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TECHNICAL REPORT

of the Project Consultant for Rattan Cane Processing
ITTO Project PD 24/00 Rev. 1(I)
Promotion of Sustainable Utilization of Rattan from Plantations in Thailand
17 February – 1 March 2002

1. ITTO Project "Promotion of the Utilization of Bamboo from Sustainable Sources in Thailand"

On the request of the ITTO bamboo project leader, Mrs.Wanida Subansenee and with consents of ITTO, the consultant participated in the Second Project Steering Committee Meeting on " Promotion of the utilization of Bamboo from Sustainable Sources in Thailand", attended by the ITTO representative, Mr. Emmanuel Ze Meka, Assistant Director, Forest Industry in Chiang Mai, 19-20 February 2002.

1.1 Study tour to Mae Mae community forest for project activities on bamboo furniture and bamboo weaving

On the 19 February a study tour was undertaken to the project site at Baan Mae Mae Community Forest to visit the training course on Bamboo Furniture Parts and Handicraft.

Bamboo furniture
A number of villagers were engaged in making bamboo chairs. The material was still quite fresh, meant for training purpose. Some smaller parts among were old or beetle infested. The fresh state will result in a circumferential shrinkage of around 4 % with the consequence of loosing the tidiness of fasteners. These were made from rattan strips. Whereas the bamboo material came from the nearby forest, the rattans had to be imported from Singapore. Consequently the total material costs of 25 Baht resulted of 80% for the rattan and only 20% for the bamboo. This situation is most contra-productive to the project goals.

Bamboo weaving
The products made appear to be of medium quality. Only some limited deterioration by insects or fungi was noted. For the baskets the handles were made from rattan, which had been imported via Singapore.

Comments
The short visit gave the impression, that the training is well on its way and will produce skilled villagers.

It appears questionable, if the heavy and bulky models of furniture, even when air-dry, would find their way to the market in Chiang Mai or somewhere else to meet a demand. However, the products seen are made only for manufacturing and weaving skill. The lecturers also present the theoretical methods for seasoning and natural preservation (immersion in water), so that after the course the trainees will be able to produce good quality products. It was mentioned, that the product diversification by coloring, as investigated by the project member Mrs. Nutchanart Nilkamhaeng will be included later.

Rattan cane could possibly being taken also from Mae Mae Forest nearby, as it is normally use in the local area. But for the convenience of the training course they prefer imported cane.

For rattan fastenings also other material should be considered, like plastic (depending on the price) or thin lianas for the handles of bigger baskets. This could reduce the cost of the product.

The danger of infestation by beetles or mould has to be considered, especially during the wet months. Culms for furniture should be carefully dried under shade. The water-storage of culm parts for slivers should be investigated to reduce the danger of infection.

The type of products produced should be more variable, considering the demand of the market. Most important appears to introduce further bamboo products by design and to study the market situation, so that the handicraft work will be economical and can contribute to the rural welfare.

No comments are to be made on the short visit of the plantation site.

1.2 The Second Project Steering Committee Meeting, 20 February, 2002.

Within the program of the Steering Committee Meeting also progress reports were presented about the work undertaken since the First Project Meeting, 16 July, 2001 in Bangkok..

The consultant discussed their content and the consequences later at the Royal Forest Department (RFD), Bangkok, on

- management research with Mr. Kowit Sombun
- bamboo properties with Mr. Suchart Thaipetch
- chemical properties with Ms. Pannee Denrungruang
- preservation research with Ms. Paiwan Lek-u-thai, Mrs. Mayuree Jitkaew and Mrs. Arunee Veenin, (results on immersion and chemical treatment after 6 months exposure to insects and fungi).

A Brochure about the ITTO Bamboo Project was produced and widely distributed for information. Some comments on content and layout were made for the next edition.
The consultant informed about
-the intention to construct a large bamboo globe with 11 m diameter at Doisaket in Chiang Mai on the site of Mr. Peter Seierman as part of the Project " Art in Nature" by a German artist- designer, Markus Heinsdorff, Muenchen. Contacts were made for possible material questions.

-the completion of a “Bamboo Preservation Compendium” (with S. Kumar), which is now in print as INBAR Technical Report no 27.

2 ITTO Project “ Promotion of Sustainable Utilization of Rattan from Plantation in Thailand “

2.1 Review on rattan utilization

A literature review on rattan utilization has been made by the consultant prior to departure. The items concerning the TOR are summarized in the following chapters under “general”, whereas details related to the situation in Thailand are given under “specific”. This information has necessarily to be limited, since it could be obtained only during visits to two rattan furniture shops at Krabi province on February 21st and at a visit to the rattan furniture company Kowsupamongkol Export Co.Ltd., Romkloa, Bangkok on February 25. Detailed reports about these visits were made by Mrs. Mayuree Jitkaew and Ms. Paiwan Lek-u-thai as project documents. The reports contain valuable information about the species used, processing, preservation, wages, economical aspects and problems faced. Therefore only some details are mentioned in the related chapters to follow. The visits have provided valuable information to the Project Members and the Consultant about the real world of rattan processing and its constraints. Information was obtained about the price for rattan as higher than anticipated. Impressive was the wide application of the Water hyancinth, *Eichornia crassipes*, a dangerous pest on lakes in many countries Their stems are used for weaving almost all parts of furniture at theKowsupamonkol Export Co.,Romkloa. Detailed investigation by the project on its properties are recommended, since it can substitute the scare rattan in many locations.

A planed visit to the rattan marketing in Angthong province on February 27 had to be cancelled due to time pressure due to office work.

A comprehensive information on “Thai rattan in the early 2000” has been provided by Prof. Isara Vongkaluang at the FAO Expert Consultation on Rattan Development Rome, 5-7 December 2000. All 21 papers presented at this Conference with an evaluation and recommendations are now on 270 pages in print and a CD-ROM with the full text has been given to the project (Dransfield et al. eds., 2002). Since it presents the most updated source on rattan its thorough study by the project members is recommended. Specially the paper by I. Vongkaluang is a “must reading” so that no need for citing details related to the project appears necessary.

2.2 Review of the existing commercial grading system in national and international market and propose possible new grading system to be introduced in the country

General

The grading of rattan stems is a very important, although still controversal, step in processing. Grading is crucial to trade and influences producers, processors, exporters and importers, as well as the end users.

The first stage of grading is carried out at the level of local village processors or, on a larger scale, intermediaries or trade centres. The criteria at this stage are dimensions (thickness, length of cane and internodes), hardness and defects. Canes are frequently divided into categories of large and small diameter; 18 mm is the most widely used

cut-off. Hardness (related to anatomical characters, differences among species or age of stems) is tested by bending the stem by hand and noting whether it regains its original form quickly or slowly, or breaks. A second stage of grading, mainly aesthetic, is done on the basis of surface colour after processing.

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

The brochure by K. M. Bhat on "Grading rules for rattan–a survey of the existing rules and proposals for standardization" has been given to the project.

Specific

The information obtained from the rattan furniture company and at the two processing shops at Krabi province revealed that the rattan used is mainly imported, either "fresh" from Myanmar or air-dry via Singapore/Hong Kong. The grading at the processing companies is done according to their internal requirements. The small volume obtained from local resources did not lead to any special grading system so far.

Considering this small amount and the dispersed harvesting sites, it is not recommendable to develop a "possible new grading system to be introduced in the country" presently, as outlined as point 2 in the TOR. Instead, the grading proposed by Bhat (1996) should be tried for application to the extent of own resources available.

2.3. Design of a research methodology to develop sustainable utilization of rattan on these topics.

2.3.1. Harvesting regimes

Most of the rattans used in Thailand are imported. Only a small amount is harvested from the wild and exceptionally from the few plantations. The methods for harvesting are the traditional ones. Therefore no need to consider research on harvesting regimes appears of immediately importance.

The detailed research program on rattan planting and required management by Mr. Kowit Sombun has been discussed.

2.3.2 Storage and Protection

General

Storage.

Proper storage of canes is necessary to maintain the high quality of rattan products. The moisture content of fresh stems varies between 130 and 160%, with an increase

from the base upwards. Harvesting and seasoning should preferably been done during the dry months to reduce the initial moisture and to speed up air seasoning

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

Protection against defects by staining and insect attack

Rattan, during storage is particularly liable to infestation by fungi and insects because of its high starch content. Defects resulting from infections by staining fungi and beetle attack can result in severe losses. Fungi cause discoloration of the canes, while beetles cause pinholes or worm holes. Fungal invasion may occur within one day of cutting.

The most common cause of staining are blue stain fungi which penetrate with their hyphae deep inside the stem, utilizing starch and sugar. It is generally estimated that about 20 percent of harvested canes become stained. During the visits to the storage sites at the processing plants stained material as stems or parts of furniture components have regularly been seen

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

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

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

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

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

For protection against beetles an insecticide has to be applied very early, usually by dipping or soaking. Again the consequences of pollution must be taken into

consideration. The availability and legal acceptance of suitable preservatives differ from country to country.

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

Specific

A proposal for research on rattan preservation has been prepared by Mrs. Mayuree Jitkaew and Ms. Paiwan Lek-u-thai and consequently discussed regarding technical details. The literature given by the consultant should be integrated in the final lay-out. For the evaluation of results also economical aspects have to be considered and practical consequences elaborated.

2.3.3. Post Harvesting Treatment

General

Curing is the immersion of canes in a hot oil bath to prevent deterioration by reducing the moisture content (Bhat and Dhamodran, 1993; Silitonga, 1989). It is often an integral part of the processing line.
The stems, as fresh as possible, are cut to the desired length, bundled, and soaked for a given time in an oil bath. The oil penetrates the cane axially, while radial penetration through the skin is almost nil because of its refractory anatomical structure.

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

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

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

Specific

The research program on rattan preservation mentioned under 2.3.2 includes methods for curing and preservation. The most recent comprehensive report on methods for rattan oil curing, bleaching and preservation by Razah et al. (2002) as INBAR-TOTEM has been given to the project and has to be considered for the experimental execution and evaluation.

2.3.4.Production Processing

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

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

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

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

There is a number of literature on rattan processing available, like the Illustrated Manual on Local Tools, Equipment and Technologies for Processing Bamboo & Rattan by Gnanaharan and Mosteiro (1997), which should be studied by the team members.

3. Improving Rattan Utilization : Opportunities and constraints

3.1 Species differences

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

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

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

Structural properties

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

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

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

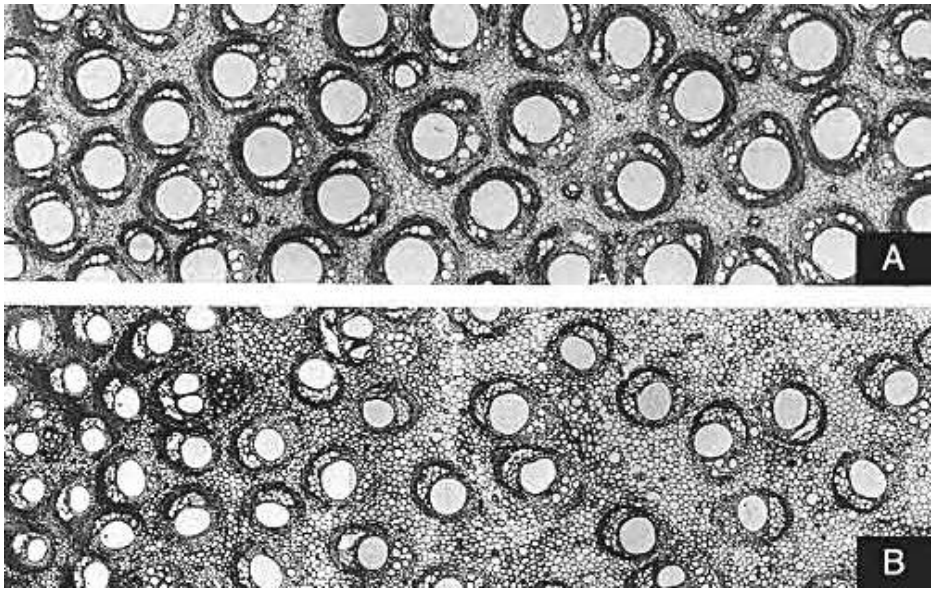
The basic information on rattan anatomy obtained in recent years has been used in the study of 433 rattan species to clarify if certain structural features are characteristic for a “commercial” cane since, of the total of around 600 species, only a small portion is utilized. It became clearly evident that a commercial cane is characterized by definite criteria such as:

- even distribution of vascular bundles over the stem, cross-sectional composition of about 20-25 percent fibres, 45 percent conducting cells and 30-35 percent ground parenchyma,
- fibre caps of equal size, equal fibre length, walls with polylamellate structure,
- ground parenchyma of small cells with thick polylamellate walls.

Thus, anatomical features can help to predict physical and mechanical properties. Especially, vascular bundle distribution and fibre dimensions, such as wall thickness, correlate with shear, compression parallel to grain and static bending.

This characterization can serve to analyse also hitherto unused species regarding their processing potential. Sample investigations of the rattans of West Africa have shown that the three endemic genera (*Eremospatha, Laccosperma, Oncocalamus*), with about 25 species, have the same basic structures as the well-used Asian rattans. This indicates the possible usage of these rattan genera, which have so far not been adequately processed for furniture.

Literature about structural details for distinguishing the rattans has been given to the project (Bhat et al. 1990, Weiner and Liese 1991, 1993, 1994), together with further papers on rattan anatomy.



Rattan structures can be used to distinguish species suitable for utilization as ***A*** for *Calamus* from less promising species, like **B** for *Plectocomia)*

3.2 Availability of raw material

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

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

3.3 Technological issues

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

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

Specific

The visits to the two rattan processing workshops near Krabi and especially the Rattan Factory at Romklao have shown an impressive level of technical and technological skill. Some technical details, like on the curing parameters or on machinery were not disclosed, which is quite understandable. The question will be, to what extent these companies are willing for any cooperation with researchers from far-away institutions, who cannot have the same level of knowledge as is already in use there. It appears therefore doubtful, if the ITTO Project with its intended research activities can substantially contribute to an improved processing. A possible approach might be to ask the companies for any shortcomings in their processing with the offer to cooperate in research work with the institute's equipment in Bangkok.
A research program by Mr. Suchart on "Outline of Physical and Mechanical Properties testing on Rattan" with various properties to be investigated has been discussed. Methods for testing rattan properties will be submitted to the Project. The evaluation of results should mention the data and experience obtained by other researches for same or similar species.

4. Constraints for rattan utilization

There are a number of general constraints for rattan utilization, which relate also to the situation in Thailand:

Natural constraints, rattans are part of the evergreen forest, they occur irregular and are difficult to harvest. Over-exploitation is common as well as a negligence of the resource. Mechanization of harvest is not possible.

Lack of sufficient supply in quality and quantity. Extinction of the commercial species. No plantations for rattan to secure supply.

Utilization of lesser known species to increase supply.

Low durability. Rattan stems are fast discoloured and damaged by insects and fungi, chemical protection is mostly not possible and restricted by environmental consequences.

Low processing technology, mostly done at the village level.

Low quality and diversity of products, possibilities for value-added products.

Alternative materials replace rattan products in many market segments.

Competition for handicrafts and furniture from other regions and countries.

Lack of proper marketing set-up, trade, demand with a low marketing margin

Neglect of socio-economic importance for the rural areas.

5. Research needs for enhanced rattan utilization

During the last years considerable progress has been achieved about rattan utilization. A number of papers have been published, most recently the Transfer of Technology Models (TOTEM) by INBAR on various topics of rattan management and utilization. Progress has been achieved especially in the areas of better hand tools and hardware, improved processing technologies and better finishes and colouring, albeit mostly at the larger processing factories, hardly at the smaller units. However, structural properties, product relations, protection and waste utilization are still neglected areas of research. Indeed, the following priority needs for rattan research were listed a decade ago in a report to the International Development Research Centre (IDRC) (Williams et al. 1991) and are mostly still valid:

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

In the execution and further development of the ITTO Project on “Promotion of Sustainable Utilization of Rattan from Plantation in Thailand” these general needs should be considered according to the specifics of the project goals.
For promotion programs marketing studies have to be made to identify the demand at the regional/national level and for export to determine what the consumer really wants. Such information is available at the larger processing companies, working mostly for export for their own use and would hardly be disclosed.

6 Further items

6.1 Information supply

On request of the Project the consultant gave a lecture on “”Properties, protection and utilization of rattan” at the Royal Forest Department on Febrary 28 to inform about the rattans in a broad context.

For further information various literature has been given to the Project, among these the final version of the Expert Consultation on Rattan Development, organized by FAO and INBAR, Rome 5-7 December 2000, (Dransfield et al. 2002, in press). The Proceedings of about 270 type written pages with 20 papers provide the most recent information on rattan.

For both ITTO Projects, on Bamboo and on Rattan, the recently published INBAR-Transfer of Technology Models (TOTEMs) are a most valuable source of practical information. They are comprehensive multimedia information packages on bamboo (15) and rattan (6) technologies, covering the cultivation, processing and utilization stages. They are available on CD-ROM with details on the INBAR website (http://www.inbar.int).

6.2 Study Tour to the Philippines

The Project Leader submitted a written request to the consultant for contacts to undertake a study tour to the Philippines on rattan management, preservation and utilization for one week (4-5 people). As most competent Prof. Dr. Florentino Tesoro, Director Forest Products Research and Development Institute, UPBC College 4031, Laguna email : Ftesoro@laguna.net was proposed. He presented at the Rattan Expert Consultation, Rome, Dec. 2000 a Report on Rattan Resource of the Philippines, their extent, production and issue on resource development which will provide an important source of information for the project.

The consultant will contact Prof. Tesoro, who is well known to him.

7. Conclusions

Within the foregoing elaboration a number of comments and conclusions have already been made. Only a few general ones should be listed at the end:

7.1 The work of the Project on Rattan Cane Processing is presently still in an early stage, so that the discussion of the consultant with Team members concentrated mainly on the experimental lay-out and procedures. It was considered to be important to indicate and present the rich sources of information available to be integrated in the program and the evaluation of results. The experimental work will anyway be influenced by certain limitations in human capacity and the technical facilities available

7.2 The visits to the rattan processing units at various levels gave valuable information to all participants about the technological stages in processing as well as regarding certain gaps and constraints. It will be a demanding task for the Project to execute its program to the real benefit of the processors, both at rural and industrial level. A cooperation to identify gaps should be tried with the offer to consider these in the Project's program.

7.3 At the termination of the Project the results should be made available, as discussed with the Project Leader. Several ways can be considered, like a joint report at a national/international Workshop and papers in a Technical/Scientific Journal. The practical consequences should be summarized in short leaflets in Thai language for the local population.

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APPENDIX 1

TOR

of the International Processing Consultant

PD 24/00 Rev. 1(I)

Promotion of Sustainable Utilization of Rattan from Plantation in Thailand

The International Processing consultant on rattan properties, protection and utilization will :

1. Review of rattan utilization.
2. Review the existing commercial grading system in national or international market and propose possible new grading system to be introduced in the country.
3. Design a research methodology to develop sustainable utilization of rattan on these topics.
    1) Harvesting regimes
    2) storage
    3) post harvesting treatment
    4) production processing
4. Prepare the technical report at the end of the mission including recommendations and submit to project leader.

APPENDIX 2

Program for the International Rattan Cane Processing Consultant

Prof. Dr. Walter Liese

16 February – 2 March 2002

14-15. Feb.	Literature work at Hamburg
16. Feb.	19.00 dep. Hamburg
17 Feb.	14.40 arr. Bangkok, 19.25 arr. Chiang Mai,
18 Feb.	study of project documents
19. Feb.	study tour to Mae Mae community forest for bamboo project activities, training on bamboo weaving and bamboo plantation
20.Feb.	The Second PSC meeting of the ITTO Bamboo Project 17.15 dep. Chiang Mai for. Bangkok
21. Feb	07.05 leave for Trang tour to rattan experimental forest, Krabi overnight at Trang
22. Feb.	09.15 Trang-for Bangkok, Discussion at Royal Forest Dep .on ITTO Bamboo and Rattan project
23. Feb.	Study of literature and project document
24. Feb.	Study of literature and project document
25 Feb.	Visit rattan furniture factory, at Romklao Discussion with Project Leader and Team members
26 Feb.	Discussion with Project Leader and Team members
27 Feb.	Discussion with Project Leader and Team members
28 Feb	Lecture on ”Properties, protection and utilization of rattan” at Forest Research Office, RFD, Bangkok Discussion with Project Leader and Team members
1. March	Discussion and design experiments
2. March	13.15 dep. Bangkok for Frankfurt 22.55 arr. Hamburg
4-7 March	Finalizing the Technical Report