C. subenermis H.A. Wendl. ex. Becc.	Palawan	bugtung
	C. symphysipus Mart.	Palawan	apas, bolanog
	C. usitatus Blanco	Luzon, Visayas, Mindanao	tandualng-parang-talora termarura
	C. vidalianus Becc.	Luzon	butarak, taguiti, Quwen lentos
	C. vinosus Becc.	Mindanao	
	C. viridissimus Becc.	Mindanao	Akal
Daemonorops	*D. affinis* Becc.	Mindanao	bag-bag
	D. cleminsiana Becc.	Mindanao	
	D. curanii Becc.	Palawan	pitpit, saranoi
	D. gracilis Becc.	Palawan	
	D. longipes (Griff.) Mart.	Palawan	labsikan
	D. loheriana Becc.	Luzon	

Appendix 1. Checklist of Philippine Rattan *(continuation).*

Genus	Species	Distribution	Vernacular Name
Daemonorops	*D. margritae* (Hance) Becc. var. *palawanicus* Becc.	Palawan	pin-pin
	D. mollis (Blanco) Merr.	Luzon, Visayas, Mindanao	ditaan, quwen, mangnaw nanga, gatasan, sumulid
	D. ochrolepis Becc.	Luzon, Polillo, Leyte,	sumulid, palaklakanin ditaan, nokot
		Mindanao	taletol, pagit, saroringan
	D. oligolepsis Becc.	Mindanao	ragman
	D. pannosus Becc.	Mindanao	sabilog
	D. pedicellaris Becc.	Leyte, Mindanao	hanamham, delot, logman, hiyod, oban-oban, rogman
	D. polita E. Fern.	Mindanao, Zamboanga	lapa-utong
	D. urdanetanus Becc.	Mindanao	sahaan
Korthalsia	*K. laciniosa* (Griff.) Mart	Luzon, Polillo Mindanao	danan, tambuanga, planug, miling-piling
	K. merrillii Becc.	Palawan	buragat
	K. rigida Bl.	Palawan	
	K. robusta Bl.	Palawan	kalalias
	K. scaphigeroides Becc.	Mindanao	kapnigid
Plectocomia	*P. elmerei* Becc.	Mindanao	ungang
	P. elongata Mart. ex Bl. var. *philippinensis* Madulid	Palawan Mindanao Leyte	pason, panog kalaanan, laanan, binting dalaga paang dalaga

Sources: Fernando (1990); PCARRD (2002)

COUNTRY REPORT ON THE STATUS OF RATTAN RESOURCES AND USES IN THAILAND

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1. INTRODUCTION

The Kingdom of Thailand is in the Indochinese Peninsula of the Southeast Asian Region and is located between 5-20 North latitude and 97-106 east longitude. The neighbouring countries are Myanmar in the north and west, the Democratic Cambodia in the east, Laos in the north and northeastern and Malaysia in the south (Figure I). The Kingdom of Thailand has a total area of 513,115 sq km or 320,696,882 rais.

The population totalled 63,216,812 inhabitants (in 2004) with an annual growth rate of 1.1%. The population density is 123 persons/sq km.

Administratively, Thailand is divided into five regions, that is, the Northern, the Northeastern, the Central, the Eastern and the Southern Regions, 76 provinces (Chang Wad) and 716 districts (Amphoe). The capital of Thailand is Bangkok (Krung Thep Maha Nakhon) which is located in the Central Region.

In 1961, the total forest area of Thailand was about 171 million rais or 53.3% of country area. Later on, forest areas were encroached upon for the purpose of slash-and-burn, shifting cultivation, land resettlement, dam and road construction, land reform for agriculture etc., and declined to 81.0 million rais or 25.28% of country area in 1998 (Table 1).

The National Forest Policy dated 3 December 1985 mandated that the forest cover of the country should be maintained at 40% of country area or 128 million rais. This means the government (Ministry of Agriculture and Cooperatives) has to try its best effort to increase by 47 million rais the forest areas to meet the said policy. The reforestation scheme will probably be done by government agencies (The Royal Forest Department-RFD, National Park, Wildlife and Plant Conservation Department, Forest Industry Organization-FIO, and Thai Plywood Company-TPC) as well as private sectors under the 8th & 9th National Economic and Social Development Plans.

In Thailand, there are two main types of forests; the evergreen forest and the deciduous forest where the tree species and nonwood forest products (NWFPs) are found. The main NWFPs consist of bamboos and rattans.

Rattan is the climbing palm belonging to subfamily Calamoideae (Dransfield 2000), Family Palmae (Yamsakha). Rattan is a tropical plant which occurs in the moonsoon region and humid areas in tropical rain forest, peat swamp forest, mangrove forest and deciduous forest in Africa, Southeast Asia, northern parts of Australia and Papua New Guinea (Semsuntud,1988)

There are 13 different genera of rattans that include in all some 600 species (Dransfield 2000). In Thailand, there are 62 species of rattans under six genera that have been recorded (Dransfield,2000). About twenty species have been practically utilized. Basically, the word "rattan" in the commercial way has 2 meanings: the first one is "cane" that means the rattan has diameter greater than 2 cm, and the second one, the diameter is less than 2 cm and is called "rattan".

Rattan is becoming important next to the timber for the Thai national economy. Presently, the demand for rattan has been rapidly increasing, in particular by the furniture industry, but the supply has decreased because the country's rattan resource has been over-exploited for many years. When the forest resources are destroyed, the rattan resources are inevitably reduced. Thus, the lack of rattan, for raw material, is the main problem for rattan factories. So rattan plantations establishment should be implemented in order to supply rattan material for those factories and local uses as well as well as to reduce the quantity of rattan importation from abroad.

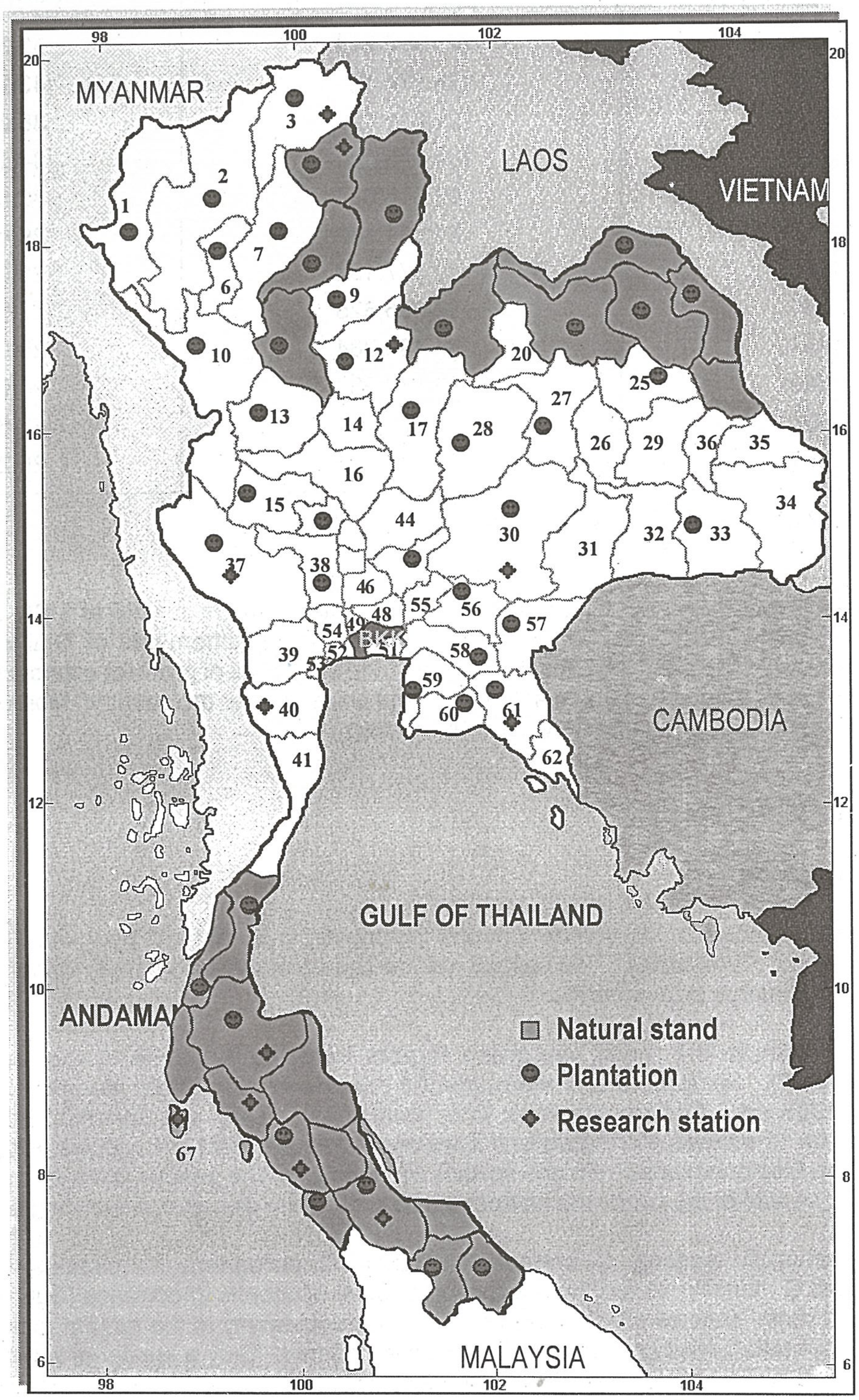

Figure 1. Map of Thailand.

Table 1. Existing Forest Cover in the Period of 37 Years.

Year	Existing Forest Cover	
	Rai	Percent
1961	171,017,812	53.33
1973	138,578,125	43.21
1976	124,010,625	38.67
1978	109,515,000	34.15
1982	97,875,000	30.52
1985	94,291,349	29.40
1988	89,877,182	28.03
1989	89,635,625	27.95
1991	85,436,284	26.64
1993	83,470,967	26.03
1995	82,178,161	25.62
1998	81,076,428	25.28

Source: Jaruphathana, Thongchai, 2000

The Royal Forest Department started the rattan plantation establishment in 1968 at "I-SA-TEAR" Rattan Plantation Unit, located in Rangae District, Narathiwat Provinice, southern part of Thailand. The area plantation is 1,330 rai or 213 ha. Only Calamus caesius, one of species of greatest economic importance, is planted. At present, rattan has been planted in a large scale all over the country. Moreover, research and study have been conducted on many aspects of rattan.

2. RATTAN RESOURCES

A. Natural stands

Rattan can be found mostly in the southern part of the country in Suratthani, Songkha, Ranong, Krabi, Pattani provinces etc (Yamsakha). The second natural source of rattan is in the northern part in Nan, Phrae, Phayao, Sukhothai provinces etc.

Rattan grows mostly in the moist evergreen forests from the lowlands to the top of the hills (Vongkhaluang,2000). Six genera and more than 60 species of rattans are recorded in this country (Smitinan,Tem,1988 cited by Ngamchareon, Charnchai,2001). They are Calamus with 46 species, Daemonorops with 12 species, Korthalsia with 3 species, Myrialepis with one species, Plectocomia with three species and Plectocomiopsis with one species (Appendix1). The genus Calamus is widespread all over Thailand. The size of the canes varies from 3 mm to 15 cm in diameter, depending on the species.

Calamus longisetus, C. wailong, C. erectus, C. manan, C. peregrinus, C. caesius, C. blumei, C. pandanosnus and C. densiflorus are the species of greatest economic importance (Subansenee,1996, Appendix 2). All these species are decreasing in quantity exclusively in the natural forest. So far, an intensive survey of rattan resources has not yet been conducted. Only a survey of rattan species has been recently done by Kaewkul and et al. The survey was conducted in BA-LA Forest located in Wang district, Narathiwat Province, southern part of Thailand. BA-LA Forest is natural forest classified as Wildlife Sanctuary. It is one of the protected areas. The method of survey was to walk and enumerate the number of rattan species as well as to identify the phenology of rattans by using John Dransfield's manual of the Rattans of the Malay Peninsula. There are five genera and 22 species documented. They are Calamus with 9 species, Daemonorops with 8 species, Korthalsia with 3 species, Myrialepis with one species and Plectocomiopsis with one species (Table 2).

Table 2. Existing Rattan Species in BA-LA Forest.

No.	Botanical Name	Thai Name
1	*Calamus axillares* Becc.	Wai Ta Kha Nam
2	*Calamus ornatus* Bl.	Wai Chang
3	*Calamus manan* Miq.	Wai Kor Dum
4	*Calamus insignis var. longispinosus* Dransfield	Wai Hin
5	*Calamus javensis* Bl.	Wai Khao Sarn
6	*Calamus densiflorus* Becc.	Wai Khee Rae
7	*Calamus laevigatus* Mart.	Wai Kri Ya
8	*Calamus radulosus* Becc.	Wai Kra Kree Ya
9	*Calamus exilis* Griff.	Wai Phra Ram
10	*Daemonorops didymophylla* Becc.	Wai Phon Khee Ped
11	*Daemonorops sabut* Becc.	Wai Phon Khon Non
12	*Daemonorops macrophylla* Becc.	Wai Ler Bae Lek
13	*Daemonorops verticillaris (Griff.)* Mart.	Wai Ta Pla
14	*Daemonorops geniculata (Griff.)* Mart.	Wai Ta Nouh
15	*Daemonorops periacantha* Miq.	Wai Mane
16	*Daemonorops kunstleri* Becc.	Wai Nang
17	*Daemonorops sepal* Becc.	Wai Ta Wa
18	*Korthalsia rigida* Blume.	Wai Dao Nu
19	*Korthalsia grandis,* Ridley	Wai Dao Yai
20	*Korthalsia scortechinii* Becc.	Wai Kung
21	*Myrialepis paradoxa (Kurz.)* Dransfield.	Wai Daeng
22	*Plectocomiopsis geminiflorus (Griff.)* Becc.	Wai Kung Nam Prai

B. Existing plantation

As we know, rattans are spiny, climbing plants. Rattan forms the raw material principally for furniture, although several other articles, such as baskets, are made from it. It is strong, durable and bends readily to allow formation of a wide variety of shapes. Although rattan is classified as a minor forest product, its commercial and social importance is second only to timber.

In the last 30 years or more, concessions to exploit rattans were given without limit. The canes were extracted from the forest easily and in large quantity without any replanting and/or establishment programme. As a result of deforestation and over-exploitation. Thailand has lost its rattan resources. Thongma and Yamsakha (1995) mentioned that rattan plantation was established by the Royal Forest Department in the following areas:

1) The rattan plantation was operated at National Forest Reserves "I-SA-TEAR" Rangae District, Narathiwat province. The plantation area of 1,330 rai or 213 ha with Calamus caesius has been established since 1968.

2) The rattan plantation under the King's Project at Sukirin District, Narathiwat Province. Calamus caesius was also planted in this area starting in 1980 with the total area of 2,037 rai or 326 ha. So far, the total plantation area is 4,730 rai or 757 ha. Calamus caesius, C. manan, C. longisetus and C. peregrinus were planted.

3) A rattan plantation was established in 1979 at Ngoa Waterfall, Muang District, Ra-nong Province, with the area of 100 rai or 16 ha.

4) A rattan plantation was established in 1979 at Khao Tha Petch, Muang District, Suratthani Province, with the area of 100 rai or 16 ha.

5) A rattan plantation was established in 1979 at Ka Poh Waterfall, Tha Sae District, Chumporn province, with the area of 100 rai or 16 ha.

The objectives of the planting would be mainly for genetic conservation rather than for cane production. Then following plantation have been operated in the other regions of Thailand under different programme/ project and objectives.

a. Rattan Plantation Establishment under Silviculture Research Division Programme.

The programme started in 1989 with the objectives to conduct research genetic conservation, plantation establishment, ecology and development of rattan resources for maximum uses as well as to establish seed production area. The first year, rattan plantations were established for research and seed production project in the Central and Southern Region with 250 rai or 40 ha. Presently, the programme consists of 12 projects in 4 regions with total plantation area of 13,652 rai or 2,184 ha. (Table 3).

From the progress report prepared by Chareonrattawong, Chanya, 2000 mentioned that TUEK KHAO BAN TAD Rattan Research and Development Station No. 2 has been responsible for rattan plantation establishment. The plantation has been established since 1991 (Table 4). The activities undertaken in the rattan plantation establishment are as follows:

1. Site preparation and planting
   - survey and selection of planting site
   - preparation of stakes and lining of stakes
   - establishment inspection line and area demarcation
   - seedling transportation
   - planting out and replanting
   - soil mulching and fertilizer application

2. Nursery
   - preparation of seedbed
   - preparation of soil mixture and filling soil into plastic bags
   - selection of rattan resource area
   - collection of rattan seed
   - cleaning of rattan seed
   - germination and transplanting of seed
   - recording
   - maintenance of seed

3. Maintenance of Plantation
   - circular weeding
   - soil working and fertilizer application
   - replanting

From Table 4, it is indicated that the total area of rattan plantation was 1,315 rai or 210 ha. Five species of rattan plantation for research were Calamus longisetus (865 rai or 138 ha), Calamus latifolius (300 rai or 48 ha) and the other three species of Calamus palustris, Calamus caesius and Calamus rudentum with the area of 50 rai or 8 ha of each species.

b. Rattan Plantation Establishment Under Royal Initiatives Programme

The programme started in the Northern Region in 1997. The objectives of the programme are to maintain the the balance of ecosystem and to serve as food bank as well as to produce value-added forest products. The area of plantation was established in the after-care plantation and/or under the natural forest area where is suitable for the rattan plantation. The native/ local species is recommended for the plantation with the rattan seedling at 200 seedlings per rai. So far, the programme includes 12 projects in 3 regions with total plantation area of 3,200 rai or 512 ha (Table 5).

Table 3. Rattan Plantation Establishment for Research and Seed Production.

Year Planted	Area Planted (Rai)															
Location	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
1. Northern Region	-	-	-	-	-	-	-	-	-	-	-	100	100	100	50	350
2. Northeastern Region	-	-	-	-	-	200	200	-	-	-	-	-	-	-	-	400
3. Central Region	50	50	50	50	50	50	50	38	-	-	-	-	250	200	50	888
4. Southern Region	200	200	200	1,200	1,200	950	950	884	950	800	950	850	880	700	100	12,014
Grand Total	250	250	1,250	1,250	1,250	1,200	1,200	922	950	800	950	950	1,230	1,000	200	13,652

Table 4. Maintenance of Rattan Plantation Aged 2 yr to 10 yr.

Item	Species	Fiscal Year			7-10 yrs (rai)	2-6 yrs (rai)	Survival Percentage (%)
		Start	End	Area			
Seed Pro. Area	*C. longisetus*	1991	2000	100	200	-	90
	C. latifolius			100			90
Seed Pro. Area	*C. longisetus*	1992	2001	100	200	-	95
	C. palustris			50			95
	C. caesius			50			70
Seed Pro. Area	*C. longisetus*	1993	2002	100	200	-	85
	C. rudentum			50			90
	C. latifolius			50			90
Seed Pro. Area	*C. longisetus*	1994	2003	100	-	150	90
	C. latifolius			50			93
Seed Pro. Area	*C. longisetus*	1995	2004	100	-	150	92
	C. latitolius			50			91
Seed Pro. Area	*C. longisetus*	1996	2005	115	-	115	94
Seed Pro. Area	*C. longisetus*	1997	2006	100	-	150	90
Seed Pro. Area	*C. latifolius*			50	-		89
Seed Pro. Area	*C. longisetus*	1998	2007	150	-	150	91

Source: Chareonrattawong, Chanya, February 2000

Table 5. Rattan Plantation Establishment under Royal Initiatives Programme (F.Y. 1997-2003).

Location	Area Planted (Rai)							Total
	1997	1998	1999	2000	2001	2002	2003	
a. Northern Region	100	300	150	250	550	300	400	2,050
b. Southern Region	-	350	100	200	100	200	100	1,050
c. Northeastern Region	-	-	-	50	50	-	-	100
Grand Total	100	650	250	500	700	500	500	3,200

Source: 1. Fact Sheet of Special Project Division as of 14 November 2003
2. Chudchawan Sutthisrisilapa and Bunyarit Puriyakorn, November 2003

c. Rattan Plantation Establishment under the Supervision of State Reforestation Division.

The programme was launched in Northern, Northeastern, Central and Southern Regions of Thailand in 1997. The objectives of the programme were to serve as food bank and to produce value-added reforest products as well as to prevent the reforestation area from the encroachments. The area of plantation was established in the after-care plantation. The native/local species is recommended for the plantation with the rattan seedling at 200 seedlings per rai. Presently, the programme comprises 189 projects of 4 Regions with total plantation area at 38,850 rai or 6,216 ha (Table 6).

Table 6. Rattan Plantation Establishment under the supervision of State Reforestation Division.

Location	Area Planted (Rai)							Total	2 yr to 6 yr '99-'03	7-10 yrs. '95-'98
	1997	1998	1999	2000	2001	2002	2003			
1. Northern Region	1,000	1,850	4,500	2,650	2,850	2,750	2,550	15,150	15,300	2,850
2. Northeastern Region	250	600	750	350	650	200	900	3,700	2,850	850
3. Central Region	1,050	1850	1,350	1,850	2,100	2,200	1,800	12,200	9,300	2,900
4. Southern Region	200	700	750	650	900	850	7500	4,800	3,900	900
Grand Total	2,500	5,000	7,350	5,500	6,500	6,000	6,000	38,850	31,350	7,500

Source: 1. Fact Sheet of State Reforestation Division as of 17 November 2003
2. Chudchawan Sutthisrisilapa and Bunyarit Puriyakorn, November 2003

Ratanavirakul Apichart (1998), working for Pattani Regional Forest Office, conducted the research "A Study of Rattan Growth in the Rattan Plantation under the Supervision of Pattani Regional Forest Office". From his study, he found that rattan at the age of 14 years has maximum growth rate at 0.49 m/yr followed by the ages of 11 yr and 12 yr with the growth rate at 0.46 m/yr and 0.45 m/yr respectively (Table 7). For growth and length of node, the maximum growth of node is 10.50 mm at the age of 12 yr while the next is 9.36 mm at the age of 14 yr. The maximum length of node is 28.92 mm at 12 yr. And the next is 28.02 cm at the age of 13 yr. When the value of growth and length of nodes was plotted (Appendix 3), it was clearly seen that the growth and the length had the tendency to increase in the ages of up to 12 yr. After that the tendency declined. So, it may be indicated that age should be the good indicator for rattan harvesting. The appropriate age for the utilization of rattan is 12 yr old.

Table 7. Average Growth of *Calamus caesius* at King's Project Sukirin.

Age (yr)	Growth of Node (mm)	Length of Node (mm)	Length of Cane (m)	Growth (m/yr)	Number of Canes	Relative Light Intensity (%)
4	-	-	-	-	3.34	6.8
5	-	-	-	-	3.38	5.84
6	7.3	17.9	1.69	0.28	5.77	1.17
7	6.55	18.71	1.83	0.26	3.54	2.9
8	6.87	16.37	1.71	0.21	1.19	3.38
9	7.25	21.56	3.98	0.44	2.44	2.85
11	8.02	27.36	5.03	0.46	3.52	3.05
12	10.5	28.92	5.44	0.45	13.42	8.94
13	8.68	28.02	5.63	0.43	4.72	5.02
14	9.36	27.28	6.85	0.49	9.06	6.78
15	7.95	25.63	-4.07	0.27	3.93	6.77

Source: Ratanavirakul Apichart,1998

C. Economically and commercially important rattan species

a. Role of rattan in the economy

The demands for rattan both inside and outside of Thailand has risen considerably. Rattan furniture is attractive and hardwearing, besides wooden furniture is more expensive, hence rattan furniture is more popular in many countries instead of wooden furniture. Thailand has exported rattan furniture to other countries over the world; European countries such as France, Germany, England, Scandinavian countries, U.S.A, Japan, Australia, and New Zealand etc. in large quantities and value. The value of exporting trends to rapidly increase with each year, from 1983 to 1986, Thailand exported 399, 358, 411 and 520 million baht of rattan furniture across those years; in four years the total value was about 1,600 million baht. More than 200 rattan furniture factories are in Thailand, but most of them are small factories which may be household manufactures. Only 3 factories are large and can export their products. The advantage of the rattan furniture industry is not only in increasing the national income which comes from exporting, but also in reducing unemployment.

The more rattan furniture manufactories are available the more local people have jobs. In a large manufacturing business, there are 20 to 400 workers, half of them ordinary workers and the other half skilled. And in a small factory, there are 2 to 20 workers which are members in the family or skilled workers in the local region (Jampathong, 1986). Consequently, the small manufacture who makes furniture and other rattan handicrafts can get more profit and improve the economical status of the local people. Apart from rattan furnitures, other items are made from rattan such as mats, curtains, baggages, baskets etc. for use in country and for export abroad in a large amounts. In each year, the value of export is more than thirty thousands baht and will continue to increase in the future. The marketing of raw materials supplied to the rattan industrial can help the local people who deal in rattan. The total cost of the raw materials depends on the kind and size of rattan; the cost also varies from region to region. For example, in Bangkok the cost of cane is more expensive than in the southern part of Thailand. Although Thailand has a lot of rattan natural resources, it is still not enough for manufactures. Consequently, rattan is also imported from other countries such as Malaysia, Indonesia, Laos, Cambodia, the Philippines, Burma, India, and Hong Kong, but is decreasing each year. Likewise, the rattan furniture import is decreasing every year.

b. Economically and commercially important rattan species

Subansenee (1996) mentioned that there are two sizes of economically and commercially important rattan species (Appendix 2) *Calamus longisetus* (Wai Kam Puan), *C. wailong* (Wai Nam Pueung), *C. erectus* (Wai Kee Sien), *C. manan* (Wai Kor Dum) and *Calamus peregrinus* (Wai Nguang) are large-size rattans. Small-size rattans are *Calamus caesius* (Wat Ta Kha Thong), *C. blumei* (Wai Khae Pueng), *C. pandonosmus* (Wai Lek) and *Calamus densiflorus* (Wai Khee Rae).

3. PRODUCTION AND RESOURCE MANAGEMENT FOR CANE AND SHOOT PRODUCTION.

A. Technology practiced by the Department

The method of plantation is as follows. (Semsuntud, Nutthakorn, 1988)

Seedling preparation

Basically, the seedling which is used in planting has 3 types of preparation: direct sowing of seed, wilding seedling which regenerates in the natural resource and vegetative propagation such as tissue culture, cutting, sucker or rhizome vegetation. In the economic rattan plantation, seedling from seed sowing is the most suitable method.

Seed collection and storage

Rattan seed is collected from the natural resources. Rattan can produce a lot of seeds each year. Wai Kor Dum (*C. maman*) can produce 3,000 to 5,000 seeds at 9 yr of age. However rattan seeds are in short supply which is the main problem in storing them. Their moisture content is the most important factor. A rage of 45% to 55% of seed moisture content is suitable for storage. Over 60% of moisture content causes seed germination, but if the seed moisture content is reduced to less than 40% the rate of seed germination will be also reduced. The most suitable condition for storing rattan seeds is storing them in plastic bags and sealing tightly in nearly vacuum condition at ambient room temperature. This keeps the seeds viable for 1 mo, and many months at 10°C to 14°C (Ahmad and Hamzah, 1984).

Seed germination

The percentage of rattan seed germination is very low, because its coat is too thick, so that it is difficult for water and gas to enter the seed to activate the germination. The rate of germination is slow. It has been found that some rattan spends 45 d to 6 mo to germinate, likewise in the natural condition, the time to germinate is over 45 d. Moreover there are variations in seed germination within and between species. In case of Ta Ka Thong (*C. caesius*) 13% to 80% of fruits germinate in 8 to 16 weeks (Sawintara, 1986). In the case of Wai Pong (*C. longisetus*), a study showed that of the three types of planting materials, 54.5% of whole fruit, 32% of removed seedcoat and only 16% of seeds germinated. (Silvicultural research sub-division, 1987).

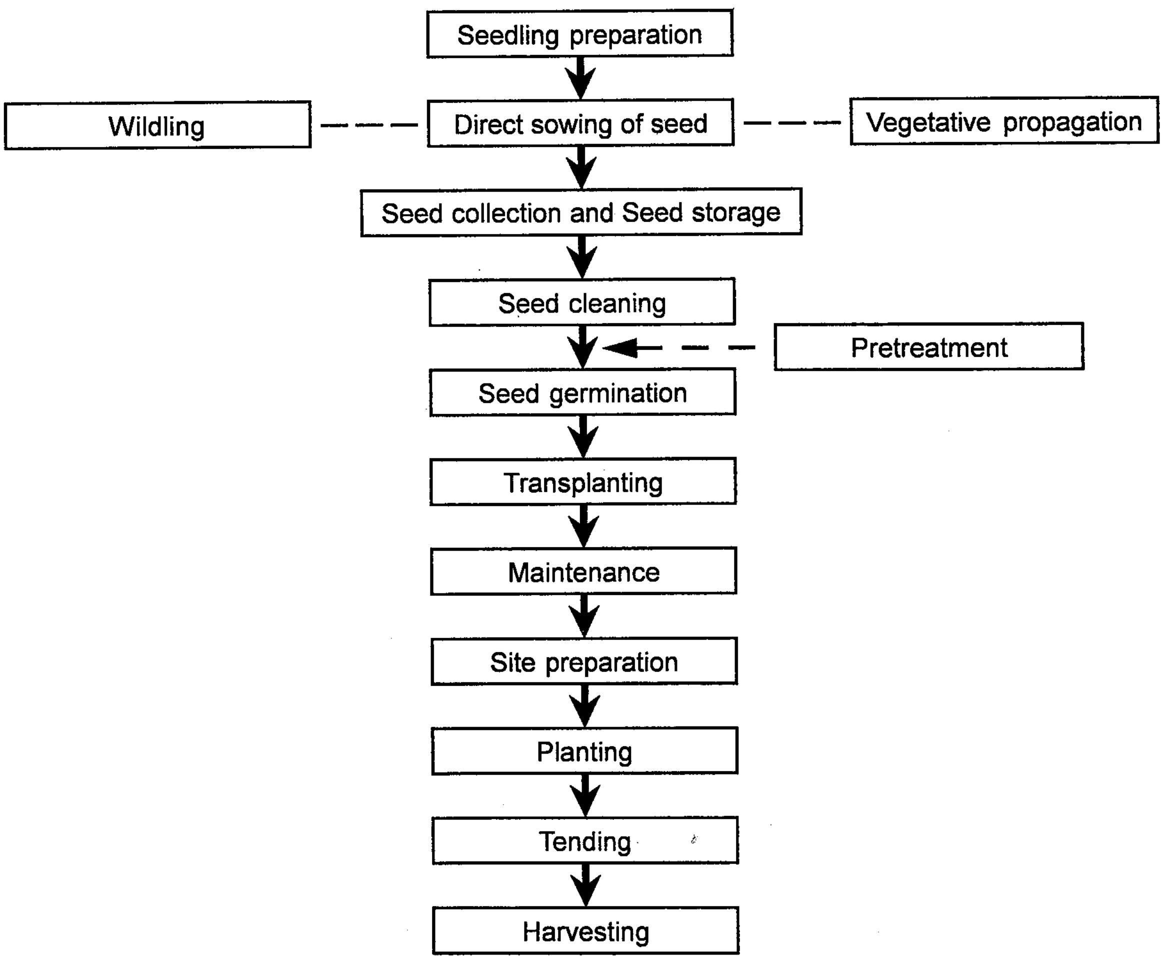

Figure 3. Diagram of the rattan plantation technique in Thailand.
Source: Semsuntud, Nutthakorn, 1988

Pretreatment for Seed germination

On account of low germination, the right pretreatment for improving the quality and quantity of germination is needed. There are many ways to treat it, such as to remove the seed coat, to dry the seed at a low temperature or to soak the seed in running water. In an experiment, Wai Pong (C. latifolius) with the seeds soaked in running water or or dried at 40°C for 24 hr, 48 hr and 72 hr, drying at 40°C for 24 hr and 48 hr produced the best results, with germination at over 70% (Silvicultural Research Sub-Division, 1987).

Seed Sowing

After seed collection and cleaning, the seeds are sown in the seedbed with or without pretreatment. In practice, the media for germination consist of soil and sand in a ratio of 3:1 (Sawintara, 1987). Other media which can absorb moisture may be used, such as sawdust, burned-husk, vermiculite. The seeds are sown in rows which are 4 cm away from each other, and each seed is 2 cm to 10 cm away depending on the seed size. The top is covered with a 3 cm thin layer of sawdust and palm leaf shelters in order to control moisture and protect overheating from the sun. About 30% of light intensity is a suitable condition for seed germination. In some places, such as the I-SA-TEAR rattan plantation, they sow rattan seeds in plastic bags. Watering should be done twice a day, once in the morning and once in the evening.

Transplanting

After the seedlings have grown 2 cm to 3 cm in height, they should be transplanted into into plastic bags of the size 5/8 inches. Before transferring, watering the seedbed should be done so that the seedlings can be pulled out easily and the root system is protected from damage. After that the seedlings are kept in a nursery which allows 50% of light intensity to pass. In the next 8 to 12 mo, the seedlings should be looked after, watered twice a day, fertilized, weeded especially in the first 6 mo in order to reduce competition between the seedlings and other species, and for pest and disease protection.

Planting

The site of the rattan plantation is selected carefully for optimum or near–optimum conditions for rattan growth. In the first stage of growth, rattan seedlings need shading and in the next stage, they need supporting trees for climbing. Light intensity is an important factor in choosing where to set up the seedling. In a case study on Wai Ta Ka Thong (*C. caesius*), Wai Nguay (*C. peregrinus*), Wai Khee Sean (*C. rudentum*), Wai Dam (*C. oxleyanus*) and Wai Dao Yai (*K. grandis*), it was found that the seedling grown in a shaded area, with about 3 to 10 times lower light intensity, grew better than seedlings which grew in an open area (Vongkaluang, 1987b.). The optimum condition for Wai Kor Dum (*C. manan*) seedling is a relative light intensity of 40% to 50% (Mohamad, 1987). Nevertheless, the light requirement increases when the seedlings grow up to mature stage (Vongkaluang, 1984.). Consequently, the rattan seedlings should be planted together with other plants as in the agro-forestry system or multistorey system, i.e., in the natural forest, forest plantation, rubber tree plantation, or fruit orchard.

Site Preparation

The plantation site is usually prepared in the rainy season, but in some areas, flooded areas, it may be done after this. Practically, the forest floor is cleared into strips of 2 m to 4 m wide, in the north-south direction or following the contours of the planting site. Spacing for planting depends on species and other factors; for example budget, management style, or the characteristic growth of the rattan. Clustering rattan consists of many stems, thus the spacing should be wider in order to spare space for their growth in the future. There are 2 patterns of planting: row and cluster planting in which 3 to 5 trees/cluster are planted. In the case of row planting, they always plant with a spacing of 1.8 m x 10 m while in cluster planting, the spacing is 5 m x 10 m or 10 m x 10 m.

In general, a hole is dug to plant the rattan seedling. The size of the hole should be bigger than the plastic bag that holds the seedling. When planting, the plastic bag is carefully removed in order to protect the root system, damage to which is the cause of the delays or failure in establishing the seedling. The seedling is placed in a straight position and the root collar is at the same level as the soil surface. After that the top soil is compacted around the seedling tightly.

Tending

In the initial years, the rattan seedling needs much looking after to increase the survival rate, improve growth and speed up the seedling establishment. Sometimes some seedlings die; replacing should be done as quickly as possible in the same season, but if it cannot be done, replanting will be done in the next year by using good seedling. Weeding is needed once in the first year, with removal of other plants from 1 m around the seedling in order to reduce competition. Besides this, 9 mo after planting, the unwanted trees are removed and the canopy is gradually opened 3 m around the seedling to increase the light intensity to an optimum for seedling growth at 60% to 70%. This treatment will be done when the age of seedling is 3 mo, 9 mo, 18 mo, and 30 mo in that order.

Fertilizer application is needed for the seedlings in order to promote their growth. The fertilizer should be applied at the age of 3 mo and 9 mo, after the seedlings have established themselves, when new shoot tips occur or after weeding in the early rainy season. Fertilizer is bestrewn and mixed together with the top soil around the seedlings. In practice, 60 g of rock phosphate is applied about 0.5 m around each of the seedlings.

In addition to these, the seedlings should be protected from pests and disease also (Sawintara,1987).

Harvesting

The age when rattan can be harvested depends on its growth, kind and site of rattan. For example Wai Tha Ka Thong (*C. caesius*) which is planted in Istear plantation, Narathiwat province at spacing 4 m x 4 m in 1 yr to 5 yr, grows very slow, the average stem length is 0.6 m/yr to 1 m/yr, whereas in 10 yr to 15 yr, the growth increases to 2 m/yr to 3 m/yr. The rotation of the large-stem rattan is about 15 yr, while that of the small-stem rattan is about 7 yr to 10 yr.

B. Local Technology

During the field visit in Prajinburi Province, we had the chance to visit one farmer who produced rattan seedlings (*Calamus siamensis*) to sell to the other farmers and interested rattan growers for shoot production.

The local technology on seedling production is in the following:

a. Local Technology on Seedling Production
    1. Gather fruits or seeds from his own mature rattan planted in his property.
    2. Seedling production is undertaken by a group of 15 farmers.
    3. Peel off outer cover (sarcotesta) of the seeds.
    4. Expose under the sun for 3 days
    5. Soak in water overnight.
    6. Air-dry
    7. Sand to remove remnants of the skin or cover.
    8. Dry under the sun for 3 hr.
    9. Air-dry for 5 days. Stir to aerate and prevent molds or insects to attack seeds.
    10. Sterilize by dipping in hot water for 5 sec.
    11. Air-dry
    12. Mix seeds with finely shredded coconut coir dust and place in a plastic bag (Around 2 kg of coir dust seeds).

13. Place 3 to 4 plastic bags with the seeds and coir dust in a metal box and allow to germinate for 2 mo.
14. After 3½ mo transfer germinants individually in plastic bags and place in the nursery.
15. Water and remove weeds if necessary.
16. Cost of seedlings Baht 3.00 (small) and Baht 4 to 5 (large).
17. Production – 100,000 seedlings/season to 150,000 seedlings/season.
18. Monthly sale of 7,000 to 10,000 seedlings.

b. Technology developed by Ecoforest Village Group
   1. Nursery activities are similar to 111 Ba
   2. Plantation establishment (one year of seedlings to be out planted, distance of planting between trees of *Pterocarpus macrocarpus* and *Dalbergia cochinchinensis* (4 m x 4 m), in the area, care and maintenance),
   3. Harvesting (For food plantation, rattan need to be only 4 yr old; in the natural stand, local technology includes grading and sorting according to size).

c. Rattan Grower (Local technology)! (3-yr to 4 yr old rattan for shoot)
   1. 2.5 rai
   2. One seedling/hole
   3. Distance of planting 1.5 m x 0.75 m
   4. Plant during the rainy season so that you do not have to water the seedlings.
   5. 2 to 7 suckers/plant.
   6. Fertilization by chicken dung.
   7. Shoots sold for Baht 4.00 to 5.00/pc
   8. Sold in bundle with 5 pcs of shoots (Baht 20.00)
   9. Grower also plant rice as a major crop, 20 rais
   10. Net income of Baht 20,000.00/yr.

d. Rattan Grower (Ecoforest Village)
   1. Plants rattan together with banana, mango and jackfruit.
   2. 2 rais
   3. Distance of planting.
   4. Three seedlings/hole.
   5. Rattan is only 1-yr old.

4. PROCESSING AND UTILIZATION

A. Major Products

1. Primary (canes-imported from Indonesia, Malaysia, Myanmar, Laos)
2. Secondary (wickers and cores)
   a) Canes are sorted by size and passed through the coring or wickering machine.
   b) Sizes of wicker are 2 mm, 3 mm, 4 mm, 5 mm, and 6 mm.
   c) Sizes of cores ranges from 1 mm to 30 mm
   d) Materials are soaked in chlorine for 30 min,
   e) Air-drying
   f) Sorting
   g) Grading
   h) Wickers or cores are graded according to color from A to D depending on the whiteness of the materials.
   i) Those that do not pass the standard are bleached for the second time (however, no data is available on the duration ot the 2nd soaking period.)
   j) The products are bundled into 50 kg and packed in jute sacks (Figure 4)
   k) These are sold directly or indirectly to buyers or exporters at Baht 125/t.
   l) Production is 1000 k/day, 30% are wicker and 70% are cores.
   m) Cost of labor is Baht 100/day.

3. Finished products (handicraft, baskets and others.)
4. Others (dyes, food, medicines and utensils)

Figure 4. Rattan packed into jute sacks.

B. Methods of Improving rattan products

1. Chemical/Nonchemical treatments (What chemical preservative is used by the handicraft industry?)
2. Processing technologies (e.g., sanding, bleaching with chlorine and sodium hypochlorite, drying by air or a simple oven, bending, preservation by sulfur application, finishing)
3. Grading Standards (none)
4. Packaging or raw materials and products.
   Wickers and cores are bundled into 50 kg and packed in jute sacks prior to transport. Shoots are bundled into 5 pieces and brought to the market.

V. MARKETS AND SOCIOECONOMICS

A. Participants in the Rattan Sector

Item	Exporter	Trader	Manufacturer	Plantation Grower	Gatherer
1. a. Years in Operation b. Location	NA	a. 1995 b. South: Nakhon Sithammarat	a. 1998 b. Northeast: Loei	a. 1986 b. Northeast: Udornthani	a. 1985 b. Northeast: Sisaket
2. Size	NA	Small	Small	Small	Big
3. Volume	NA	-	32 m^3	2 rai	500 rai
4. Ownership	NA	Sole proprietor	Group	Sole proprietor	Group
5. Investment	NA	20,000 Baht	250,000 Baht	47,000 Baht	-
6. a. Types of Rattan handled b. Distribution Systems	NA	a. Furniture, handicraft b. Delivered by car	a. Whole cane, core, wicker b. Transported by car	a. Edible rattan *C. viminalis* b. Secured by himself	a. Cane/stem b.Transported by sked

A. Participants in the Rattan Sector (continuation).

Item	Exporter	Trader	Manufacturer	Plantation Grower	Gatherer
7. Type of Market	NA	Open market	Trade fair Open Market	Trade fair Open Market	Open market
8. Other source/s of Income	NA	Sale of accessory	Agriculture	Fruit orchard	Agriculture
9. Membership in Association	NA	-	Rattan Handicraft and Weaving Development Group	Woman Group	Agriculture Group
10. Labor/Wages	NA	Work for himself	Piece work	Work for himself	Work for himself

The data on traders, manufacturers, plantation growers and gatherers are presented, but information on exporters are inaccessible.

B. Contribution of Rattan to the National Economy/GNP

From Table 8, Thailand has imported a great quantity of rattan raw material during the period 1994-2003. The maximum value of imported rattan was 115,251,000 Baht in 1996. The minimum value is 47,506,180 Baht in 2003. While the most value of exported furniture was 87,951,721 Baht in 1994. The least value was 32,796,765 Baht in 2003. Regarding the Gross National Product by Industry at 1988 Prices, 1997-2001 mentioned in Forestry Statistics of Thailand 2002, it is said that industrial origin in Agricultural Sector (crops, livestock, fisheries, forestry, agricultural services and simple agricultural processing products) contributed 356.1 Billions of Baht in 2001. In the same year, Gross National Product (GNP) earned 3,038.50 Billions of Baht. In addition, the forestry unit contributed to GNP about 3.5 Billions of Baht or around 1/1000 comparing to GNP ratio.

As mentioned earlier, rattan has played an important role in contributing to National Economy. Rattan, itself, is one component of forestry unit. So the contribution of rattan to National Economy comparing to GNP is relatively low.

Table 8. The Import and Export Value of Rattan (Raw Material and Furniture) 1994-2003.

Year	Raw Material		Furniture	
	Import (Baht)	Export (Baht)	Import (Baht)	Export (Baht)
1994	111,794,000	201,000	3,943,929	87,951,721
1995	109,847,000	192,000	4,150,000	70,538,000
1996	115,251,000	202,000	2,028,000	66,174,000
1997	81,805,049	-	933,179	37,858,416
1998	68,722,932	1,000,370	296,137	59,948,835
1999	76,706,575	1,931,095	2,313,328	50,954,531
2000	76,308,910	1,528,178	2,045,999	40,012,494
2001	91,715,572	415,908	5,088,600	42,130,607
2002	78,528,773	298,131	21,966,383	33,860,015
2003	47,506,180	671,016	9,837,965	32,796,765

Source: 1. Switchart, Somkuan and Denrungreong, Pannee,1998
2. Forestry Statistics of Thailand, 1998 and 2001
3. http://www.customs,go.th/Statistic/Statistic Result jsp.2003

The raw materials are imported from foreign countries e.g., Indonesia, Malaysia, Myanmar, Cambodia, Laos. The imported rattan is transported to the factory where sorting and grading are done. After grading, some of rattan are bundled and packed into jute sack and sold to buyers/exporters. The remaining rattans are processed. Then, the processed rattan are bundled and packed into jute sack and sold to manufacturers/exporters. The manufacturers utilize the processed rattan to make furniture, handicraft, semi-finished products and finished products and sell these to the traders and/or to the buyers and/or export them to other countries (Figure 5).

C. Market Channels

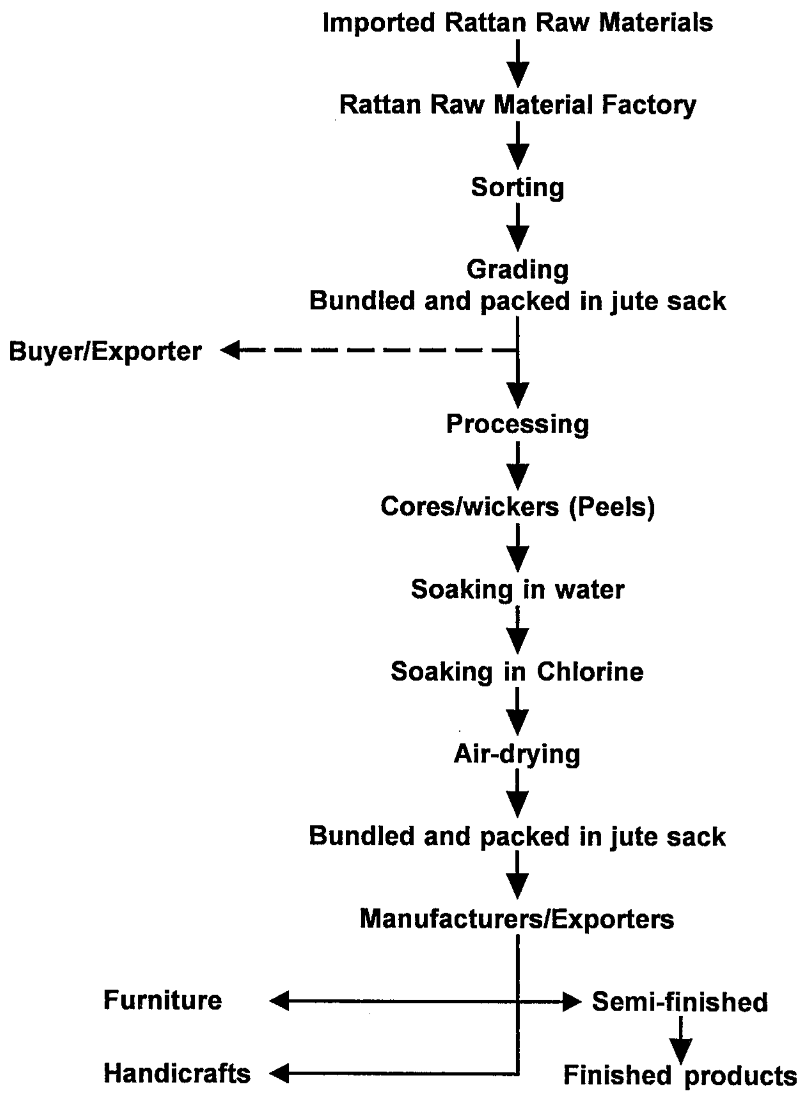

Figure 5. Diagram of Rattan Raw Material to Manufacturers/Exporters.

D. Prices

Prices depend on the product type and quality, rattan raw materials and finished products. Product type can be classified into 2 categories: furniture and handicraft. Prices of rattan raw materials are dependent on quality of rattan and quantity used. To set the price of finished products, the traders and manufacturers negotiate. They consider size and price of rattan raw materials, processing technologies, quality of product and wages (Table 9).

Table 9. Prices of Products and of Rattan Raw Materials.

Product Type	Price of Rattan Raw Materials (Baht)	Finished Product (Baht)
1. Furniture		
a. set for visitors	7,500	23,000
b. set for meal	2,400	8,500
c. swing	800	2,500
d. chair	1,400	3,800
2. Handicraft		
a. book holder	140	350
b. wine holder	35	85
c. bin	140	380
d. picture frame	650	800-1,200
e. lamp	600	1,200

According to Menon (1979) cited by Switchart and Denrungreong (1998), a study on income from a rattan plantation in Malaysia, the grower earned a profit about 1,500 Malaysian dollars per acre.

In Thailand, Khuha (1981) cited by Switchart and Denrungreong (1998) reported that income from rattan plantation in area of 1 rai with spacing up to 2 m x2 m and 400 rattan seedlings was valued at 12,500 Baht in a 10-year plantation (Table 10).

E. Financing Feasibility of Rattan Plantation

Table 10. Economic Return from Rattan Plantation.

Item	Project Year										
	1	2	3	4	5	6	7	8	9	10	11
Expenditure											
a. seedling	800	-	-	-	-	-	-	-	-	-	-
preparation,											
transporatation											
and planting out											
(2 Baht/seedling)											
b. maintenance	200	200	200	200	200	-	-	-	-	-	-
twice a year											
c. fire line/											
inspection line											
establishment	50	50	50	50	50	50	50	50	50	50	-
d. insecticide and	20	20	20	20	20	20	20	20	20	20	-
other											
Income											
a. sale of cane											
(cane length 4 m to 6 m											
sold at 10 Baht to 15 Baht)											15,000
Net Financing	(1070)	(270)	(270)	(270)	(270)	(70)	(70)	(70)	(70)	(70)	15,000

Source: Khuha, Bumroong 1981 cited by Switchart, Somkuan and Denrungreong, Pannee (1998)

VI. POLICY AND LEGISLATION

Rattans are under the control of the Royal Forest Department. In the early years, there were four Laws related to forestry: Forest laws B.E. 2484 (1941), Wildlife Preservation and Protection Act B.E. 2503 (1960) and Amendment B.E. 2535 (1992), National Park Act B.E. 2504 (1961), and National Forest Reserves Act B.E. 2507 (1964). Regarding the prohibition of Wildlife and National Park Acts, nobody is allowed to gather rattan and to take them from the said areas. So the control of rattans are under the Forest Laws and National Forest Reserves Act.

A. What is rattan?

Rattan can be "timber" and "forest product or non-timber forest products" with regard to Forest Laws B.E. 2484, article 4(2) and article 4(7) respectively.

a. The control of rattan as "timber"

1. Rattan cultivation from the forest

All species of rattan standing in the general forest except *Calamus caesius* (Wai Ta Kha Thong) in the 14 southern provinces are nonreserved timber. In order to cultivate rattan from the forest, the rattan gatherer does not need to ask permission from the forestry officer. Moreover, the gatherer does not need to apply for concession following Article 11, pay for royalty with regard to Article 9 and Article 14 and pay for forest improvement as well. This means anybody can cultivate rattan from the forest freely.

2. Transport of rattan

When the cultivated rattan having been taken away from the forest for commercial purpose passed the first forestry cheek point, the mover has to pay the fee in the rate of not more than 10% of rattan price in the local area following Article 25, Article 26 and Ministry of Agriculture and Cooperatives' Announcement.

3. Conversion of rattan

Rattan conversion for furniture and articles that apply are under the rules for timber conversion. The entrepreneur has to ask permission in order to establish "Timber Conversion Factory" from forestry officer following Article 48.

b. The control of rattan as "nontimber forest product" or "forest product"

Some years ago, all species of rattan growing in the general forest, except *Calamus caesius* in the 14 Southern provinces, (Chumporn, Ranong, Suratthani, Pangnga, Phuket, Trang, Krabi, Nakhonsithammarat, Patthalung, Satul, Pattani, Yala and Narathiwat provinces), are nonreserved forest product. No permission is required. Then, there is Royal Decree B.E. 2530 (1987) on Specifications of Reserved Forest Product. So all kinds of rattans available in Thailand, excluding imported rattan from abroad, are reserved forest products. To gather rattan in the forest, he/she has to follow the Ministerial Rules No. 19 (B.E. 2507, 1964) on "Gathering of Reserved Forest Products", and has to ask permission from forestry officer following Ministerial Rules No. 21 (B.E. 2517, 1974) on "Trading of Reserved Forest Products." and to pay for the fees with regard to ministerial Rules No.23 (B.E. 2517, 1975) on" Rate of Fees".

c. The control of rattan according to National Forest Reserves Act B.E.2507

Regarding this Act, rattan is considered as only "timber". To cultivate the rattan from National Forest Reserves, he/she has to get permission from forestry officer, pay for royalty at the rate of 4 Baht/cu m or at the rate 10% of market price and pay for forest improvement charges at twofold of royalty following Article 15, National Forest Reserves Act, Ministerial Rules No.1106 (B.E. 2528, 1975) on "Logging in the National Forest Reserves and Ministerial Rules No.1221 (B.E. 2531, 1978).

B. Allowable cut

Sutthisrisinn (1998) mentioned that data on rattan collection are scanty. The RFD figures represent only what is collected with permits. Licensed production fluctuated in the early to mid-1980s, and has been declining since 1987, when 5,960 t, valued at 74.5 million baht, were collected. In 1990, the licensed production was 1,098 t, valued at 15.2 million bath. While the licensed production is only a part of total production, the declining trend is clear and can be expected to continue into the future (Table 11).

Table 11. Permission of Rattans Collection.

Year	Quantity (t)	Value (Million Baht)
1980	2,320	4.5
1981	205	1.5
1982	385	3.4
1983	2,924	35.0
1984	1,405	15.3
1985	2,588	30.3
1986	3,147	37.6
1987	5,960	74.5
1988	3,558	46.2
1989*	1,235	16.7
1990	1,098	15.2
1991	868	13.2
1992	417	6.5
1993	330	5.9
1994	545	-
1995	59	-
1996	492	-
1997	75.8	-
1998	52.5	-
1999	17.4	-
2000	18.5	-
2001	0.6	-

Source: 1. Forestry Statistics of Thailand 2001 and 2002
2. Subanasenee,1996

*Abolishment of Logging Operation Concession.

C. Policy related to:

1. Controlling or regulation internal trade of rattan – There is no clear policy available in the said issue.
2. Controlling or regulation external trade of rattan – There is Commercial Ministerial Announcement on" Commodity Exportation to Other Countries (No.51) B.E. 2521 (1978) dated April 18, B.E.2521.
3. Controlling or regulating access to rattan raw materials/ products – There are laws namely; Forestry Act B.E.2484 and National Forest Resources B.E. 2507 with their penalties.
4. Biological protection and genetic conservation – There is present in the Constitution of the Kingdom of Thailand 1997 provisions on local participation in natural resource management section 56, the right of communities to participate in the preservation and exploitation of natural resources and biological diversity and in the protection, promotion and preservation of the quality of the environment, right to quality life.

5. Controlling or regulating domestic/foreign access to technologies (production/utilization) – There is "Intellectual Property Laws" under Ministry of Commerce to protect such technologies invented by Thai citizens from exploitation by foreigners.

   Indigenous knowledge system – It is stated in the present Constitution, Section 46 persons so assembled as to be a traditional community shall have the right to conserve or restore their customs, local knowledge, arts or good culture of their community and of the nation and participate in the management, maintenance, preservation and exploitation of natural resources and the environment in a balanced fashion and persistently as provided by law. In addition, the government has initiated One TUMBON-One Product (OTOP) Project since September 2001. OTOP has encouraged rural communities to depend on themselves through in one-producing local products and local resources OTOP products are now exported to world markets.

6. Development of rattan on government and/or private lands – It is recorded that the government lands of 30,710 rai or 4,914 ha are planted to rattans all over the country. All planted rattans are still maintained through replanting, weeding, mulching, soil working, fertilizer application, survival percentage enumeration as growth lands, the Department has proposed plan to produce the rattan seedlings and give them to the private sectors to plant in the private farms and/or rubber plantation areas. Furthermore, the Chaing Rai Training Center reported to the Department that 100,000 rattan seedlings are produced and some of them are given to the farmers to plant in their farms.

7. INSTITUTIONAL CAPABILITY AND LINKAGES

A. Academe

Kasetsart University (KU) was established in B.E. 2486 (1943). KU includes 15 Faculties in the main campus in Bangkok. Faculty of Forestry (FF.) is one of the faculties in KU. KUFF has produced undergraduate and graduate students in various fields: forest management forest biology forest products, silviculture, forest engineering and watershed conservation departments. KUFF's research activities are coordinated by the Forestry Research Center Research work of more than 60 academic staff and thesis students are handled by the center.

Publication of research results is done mainly through the Thai Journal of Forestry of KUFF, which publishes completed works and occasional research articles in its Forestry Research Bulletins, Research Notes and the Technical Papers of the different departments.

Most of the Department's officers graduated from the Faculty of Forestry. Some of the Department's officers are invited as special lecturers. The FF professionals/instructors are invited to on-the-job training programmes as resource persons.

B. Government

The following government agencies have existing or potentials related to forestry.

- Royal Forest Department. Regarding the restructuring organization which is effective on October 2, B.E. 2545 (2002). The Royal Forest Department was divided into 3 Departments; Royal Forest Department (RFD), National Park Wildlife and Plant Conservation Department, and Marine and Coastal Department. The RFD, and the other two Departments are under Ministry of Natural Resources and Environment (MONRE). RFD is responsible for forest areas outside protected areas. The RFD and National Park Department have good relationships in the implementation of many projects especially the rattan pre-project [Promotion of Sustainable Utilization et Rattan form Plantation in Thailand PD 24 / 00 Rev.1(I)] funded by ITTO.

• Department of Agriculture. This department provides technical assistance to farmer. It performs a forestry development function in the sense that some tree crops especially rattans can be treated both as agricultural and as forestry crops. A good example of cooperation between forestry and agricultural sectors have been performed at Narathiwat Rubber Research Station. Rattans have been planted in the rubber plantation since 1975.

• Department of Agricultural Extension. The extension function of this office extends to the promotion of tree crops, some of which can produce wood. In the future, as the demand for expands, it can lend assistance to National Park, Wildlife and Plant Conservation Department. Duplication of extension work by several agencies will not be efficient, and may be confusing to the farmer, especially if conflicting messages are given.

• Land Development Department. A division of this department is responsible for land-use planning. Several categories of forestry land uses are included in its land-use related work. Conflicting results often arose in its land-use interpretation and mensuration with those by the RFD Remote Sensing Office. Better collaboration between these two offices is needed.

• Office of Agricultural Economics. This office collects statistics and conducts economic studies concerning agricultural crops. Forestry information is also included among the concerns of this office

C. *State enterprises*

• Forest Industry Organization (FIO). The FIO is an autonomous state corporation, which was set up to harvest teak forests and to process wood into usable forms. Subsequently, the FIO got widely involved in reforestation, in accordance with the government policy to reforest logged-over areas. In its reforestation programme, the FIO applies the forest village system, which employs landless villagers as workers and allows them to interplant rattans between the rows of newly established trees.

The FIO will have to evolve into an organization that will be responsible for providing support to forest-based communities and villagers in forest management. Depending on the decision of the government, the expanded functions of the FIO may include supplying quality planting materials, piloting new processes for raising source plants for non-wood forest products, channeling funds for tree planting, and developing markets and providing market guarantees for forest products.

• Marketing Organization for Farmers. This office is a possible alternative to the FIO in developing markets for forest products.

D. *Nongovernment organizations*

There are many types of organization within the NGO community, whose activities bear on the concerns of the forestry sector, some with local development, and others with both. Of special concern to the future development of the forestry sector are the NGOs, secular organizations, which can operate at grassroots level to support rattan plantation as forest-based rural development.

E. *International linkages*

Recognizing the emerging constraints and innovative mechanisms, a number of international organizations have established networks to support implementation, coordination, research development and training activities in non-wood/timber forest products, agroforestry and joint management of protected areas. These include:

- Forest, Trees and People Programme (FTPP global programme based of FAO, Rome; FTPP in Asia based at RECOFTC)
- Regional Community Forestry Training Centre (RECOFTC, based in Kasetsart University)
- International Tropical Timber Organization (ITTO, based in Yokohama)

- Danish International Development Assistance (DANIDA, based in Copenhagen)
- International Plant Genetic Resources Institute

8. CONCLUSIONS AND RECOMMENDATIONS

Rattan has played an important role in the national economy. Thailand is one of the countries which exports a great number of rattan furniture each year. At the same time, Thailand also imports a great deal of raw materials, because the supply of raw materials is declining rapidly due to the destruction of natural forest resources.

The decline in the resource base has affected not only Thailand, but also other countries such as Indonesia, Malaysia and the Philippines. In Thailand, the expansion of rubber plantations in the South and farms in forests nation-wide has left the Kingdom with a very small rattan resource base. The exact size of the remaining resource is unknown, yet rattan collection continues. The growing demand for rattan furniture in the world market has led to greater competition among rattan furniture-exporting countries, and has fuelled the rapid depletion of the resource. To save the resource and the industry upon which it is based, there is an urgent need to:

- Step up research on the sustainable cane harvesting capacity of the natural resource base, covering both favoured and unexploited rattan species.
- Promote the establishment of rattan plantations by identifying suitable sites, conducting feasibility studies, research on the technology for raising rattan, securing investments, and designing management schemes.
- Providing support for proper management of the remaining resource and for plantation establishment by policy and institutional reform, promotion campaigns addressed to farmers and industries, and provision of incentives.

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Appendix 1. Checklist of Thai Rattan.

No.	Botan'-al Name	Thai Name	Locality
1	*Calamus acanthophyllus Becc.*	Wai Nang	NE
2	*C. arborescens Griff.*	Wai Phang	S
3	*C. axillarisBecc.*	Wai Tha Kha Nam	S
4	*C. balingensis Furtado*	-	S
5	*C. blumei Becc.*	Wai Khee Pueng	S
6	*C. bousigonii Becc.*	Wai Sae Ma	S
7	*C. caesius Bl.*	Wai Ta Kha Thong	S
8	*C. cambojensis Becc.*	Wai Prid	E
9	*C. castaneus Griff.*	Wai Kling	S
10	*C. concinnus Mart.*	-	S
11	*C. densiflorus Becc.*	Wai Khee Rae	S
12	*C. diepenhorstii Miq.*	Wai Khom	S
13	*C. erectus Roxb.*	Wai Khee Sien	S
14	*C. erinaeeus (Becc.) Dransfield*	-	S
15	*C. floribundus Griff.*	Wai Nam Khao	N
16	*C. godefroyi Becc.*	Wai Nam	NE
17	*C. gracilis Roxb.*	Wai Sam Bai Tor	C
18	*C. gurrba Ham.*	-	NE
19	*C. harmandii Pierre ex Becc.*	-	NE
20	*C. insignis Griff.*	Wai Kor Ta Ba Tu	S
21	*C. insignis var. longispinosus Dransfield*	Wai Hin	S
22	*C. insignis var. robustus (Becc.) Drandsfield*	-	S
23	*C. javensis Bl.*	Wai Lek	S
24	*C. kerrianus Becc.*	Wai Sai Kai	N & NE
25	*C. latifolius Roxb.*	Wai Pong	C
26	*C. longisetus Griff.*	Wai Kam Puan	S
27	*C. luridus Becc.*	-	S
28	*C. manan Miq*	Wai Kor Dam	S
29	*C. multirameus Ridley*	-	S
30	*C. myrianthus Becc.*	Wai Khee Kai	E & S
31	*C. ornatus Bl.*	Wai Chang	S
32	*C. oxleyanus var. montanus Furtado*	Wai Dum	S
33	*C. palustris* Griff.	Wai Kring	S
34	*C. pandanosmus* Furtado	Wai Lek	S
35	*C. peregrinus* Furtado	Wai Nguay	S
36	*C. rotang* Linn.	Wai Khom	N
37	*C. rudentum* Lour.	Wai Yae	N+S
38	*C. scipionum* Lour.	Wai Mai Tao	S
39	*C. siamensis* Becc.	Wai Dong	C & S
40	*C. siamensis* var. malaianus Furtado	-	S
41	*C. spectatissimus* Furtado	-	S
42	*C. tenuis* Roxb.	Wai Chum Porn	C & S
43	*C. thawaithesii* var.canarus Becc.	Wai Nam Rob	N
44	*C. trigrinus* Kurz	Wai Ta Kha	C & S
45	*C. viminalis* Willd.	Wai Khom	C & N
46	*C. viridispinus* Becc.	Wai Sai	S
47	*Daemonorops angustifolia* (Griff.) Mart.	-	S
48	*D. brachystachys* Furtado	Wai Khee Kai	S

Appendix 1. Checklist of Thai Rattan *(continuation)*.

No.	Botanical Name	Thai Name	Locality
49	*D. calicarpa* (Griff.) Mart.	-	S
50	*D. didymophylla* Becc.	Wai Khee Ped	S
51	*D. geniculata (Griff.) Mart.*	-	S
52	*D. grandis Mart.*	-	S
53	*D. kunstleri Becc.*	Wai Ngoy	S
54	*D.* lewisiana *(Griff.) Mart.*	Wai Kium	S
55	*D. monticola (Griff.) Mart.*	-	S
56	*D. sabut Becc.*	Wai Pon Khon Norn	S
57	*D. schmidtii* Becc.	Wai Som Khao	E & S
58	*D. verticillaris* (Griff.) Mart.	-	S
59	*Korthalsia grandis* Ridley	Wai Dao Yai	S
60	*K. laciniosa* (Griff.) Mart.	Wai Dao Bai Yai	S
61	*K. rigida* Bl.	Wai Dao Lek	S
62	*K. scaphigera* Griff. Ex Mart.	-	S
63	*Myrialepis scortechinii* Becc.	-	S
64	*Plectocomia griffithii* Becc.	Wai Wa Ta Ma Da Long	S
65	*P. kerrana* Becc.	-	N+E
No.	Botanical Name	Thai Name	Locality
66	*P. macrostachya* Kurz	Wai Kom Pod	S
67	*P. pierreana* Burret	-	E & S
68	*Plectocomiopsis geminiflorus* (Griff.) Becc.	Wai Kung Nam Prai	S

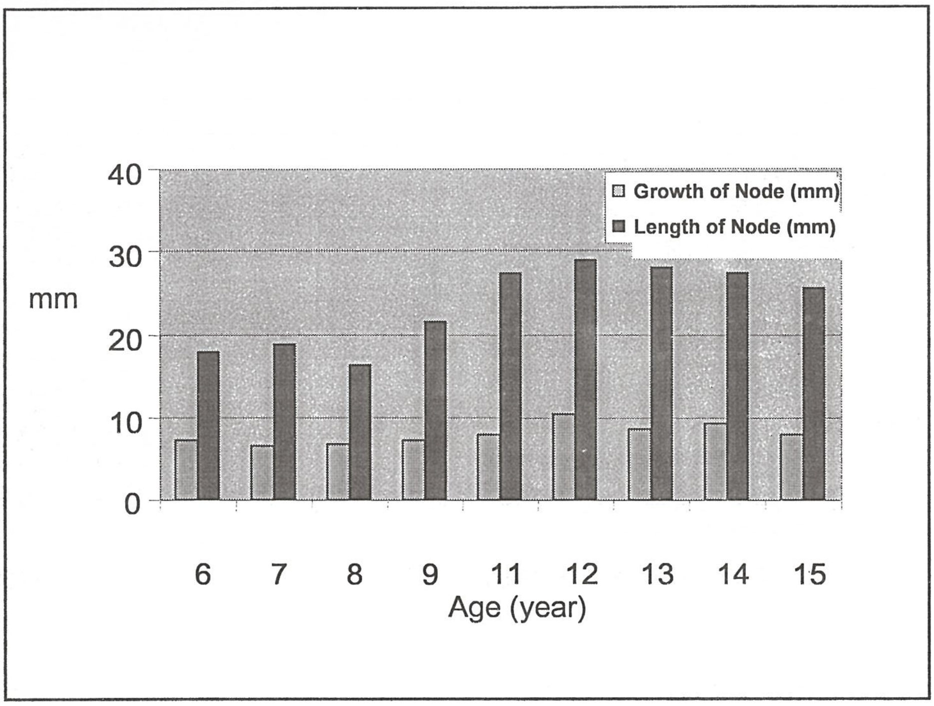
Source: Smitinan, Tem 1988 cited by Ngamchareon, Charnchai 2001

Appendix 2. Economically and Commercially Important rattan species of Thailand.

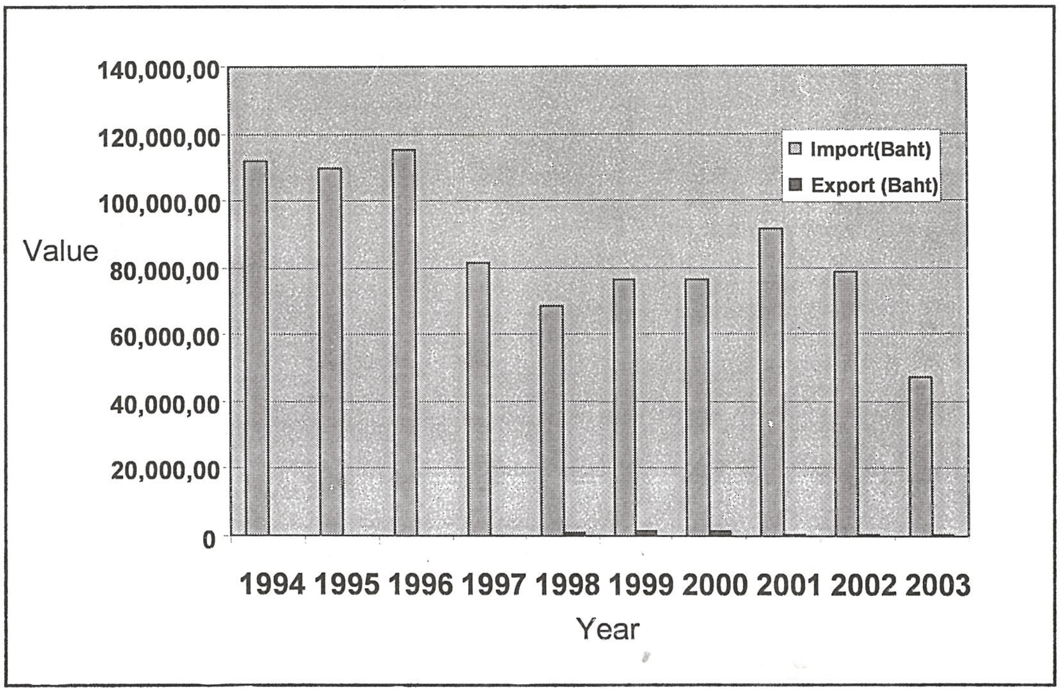
Scientific name	Local name
I. Large size	
1. Calamus manan	Wai Kor Dum
2. Calamus wailong	Wai Nam Pueng
3. Calamus peregrinus	Wai Nguay
4. Calamus longisetus	Wai Kam Puan
5. Calamus erectus	Wai Khee Sien
6. Calamus latifolius	Wai Pong
II. Small size	
1. Calamus caesius	Wai Ta Kha Thong
2. Calamus axillaris	Wai Ta Kha Nam
3. Calamus blumei	Wai Khee Pueng
4. Calamus pandanosmus	Wai Lek
5. Caluamus myriantus	Wai Khee Kai
6. Calamus SP.	Wai Sum
7. Daemonorops sabut	Wai Pon Khon Norn
8. Calamus siamensis	Wai Dong
9. Calamus densiflorus	Wai Khee Rae
10. Calumus palustris	Wai Kring

Source: 1. Subansenee, Wanida 1996
2. Kuldilok, Chanatip 2001

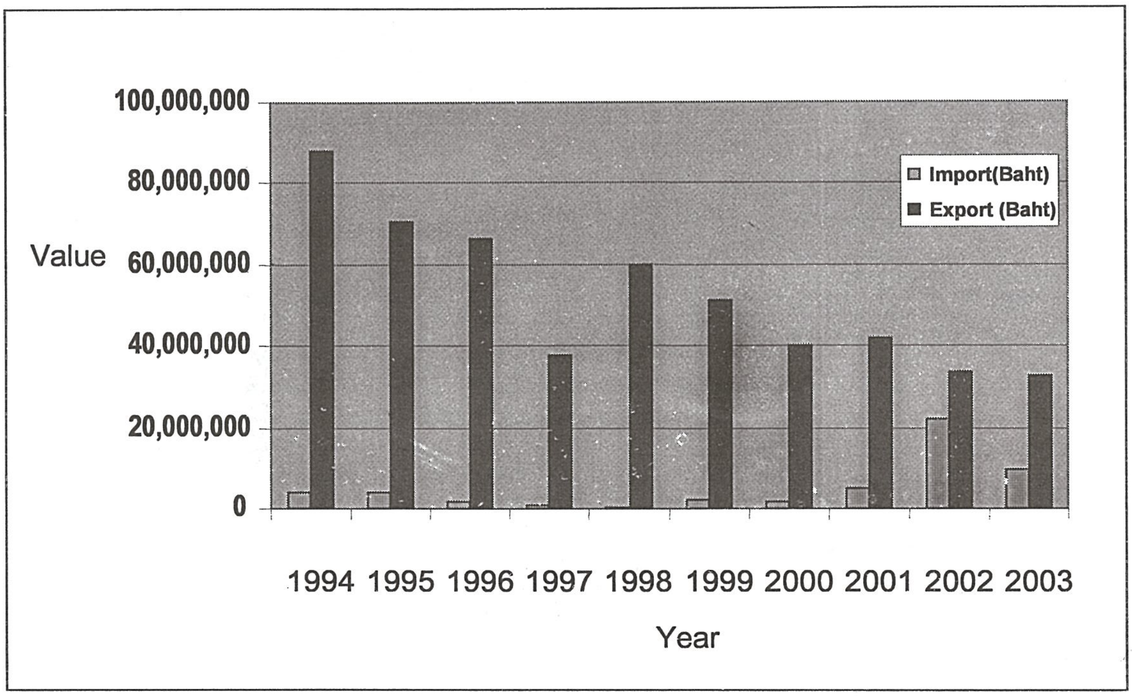
Appendix 3. Growth of Node and Length of Node.



Appendix 4. Import and Export of Rattan Raw Materials.



Appendix 5. Import and Export of Rattan Furniture.



Country Report of Rattan in Vietnam

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I. INTRODUCTION

Vietnam has around 25 million minority people and their lives depend on the cultivation and harvesting of nontimber forest products, of which rattans play an important role. In the previous years, it is estimated that about 20,000 t of rattan handicrafts were exported to many countries. This created a lot of work and benefits for groups of people that helped improve and develop the social and economic conditions in Vietnam in general. Currently, the rattan sector is of interest to the government authorities, organizations, manufacturers, and villagers both from the traditional and urbanized villages. There are no estimates of the quantity of the available rattan because a comprehensive inventory has not been done yet. Therefore, it is necessary to quickly inventory the areas, and determine the yield and quality of rattan in Vietnam. These will be the basis of various programs for the cultivation, harvesting and processing of the resources.

II. RATTAN RESOURCES

Rattans are widely distributed in Vietnam, but found abundant in the following regions/provinces:

- In northern Vietnam: Ha Giang, Tuyen Quang, Yen Bai, Bac Thai
- In middle Vietnam: Nghe An, Ha Tinh, Quang Binh, Quang Tri, Thua Thien Hue, Quang Nam, Nghia Binh, Sac Lak, Binh Thuan.
- In southern Vietnam: §ong Nai, Binh Phuoc.

In Vietnam, rattan has not completely been studied. Vu Van Bay and Le Huy Cuong found 6 genera with 30 species, included: *Calamus* (19 species and 01 subspecies), *Daemonorops* (04 species), *Korthalsia* (02 species), *Myriapis* (01 species), *Plectocomia* (02 species), *Plectocomiopsis* (01 species); of which 15 species are harvested and used, but only 5 species harvested in large number. They are: Maay neeps *(Calamus tetradactylus)*, Maay ddawngs *(C. tonkinensis)*, Song maatj *(C. platyacanthus)*, Song ddas *(C. rudentrum)*, and Song bootj *(C. poilanei)*.

No	Common name	Local name	Scientific name	Distribution
	I. Maay neeps		***Calamus L.***	
1	Mais (*)	Mais nuwowcs	*C. armarus* Lour. (*)	in the north of Vietnam
2	Maay ba lawng sa		*C. balanseamus* Becc.	Ha Bac, Ha Giang
3	Maay bon		*C. bonianus* Becç.	
4	Maay las roongj	Cheof ddooif	*C. bousing onii* Pierre ex Becc.	from Da Nang to Dong Nai
5	Maay cam boots		*C. cambodiensis* Becc.	Dong Nai
6	Maay roi		*C. ceratophorus* Courord.	from Nha Trang to Phan Rang
7	Maay taauf (*)	Maay las lieeux	C. *dioicus* Lour. (*)	from Thua Thien Hue to Dong Nai
8	Maay ddoongf nai		*C. dongnaiensis* Pierre ex Becc.	Lam Dong, Dong Nai
9	Maay pha bee	Maay thur coong	*C. faberii* Becc.	Thua Thien Hue
10	Maay nam booj	Maay taauf	C. *palustris* Griff. var. *cochinchinensis* Becc.	from Ha Tuyen to Dong Nai

11	Song maatj (*)	Song mets	*C. platyacanthus* Warb. ex Becc. (*)	in the north of Vietnam: Vinh Phu, Yen Bai, Tuyen Quang
12	Song bootj (*)	Treof ddooif, Poongs	*C. poilanei* Conrard. (*)	Thanh Hoa, ..., Lam Dong, Binh Thuan
13	Heof giar (*)		*C. pseudoscutellaris* Conrard. (*)	in the north of Vietnam
14	Song ddas (*)	Song dden	*C. rudentum* Lour. (*)	in the south, also in the north
15	Maay taauf		*C. speciosum* Lour.	in the south
16	Heof		*C. sactellaris* Becc.	Thanh Hoa
17	Maay neeps (*)	Maay tawts, Maay ruootj gaf	*C. tetradactylus* Hance. (*)	Ha Tuyen, Quang Ninh, Thai Binh, Hai Phong, Ha Noi, Nam Ha, Ninh Binh, Thua Thien Hue, Dong Nai.
18	Maay ddawngs (*)	Mais	*C. tonkinensis* Becc. (*)	Quang Ninh, Thua Thien Hue, Nha Trang, Ninh Thuan, Dong Nai.
19	Maay cats	Maay deor, Maay rax	*C. viminalis* Willd.	from Quang Ngai to Dong Nai, and Phu Quoc.
	II. Maay nuwowcs		***Daemonorops* Blume**	
20	Maay nuwowcs	Maay thowm, Maay giang, Maay ddor	*D. geniculatus* Mart.	Nha Trang
21	Maay nuwowcs mo daif		*D. longispathus* Becc.	Nha Trang
22	Maay nuwowcs		*D. margaritae*	in the north
23	Maay nuwowcs Pie (*)	Maay ddor	*D. pierreanus* Becc. (*)	in the south: Quang Nam Da Nang, Phu Yen, Khanh Hoa, Dong Nai
	III. Phuwowns		***Korthalsia* Blume**	
24	Phuwowns	Maay taamf voong	*K. laciniosa* (Griff.) Mart.	(Tay Nguyen), Dong Nai, Song Be
25	Phuwowns las hepj		*K. farinosa* Becc.	Dong Nai
	IV. Maay rups		***Myrialepis* Becc**	
26	Maay rups		*M. paradoxa* Kurz.	Binh Thuan, Ninh Thuan, Dong Nai
	V. Song las bacj		***Plectocomia* Mart et Blume**	
27	Song las bacj		*P. elongata* Mart et Blume	Quang Nam Da Nang
28	Maay xuwowng mocs		*P. khasyana* Griff.	Binh Thuan, Ninh Thuan
29	Song las bacj bawcs		*P. microstachys* Burret.	in the north
	VI. Song voi		***Plectocomiopsis* Becc**	
30	Song voi (*)	Song ddotj ddawngs	*P. gemniflorus* Becc.	Lam Dong

Note: (*) Major commercial species, as defined by Vu Van Dung and Le Huy Cuong, 1996.

Recently, rattan attained high export value and mass market; subsequently, the rattan resource of the country has been overexploited and is becoming poorer. Some rattan species are disappearing in some areas; in fact, two species *(C. poilanei and C. platyacanthus)* are recorded in the Red Book of Plant of Vietnam (1996).

The statistics on the rattan harvest during the period 1995 -1999 is as follows:

Year	1995	1996	1997	1998	1999
Quantity in tones	28,500	25,975	25,639	80,097	65,700
Amount in million USD		119	no data	no data	no data

III. PRODUCTION AND RESOURCE MANAGEMENT

Rattan, one of the groups of NTFP, has been grown by the people and developed very early in Vietnam. Rattan has been cultivated at three scales: plantation scale for commercial use, village scale for domestic use and as a cash crop, and experimentally in small plots.

The rattan supply mainly comes from the natural forest. Some species are planted in the gardens, of which Maay neeps *(C. tetradactylus)* is a special one. Cultivation of this started in the northern Vietnam more than a hundred years ago. At first, Maay neeps was planted in Thai Binh and Ninh Binh provinces; then the practice spread to Hai Hung, Ha Tay, Hoa Binh, Thanh Hoa, Nghe An. At present, most provinces in North Vietnam have planted this species. Since 1975, some provinces in South Vietnam have also been planting Maay neeps.

Rattan has been mainly planted at the household garden scale for home use. So far, there are 4 rattan species planted namely: Maay neeps, Maay ddawngs *(C. tonkinensis)*, Song maatj *(C. platyacanthus)*, Song ddas *(C. rudentrum)*, of which Song maatj *(C. platyacanthus)* planted at small scale in Hoa Binh. Maay neeps is planted more widely and has an estimated yield of 2500-3000 t/yr.

Under the project entitled "Sustainable Utilization of Non-Timber Forest Products", 194,238 seedlings of Maay neeps were planted in the Cam Xuyen district, Ha Tinh province during 2 years (2000-2001). The rattans were interplanted with agricultural trees.

number of households planted rattan in their gardens	number of seedlings planted in this area	survival rate in per cent	capital investment in VND
136	194,238	80	70,902,500

In the last two years, the Huong Son Plantation germinated and planted 20,000 rattan seedlings of *C. tetradactylus* and *C. tonkinensis*. Huong Son plans to produce 50,000 seedlings in the coming years. In the plantation, farmers planted 2 seedlings/supporting tree, selected at a spacing of 4 m x 4 m (approximately 600 seedlings/ha). The cost of forest protection is 30,000VND/ha/year.

Cost of 1 ha of rattan plantation in Huong Son, HaTinh is as follows (*):

Activity	establish plantation	seedling	labor	maintenance	Total Cost
Amount in VND	70,000	300,000	700,000	30,000	1,100,000

Note: (*) data cited from the document on rattan plantation establishmenr, by Le Dinh Loi (May, 2003).

Rattan is mainly exploited from natural forests. Groups of villagers (3 to 5 persons) go to the forests for several days (5 to 6 days) at a time during the harvesting season from June through October. Each person can cut an average of 3 pieces (4.5 m length) of large diameter cane/day. The canes are carried out of the forests by the harvesters (each one carries an average 30 kg to 40 kg) and sold to the gatherers or collectors at 10,000 VND/piece.

The canes are not treated from the attack of molds by harvesters, but this is usually done by gatherers or agents. Rattans are treated according to the following: large- or even small-diameter canes are boiled in oil (diesel oil) in varying proportions for varying periods of time. Treated canes are rubbed with sawdust, seasoned, graded, bundled, and stored until sold.

IV. PROCESSING AND UTILIZATION

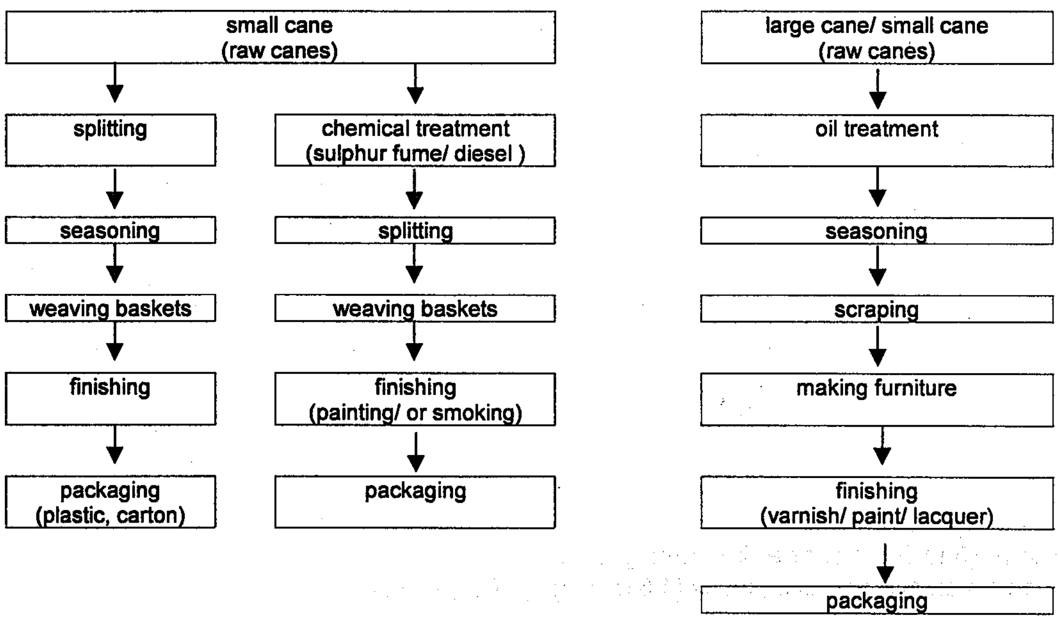
Household-level Processing: The local people receive orders to manufacture the designed products from the local collectors or traders. Normally, the village people get the raw materials or primary materials from the collectors and take them home to manufacture. Here, rattan processing is mostly manual. Peeling and splitting are done by hand, and only very rudimentary tools are used in bending and manufacture of furniture. The payment is made based on piece work. As an example, in a village in Phu Nghia - Ha Tay, there are 5,000 of total 8,000 people who make rattan and bamboo handicrafts. Their average income is 350,000 to 450,000 VND/mo which is equal to three-fourth the annual income of a farmer.

Small-scale Industrial Processing: Actual processing activities may be manual, semi-mechanized or mechanized depending upon the requirements and level of investment. These manufacturing enterprises are often located in areas rich in rattan raw materials (Da Nang in the middle of Vietnam is an example). These enterprises mainly process rattan canes into primary materials and supply to the manufacturers.

Large-scale Industrial Processing: In Vietnam, there are around 36 rattan-processing enterprises, with a total output 26,840 t/yr. They are concentrated in Ho Chi Minh, Nha Trang, and Da Nang. RAPEXCO in Nha Trang is one of the biggest factories.

Process flow for raw canes, finished products (furniture, basketry).

The flow is like this: Harvested canes ==> Classification (based largely on experience) ==> Bundle ==> Yard 1 (by farmers / and or buffaloes) ==> Yard 2 (by trucks/ and or train) ==> Processing area ==> oil treatment (canes are boiled in oil solution of 80% of diesel, at temperature 65°C to 70°C in about 30 min; cost of treatment 30 VND/m long) ==> Seasoning ==> Splitting (recovery rate 60% to 65%) ==> Manufacturing.



V. MARKETS AND SOCIOECONOMICS

Participants in the rattan sector

Item	Exporter	Manufacturer	Plantation/ Grower	Gatherer
1. a. year in operation	1995 – 2003	1995 - 2003	1997 – 2003	2001 – 2003
b. location	HaTay	DaNang	HaTinh	HaTinh
2. Size	medium	large	small	large
3. Volume	200.000 products per year	140 tones	1.5 – 2 tones/ year	200 tones
4. ownership	family	family	family	company
5. Investment	500 million VND	1 billion VND		
6. a. type of rattan handed				
b. distribution systems				
7. Type of market				
8. Other source of income	None	none	timber	service
9. Membership in association	cooperative club	bussiness asso.	cooperative club	
10. Labor/ Wage	20 labors	300 labors	3 labors	150 labors

The following table shows 5 commercial rattan species, their characteristics and uses.

T	Species	Characteristic	Use	Price/ (*) in VND
1	Maay neeps *(Calamus tetradactylus)*	small cane (0.8 cm to 1.2 cm diameter), stems ultimately to 10 m to 15 m or more in length, internodes 15 cm to 40 cm long, flexible, ivory colour, split easily.	handicrafts, baskets and furniture.	7,000 to 8,000
2	Maay ddawngs *(Calamus tonkinensis)*	cane 1 cm to 2 cm in diameter, stems 20 m to 30 m long, flexible, white colour and smooth glossy outer surface, but internodes short (6 cm to 10 cm long)	not used for handicrafts, but largely for cordage	4,000 to 5,000
3	Song maatj *(Calamus platyacanthus)*	large cane (4 cm to 6 cm diameter), long stems 20 m to 30 m or more up to 100 m long in old forests, internodes 8 cm to 25 cm long, flexible, good strength, and very durable, cream coloured surface.	canes are used mainly for furniture, bridge cables, cables for ferry boats, for hauling logs.	5,500 to 6,000
4	Song ddas *(Calamus rudentrum)*	large cane (2.5 cm to 4 cm diameter), internodes 40 cm long, smooth glossy surface, but the vessel bundles large and sparse, hard to bent.	split cane is used for making basket frames, chair's braces	4,000 to 5,000
5	Song bootj *(Calamus poilanei)*	large cane (the small ends 4 cm to 6 cm in diameter), internodes 20 cm to 25 (40) cm long, white colour and smooth glossy surface, flexible, easy to bend.	whole canes are used for high quality furniture frames	6,000 to 7,000

Note: (*) farmer's price at the forest / and or garden in HaTinh and Daklak provinces, as interviewed by Do Thi Ngoc Bich (July 2003).

VI. POLICY AND LEGISLATION

In Vietnam, the government has issued a lot of policies for the development and protection of the forest resource. However, there is no specific policy or program on nontimber forest products (NTFP) management.

The most important policy that made the great changes in the forest resource is the policy by Government on Land and Forest Allocation to the households and communities for management (The Decision No 02/CP dated 15 January, 1994 on the right of forestland use; Instruction No. 06 LN/KN on forestland allocation; The Decision No. 163/CP dated 16 November, 1999 on the rent and allocation of forestland. This policy states that communities and households have the right to grow forest trees on their forestland area (consisting of timber trees and other species such as bamboo, rattan, etc.).

Five million hectares of the reforestation Program (Project 661/Q§-TTg dated 29 July, 1998 by the Government) are also concerned with the development of non-timber forest products.

Law on Forest Protection and Development dated 19 August, 1991; and the Decision No 18-H§BT dated 17 January, 1992; Instruction No 13/LN/KHLN by the Ministry of Forest. These regulations issued many stipulations on the Development and Protection of Forest Resource.

The Decision No. 664/ TTg dated 18 October, 1995 by the Prime Minister stipulated on the export some valuable nontimber forest products: "Banning Exportation of Bamboo, Rattan, and the Leaves of the Forest Trees".

The Decision No. 66/TTg dated July 29, 1998 by the Prime Minister stipulated: forest products that are harvested from plantation; bamboo and other minor forest products from nature forest are traded freely in the market. Timber and other forest products harvested in the natural regenerated forest that belong to the production forest, of which the forest owners are households or individuals, are traded freely in the market.

The Decision No. 65/TTg dated 24 March, 1998 by the Prime Minister on the exportation of wood products; forest products; and the importation of wood as raw material and forest products. According to this, wood products could be exported including the fine-art wood products, in which the products are made from wood, bamboo or rattan. These products are processed and exported, except the forest products belonging to IA group that spitulated in Regulation No 18/HDBT dated January 17, 1992.

Instruction No. 19/ CT-TTg dated 16 July, 1999 by the Prime Minister on the implementation of ways for the enhancement of value of wood coming from plantations stipulated that enterprises are allowed to export wood products; the favored tax applied to products made of wood comes from plantation.

The Decision No. 09/NQ-CP dated 15 June, 2000 by the Prime Minister on the policies for the transference of economic structure and consumption of agricultural products. The Decision impressed in developing the special tree species *(Cinnamomum casia, etc.)*, timber trees, and trees as raw materials for production of goods, such as handicrafts, bamboo and rattan products, especially for export.

The Decision No. 132/ TTg dated November 24, 2000 by the Prime Minister concerning policies on the encouragement of rural livelihoods, making plans for the development of raw material zones.

Decision No. 661/TTg dated 29 July, 1998 impresses on gene study for the selection, hybridization, and Importation the new tree species that gives good results in growth and yield.

VII. INSTITUTIONAL CAPABILITY AND LINKAGES

1. *Research Agencies and Universities*

- Hanoi Special Forest Products Research Center (TTNCLDS)
- Forest Science Institute in Hanoi (FSIV)
- Forestry Inventory and Planning Institute in Hanoi (FIPI)
- Forestry University in Hatay (FUV)
- Sub-Institute of Economy, Resources and Environment (SIERES)
- Institute of Ecology and Biological Resources (IEBR)
- Non-Government Economic Development Center (Nedcen)
- Non-Government Economic Development Center (Nedcen)
- Research and Training Center for Community Development (RTCCD)
- Medicinal Plant Research Center (MPRC)

2. *Government*

- IADA's Government (Government of Philippines)

3. *Non-government Organizations*

- The Center for Natural Resources and Environmental Studies (CRES) of the University of Hanoi (UoH).
- The Institute of Ecological Economy (ECO).

4. *International linkages*

Table 1. Institutional Capability and Prospects.

Field	Related Institution	Strength and Weakness	Prospect in the Cooperatives
Biology	FIPI, IEBR	Knowledge on NTFPs is limited, but having foundation to expand.	very good, having the individual relationships
Marketing Study	FSIV, NedCen	Good skills, but lacking of the sources for intended study.	available
Resource Management	TTNCLDS, FIPI, SIERES, MPRC	at the beginning state	good
Production Development	FUV, CraftLink, NedCen	Specialize bamboo, and handicrafts.	good
Post Harvesting Technology, quality improvement.	NedCen,UoH, Institute of Chemistry	quite strength,	good

VIII. CONCLUSION AND RECOMMENDATIONS

Matrix 1. Issues and Concerns confronting the rattan industry and recommended Solutions and Research and Development (R and D) strategies to address concerns.

Issue/Concern	Recommended Solution	R and D strategy to address them
1. Production	- setting the priority areas for cultivation of rattan (establish rattan plantation) - protection from blue stain and borers for raw canes - change in production scale from household level to medium or large scale - establish the small- or medium-scale processing mills at the raw material zones that could reduce price for the semi-finished or finished products.	- study on propagation, cultivation and disease for the important rattan species - enhance the post-harvest technology - import rattan processing machines from countries with strength in rattan industry. - training in harvesting, processing and coating techniques
2. Protection	- management of wild stands in a sustainable fashion. - conservation of threatened rattans and their habitat	-.inventory of the rattan resources: species, distribution, ecology, area (ha), and volume (lineal meter). - establish the seed orchards for longer term use.
3. Marketing	- market expansion and promotion	- market survey, forecast market demand - designation needs to create suitable products for various markets
4. Information System	- update, propagate and exchange information on the nursery works, cultivation, harvesting, protection, processing. - setting up an information center with a herbarium on international level with proper collection, information and databasing.	- setting the website, library related to rattan industry - enhance the activities on training, introducing the issues related to rattan
5. Administrative a. policy implementation b. linkages c. tenurial system	- make suitable specific policies on rattan, especially on taxation, exportation. - strengthen the relation among the rattan participants such as growers and manufacturers and exporters	- call for the support of individuals, organizations, governments, and non-governments on rattan.
6. Others	- carry out the training courses in taxonomy, herbarium management and fieldwork either for students or interested staff members in the country - human resource development for Vietnam Forestry University: Master and PhD Degree, particularly in rattan processing, preservation and taxonomy.	

Matrix 2. Strength, Weaknesses, Opportunities, Threats in the rattan industry.

Item	Strength	Weakness	Opportunity	Threat
1. Production of raw materials	- labour available and cheap	- lack of capital for rattan cultivated	- create job for local people	- lack of knowledge for planting, treating diseases
2. Marketing a. raw materials	- large demand - the competition on price at the different areas	- lots of middle-men - lack of market information	- farmers readily to participate	- distribution sparsely - high transportation costs - harvest time
b. finished products	- high quality products, cheap and various kinds of products - traditional products	- market survey - market information - old-fashioned designs	- internal and external trade has been expanded	- unstable markets - competition with foreign countries' products
3. Utilization/ Manufacturing	- labour available, skillful, and heavy in experience.	- manual production - protection of raw materials and finished products	- technology transfer - imported modern machines - application of science knowledge in rattan processing	- lack of processing knowledge - lack of raw materials
4. Policy	- support to the state's policies on the development of the professional villages	- specific policies related to rattan	- the necessary policy for the development of rattan industry	- the farmer's knowledge - policy implementation
5. Information	- showrooms for rattan products	- lack of interdisciplinary linkages	- biodiversity information center and network on rattan	- information analysis and processing.
6. Institutions				

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The Status of Rattan Resources and Rattan Mills in Cambodia

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I. INTRODUCTION

Rattan has been used for approximately more than 400 years till presence in Cambodia. Khmer (Cambodian) people used to exchange goods derived from rattan for clothes and other utensil with Chinese business people (Ly Theang Teng, 1973). During the period of the Empire of the Khmer, thousands of domestic elephants were used to be warriors and by then several tons of rattans used to equip warrior's materials. The evidence, so far, lies with mahouts keep using rattans, as ties when they go in the forest even though industrial robs are available in their villages.

Rattan is becoming more often used in everyday life of people living in cities (big and small). Furniture made from rattan is light and comfortable to use. It is mainly used for producing the furniture like chair, table, bookshelf, and wardrobe. In Cambodia, furniture derived from rattan is preferably used by foreign people working and living in Cambodia. Most office furniture of NGOs is made from rattan.

Since rattan is getting more used to be raw materials and in larger scale, identification of sustainable use methods should be urgently needed. It is noted that all rattan used in Cambodia are collected from the wild forest areas. Moreover, study for sustainable use of rattan has not been conducted even once, although people keep saying that rattan naturally grows in most parts of forests areas in Cambodian. If possible, taxonomical study in rattan is even urgent needed before the diversity of rattan species disappeared from this country.

Since there has not many, if there would be one, records of number of rattan species and their use, Forest and Wildlife Research Institute, Forestry Administration (FA) teamed up in order to conduct countrywide study of rattan in Cambodia. However, due to limited financial support from ITTO Rattan Project the study was carried out in pilot provinces such as Siem Reap, Kampot, Kampong Thom, and Kampong Speu only. The study was, also, conducting interviews with rattan handicraft workshops and markets in the survey sites.

II. RATTAN RESOURCE

Rattan grows naturally. There have no rattan cultivation in Cambodia so far. Rattan can be found in provinces such as Kampot, Kampong Speu, Koh Kong, Pursat, Kampong Thom, Battambang, Kratie, Rattanakirie, Mondulkiri, and Steung Treng.

We have no precise data about the resource of rattan in the country. The study about the use of rattan has not been carried out until now throughout the country. From the project support, there were five provinces where the study has been made: Kampong Thom, Siem Reap, Kampong Speu, Kampot, and Kandal.

Rattan Species

There are many species of rattan in the country. However, only six species of rattan are mainly used in Cambodia such as Phdao Dombaong, Phdao Kreik, Phdao Som, Phdao Russey, Phdao Prah Pdeiv, and Phdao Seoung.

a. Phdao Dombaong species: This species is the biggest stump of all rattan species found in Cambodia. Its diameter is bigger than 18 mm and grown in some provinces like Kampot, Siem Riep and Kampong Speu. This species is used for producing, chair leg, table leg and cupboard leg (because of the size of the diameter is higher than 18mm, and its straightness). The price of this species is higher than any other.

b. Phdao Prah Pdeiv species: This rattan has the diameter a little bit smaller than Phdao Dambaong. It can be found in provinces like Kampot, Sihanouk Ville and Siem Riep.

c. Phdao Kreik (Phdao Achmoun or Phdao Chvang)
The name of this species of rattan is called differently depending on the locations in country. For example, the name of Phdao Achmoun or Phdao Chvang is known only in the province of Koh Kong, and in another provinces this sort of rattan is known as Phdao Kreik. It could grow in almost every part of the country and very popular for its use. This rattan has the diameter about 10mm (almost the same size the finger). Its use is known for producing furniture parts.

d. Phdao Som: This rattan is very rare, and can be found only in Kampong Thom province. It has the diameter bigger than 20mm. The quality of this species is not as good as others. Its use is for producing, chair, table, and cupboard. The use of this sort is not so popular throughout the country.

e. Phdao Rusey: Phdao Russey has the size a little bit bigger than Phdao Dambaong. It is known for its strength, straightness (like bamboo), but it is very difficult to bend. It can be found in Siem Riep province (only in small quantity). Its use is for producing the furniture frame, where there is not much need to bend.

f. Phdao Seoung: This rattan has smaller diameter than any other and has been found growing only in Kampong Thom province. Its use is for producing some fishing instrument.

III. RATTAN CULTIVATION

Cultivation of rattan has not been carried out in Cambodia so far. For more than two hundreds years of use of rattans, the rattans have been only collected from the forest areas. Hopefully in the near future, as large quantity of rattan demanded, the rattan would eventually planted.

IV. THE RATTAN SUPPLY FOR THE INDUSTRY

There has not been industrialized in any kind of rattan so far in Cambodia. The highest quantity extracted from the wild was only by ox cart means. The biggest quantity of rattan use was in the fishing instrument, which is located surrounding the Tonle Sap lake of Cambodia. Second biggest site of rattan use is within Phnom Penh city.urban. However, there is no modernized rattan industry in Phnom Penh rather than handicraft workshops.

V. RATTAN HARVESTING

Rattan harvesting in Cambodia is not much different, compared with other Asian countries. It is based on the traditional techniques. The villagers residing close to the forests harvest rattan in term of a full time and short time basis. Each time, they spend 3 days to one week in the forest to harvest rattan.

The activity involves in walking into the forest in search of matured species for its usable canes. In general, the species that they search depend on the need of manufacturers or middlemen. And the traditional technique of harvesting is by cutting the stem and hauling it down. Afterwards the cane will be cut depending on the diameter. The rest of the cane is left behind in the forest. The loss of the cane can reach up to 50% of the total cane length.

An alternative method is to cut the matured cane and left it 1 or 2 days, so that the branches of the cane dried enough and then hauling it down. The loss of the cane can be reduced because the branches are not too much entangled with the surrounding rattan canopy. Extractions of rattan from natural forests are another difficulties and it requires some skills and experiences.

Collectors are going (or sometimes they use oxcart) to the jungle to search for rattan. The time they need for collecting the rattan is from sunrise to sunset, as long as they can see. Normally for one day, depending on the species, diameter, and difficulties of collecting, one rattan harvester can collect 3 to 5 canes with each cane length of 3 m to 5 m.

For rattan harvester coming from far away, each time they spend 5 to 8 days in the forest. They can collect 1-2 bundles, containing of 100-150 canes of mixed species and size (diameter and length). The canes are transported to a temporary collection sites, where the canes are purchased by the middlemen and finally to the manufacturers.

1. Mechanical harvesting

At present rattan harvesting from the wild is being done mainly by the traditional methods, by hand and local instruments. There is no machine harvesting in Cambodia. Oxcart and domestic elephants are sometimes used to extract rattans from forest areas.

2. Grading of raw cane

There is no national unified grading rule in Cambodia. Grading in rattan is usually derived from long traditional practices established in specific localities, by local communities or even by individual traders. Traditional, but not formal, grading rule in Cambodia depends on the species, size (diameter and length), and quality of rattan. Because of this, the selling price may vary according to the criteria mentioned above.

3. Transportation

At present most raw canes are obtaining from the natural forest, where they grow naturally. Different part in Cambodia has different ways and means of transporting rattan canes out of the forests. In Cambodia the use of animals as means of transportation is still practiced, such as ox, buffalos, domestic elephants, and bicycle. Transportation is by means of river (rattan raft navigated by boat) in Cambodia. Another means of transportations are also motorboat, vehicles and trucks. The rattans are transported to a temporary depot(s) before transporting to the processing sites.

4. Rattan Storage

The rattans that have been transported to the depots or the processing sites are normally of mixed species, size and quality. Because of this, upon arrival, they are immediately segregated according to species and diameter (big canes >18mm; small diameter <18mm). The type of the rattan species, their initial physical condition and diameter, mostly indicates the method used in processing the rattans for storage.

For quality determinations, both the larger and smaller diameters, rattans are sorted into two quality classes: (a) good quality with no or few defects (good); and, (b) heavily defective (inferior).

After grading, rattans must be sun-dried before processing. The sun-dried will be stored in go downs, where they are stacked horizontally in a criss-cross manner in order to facilitate the circulation of air and to prevent discoloration due to dampness. Oil boiling and curing process are not practiced in Cambodia yet.

5. Rattan Processing and Utilization

5.1. Rattan processing mills in Cambodia

There is no rattan processing mills in Cambodia. Rattans are processed handicraft. There are small handicrafts with only 5 to 10 skill workers, where rattans are processed. Traditional processing methods are practiced, such as:

- Sun-drying
- Debarking
- Splitting
- Bending
- Weaving
- Sulphur-fumigation and
- Finishing

All of these above mentioned methods are not used countrywide in Cambodia. There are other methods practiced depending on experiences. Among the products of small diameter canes are cores, splits, skins and washed sticks that are used as webbings, weavings, binds, basketry, and or furniture components.

5.2. Grading

As mentioned earlier, there has no formal grading rule in Cambodia yet. A not formal grading rule practiced by the traders and manufacturers are as following:

- Grading according to dimension
- Grading according to defect
- Grading based on color

VI. MANUFACTURING TECHNOLOGIES

Rattan furniture manufacturing technologies are as follows:

1. Cane Selection

Rattan poles are selected according to the size, species, and the quality of furniture they are intended for. The poles with big diameter are used as mainframe components such as backrest and legs. Another use of rattan poles is used for weaving.

2. Straightening of rattan poles

Rattans poles are in their nature bent out of shapes a little bit or due to the vertical storage. Because of that, before they are processed for furniture manufacturing, they must be straightened first.

Straightened rattan poles would ease further processes of making higher quality rattan furniture. In Cambodia, the bend rattan poles are straightened manually by using blowtorch so that they become soft and pliable.

3. Measurement and Cross-Cuttings

The straightened rattan poles are measured and cut into the desired lengths. Measurements could be made using 1:1 scaled plan. Radial arm-saw or small saw-machine is used for cutting the poles.

4. Bending and Moulding

After the straightened rattan poles have been cut, they are bent manually or by using moulds. Blowtorches are also used to pre-heat the rattan parts that need to be bent. The heating time varies from 10 mm to 30 mm depending on the diameter of the poles. The setting time of simple moulds is about 5 hours and the time is longer for more complicated shapes.

5. Drilling and Grooving

The method of drilling and grooving from all manufactures is the same. Most rattan furniture components especially the seat and backrest are drilled with series of holes for inserting rattan webbing. Depending on the shape of the furniture components, the drilling and grooving are done either prior to or during the assembly process. For the straight component, drilling and grooving are achieved using bench-drill units. For the molding components, drilling and grooving are done manually using hand-drill when the basic frame is assembled.

6. Assembly

Assembly methods are almost the same from one manufacturer to another. The furniture components are assembled together to form frame structure. Screws and nails are the common fasteners used to join the components.

In assembly, the process is done by two stages:

- Sub-assembly to form a basic frame structures and
- Final assembly to attach additional components.

7. Binding and weaving

The popular materials are rattan skins, splits and core. Some workers prefer to sit on a low stool or even on the floor to do this work, while others like to work at a low bench on which the frame is placed. Either sitting down or standing up it is important to ensure that a comfortable working and that the materials needed are readily available so that the binding time is reduced to a minimum.

8. Scraping and sanding

Scraping and sanding are the process to smooth the surface of the components using sanding papers. The works are done at various places in the workflow. It can be after the cross cutting, after bending and molding, after assembly and during finished process. After bending the sanding is required to polish rough rattan surface due to the steaming process or to remove the burned marks caused by blowtorch. Scraping is done using hand scrapper to remove excessive putty.

9. Finishing

Finishing is to ensure the final quality of furniture. In Cambodia, furniture is not painted or sprayed with glossy paint, but sprayed with a kind of varnish material to get a glossy looking.

To achieve the quality of finishing, spraying is carried out is an enclosed room with spray booths. Otherwise, the finishing can be carried out with a normal paintbrush.

10. Packaging

The finished products are packed depending on the transportation distance, the quality and the size of the products. Some manufacturers pack their products with carton or with plastic material to prevent getting dusty and scratching.

VII. MARKET AND SOCIOECONOMICS

Taking into consideration that the rattan furniture are getting popularity from day to day, therefore, it should take some measures on creating:

- More market opportunities (domestic and abroad)
- So-called community cooperative business so that the villagers can become the workforces.

Some of the requirements, also, should be provided:

- Financing for small-scale manufacturers at below market interest,
- Technical service and training.

1. Rattan Marketing and Trade

As mentioned above in the previous sections that in Cambodia there is no formal rule for rattan exploitation. Rattan exploitation in Cambodia is only so-called small-scale rattan exploitation and its use only for the domestic needs.

The selling price of rattan varies, depending on the season. For a 5 m long rattan pole, the selling price could be around 1000 Riels (about USD 0.25) to 5000 Riels (about USD 1.25) depend on the quality and diameter. That's why we cannot create a precise pricelist like many other countries do.

VIII. ENVIRONMENTAL ISSUES

The rattan furniture manufacturing in Cambodia is only small-scale. Therefore, threat to the environment would not be occurred. The big problem faced is the high wastage of rattan raw material, especially rattan poles, which often become a burden to the environment through open burning and illegal dumping. A productive way of managing the waste is by using them as fuel.

IX. CONCLUSIONS AND RECOMMENDATIONS

Improving and encouraging the use of rattan and other nontimber forest products (NTFPs) instead of timber would be one of the options to wisely natural resources. At this stage, among ASEAN countries, Cambodia would be the one where NTFP could be substantially replaced timber utilization. Besides rattan, liquid and hard resin have been use, both domestic and exported, countrywide.

Because the use of rattan furniture is getting more popularity, the rattan exploitation is also getting more out of control. In this reason exploitation rules should be established and gotten into force as soon as possible.

Moreover, some concerns for rattan development should be taken into consideration. For example creating a trail basis for:

- Rattan cultivation in natural forests,
- Rattan cultivation in forest plantation, and
- Raise planting stocks.

X. Reference

Ly Theang Teng. 1973. The Manual of Chiev Ta Khvan: the Tradition of Chenla villagers.

COUNTRY: Myanmar

Area of Concern	Status/Problem	Need
1. Resource Inventory		
a. Taxonomy	Taxonomy is not complete.	Consultant on rattan taxonomy
b. Extent of natural stand/plantation	No inventory of rattan FD has inventory section but trained on rattan	Need training and funding/project to do rattan inventory
2. Nursery activities a. Propagation b. Seedling care and maintenance	Vegetative propagation research was started but discontinued	Funding on vegetative propagation research needed
3. Plantation establishment a. Site requirement b. Site preparation c. Outplanting d. Maintenance and protection	One hectare of experimental plot was established in 1985 but monitoring growth and yield did not materialize	Funding on research of trial plantation and project for launching plantation programme needed
4. Harvesting system	Only conventional harvesting waste and method.	Improve techniques needed
5. Grading standards	No national grading systems and rules	Consultancy fro both national and regional experts
6. Transporting/hauling	Use manpower, trucks and boats	
7. Post-harvest activities	Sundry, diesel cooking, sanding. No chemical treatment. Loses still high	Improve and more efficient method
8. Marketing	Local market is limited. Raw material export market at border with China is tremendous	Market information for export of finished products needed

COUNTRY: Brunei

Area of Concern	Status/Problem	Need
1. Resource Inventory a. Taxonomy b. Extent of natural stand/plantation	Inventory is not expensive	Complete inventory should be done
2. Nursery activities a. Propagation b. Seedling care and maintenance		Funding on vegetative propagation research needed
3. Plantation establishment a. Site requirement b. Site preparation c. Outplanting d. Maintenance and protection	▪ Limited land for rattan plantation ▪ Lacking of appropriate silvicultural technique wrong choice	▪ Policy reforms ▪ Strengthening the capability ▪ Appropriate site-matching through R and D
4. Harvesting system	Only conventional harvesting waste and method.	Improve techniques needed
5. Grading standards	No national grading systems and rules	Consultancy fro both national and regional experts
6. Transporting/hauling	Use manpower, trucks and boats	
7. Post-harvest activities	Sundry, diesel cooking, sanding. No chemical treatment. Loses still high	Improve and more efficient method
8. Marketing	Local market is limited. Raw material export market at border with China is tremendous	Market information for export of finished products needed
9. Financial analysis	No study of economic alternative of land use	

COUNTRY: Vietnam

Area of Concern	Status/Problem	Need
1. Resource Inventory a. Taxonomy b. Extent of natural stand/plantation	No knowledge in technologies	▪ There is need to establish a common regulation/method in principal forest resource inventory ▪ Training and exchange experiences between countries ▪ Training the staff on this area; establish herbarium
2. Nursery activities a. Propagation b. Seedling care and maintenance	Not as good as other country	Exchange technique/ experience in all nursery activities to improve the quality of seedling
3. Plantation establishment a. Site requirement b. Site preparation c. Outplanting d. Maintenance and protection	Not so sure	Plantation establishment in 3 regions: North, middle and in south of the country.
4. Harvesting system	No technique of harvesting system; just traditional method	Training extension
5. Grading standards	No grading standard	We need a common grading standard
6. Transporting/hauling		
7. Post-harvest activities		
8. Marketing	No marketing systems	▪ Need to do researches on marketing ▪ Transfer/ extension the system ▪ Knowledge to the farmer

COUNTRY: Lao PDR

Area of Concern	Status/Problem	Need
1. Resource Inventory a. Taxonomy b. Extent of natural stand/plantation	▪ It has been done (guide book to rattan of Lao) but not complete yet. ▪ Only plantation for shoot plantation	▪ Inventory method ▪ Addition to identify the remaining voucher specimens
2. Nursery activities a. Propagation b. Seedling care and maintenance	▪ Seed collection ▪ Preservation ▪ Nursery practice ▪ Seedling are kept in one place	Improve germination
3. Plantation establishment a. Site requirement b. Site preparation c. Outplanting d. Maintenance and protection	▪ Suitable site for each rattan species ▪ Suitable site and eco. ▪ Planting when? ▪ Maintenance for how long	▪ Demonstration plots ▪ Visit to previous successful areas in ASEAN countries
4. Harvesting system	First maintenance- how to handle newly cut canes	Awareness for selection of canes for cutting
5. Grading standards	Low awareness on rattan grading	Awareness raising among gatherers and trader
6. Transporting/hauling	From forest: big/large canes have been dragged or pulled on the ground	Awareness on better protection to avoid the damage on canes
7. Post-harvest activities	Laying canes on ground or placed in water	Awareness on better post-harvest practices
8. Marketing	▪ Gatherers never bargain the prices ▪ Finished products did not have standard market	▪ Market available ▪ Organize village groups

COUNTRY: Lao PDR

Area of Concern	Status/Problem	Need
1. Resource Inventory a. Taxonomy b. Extent of natural stand/plantation	▪ It has been done (guide book to rattan of Lao) but not complete yet. ▪ Only plantation for shoot plantation	▪ Inventory method ▪ Addition to identify the remaining voucher specimens
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3. Plantation establishment a. Site requirement b. Site preparation c. Outplanting d. Maintenance and protection	▪ Suitable site for each rattan species ▪ Suitable site and eco. ▪ Planting when? ▪ Maintenance for how long	▪ Demonstration plots ▪ Visit to previous successful areas in ASEAN countries
4. Harvesting system	First maintenance- how to handle newly cut canes	Awareness for selection of canes for cutting
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6. Transporting/hauling	From forest: big/large canes have been dragged or pulled on the ground	Awareness on better protection to avoid the damage on canes
7. Post-harvest activities	Laying canes on ground or placed in water	Awareness on better post-harvest practices
8. Marketing	▪ Gatherers never bargain the prices ▪ Finished products did not have standard market	▪ Market available ▪ Organize village groups

COUNTRY: Indonesia

Area of Concern	Status/Problems	Needs
1. Resource Inventory a. Taxonomy b. Extent of natural stand/plantation	▪ 300 species with 7 genera ▪ Only 150 species are identified locally ▪ Out of the know 150 locally identified only 56 are scientifically known ▪ Natural stand are estimated to be 26.57 million ha with average potency of 615000 t ▪ Plantation are estimated area of 110,000 ha ▪ No accurate inventory on natural stand and plantation ▪ Extraction of rattan is greater than replanting ▪ Harvesting of rattan in the natural forest is concentrated on 28 spp. ▪ Harvestable volume of rattan plantation is not certain	▪ Ethnobotanist to properly identify other rattans ▪ Conduct inventory as to location and volume of these species ▪ Conduct inventory on natural stand and plantation establishment
2. Nursery activities a. Propagation b. Seedling care and maintenance	1 mo to 2 mo for seed to germinate Long germination period	Technology to shorten Germination of seed rattan
3. Plantation establishment a. Site requirement b. Site preparation c. Outplanting d. Maintenance and protection	▪ No proper selection of host tree ▪ Not all trees are ideal host tree for rattan ▪ Poorly manage and protection ▪ No problem for maintenance and protection	▪ Study on profitability comparison of rattan plantation ▪ Study on potential host tree for cultivation
4. Harvesting system	▪ Traditional way; cut and climb ▪ Traditional technique for rattan handling after harvest ▪ Higher harvesting wastage ▪ Takes time to handle rattan	▪ Appropriate harvest technology ▪ Appropriate post-harvest technology
5. Grading standards		
6. Transporting/hauling	▪ Rattan is transported manually through boat or by walking ▪ The long travel of transporting rattan exposes them to possible fungal attack	▪ Preservation of harvesting area ▪ Study on environment-friendly chemical preservation of rattan
7. Post-harvest activities		
8. Marketing	▪ Long existing market channel ▪ Farmers get less benefit	▪ Shorten market channel for rattan ▪ Organize farmers, so that industry buys rattan at farmer level ▪ Study on the impact of organized group of farmers in the marketing of rattan

COUNTRY: Cambodia

Area of Concern	Status/Problem	Need
1. Resource Inventory a. Taxonomy b. Extent of natural stand/plantation	▪ Only 11 species identified ▪ Level of basic knowledge about the exact species being used ▪ No complete inventory of the actual extent of the resources	▪ Taxonomic studies of the unidentified species ▪ Survey/assessment of actual resources
2. Nursery activities a. Propagation b. Seedling care and maintenance	No identified nursery activities	▪ Development of plantation through community based-trial ▪ Enrichment planting to secondary forest
3. Plantation establishment a. Site requirement b. Site preparation c. Outplanting d. Maintenance and protection	No plantation establishment	▪ Introduction of rattan into agroforestry systems ▪ Encourage the regenerations of rattan through assisted natural regenerations.
4. Harvesting system	No establish technology methods, undertaken only by individuals usually farmers	Effective utilization of rattan through studies that will help identify the most appropriate harvesting systems/regimes for each species
5. Grading standards	No falling grading standard	
6. Transporting/hauling	Gatherer transport the harvested rattan to the local trader by the use of animals, motorbikes	
7. Post-harvest activities	Manually processed resulting to low quality cane	▪ Introduce appropriate processing technologies ▪ Training and demonstration
8. Marketing	Very limited data, done only by individuals	Organize cooperative to lead

COUNTRY: Malaysia

Area of Concern	Status/Problem	Need
1. Resource Inventory a. Taxonomy b. Extent of natural stand/plantation	a. Malaysia has already produced 3 volumes of rattan manual on species identification for Peninsular Malaysia, Sabah & Sarawak. b. For natural resource inventory is done at National inventory level whereby only clumps of 5 commercial species were recorded and the others were reported for small and large diameter. c. Inventory tech. for rattan has already established.	
2. Nursery activities a. Propagation b. Seedling care and maintenance	a. Tech. on propagation through seed, tissue culture has already developed. b. All seedling care and maintenance has already established according to standard practice.	
3. Plantation establishment a. Site requirement b. Site preparation c. Out planting d. Maintenance and protection	Malaysia is quite advance in rattan cultivation from establishment, maintenance and experiences in problem after planting.	
4. Harvesting system	a. Malaysia is still using traditional harvesting done by climbers. Climbers climb to the nearest tree to the rattan plant and cut the rattan stem up to level he can reach. This lead to some wastage. b. FRIM is developing new techniques in harvesting using cutting tools and cables. This tech. does not need climber. The tech. is still need improvement through R and D.	
5. Grading standards	Please refer to Tables 4c, 4d, 4e, 4f, 4g, 4h.	
6. Transporting/hauling	Using 4WD such as small lorry and pickup	
7. Post-harvest activities	Please refer to Figures 3 and 4	
8. Marketing	Direct selling to local buyers (majority) and export to other countries if they have contacts overseas (not big in terms of number), display in showrooms, display product through websites (but still new and small), participating in the international furniture fairs, through brochures	Still needs better mechanism and effective in marketing Malaysia rattan products.

Table 4c. Malaysian grading system for round and peeled canes based on outer skin quality and diameter size of the canes.

Cane	Grade	Criterion
Round cane	1/1 1/3 4/5	No black or brownish spots Little spots Many spots
Cane	**Grade**	**Criterion**
Peeled	A B	Uniform whitish colour Some discoloration

Table 4d. Classification of rattan poles according to trade name.

Country	Trade name	Species group	General characteristic
Malaysia	Manau	*C. manan*	Glossy, not flexible, creamy colour, thin nodes with diameter of 2.5 to 4.5 cm.
	Semambu	*C. scipionum*	White creamy, less flexible, thick nodes with diameter of 2.5 to 4.5 cm.
	Sega	*C. caesius*	
	Irit	*C. trachycoleus*	Less glossy, brown colour, thick nodes with diameter of 1.6 to 2.5 cm. Grey colour with diameter of 3 to 5 cm.
	Dahan	*Khortalsia*	Brown colour

Table 4e. Classification of large size rattan poles or round canes by diameter sizes for different countries.

Country	Grade	Diameter	Length (m)	Criterion
Malaysia	A B C D E	40 mm and above 35 mm to 39 mm 30 mm to 34 mm 25 mm to 29 mm 24 mm to 19mm 18 mm and below	Large diameter canes, 3 m Small cane, 6 m	

Table 4f. Grading for small diameter canes.

Country	Grade	Criterion	Source
Malaysia (general grading rules)	1	Yellowish white in colour, smooth surfaces, and with no or few defects on epidermis, outer or inner portion of the stem.	Abd. Latif (1992)
	2	Reddish in colour and with few defects either on epidermis, outer or inner portion of the stem.	
	3	Reddish in colour with heavily defective stem	

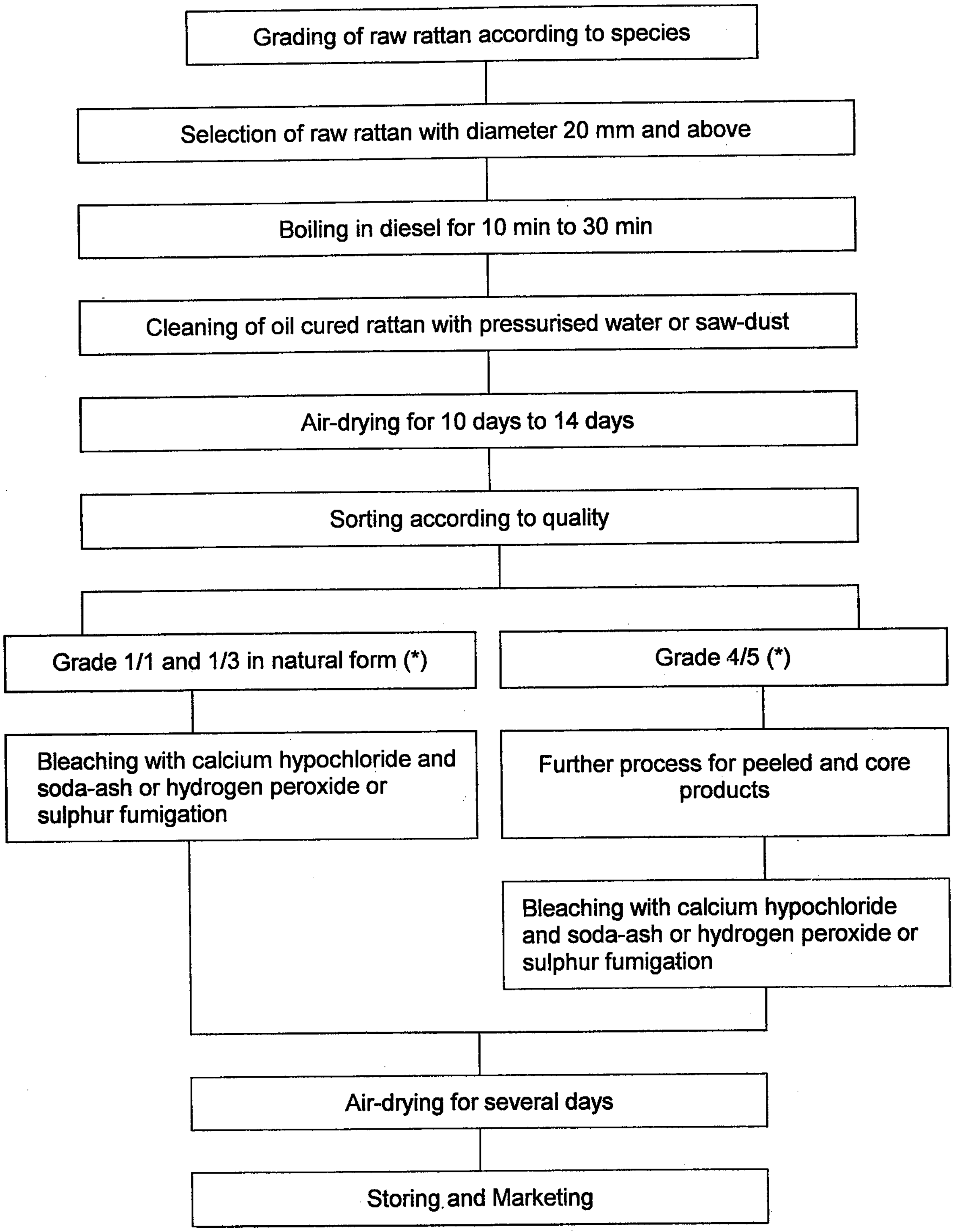
Table 4g. Grading of rattan based on skin appearance and defects.

Country	Grade	Criterion
Malaysia	1	Straight pole, ivory-white or brown or yellow colour, up to 5% allowable defects, mature with no cracks, borer or twists.
	2	Cream colour, 6% to 15% allowable defects within 25 cm distance from either end, mature.
	3	Light brown to reddish, 16% to 25% colour allowable defects like blue stain, worm holes.
	4	Reddish to black, more than 25% allowable surface defects like swollen nodes, blue stain.
	5	Heavy defective and often tender lightweight stem with shrunken portion and cracks.

Table 4h. Malaysian grading system for round canes based on outer skin quality and diameter size of the canes.

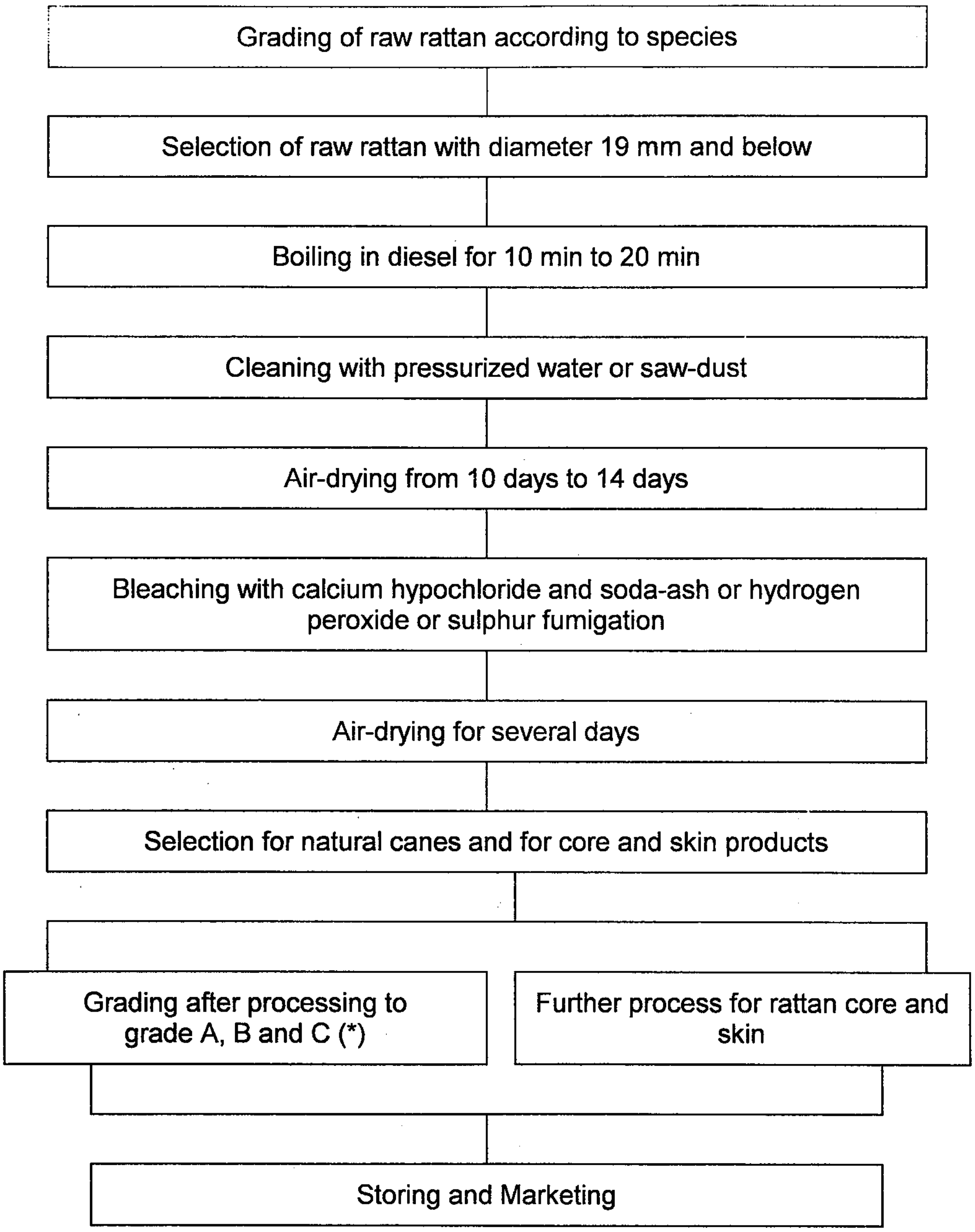
Grade	Class	Quality
A	1	No stain or any dark spot
B	2	2 or 3 staining or dark spot
C	3	Plenty of staining or dark spots
Grade	**Size**	**Diameter**
A	1	Diameter 40 mm and above
B	2	Diameter 35 mm to 39 mm
C	3	Diameter 30 mm to 34 mm
D	4	Diameter 25 mm to 29 mm
E	5	Diameter 24 mm and below

Figure 3. Processing steps for big diameter canes in Peninsular Malaysia.
(Source: Razak *et al.* 2001)



(*) Please refer to Table 4c for descriptions

Figure 4. Processing steps for small diameter canes in Peninsular Malaysia. (Source: Razak *et al.* 2001)



(*) Please refer to Table 4e for descriptions

COUNTRY: Thailand

Area of Concern	Status/Problem	Need
1. Resource Inventory	▪ Not yet done	▪ Appropriate method for resources survey ▪ Bio-diversity of resources base ▪ Funding required
a. Taxonomy	▪ Lack of rattan taxonomists	▪ Well-trained taxonomists
b. Extent of natural stand/plantation	▪ Natural stand not started/ Plantation started/ ▪ Lack of incentive and conflict on legal	▪ Proper method of existing natural stand ▪ Monitoring and evaluation of uses by indigenous people ▪ Document collection ▪ Proper promotion and compromise policies from the government ▪ Species selection, provenance trials
2. Nursery activities	▪ Slightly developed	▪ Developed techniques required
a. Propagation b. Seedling care and maintenance	▪ Slightly developed / Pest and diseases (not serious) and amount of seed supply/season	▪ Developed techniques required ▪ Pest and diseases studied
3. Plantation establishment		
a. Site requirement	▪ Started	▪ Exchange knowledge and information
b. Site preparation	▪ Enough	▪ nil
c. Outplanting	▪ Developed	▪ Training and study tour required
d. Maintenance and protection		▪ Pest and disease studied
4. Harvesting system	Not developed	▪ Training of staff ▪ Cross visit ▪ Well developed techniques and post harvest research and studied
5. Grading standards	Not started	▪ Training of staff ▪ Cross visit
6. Transporting/hauling	Not developed	▪ Training of staff ▪ Information required
7. Post-harvest activities	▪ Wastage ▪ Infection with staining fungi and attack by insect	Treatment within 24 hours
8. Marketing	Insufficient of information	▪ Information ▪ Research and study

COUNTRY: Philippines

Area of Concern	Status/Problems	Needs
1. Resource Inventory a. Taxonomy b. Extent of natural stand/plantation	▪ Method in inventory of rattan resources not fully developed ▪ Many lesser known species not utilized ▪ Only 1 FRI method applied ▪ Interactive key developed but yet used widely ▪ No updated inventory ▪ Inventory data in terms of lineal meter clumps ▪ Area of plantation given but nothing on stock	▪ Development of inventory techniques ▪ Field manual by use of interactive ground truthing ▪ Standard inventory techniques ▪ Popularize use of interactive key ▪ Comprehensive inventory in both natural old and secondary forests; different habitat ▪ Assessment of stock in plantation
2. Nursery activities a. Propagation b. Seedling care and maintenance	▪ Identification of technologies using other species ▪ Prolonged grass stage ▪ Performance of micropropagated methods not yet assessed ▪ Mini-clump division tried	▪ Breaking stage through chemical induction ▪ Packaging and transfer of technology
3. Plantation establishment a. Site requirement b. Site preparation c. Outplanting d. Maintenance and protection	▪ Eco-physiological studies lacking In secondary forest: ▪ Performance not fully assessed ▪ Regeneration method not studied In agroforestry and tree plantations: ▪ Support trees not fully determined ▪ Age of support trees/data ready for rattan intercropping not yet determined ▪ Effects on support trees not yet assessed	▪ Species/site characterization
4. Harvesting system	▪ Crude and wasteful harvesting system in plantation ▪ Season of harvesting in relation to fruiting/flowering and susceptibility to stain and beetle attack is not given attention ▪ Cutting canes and leaving them for a certain period before pulling/collecting be studied ▪ Harvested canes are categorized into only 3 or 4 species and only based on diameter thus giving the impression that only few species are commercially utilized	▪ Develop appropriate techniques for large and small diameter canes

COUNTRY: Philippines ***(continuation)***

Area of Concern	Status/Problem	Need
5. Grading standards	▪ Non-implementation and adoption of proposed grading rules	
6. Transporting/hauling	Drying/seasoning/preservative treatment at the rattan landing site before hauling	
7. Post-harvest activities		
8. Marketing	Insufficient marketing system	▪ Need for pricing and grading standards ▪ Support systems (infrastructure, financial, market) ▪ Establishment of marketing coops through CBFM
9. Indigenous knowledge system	Ethno-botany of 100 ethnic groups	
10. Gender and Development		
11. Policy	Inconsistent, inefficient, inadequate policies	▪ Policy review/revision
12. Others		▪ Capability building ▪ Organizing of collectors and training them also as traders and as processors /manufacturers ▪ Social acceptability of rattan production and intercropping in CBFM, agroforestry areas

COUNTRY: Myanmar

Area of Concern	Status/Problem	Need
Post Harvest 1. Preservation	No chemical treatment	Improved method
2. Bleaching	No chemical treatment	Cost effective Improved method
3. Drying	Sun dry	
Secondary Processing 4. Preservative Treatment	No chemical treatment	Cost effective Improved method
5. Bleaching	Only big factories use	Environment friendly methods
6. Drying	Sun dry	
Finished Products Production 7. Weaving	Only big companies have machines for furniture	Technical and financial support
8. Bending	Use blow torch	Techniques
9. Jointing	Use nails	Techniques
10. Finishing	Brush, spray guns, dipping	Devices and techniques
11. Pollution Control	Use mask only during sanding and polishing	
Other Concerns	Cottage industries for handicrafts and furniture manufacturing need to be encouraged.	Technical training and financing

COUNTRY: Brunei

Area of Concern	Status/Problems	Needs
Post Harvest 1. Preservation		
2. Bleaching		
3. Drying		
Secondary Processing 4. Preservative Treatment		
5. Bleaching		
6. Drying		
Finished Products Production 7. Weaving		
8. Bending		
9. Jointing		
10. Finishing		
11. Pollution Control		
Other Concerns 12. Marketing	No prospect buyers from the local people	▪ Establish appropriate linkages between the producer and the users ▪ Identification of appropriate market

COUNTRY: Vietnam

Area of Concern	Status/Problem	Need
Post Harvest 1. Preservation	No preservation activities (Sometimes soak in water)	Preservation methods
2. Bleaching		
3. Drying	▪ Normally by air drying and kiln drying ▪ No drying schedule	Drying schedule by kiln drying need to be done by the research
Secondary Processing 4. Preservative Treatment	▪ Using sulfur fume ▪ Smoking -polluted	Need new techniques on preservation
5. Bleaching	Soaking in solutions of HCl/H202+NaOH+Silic	Drying techniques (Research/training)
6. Drying		
Finished Products Production 7. Weaving		
8. Bending		
9. Jointing		
10. Finishing	The surface of the products are not as good as other country	Training or do researches on finishing to the researcher as well as farmers
11. Pollution Control	▪ So polluted in the processing areas ▪ No control	Need pollution control
Other Concerns 12. Marketing	▪ Establish the herbarium on rattan/research center on rattan ▪ Improve human resources: training the staff of the VFU in other institution on rattan by short term or long term (Master/PhD)	

COUNTRY: Lao PDR

Area of Concern	Status/Problem	Need
Post Harvest 1. Preservation	No input	Need more information
2. Bleaching	No	Need more information
3. Drying	Air drying	Need more information
Secondary Processing 4. Preservative Treatment	Air drying and/or smoking, boiling i.e., kerosene	
5. Bleaching	Clean the skin with water	Introduce technologies/awareness
6. Drying	Air drying	Other alternatives
Finished Products Production 7. Weaving	By hands	If other countries have advance tools
8. Bending	By simple tools	----
9. Jointing	In most of the cases by nails	If other countries have advance technologies
10. Finishing	No proper packaging	Awareness raising
11. Pollution Control	No pollution sign yet!	
Other Concerns 12. Marketing		

COUNTRY: Philippines

Area of Concern	Status/Problems	Needs
Post Harvest 1. Preservation	Existence of preservation, protection but need improvement, lacks of awareness of technology	▪ Environment friendly treatment process. ▪ Disseminate information
2. Bleaching	Only the private sector who are ware of the technology	Information/Demonstration dissemination – training Improvement of processes
3. Drying	Information not available to end-users	▪ Information/Demonstration dissemination – training ▪ Improvement of processes
Secondary Processing 4. Preservative Treatment	Information available, further improvement	▪ Information/Demonstration dissemination – training ▪ Improvement of processes
5. Bleaching	Same as about information on bleaching	
6. Drying	Same as about information on drying	Mechanized weaving for man production
Finished Products Production 7. Weaving	Manual weaving	Mechanized bending process
8. Bending	Manual/conventional	Mechanized bending process
9. Jointing	Information available, further improvement	Improvement of techniques
10. Finishing	Available but have to be improve	▪ Information/Demonstration dissemination – training ▪ Improvement of processes
11. Pollution Control	Chemicals for paints/preservative treatment	Information/Demonstration; Improvement of processes
Other Concerns 12. Utilization of lesser used species Marketing Grading Standard Product Development	Processing of technologies Competition	▪ Information/processing techniques treatment ▪ Promotion ▪ Standardization ▪ Training

COUNTRY: Indonesia

Area of Concern	Status/Problem	Need
Post Harvest 1. Preservation	▪ Use chemical for cane treatment ▪ Use the conventional way of treating rattan ▪ Improper handling and chemical use	▪ Use environmental human friendly chemical ▪ Proper chemical and preservation technique ▪ Educate worker on proper way to handle chemical
2. Bleaching	Bleaching affects rattan process	Proper bleaching condition
3. Drying		
Secondary Processing 4. Preservative Treatment	Improper chemical and processing use	Use environmental friendly chemical and preservative technique
5. Bleaching		
6. Drying		
Finished Products Production 7. Weaving		
8. Bending	A proper modulus of elasticity of each species	Unknown of MOE for each species
9. Jointing		
10. Finishing		
11. Pollution Control	▪ Existing technology to pollute the environment ▪ Not done regularly ▪ Poor technology to minimize pollutant	▪ Strict implementation assessment ▪ Improve technology to minimize pollutant environment
Other Concerns 12. Industrial rattan waste	High rattan waste during production	▪ Utilization of rattan wastage for other products ▪ Reduction of waste by improving tool and equipment use

COUNTRY: Malaysia

Area of Concern	Status/Problem	Need
Post Harvest		
1. Preservation (boiling)	Almost all utilized raw canes are boiled in diesel or a mixture of diesel + cooking oil with various combination and period of boiling varies from 5 min to 40 min depending on species	
2. Bleaching	No	
3. Drying	The cooked canes immediately clean with pressurized water or rubbed with saw dust or coconut fibers and air dried for 10 days to 14 days depending the size of the canes.	
Secondary Processing		
4. Preservative Treatment	Preservative treatments will be conducted whenever required. (e.g., when there is an initial sign of fungus attack)	
5. Bleaching	**For large diameter canes:** 1) Good quality canes will be bleached with calcium hypochloride and soda ash or HO_2 or sulfur fumigation. 2) Low quality canes will be only process for peeled and core products. **For small diameter canes:** All canes will be bleached with calcium hypochloride and soda ash or HO_2 or sulfur fumigation.	
6. Drying	Air drying for several days and stored in a ventilated storage room	
Finished Products Production		
7. Weaving	Various types of materials have been used in the industry for binding and weaving works. The popular materials are rattan skins, splits and cores. Sometimes, leather and plastic strips are also being used. While leather bindings are normally being chosen for the high-end rattan furniture, plastic bindings are gaining popularity especially in rattan chair sets used in western pavement cafes. For this proposed model, rattan splits (without skin) 6 mm wide is used as the binding materials.	Need training in weaving skills for better design
8. Bending	Bending is done after heating the canes in steaming chest for 20 min to 30 min. Sometimes blowtorches are also used to pre-heat the rattan part that need to be bent.	

COUNTRY: Malaysia (continuation)

Area of Concern	Status/Problem	Need
9. Jointing	Most rattan furniture components are drilled with series of hole for inserting slates or grooved for inserting rattan weaving.	
10. Finishing	Finishing is the stage to ensure the final quality of furniture. Spray guns powered by compressed air are used for spraying the furniture. For best quality of finishing is done in an enclosed spraying rooms equipped with spray booths and proper exhaust system. The workers must wear proper personal protective equipment (PPE) that conforms to the standards imposed by the government.	Need training in furniture and handicraft skills for better design and for better quality finished products
11. Pollution Control	Rattan furniture manufacturing does not impose a threat to the environment as significantly as the wood-based manufacturing industries. Nevertheless, one major problem that needs to be looked into is the high wastage of rattan raw material, especially rattan poles, which often become a burden to the environment through open burning and illegal dumping. Rattan poles are wasted even before the furniture manufacturing process takes place because both ends of the poles supplied are normally rendered unusable by fungal attacks and non-uniform diameter. A productive way of managing the waste is by using them as fuel for the steaming chest.	
Other Concerns	Occupational safety and health problems (hazardous working condition) would come from the usage of hand tools such as nail drivers, staplers and spray guns. Carelessness in operating the tools might cause serious injuries to the workers. Prolonged inhalation of finishing chemicals from spray guns could cause long-term health problems (especially the respiratory system). Therefore, the workers must be made to wear proper personal protective equipment (PPE) while working.	

COUNTRY: Thailand

Area of Concern	Status/Problem	Need
Post Harvest 1. Preservation	▪ Being practiced	▪ Improved
2. Bleaching	▪ No natural raw materials to be processed as the logging operation was banned since 1989	
3. Drying		
Secondary Processing 4. Preservative Treatment	▪ Being practiced ▪ Imported materials have been preserved but not meet the standard requirements	▪ Improve processing technologies ▪ Research and study ▪ More information, Knowledge/experiences exchange ▪ Standard regulation in quality controls
5. Bleaching	▪ Being practiced ▪ Suitable technique, time and concentration of bleaching solution for different rattan species have not been determined	More researches related to these topics
6. Drying	▪ Being practiced ▪ Problem on moisture re-absorption during wet seasons	Suitable technique to prevent re-absorption of moisture
Finished Products Production 7. Weaving	▪ Being practiced	▪ Well trained to produce high quality and value added products ▪ Research and study tours
8. Bending	▪ Lack of experiences and skills	
9. Jointing		
10. Finishing		
11. Pollution Control	Not so strict and usually harm the crops and environment	Strong regulation in safety controlling system
Other Concerns	These assessments are based on the local community or small enterprise	

Part I. Rattan Production: Technology Needs and Prioritization.

PRODUCTION and RESOURCE MANAGEMENT	Inputs from Day 1 Discussions	Brunei Darussalam	Cambodia	Indonesia	Lao PDR
1. Resource Inventory 1.1 Taxonomy 1.2 Extent of natural stand/ plantation	▪ Identification of species ▪ Study of specie properties ▪ Molecular genetic studies ▪ Ethnobotanical studies ▪ Establish ASEAN database ▪ Develop and adopt ASEAN standard rattan inventory design	Need to complete inventory of rattan.	▪ Taxonomic studies for unidentified species ▪ Survey and assessment of the actual resources	▪ Taxonomy ▪ Ethnobotanist to properly identify all other rattans ▪ Conduct inventory for location and volume of the unidentified species ▪ Natural stand/ plantation ▪ Conduct inventory on natural stand and plantation establishment ▪ Study on basic properties of other rattan species for possible commercialization ▪ Study on Harvesting and post harvest handling for other lesser known species of rattan ▪ Conduct harvesting study for rattan plantation	▪ Incomplete Lao guidebook on rattan ▪ Inventory method to identify additional voucher specimens

Part I. Rattan Production: Technology Needs and Prioritization *(continuation)*.

PRODUCTION and RESOURCE MANAGEMENT	Malaysia	Myanmar	Philippines	Thailand	Vietnam
1. Resource Inventory 1.1 Taxonomy 1.2 Extent of natural stand/ plantation		Complete rattan taxonomy - we need experts Capability building on rattan inventory	▪ Development of inventory technique ▪ Field manual using interactive key ▪ Extent of natural stand: Establish ground truthing/ verification ▪ Look into studies related to age at harvesting, utilization, treatment for resource inventory	▪ Appropriate method for resources survey ▪ Bio-diversity of resources base ▪ Funding required ▪ Well-trained taxonomists ▪ Proper method of existing natural stand ▪ Monitoring and evaluation of uses by indigenous people ▪ Document collection ▪ Proper promotion and compromise policies from the government ▪ Species selection, provenance trials	▪ Establishment of a common regulation/metho d for resource inventory ▪ Continuous training and exchange among ASEAN countries. ▪ Establishment of herbarium

PRODUCTION and RESOURCE MANAGEMENT	Inputs from Day 1 Discussions	Brunei Darussalam	Cambodia	Indonesia	Lao PDR
2. Nursery activities 2.1 Propagation 2.2 Seedling care and maintenance	▪ Seed germination and growth studies ▪ Light and water studies during seedling stage ▪ Establish germplasm and seedbanks, and set up rules and policies similar to biodiversity guidelines		▪ Development of plantations through community-based trials. ▪ Enrichment planting for secondary forests	Propagation ▪ Technology to shorten germination of rattan seeds. ▪ Plantation ▪ Study on comparison of profitability of rattan plantation ▪ Study on potential host tree for cultivation, maintenance and protection ▪ Funds for maintenance and protection	Improved germination technology

Part I. Rattan Production: Technology Needs and Prioritization *(continuation)*.

PRODUCTION and RESOURCE MANAGEMENT	Malaysia	Myanmar	Philippines	Thailand	Vietnam
2. Nursery activities 2.1 Propagation 2.2 Seedling care and maintenance		Vegetative propagation research needed	▪ Verification technology using other species from breaking stage thru chemical induction ▪ Genetic conservation based on host trees ▪ SPA using clones for macro (suckers) and tissue culture. ▪ Molecular technology in sorting male/female seedlings of solitary species.	▪ Developed techniques required ▪ Developed techniques required ▪ Pest and diseases studied	▪ Technology exchange to improve quality of. nursery. activities

PRODUCTION and RESOURCE MANAGEMENT	Inputs from Day 1 Discussions	Brunei Darussalam	Cambodia	Indonesia	Lao PDR
3. Plantation establishment 3.1 Site requirement 3.2 Site preparation 3.3 Outplanting 3.4 Maintenance and protection	▪ Ecology and population dynamics for various plantation objectives: cane, shoots, fruits ▪ Light and water studies during seedling, juvenile, mature stages for various plantation objectives: cane, shoots, fruits ▪ Assessment of silvicultural requirements of commercially potential underutilized species ▪ Determine harvesting cycle/rotation, intensity, regeneration ▪ Analysis of Demand Versus AAC to determine sustainable levels of resource supply and demand ▪ Program to test intercropping with rattan as the primary resource	▪ Proposals for policy reform ▪ Strengthening the capability on silviculture techniques ▪ Appropriate site-matching through R and D	▪ Introduction of rattan on agroforestry systems ▪ Encourage rattan through assisted natural regeneration		Exchange visit to demonstration areas in ASEAN countries

Part I. Rattan Production: Technology Needs and Prioritization *(continuation)*.

PRODUCTION and RESOURCE MANAGEMENT	Malaysia	Myanmar	Philippines	Thailand	Vietnam
3. Plantation establishment 3.1 Site requirement 3.2 Site preparation 3.3 Outplanting 3.4 Maintenance and protection		Research on trial plantation and rattan plantation program	▪ Study on eco-physiological site characterization ▪ Study on site species matching, seed sources, distancing based on host species (depending on purpose)	▪ Exchange knowledge and information ▪ Training and study tour required ▪ Pest and disease studied	

PRODUCTION and RESOURCE MANAGEMENT	Inputs from Day 1 Discussions	Brunei Darussalam	Cambodia	Indonesia	Lao PDR
4. Harvesting system	▪ Development of appropriate harvesting devices ▪ Technology development for waste reduction ▪ Technology development/ application for alternative uses of waste products ▪ Determine harvesting cycle/rotation, intensity		Effective utilization of rattan through research studies to identify appropriate harvesting system for each specie	Appropriate harvesting and Post harvest technology to avoid wastage	Technology for awareness in selection of canes for harvest
5. Grading standards	▪ Development and adoption by ASEAN of grading standards				Awareness/information among gatherers and traders on the grading system
6. Transporting/ hauling				Preservation on harvesting area Study on environmentally friendly chemical preservation of rattan.	Better practices/system needed to avoid damages during hauling

Part I. Rattan Production: Technology Needs and Prioritization *(continuation)*.

PRODUCTION and RESOURCE MANAGEMENT	Malaysia	Myanmar	Philippines	Thailand	Vietnam
4. Harvesting system		Improved harvesting technique to reduce wastage	Develop appropriate techniques for large and small diameter canes	▪ Training of staff ▪ Cross visit ▪ Well developed techniques and post harvest research and studied	Training and extension is needed
5. Grading standards		National grading system is needed- national and regional expert is needed		▪ Training of staff ▪ Cross visit	Common grading system is needed
6. Transporting/ hauling			Improvement of road system	▪ Training of staff ▪ Information required	

PRODUCTION and RESOURCE MANAGEMENT	Inputs from Day 1 Discussions	Brunei Darussalam	Cambodia	Indonesia	Lao PDR
7. Post-harvest activities (at harvesting site)	▪ Technology development to prevent staining or reduce damage by insects ▪ Establish a practice to conduct inventory before restocking especially in logged-over areas		▪ Appropriate technology for processing. ▪ Training and demonstration for post-harvest	Set-up post harvest processing facilities near harvesting area.	Technology or Information on good post harvest practices

Part I. Rattan Production: Technology Needs and Prioritization *(continuation)*.

PRODUCTION and RESOURCE MANAGEMENT	Inputs from Day 1 Discussions	Brunei Darussalam	Cambodia	Indonesia	Lao PDR
8. Socioeconomic	▪ Study of consumption patterns, market preferences	▪ (add'l) #9. Financial Analysis ▪ Study on economic alternative land-use	Organize marketing cooperative for rattan	▪ How to shorten market channel for rattan ▪ Organizing farmers so industry directly buys rattan from farmer ▪ Study on the impact of organized group of farmers in marketing rattan	▪ Information on market availability ▪ Organize villagers group for better price negotiation

PRODUCTION and RESOURCE MANAGEMENT	Malaysia	Myanmar	Philippines	Thailand	Vietnam
7. Post-harvest activities (at harvesting site)		Improved and efficient techniques of preservation of harvested rattan on site		▪ Wastage ▪ Infection with staining fungi and attack by insect treatment within 24 hours	
8. Socioeconomic	Mechanism for effective marketing for Malaysian rattan	Market information for export of finished products	▪ Establish pricing and grading standards ▪ Establish support system (infrastructure, credit, market) ▪ Marketing cooperatives through community based forest management	▪ Information ▪ Research and study	▪ Research on market information system ▪ Transfer of knowledge in marketing to farmers

Part II. Rattan Processing and Utilization: Technology Needs and Prioritization.

PRODUCTION and RESOURCE MANAGEMENT	Input from Day 1 Discussions	Input from Day 2 Discussions	Brunei Darussalam	Cambodia	Indonesia	Lao PDR
9. Post harvest technologies (at depot) 9.1 Preservative treatment 9.2 Scraping 9.3 Drying					▪ Need for environmental and human friendly chemical for preservation. ▪ Proper handling of chemicals	Technology information is needed by our country
10. Secondary processing (at facility) 10.1 Preservative treatment 10.2 Bleaching 10.3 Drying					▪ Bleaching: Proper techniques is needed ▪ Preservation treatment: Environmentally friendly chemical is needed.	Technology on proper bleaching and available alternatives for air drying of rattan

PRODUCTION and RESOURCE MANAGEMENT	Malaysia	Myanmar	Philippines	Thailand	Vietnam
9. Post harvest technologies (at depot) 9.1 Preservative treatment 9.2 Scraping 9.3 Drying		Technology to improve methods of preservation	▪ Information dissemination of environment-friendly treatment process ▪ Technology to improve treatment/preservati on method	▪ Information ▪ Research and study	▪ Improved preservation techniques are needed. ▪ Establish effective kiln drying time/ schedule
10. Secondary processing (at facility) 10.1 Preservative treatment 10.2 Bleaching 10.3 Drying		Preservation technology that is cost effective and environmenta lly friendly	▪ Bleaching ▪ Training/info dissemination for an improved process and technique of bleaching and drying	▪ Improve processing technologies ▪ Research and study ▪ More information, Knowledge/experiences exchange ▪ Standard regulation in quality controls ▪ More researches related to these topics	Improved preservation and drying techniques

Part II. Rattan Processing and Utilization: Technology Needs and Prioritization *(continuation)*.

PRODUCTION and RESOURCE MANAGEMENT	Inputs from Day 1 Discussions	Inputs from Day 2 Discussions	Brunei Darussalam	Cambodia	Indonesia	Lao PDR
11. Finished products production 11.1 Weaving 11.2 Bending 11.3 Jointing 11.4 Finishing 11.5 Pollution control					Bending: ▪ Proper modulus of elasticity of each species has to be known. ▪ Improved technology to minimize pollution	Available technology and machine for weaving among ASEAN countries
12. Finishing			Add'l 13. ▪ Establish appropriate linkages between to the producers and the users ▪ Identification of appropriate market			

PRODUCTION and RESOURCE MANAGEMENT	Malaysia	Myanmar	Philippines	Thailand	Vietnam
11. Finished products production 11.1 Product design 11.2 Weaving 11.3 Bending 11.4 Jointing 11.5 Finishing 11.6 Pollution control		▪ Technology (machine) for rattan weaving and financial support ▪ Better technology to reduce pollution during sanding and polishing	▪ Technology for mechanized weaving and bending for mass production ▪ Info dissemination on spray booth	▪ More researches related to these topics ▪ Well trained to produce high quality and value added products ▪ Research and study tours ▪ Strong regulation in safety controlling system ▪ Improved technology for bleaching	Technology to reduce pollution but better preservation technology

Part II. Rattan Processing and Utilization: Technology Needs and Prioritization *(continuation)*.

PRODUCTION and RESOURCE MANAGEMENT	Lao PDR	Malaysia	Myanmar	Philippines	Thailand	Vietnam
12. Finishing	Proper packaging and storage		▪ Devices and cost effective technology on finishing is needed ▪ (add'l) 12: Economics of rattan industry: Continuous Technical training to encourage cottage industries and financing for efficient machines	▪ Information dissemination on improved process of finishing ▪ (add'l) 13: Utilization of lesser used species ▪ Marketing information and grading standards to be competitive – promotion and training		▪ Training or research on finishing technique ▪ Other concerns (Vietnam) ▪ Establish a rattan center ▪ Improve human resources: Short or long term training (Masters or Ph.D.) on Rattan

Part III. Sustainable Management Concerns.

13. Policies 13.1 Security of Tenure 13.2 Community-based approach 13.3 Review and updating of policies 13.4 Transfer of technologies and recognition of individual property rights	Malaysia: ▪ Experiences can be shared/demonstrated on Inventory techniques for rattan, Seedling care and maintenance following national standard practice, advance practices in rattan cultivation, grading system.
14. Establish ASEAN certification and fair trade practices	**Indonesia:** ▪ Utilization of rattan wastage for other products. ▪ Technology to reduce waste by improving tool and equipment use. ▪ Utilization of rattan for other purpose: ▪ Establish and develop rattan for dye production ▪ Explore medicinal purpose of rattan
15. Expand number of species utilized commercially	**Philippines:** ▪ Establish indigenous knowledge system: Ethnobotany of 100 ethnic groups ▪ Policy review, recommendations for revision to support rattan industry. ▪ Policy for confiscated rattan-hasten processing and put to good use ▪ Gender and development: Rattan technology to encourage participation of women
16. Adopt standard measurements units (lineal meter, metric ton, bundles, etc)	
17. Promotion of Rattan ▪ As environment friendly, supportive of Kyoto protocol ▪ As source of medicinal values (?)	
18. Protection	**Vietnam:** ▪ Establish seed orchards ▪ Conservation of threatened rattans in their habitat
19. ASEAN NETWORK ▪ Taxonomy/database ▪ Germplasm ▪ Certification/Fair trade ▪ Transfer of technology ▪ Sharing of experiences ▪ Transboundary issue on poaching, protection ▪ Coordination, compilation of documents for sharing	

Errata.....

Page	Correction
5	Plectomia should be **Plectocomia**
7	Kerala Forest Institute should be **Kerala Forest Research Institute**
9	Philippine by Director... should be **Philippines**
10	Specie should be **species**
33	Kerala Forest Research Institute Peechi...**Peechi** should be deleted
38	Joffre Hj Ali Ahmad should be **Joffre Bin Haji Ali Ahmad**
51	HANDCRAFTS should be **HANDICRAFTS**
64	E. Post-harvest Activities should be...**D. Post-harvest Activities**
76	Minester should be **Minister**
77	Fob should be **FOB**
126	5.2.2 Rattan-based Cottage Enterprises should be **2.2 Rattan-based**...
174	Forest Products Research and Development Bureau should be **Forest Products Research and Development Institute**
176, 178, 179, 185	*Calamus merilli* Becc. Should be ***Calamus merrillii***
180	In addition, in 1977, the Ecosystems Research and Development Bureau...should be the **Forest Research Institute**....
189	**Grade A** should be deleted
215	ERDB is the research and development arm of the Department of Science and Technology.... should be **Department of Environment and Natural Resources**
241	VI. POLICY AND LEGISLATION should be **6. POLICY AND LEGISLATION**
261	RATTAN RESOURCE should be **RATTAN RESOURCES**