



International Network for bamboo and Rattan

The International Network for Bamboo and Rattan (INBAR) develops, provides and promotes appropriate technologies and other solutions to benefit people and the environment. A world-wide network, it connects governmental and non-governmental organisations and the private sector. INBAR provides leadership, coordination, and support for research and development. INBAR's R&D programs cover natural and cultivated raw materials; genetic resources; processing and utilisation; economic and other social aspects; and supporting services. INBAR aims to enhance the quality of life of poor and disadvantaged people in developing countries and to make favourable impacts on forests and degraded environments.

International Network for Bamboo and Rattan
International Development Research Centre
Regional Office for South Asia
17, Jor Bagh
New Delhi 110 003
India

GRADING RULES FOR RATTAN A SURVEY OF EXISTING RULES AND PROPOSAL FOR STANDARDIZATION

K.M. Bhat

Kerala Forest Research Institute, India

INBAR Working Paper No. 6

International Network for Bamboo and Rattan

New Delhi • Guangzhou • Eindhoven

International Development Research Centre 1996

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording or any information storage and retrieval system, without permission in writing from the publisher.

ISBN 81-86247-12-2

FOREWORD

Rattan is so invaluable to village life that one could speak of a rattan civilization in the "Asian Region". This quote reflects the importance of rattan in cottage industries which provide livelihood to over half a billion people. The current global trade is estimated at over U.S. \$ 7 billion annually. International trade dates back to the mid-nineteenth century. In spite of the above, there has been a lack of research and adequate attention on rattan material properties, classification and grading. As will be evident from this publication, grading in particular is a crucial step in trading of natural products like rattan for optimum realization of its value. In addition adoption of proper grading rules will also ensure conservation of the resource base and maximization of benefits to all concerned.

Under the auspices of an INBAR internship, Dr.K.M. Bhat of the Kerala Forest Research Institute in India has put in a lot of effort to bring out this report. Besides presenting a model for grading rules, this publication will provide basic knowledge to small scale producers, traders, users and national and international standard organisations particularly in formulating raw material specifications and issuing national and international grading rules.

It is, however, cautioned that the model grading rules proposed in this document, based on the currently available data, are not without limitations. For instance, they need revision in future as and when more precise data is available on rattan colour and other features for quantitative evaluation of defects. Moreover, many countries of the Asian region may prefer to modify the specifications according to local requirements rather than follow these proposed (global) specifications. Nevertheless, it is hoped that the proposed model will be useful for producers and sellers to maintain standard product quality and for buyers to demand the desired quality.

INBAR is pleased to present this important work as Working Paper No. 6.

I.V. Ramanuja Rao
Principal Scientist
INBAR

Cherla.B.Sastry
Director
INBAR

ACKNOWLEDGEMENTS

The author gratefully acknowledges the award of an internship from the International Network for Bamboo and Rattan (INBAR) to carry out the study. The timely advice, constant support and useful suggestions provided by Dr. Cherla B, Sastry, Program Director, and Mr. Brian Belcher, Principal Economist of INBAR during the course of this study have been decisive in various ways for the outcome of this publication. The author is also indebted to Dr. S. Chand Basha, former Director, KFRI for generously extending all facilities, continuous encouragement and constructive criticism.

The comments received from the following individuals have been very valuable in the preparation of the document.

India

Dr. P.M. Ganapathy, Dr. H.N. Jagadeesh and Mr. K. Damodaran
Indian Plywood Industries Research and Training Institute, Bangalore
Dr. S. Biswas
Forest Research Institute, Dehra Dun

Indonesia

Mr. Budiyo
Division of Forest Products Standardization and
Quality Control, Ministry of Forestry, Jakarta and
Mr. Wasi Pramono
Komplek Kehutanan Block, Jawa Timur

Malaysia

Dr. Abd. Latif Mohmod
Forest Research Institute Malaysia

Philippines

Mr. A.L. Tongacan and Dr. Emmanuel D, Bello
Forest Products *Research and Development Institute, Banos*

USA

Prof. Trevor Williams
Science *Advisor*, INBAR

CONTENTS

Foreword	
Acknowledgements	
Contents	
Introduction	1
Grading stages	3
Grading rules in different countries	9
Problems with existing grading rules	17
Proposed model for rattan grading rules	20
I. Standardised terminology	20
II. General classification and nomenclature of commercial rattan species	26
III. Grading rules for unsplit rattan : Large-diameter cane	27
IV. Grading rules for unsplit rattan : Small diameter cane	30
V. Grading rules for split rattan	32
Conclusions and Recommendations	34
References	35
Appendix I : Classification of Indian rattans according to their properties and end-uses	38
Appendix II: Nomenclature of commercial species of selected countries	42

INTRODUCTION

Rattan is one of the most economically important non-wood forest products (NWFP) of the moist tropical regions in many Asian and West African countries. About 600 species of rattan in 13 genera have been identified. However, only six genera are currently exploited commercially. Rattan plants yield cane, an ecologically friendly alternative to materials such as metals, plastics and wood, especially in furniture, handicrafts, etc. World trade in rattan is brisk with cane being imported/exported both as raw material and finished products. (Fig.1)

The value of the annual global trade in rattan presently is estimated to be about US \$7 billion. In Indonesia, the largest rattan exporting country in Asia, exports have increased three fold since 1989 to an annual value of US \$ 800 million. In the Philippines, Malaysia and China, recent exports of rattan have exceeded US \$ 100 million each. Over the past decade, the rattan markets in other countries such as Bangladesh, Hong Kong, India, Japan, Laos, Myanmar, Nepal, Papua New Guinea, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam have been quite active. Countries like Hong Kong and Singapore, though not producers, play a significant role in processing and exporting finished products. They absorb 25-55% of the export from other Southeast Asian countries.

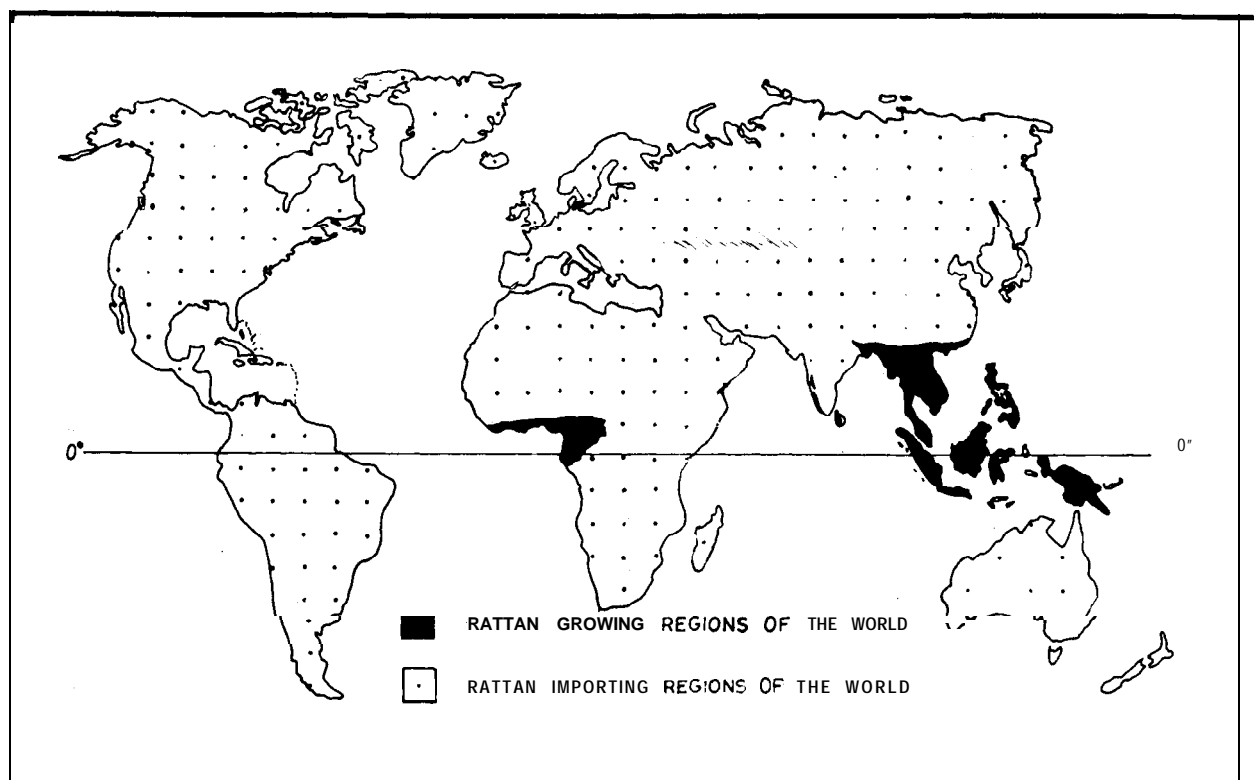


Fig. 1. Rattan producing and importing regions of the world

Grading is a crucial step in trading. It is of special significance in the trade in natural products, given the wide variations in their properties and quality. Grading rules designed to classify such products into different quality grades will ensure that the producer/processor gets optimum realisation from the product sold and the buyer is assured of return commensurate to the investment. Strict adherence to grading will preclude indiscriminate harvesting and reduce wastage on account of improper processing, thereby contributing to conservation of the resource.

As the stakeholders involved in the trade are many, viz., the producer, processor, exporter, importer, seller, buyer and user, distributed in the same or different countries, formulation of grading rules is a complex exercise, often requiring harmonising of conflicting interests. Moreover, the rules should define terms employed precisely and provide for quantitative or qualitative assessment of determinants of quality,

In this context, if the situation with regard to rattan is examined, it is clear that despite inherent variability, trade is carried out without the advantage of grading. Some countries viz., Indonesia and the Philippines have formulated grading rules and few others like Malaysia and Thailand have adopted informal grading procedures. Criteria used in these grading rules thus vary and determinants of grades are different. Their usefulness in international transactions is thus limited. As a first step to overcome this problem, existing information on rattan grading is collated and a model conceived. If producer/processor countries formulate grading rules in accordance with this model which is based on characteristics common to rattan, irrespective of species or their location, it will:

- help in standardising quality of rattan for different end uses.
- facilitate international transactions on mutually understood norms, thereby optimizing benefits to producer/processor as well as to buyer and user.
- promote fairness in trade practises.
- prevent wasteful exploitation as produce compatible to quality will only be extracted.
- conserve the resource as a result of enhanced service life imparted by mandatory provisions for processing.

Formulation and adoption of grading rules will thus contribute substantially to conserve this dwindling resource and to maximise benefits to all concerned.

STAGES IN RATTAN GRADING

Rattan is graded at different stages such as after collection, after processing and before marketing (Fig. 2&3). Grading is applied at any or all of the different processing stages. The following procedures are usually adopted:

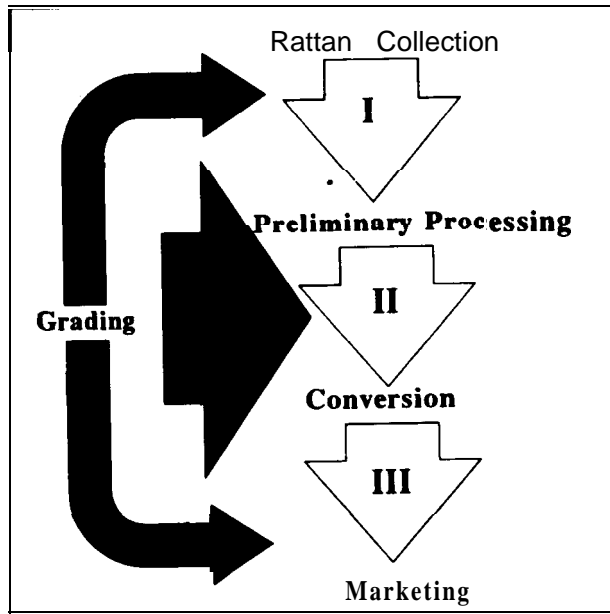


Fig. 2 Different stages of rattan grading

Grading at Stage 1

Sorting canes in the collection sites of producer countries and in trade centres of raw cane importing countries (e.g. Hong Kong, Singapore) is grading at the first stage (Fig.4).

The criteria employed are:

- I. Dimensions
- II. Hardness
- III. Defect measurement

I. Dimensions

a) Stem thickness

According to stem thickness, canes are broadly categorised into large-diameter and small-diameter classes. Conventionally, the demarcation between these two classes in a majority of the countries is 18 mm.

b) Stem length

Stem length is another parameter employed. The minimum length prescribed for large diameter canes varies from 1 to 8 m with a common range of 3-4 m. Length prescribed for small-diameter canes varies from 4 or 5 m to 8 or 9 m.

II. Hardness

On the basis of hardness, cane is graded into three categories:

- 1) Hard rattan : Rattan, when bent by hand and released, springs back and regains its original form quickly .
- 2) Moderately hard rattan : When bent by hand and released, regains its original form rather slowly and not fully.
- 3) Soft rattan : When bent, it cracks at the end or breaks, and if the bent rattan is released before it cracks or breaks, it regains its original form completely.

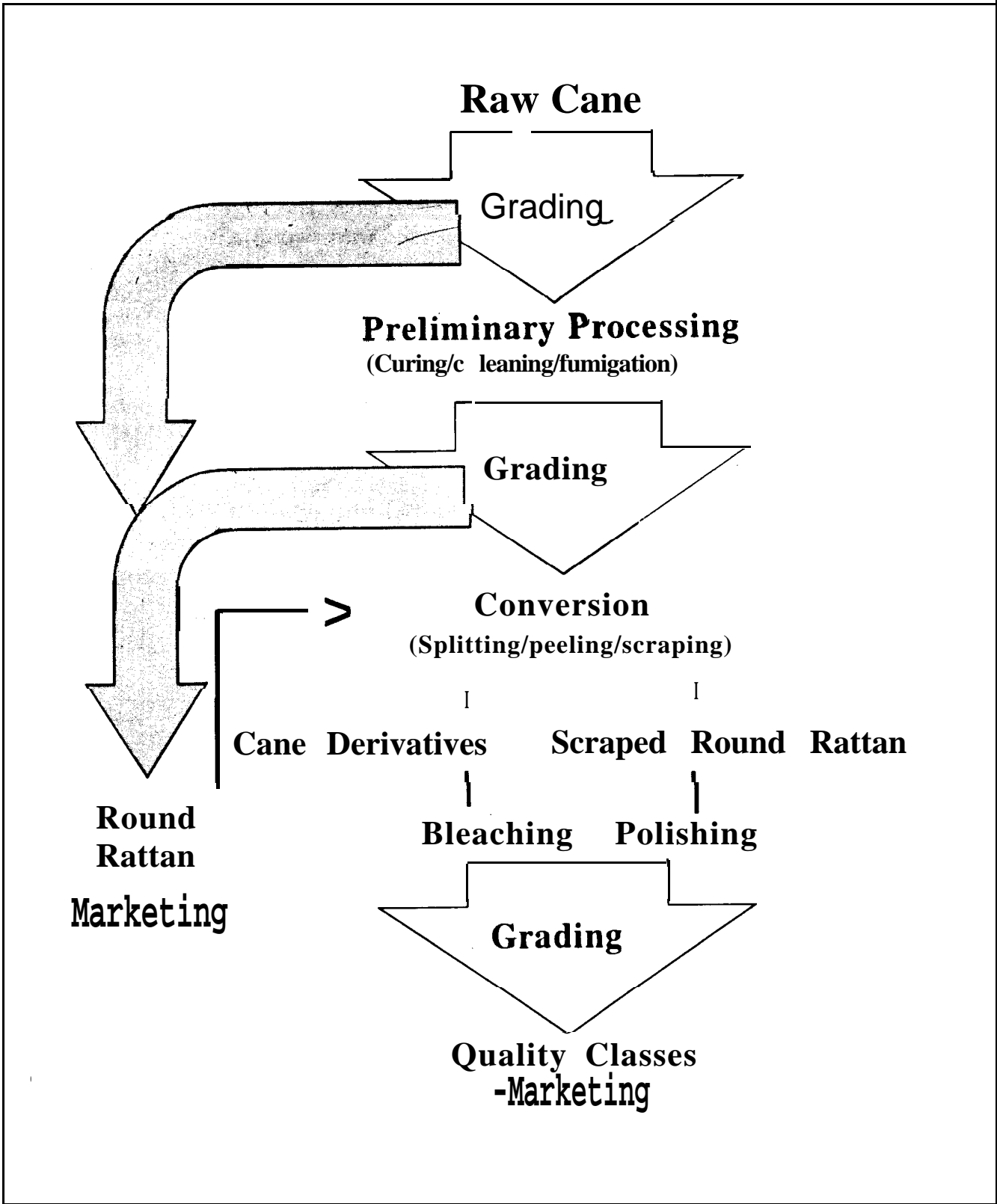


Fig. 3. Flow chart of downstream processing and grading of rattans

III. Defect measurement

Defect measurement is another procedure for grading cane at the first stage. The defects usually evaluated are discolouration caused by fungus, breaks, worm holes, scars.

- In Indonesia, sorting canes into high and low quality classes based on defects such as fungal discoloration is common. Canes are then selected on the basis of length, 3m for export purpose and shorter ones for local disposal. According to MFR (Ministry of Forestry) rules, the large-diameter canes (e.g. manau, janan and semambu) are graded into two quality classes: grade AB and grade CD. Grade CD will be processed further for scraping or polishing to classify it into grades CD1 and CD2 (reject). The grade CD2 canes are sold in the local market while grades AB and CD1 will be sorted into 7 different diameter classes from 14-16 mm to 28-30 mm for export purpose.
- In Hong Kong and Singapore, the imported raw rattan is sorted into the following grades based on hardness of the material: soft, moderately hard and hard rattan.



Fig. 4. Bundles of raw cane ready for marketing



Fig. 5. Furniture made from oil-cured canes



Fig. 6. Bleached derivatives ready for marketing

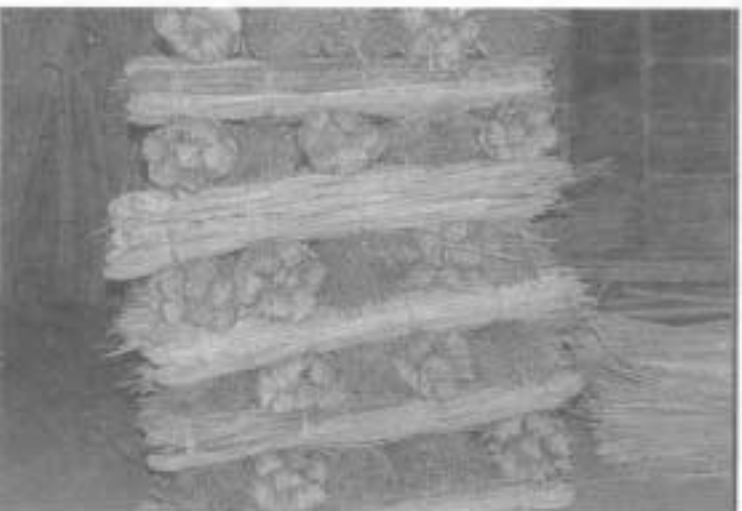


Fig. 7. Unbleached brownish cane derivatives ready for marketing

Grading at Stage II (After processing)

After processing, canes are graded on the basis of surface colour. The purpose of processing is mainly to improve the appearance and aesthetic value of rattan. Whitish, yellowish or cream coloured canes come under higher grades than brownish canes. The other parameters used with visual colour determination are brightness and sheen/lustre (glossiness). For instance, cane with bright and glossy surface is superior to that with dull and non-lustrous surface (Fig 5, 6 & 7).

I. In Hong Kong, Indonesia, Malaysia, Philippines and Singapore, brown or grey canes are bleached with hydrogen peroxide or other chemicals 'to give them a superior finish (Fig 8).

Fumigation with sulphur dioxide after washing and drying is another technique used to improve surface appearance. Artificial colouring and melamine coatings are also applied to upgrade lower quality canes (Fig 9).

II. In countries such as India, Indonesia, Malaysia and Philippines, to impart ivory white colour to cane surface, (Fig 10, 11) green rattan is oil-cured within 24 to 48 hours of harvesting. The hot oil medium used for curing is either kerosene or a mixture of diesel and coconutoil/palm oil/kerosene in different proportions which vary from place to place as do immersion periods and oil temperature.

III. In Indonesia, for export purposes, the grading rules issued by the Ministry of Trade specify the uniformity of colour in the classification of round rattan (unscraped) into 3 grades. For polished round rattan, colour difference is also taken into consideration while classifying into 3 grades.



Fig. 8. Cleaning the bleached rattan



Fig. 9. Artificially coloured chair made from wicker work coated with melamine



Fig. 10. Oil curing of rattan

Grading at Stage 111 (Before marketing)

In this final stage, the raw material in both round and split forms are graded before marketing. The criteria employed include dimensions (diameter/width, thickness, length, taper, internodal length) of both round and split canes, colour, brightness/lustre, hardness and defects such as the stem bend, fungal stains, pinholes or worm holes, bruises, checks, shakes, etc. Split canes such as flat/oval cores, peels and round cores are generally classified according to the dimensional specifications given in Table 1. Decay, worm holes, breakages and bruises are prohibited even in the lowest grade. The other defects such as blemishes, pinholes, checks and small bruises are permissible to different extents for specific grades.



Fig. 11.
Gradual change of skin colour from green to ivory-white in sun-drying of oil-cured rattan. Note the colour of untreated canes (top and bottom).

Table 1. Common grading criteria used in different countries

Dimensions Round rattan	: Diameter, length, taper, internodal length
Split rattan	: Diameter/width, length, thickness
Colour	: Whitish, yellowish/ cream, brownish
Hardness	: Hard, moderately hard, soft
Permissible defects to the extent specified	: Blemishes, pinholes, checks
Prohibitive defects	: Decay, worm holes, breakages, bruises

II. Specifications of 7 diameter classes and cane bundles of grades AB and polished CD1 and CD2 for export purpose in MFR grading rules

Diameter class m m	Number of canes	Weight kg
14-16	100	32.2
16-18	100	36.0-46.0
18-20	100	47.0-58.5
20-22	70	38.4-50.8
22-24	70	43.0-57.8
24-26	70	51.4-64.6
28-30	70	66.7-69.8

III. Specifications of 4 diameter classes of large-and small-diameter canes according to grading standards. for round rattan (Director General of Forestry Decree No. 204/KPTS / DJ/I/1983)

(a) Large-diameter canes (e.g. manau, tohiti, semambu,	(b) Small-diameter canes (e.g. sega, jahab, kooboo, etc.)
15-17 mm	4-7 mm
18-24 mm	8-10 mm
25-30 mm	11-14 mm
31-40 mm	15-21 mm

IV. Grading on the basis of colour according to MTR rules				
C a n e (species)	Grade			
	I	II	III	
I. Large-diameter canes				
1. Manau (Unsplit)	Uniform	Uniform	Not uniform	
. Manau (Polished)	White	White,brown	Grey,brown	
2. Tohiti (Whole)	Uniform	Uniform	Not uniform	
Tohiti (Polished)	Light yellow	Light grey	Brown/grey	
3; Semambu (Whole)	Uniform	Not uniform	Not uniform	
Semambu (Polished)	White brown	Brown	Dark brown	
4. Batang (Whole)	Uniform	Uniform	Not uniform	
Batang (Polished)	White brown	Brown	Dark brown	
5. Others (Whole)	Uniform	Uniform	Not uniform	
Others (Polished)	Light yellow	Light brown	Brown/ grey	

Table 4 contd

II. Small-diameter canes (Unsplit)			
1. Sega, Jahab, & others	Uniform	Uniform	Not uniform
III. Small-diameter canes (Polished/core)			
	White	Yellow	Light brown

V. Grading on the basis of colour and brightness according to MFR rules

Rattan species	I	Grade II	III
A. Large diameter			
1. Manau (P)	Bright & Uniform	Less bright & Uniform	Less bright Not uniform
2. Manau (P)	White/Cream	Brown/grey	Bright & uniform
3. Tohiti (N)	Bright & Uniform	Less bright but uniform	Not bright & not uniform
Tohiti (P)	White/Light brown	Brown or grey	No description
4. Semambu (N)	Dark brown &	Brown not uniform	No description uniform
Semambu (P)	No description	No description	No description
5. Batang	Light yellow & uniform	Dark brown uniform	Dark brown not uniform
B. Small diameter			
1. MA	Bright	Less bright & not uniform	No requirement
2. Jahab	Bright	Less bright & not uniform	No requirement
3. Kooboo	Bright	No requirement	No requirement

Notes: Colour determination is based on visual observation. In case of dispute, a colour chart published by the FPRDC was recommended for consultation.

VI. Colour code and description for rattan colour

Colour group (Proposed)	Code	Paint chart (Code*)	Description
1. WHITE	W	040	Superwhite
2. YELLOW	Y1	024	Blossom white
	Y2	029	Gardenias
	Y3	026	Lemon
3. CREAM	C1	002	Ivory
	C2	003	Magnolia
	C3	004	Off white
	C4	025	Jonquil
	C5	005	Cane
	C6	006	Cream
4. GREY	G1	011	Misty
	G2	012	Silver mist
	G3	013	Ash grey
	G4	014	Silver grey
	G5	015	Pastel grey
5. BROWN	B1	007	Rich cream
	B2	008	coffee
	B3	009	Sugar brown
	B4	037	Suede
	B5	010	Antique
6. RED BROWN	RB1	4522	Apricot
	RB2	4608	Flamenco
	RB3	028	Sunrise

Note: * Paint chart code and description is according to paint colour chart of Endana Paint Company and Wartex. Source: Karnasudirja 1986

MALAYSIA

1. Five grades of large-diameter round canes

- Grade 1: Straight pole, ivory-white or brown or yellow colour, up to 5% allowable defects, mature, with no cracks, borer holes or twists.
- Grade 2: Cream colour, 6-15% allowable defects within 25 cm distance from either end, mature.
- Grade 3: Light brown to reddish, 16-25% colour allowable defects like blue stain, worm holes, etc.
- Grade 4: Reddish to black colour, >25% allowable surface defects like swollen nodes, blue stain,
- Grade 5: Heavily defective and often tender light weight stem with shrunken portion and cracks.

II. Specifications of 5 diameter classes of large-diameter (> 18 mm) canes
 (i) 18-24 mm (ii) 25-29 mm (iii) 30-34 mm (iv) 35-39 mm (v) 40 mm and above

III. Grading rules for Sega (small-diameter cane)

Grade	Criteria
1	White to creamy white, can be easily bent Creamy white to light brown, can be easily bent with allowable defects such as minimal tapered ends
2	White to light brown in colour, can be easily bent, with allowable defects including tapered ends, short internodes, swollen nodes and shrunken tips
3	Mixed colour of white, brown and grey, hard to bend, with allowable defects including tapered ends, short internodes, swollen nodes and shrunken tips
4	Reddish in colour, brittle and heavily defective stems

IV. Grading rules for other small-diameter canes

Grade	Criteria
1	Yellowish or white in colour, smooth surfaces, and with no or few defects on epidermis, outer or inner portion of the stem.
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

V. Grading of rattan cores

Grade	Criteria
1	Whitish in colour, hard and not easily broken, or no few defects
2	White to yellowish in colour, hard, less than 15% of surface defective
3	Brown to reddish in colour, soft, more than 15% of surface defective

PHILIPPINES

I. Classification of unsplit rattans according to trade names

Trade names	Species	General Characteristics
Palasan	Palasan Batang Manau	Natural color: (dry) a. Unscraped: whitish to yellowish b. Scraped: yellowish to creamish white Diameter :25 mm and above Internode: 200 mm and above Dense core, shallow node, good bending quality
Limuran	Kalapi	Natural color a. Unscraped: creamy to yellowish b. Scraped: creamish white to milky white Diameter: 25 mm and above Internode: 200 mm and above Deep node, distinct dark ring, good bending quality, less dense core, uneven roundness
Tumalim	Tumalim Sahaan	Natural color a. Unscraped: yellowish to creamish Diameter :15 mm and above Internode: 150 mm and above Shallow node with distinct browning, good bending quality, less dense core
Olisi	Olisi Palasan-bato	Natural color a. Unscraped: whitish to yellowish b. Scraped: yellowish to creamish white Diameter : 25 mm and above Internode: 150 mm and above Shallow node, poor bending quality, very dense core. Over-dried canes are susceptible to surface cracks
Sika	Sika	Natural color a. Unscraped: bright yellow and glossy Diameter :16 mm and above Internode: 200 mm and above Shallow node, very good bending quality, less dense core.
Arorog	Arorog Tumanig	Natural color a. Unscraped: Matte (dull finish),

Panlis	light cream to cream
Sipai	Diameter: 16mm and below
Kamlis	Internode: 150mm and above
Tandulang	Shallow nodes
Parang	Good bending quality, less dense
Sik-sik	
Sik-sika	
(to include other similar species)	

11. Specifications of 5 grades used in Philippine grading rules

Grade	Quality specification
A	100% of standard length free from fungal discoloration (stains), pinholes, bruises, cracks, checks, scars and water marks
B	85% of standard length free from discoloration (stains), pinholes, bruises, cracks, checks, scars and water marks
C	70% of standard length free from fungal discoloration (stains), pinholes, bruises, cracks, checks, scars and water marks
D	40-70% of standard length free from fungal discoloration (stains), pinholes, bruises, cracks, checks, scars and water marks
E	Below 40% of standard length free from fungal discoloration (stains), pinholes, bruises, cracks, checks, scars and water marks

III. Specified diameter classes (source: PCARD 1990)

Above 50

50	38	25	12
47	35	22	9
44	31	19	6
41	28	16	3

THAILAND

I. Four quality classes (grades)

Defects	A	B	C	D
Discolouration	0 %	Not more than 5% of std.length	Not more than 5% of std.length	Not more than 5% of std.length
Pinholes	Not more than 10% of std.length	Not more than 20% of std.length	Not more than 20% of std.length	Not more than 20% of std.length
Checks	Not more than 3% of std.length	Not more than 10% of std.length	Not more than 10% of std.length	Not more than 10% of std.length
Cracks	Not more than 3% of std.length	Not more than 10% of std.length	Not more than 10% of std.length	Not more than 10% of std.length

PROBLEMS WITH EXISTING GRADING RULES

It is clear that despite some similarity in the grading criteria employed in different countries, the defect measurement systems and dimensional specifications do not allow for standardisation. Grading in these rules is based on subjective evaluations to a large extent and there are various discrepancies in categorising the different kinds of canes. Some of the problems encountered are as follows:

I. Number Of Quality Classes

A major problem is that the number of quality classes (grades) for marketing varies between the countries. For instance, in the case of round rattan, in Indonesia, 3 grades 'p' (primary), I and II are recognised; 5 grades in Malaysia and the Philippines and 4 grades in Thailand. For split canes, 2 grades are recognised in Indonesia and the Philippines and 3 in Malaysia. No definite number of quality classes has been known from other countries. Often there exists ambiguity in number of grades. For instance, in Indonesia, 4 quality classes were proposed with the first 3 further divided into 4 sub-quality classes (I, II, III, IV) in spite of the 3 grades already in vogue.

Table 2. Number of quality classes used in different countries for grading

China	India	Indonesia	Malaysia	Philippines	Thailand
			Round Rattan		
		p, I, II (3 grades) OR I, II, III, IV (4 grades)	I, II, III, IV, V (5 grades) OR I, II, III (3 grades for small diameter)	A, B, C, D, E (5 grades)	A, B, C, D (4 grades)
			Split Rattan		
		I, II (2 grades)	I, II, III (3 grades)	A, B (2 grades)	

II. Colour Perception

In most countries, colour determination in current grading practices is by visual judgement although it is known that colour perception differs from person to person. Local paint charts are often referred to for colour description. Though some attempt have been made in Indonesia to identify six colour groups with several subgroups, no standard method is available for objective and precise colour determination.

III. Vernacular Names

Another problem in existing grading methods of different countries, is the use of vernacular names. The names are usually derived from specific characteristics of the plant. These names

may refer to surface appearance, stem diameter, hardness, use, taste of apical buds, shape of leaf sheath, spinal arrangement, types of resin or sap exudation, etc. There exists ambiguity when a particular species has wider geographic distribution. For instance, *Calamus caesius* is known as "rotan sega" in Malaysia and "rotan tamam" in Indonesia.

IV. Trade names

Trade names are often developed by rattan merchants and bear little or no relation to botanical origin. They differ from country to country and even region to region and thus it is impossible to ensure any degree of standardisation. Usually commercial names are derived from the locality the cane comes from (e.g. Sampit, Palembang, Djermasin) or by their appearance (e.g. sega - polished or smooth, rotan batu - stony). There is further confusion in referring to rattans by locality and appearance or quality. In Malaysia, 4 main groups have been recognised according to the trade name as follows: Sega (all canes with siliceous outer layer that crack and spring off when they are bent); Lunti (similar to Sega except that the silica layer is removed); Ayer (non-siliceous cane); Sticks (straight lengths where stiffness and straightness are the main considerations, e.g. walking sticks and furniture frames). Species classified under Sega and Lunti are identical in stem form such as *Calamus caesius*, *C. optimus*, *C. trachycdeus* and *C. leiocaulis*. In the Philippines, round rattan is classified into 6 groups based on the trade names derived from appearance, distinguishing characteristics and species groups. They are: palasan, limuran (kalapi) tumalim, olisi, sika andarorog.

V. Size

Grading methods in different countries are based on different size perceptions and thus lead to non-standardisation. Size classes used for marketing, based on diameter, vary among the countries. In both small and large diameter canes, 4 or 5 diameter classes are made with the increase of 2, 3, 5, 6 or 9 mm. In the Philippines and Thailand, diameter is measured in mm and an allowance of 2 mm for scraping large diameter canes is provided.

Table 3. Dimensional specifications used for classification in different countries

Dimensions	India	Indonesia	Malaysia	Philippines	Thailand
			Large diameter canes	-round rattan	
Minimum diameter, mm	18	15 16 18	18		
Length, m	36	3 (1-6)	3	4 (3-6)	45
			Small diameter canes-round rattan		
Diameter, mm	<18	<18	< 8	<18	<18
Length, m	48	5-7	8-9	8	
			Split cane flat, oval cores/peels		
Length, m	-	1-4	-	2.5-3.5	-
Width, mm	-	2-8	-	2-10	-
Thickness, mm	-	1-4	-	1-6	-
			Split - - round core		
Length, m	-	2-3.5	-	3.5	
Diameter, mm	-	-	-	2-20	

THE NEED FOR STANDARDISED GRADING RULES

It is evident from a review of existing grading rules that there are several differences, ambiguities and deficiencies which preclude the application of grading rules. There is therefore, an urgent need to standardise grading rules given the economic and ecological importance of rattan. In the absence of standardised grading rules, the rattan market has been severely constrained. Some of the problems that have arisen due to the absence of standard grading practises are as follows:

1. Confusing terminology

In the absence of standard rules, material sold in the market has confusing terminology and classification systems. The existing grading methods differ not only from one country to another but often, in different parts of the same country.

2. Non-standardised grading practises

Different grades are often based on crude methods of diameter classification by referring to sizes of coins in the local currency, pencil, finger, cigarettes, etc. Further, the tentative grading rules applied in the trade are very subjective and grade classes depend on the trading experience and skill of persons employed by the-traders.

3. Improper harvesting

In the absence of proper grading rules, immature canes are often harvested leading to avoidable depletion of cane stocks. Cane gatherers have to go deep into the forest as cane growing areas on the periphery of the forest are totally depleted.

4. Production of sub-standard rattan goods

As a consequence of employing unclassified canes, product quality is seldom uniformly good.

ADVANTAGES OF STANDARDISED GRADING

The introduction of a standard grading system will have the following advantages:

1. Value-addition to rattan

Graded rattan will enjoy a higher price than ungraded material.

2. Availability of standardised rattan worldwide

The standardised differentiation of quality and consequent price structure will help in market standardisation, allowing for the same grade of rattan to be supplied in any part of the world. The consumer/buyer can specify to the supplier the particular quality they require, who then will be able to ensure that they get that grade of rattan.

3. Less material wastage

Standardised grading rules will minimise the risk of substandard products, thereby ensuring less material wastage which causes considerable loss to both producers and buyers.

PROPOSED MODEL RATTAN GRADING RULES

The recommended model of rattan grading rules has the following five essential components:

- I. Standardised terminology
- II. General classification and nomenclature of commercial species
- III. Grading rules for unsplit rattan: Large-diameter canes
- IV. Grading rules for unsplit rattan: Small-diameter canes
- V. Grading rules for split rattan

I. STANDARDIZED TERMINOLOGY

1. Bleached rattan

Cane which has been lightened in colour by bleaching agents to improve surface brightness (Figs 6 and 12).

2. Cane

A general term of convenience for any piece or stem of round rattan (Fig. 13).

3. Defect

An abnormality or irregularity in cane which lowers its technical quality or commercial value by decreasing strength or adversely affecting its appearance and use. (See definitions of different types of defects below)

4 Flat/oval core

Flat or oval shaped material, width ranging from 2 to 10 mm, obtained from inner part (core) of the cane by peeling and splitting. This is normally used for weaving and binding (Figs. 14b and 15).



Fig. 12. Bleached and unbleached

5. Fumigated rattan

Cane which has been exposed to sulphur fumes for improvement of surface appearance.

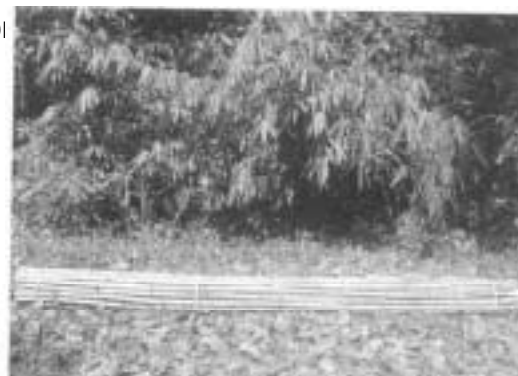


Fig. 13. Processed cane bundles ready for marketing



6. Internode

The region between nodes of a stem (Fig. 16).

7. Lustrous cane

Cane in which the surface is bright and exhibits sheen or glossiness.

8. Mature cane

Rattan stem which has attained full structural development, and does not show any deformation or fracture during drying and bending.

9. Node

The thickened part of the stem at which leaves are attached in juvenile phase of growth (Fig . 1 6) .

10. Oil-cured rattan

Cane which has been cured in hot oil media in green condition to impart desired surface colour/appearance and prevent biological degradation (Figs. 10 -11).

11. Rattan

A collective term for the climbing members of a large group of Lepidocaryoid palms (sub family: Calamoideae)

12. Rattan derivatives

Products or parts of cane resulting from rattan conversion (splitting/peeling) (Figs. 6-7 and 14-15).



Fig. 14. through a low-cost machine

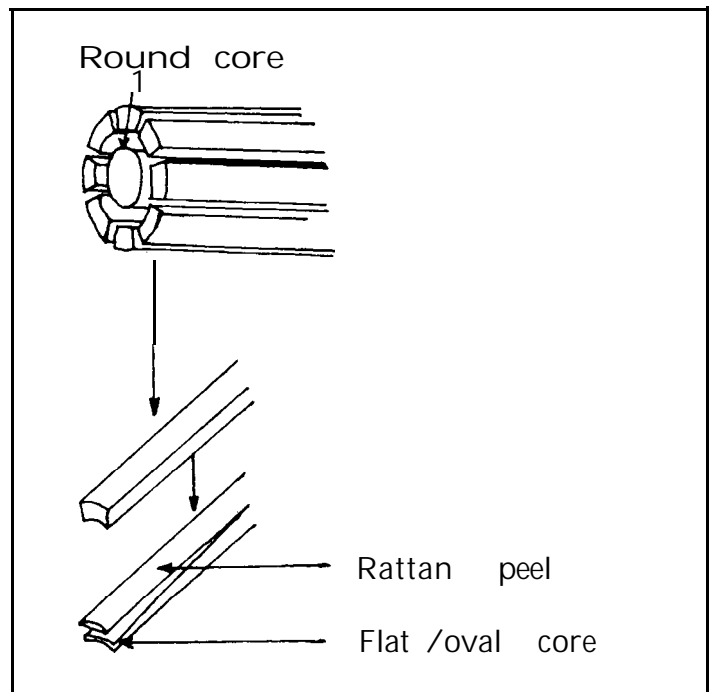


Fig. 14(b) The resultant rattan derivatives

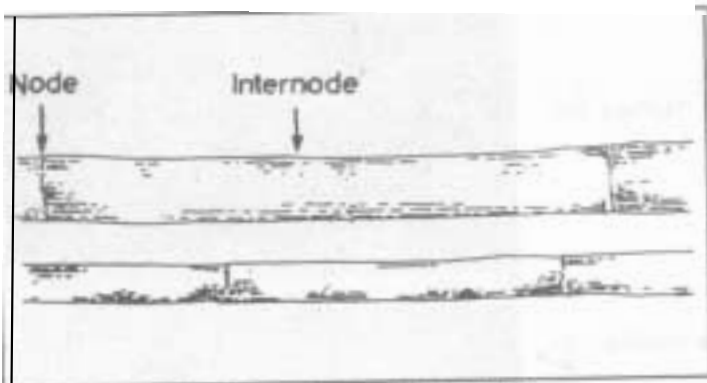


Fig. 16 Cane showing nodes and internodes

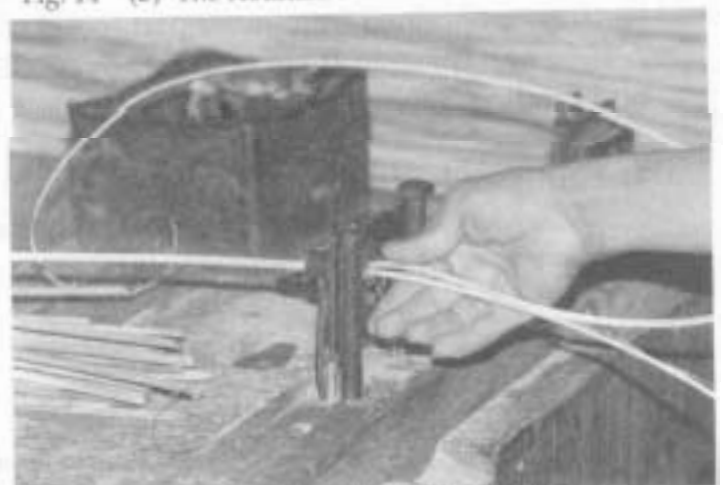


Fig. 15 Manual splitting and peeling of rattan

Defects

Bend (Curvature)

Any deviation from straightness of the cane and is measured by the chord which the curvature makes between the extreme edges of deviation and by the depth at the middle portion (Fig. 20).

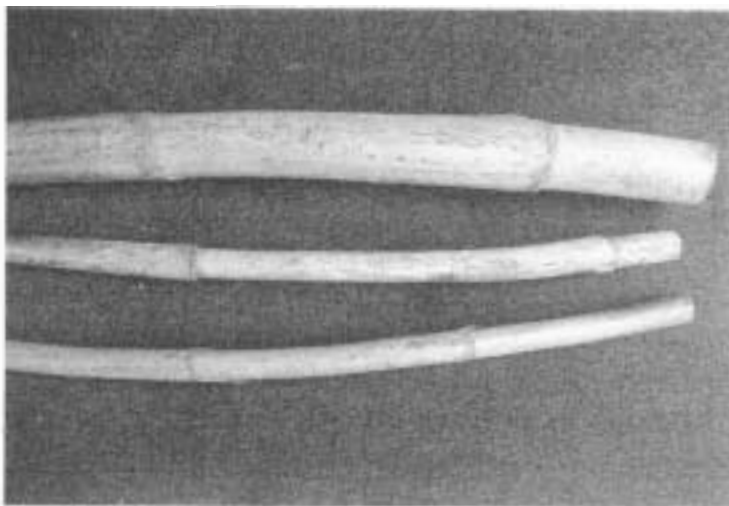


Fig. 20. Defective canes with bends

Blemish

Any feature that mars surface appearance. Whether a particular feature is classed as a blemish depends on the relevant grading rule or on the purpose for which the cane is intended. (Figs. 21-23).

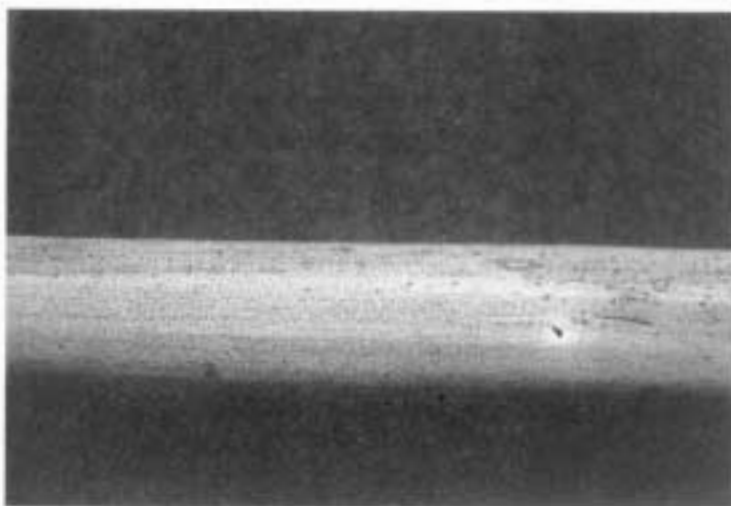


Fig. 21. Fungal blemishes - dark brown spots

Break

A separation of fibres which extends through a piece from one surface to the other usually perpendicular to the direction of the grain.

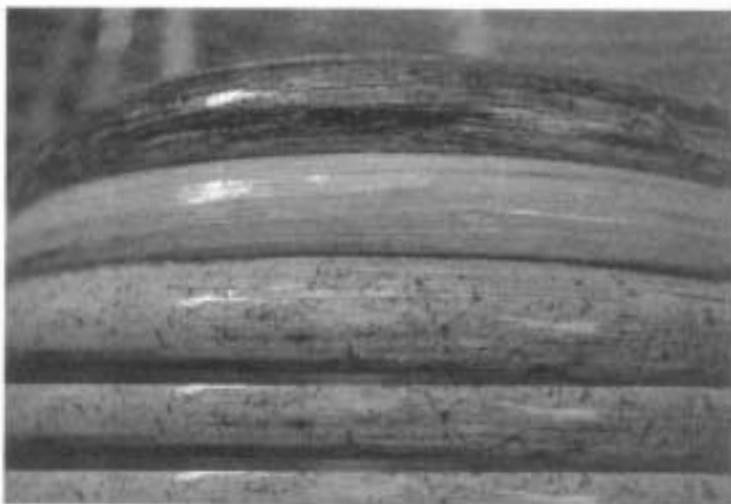


Fig. 22. Blackish fungal stains

Bruise

An injury on the surface caused by harvesting operations or improper processing (Fig. 24).

Check

A longitudinal fissure indicating separation of fibres along the cane length, not extending through the piece from one surface to another.

Hole

cavity caused by worms (worm hole), insects (pinhole) or mechanical means.

Scar

Depression or any marking on the surface other than discolouration (Fig. 25).

Shake

A partial or complete separation between adjoining layers of tissues, as seen in end surfaces, caused by stresses developed in cutting and collecting, or in unequal drying of immature stem (Fig. 26).

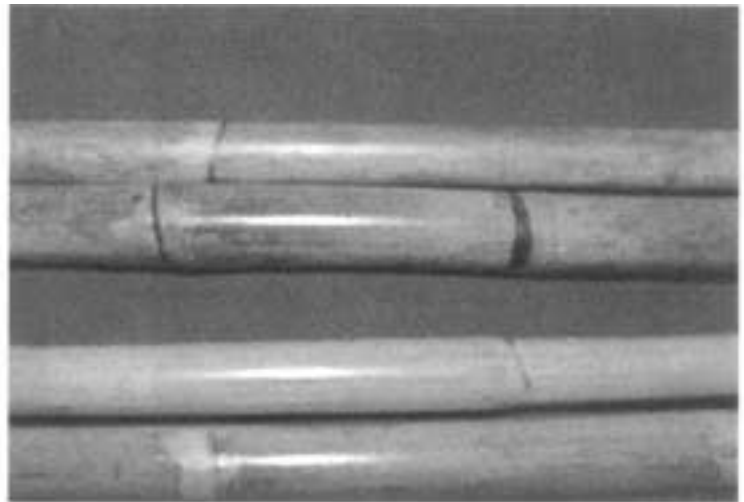


Fig. 23. Blue stain due to fungal attack

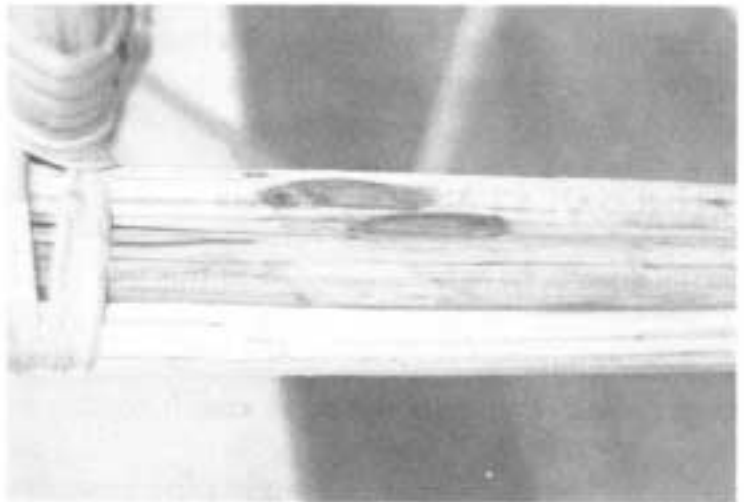


Fig. 24. Canes with harvesting defects (bruises)



Fig. 25. Defective cane of *Korthalsia* sp. with nodal scar



Fig. 26. Canes with shakes

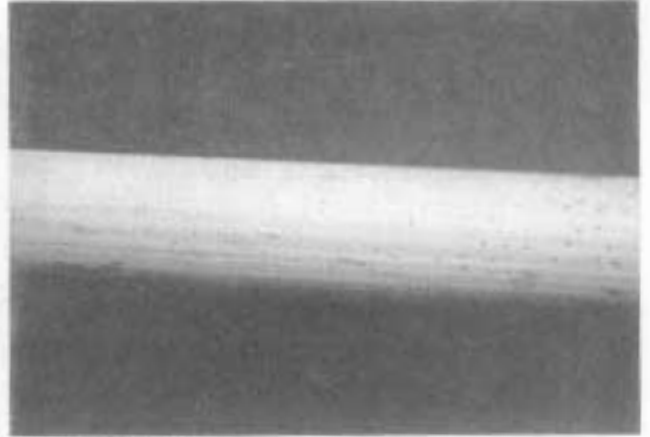


Fig. 27. Wrinkles on the surface

Other defects

Any defect not listed above but which will debar any piece from its expected utility can be considered as a defect which can be identified depending on the appearance, size, location and distribution, e.g. wrinkles on the surface (Fig. 27).

METHODS OF CLASSIFICATION

Following criteria have been adopted in this model for evaluating the quality of the rattan:

I. Diameter Class

Based on the diameter in the small end, following standard diameter classes are followed:

- (a) Large-diameter rattan : Unsplit cane measuring from 18 mm to 40 mm (or above)
- (b) Small-diameter rattan : Unsplit cane measuring below 18 mm

II. Strength Class

Based on the strength values obtained in mechanical testing, unsplit rattans are classified as follows:

- | | | |
|-----|-----------------------|---|
| (a) | Strong to very strong | : Static bending- modulus of rupture (MOR) and/or tensile strength - ultimate tensile stress (UTS) above 70 N/mm ² |
| (b) | Moderately strong | : MOR or UTS 45 - 70 N/mm ² |
| (c) | Weak | : MOR or UTS below 45 N/mm ² |

III. End-use Class

Following five categories of end-uses are recognised for assessing utilisation potential of a particular grade.

- | | |
|--|-------------------------------|
| (a) Furniture frames | (d) Handicrafts/novelty items |
| (b) Furniture seats/backs | (e) Baskets |
| (c) Walking sticks, umbrella handles, sporting goods, etc. | |

II. GENERAL CLASSIFICATION AND NOMENCLATURE OF COMMERCIAL RATTAN SPECIES

Scope

This standard provides a proforma for general classification and nomenclature of commercial rattan species in a country, with information about the source of supply/distribution, properties and potential end-uses. The important rattan genera are Calamus, Ceratolobos, Daemonorops, Korthalsia, Myrialepis, Plectocoria and Plectocomiopsis.

General requirements

When a country has distinctly different agroclimatic zones with restricted occurrence of species, zonal distribution will be included in the national classification system.

Terminology

For the purpose of this standard, the definitions given in the Standard Terminology will apply.

Classification

The listing of species suitable for each category of end use given in the Standard Terminology will include botanical name, standard trade name, distribution (source), diameter class, weight and strength classes. The sample proforma is given below.

Sample proforma for the classification and nomenclature of commercial species

(Country/Zone)

Sl. name	Botanical name	Trade/local name	Distribution	Diameter	Weight	Strength
(a)	<u>Furniture frames</u>					
(b)	<u>Furniture seats/backs</u>					
(c)	<u>Walking sticks, umbrella handles, sport goods, etc.</u>					
(d)	<u>Handicrafts/novelty items</u>					
(e)	<u>Baskets</u>					

See Appendix I for classification of Indian species according to this proforma.

111. GRADING RULES FOR UNSPLIT RATTAN: LARGE-DIAMETER CANES

Scope

This standard covers the minimum requirements for trading large-diameter canes.

Terminology

For purpose of this standard, the definitions given in Standardised Terminology shall apply.

General requirements

Canes shall have authentic identity when the species are specified by the buyer.

- Canes shall be straight, round, mature and seasoned.
- Canes shall not break or develop checks and other defects in bending or any other processing stage.
- Canes shall be either oil-cured or chemically treated with anti-staining fungicide, bleached or fumigated as specified by the buyer.
- Plugging or covering of visible defects shall not be permitted in any form,

Dimensional specifications

- 1) Length : Length shall be taken as the shortest distance in meters from one extreme end to the other. Length shall be rounded off to the nearest lower 0.05 m, It shall be as specified by the buyer.
- 2) Diameter : The minimum diameter shall be 18 mm. The standard diameters shall be expressed in mm with a tolerance of + 3 mm for scraping. The diameter shall be determined in the mid&internode of small end. Following diameter classes shall be adopted for trading:> 40 mm, 35-40 mm, 30-35mm, 25-30 mm, 20-25 mm, 18-20 mm.
- 3) Taper : The maximum taper shall not exceed 5 mm for a length of 3.5 m. Taper of the cane shall be determined by the difference between diameters measured in two extreme ends.
- 4) Internodal length : The minimum length shall be 50 mm. It shall be taken as the shortest distance from one node to another and expressed in mm.

Defects

Prohibited Defects

Defects such as decay, worm holes, breakage and shakes shall not be permitted.

Permissible Defects

Defects such as blemishes, scars, pin holes, checks and bruises to the extent specified for a specific grade shall be permissible.

Appearance

Canes shall be inspected visually for colour and brightness.

Grading

Based on the quality consideration in terms of appearance and the extent of permissible defects, four grades shall be recognised as follows,

Grade	Specifications
Super Quality	Entirely (100% of specified length) free from defects, ivory white, cream or yellowish in colour, uniformly bright or lustrous surfaces, internodal length > 100 mm
I	Extent of permissible defects shall not exceed 15% of the specified length, ivory-white, cream or yellowish in colour, uniformly bright surfaces, internodal length > 100 mm
II	Extent of permissible defects shall not exceed 50% of the specified length, ivory-white, cream or brownish in colour, internodal length > 100 mm
III	Extent of permissible defects shall not exceed 75% of the specified length, whitish, yellowish, brown or dark brown, internodal length > 50 mm

Inspection procedure

- 1) Unsplit canes shall be inspected and classified individually.
- 2) All large-diameter canes shall be single-scraped and chemically treated with anti-staining fungicide.
- 3) A minimum of 10% of the lot may be inspected at random to determine size uniformity.

Packaging and labeling

Canes shall be sorted, bundled and legibly marked according to diameter, length, grade and species. Each bundle of canes shall be labeled with the following information:

- 1) Trade name/vernacular name
- 2) Botanical name
- 3) Diameter/length
- 4) Grade
- 5) Origin or source
- 6) Number of canes per bundle
- 7) Name and address of supplier
- 8) Date of supply

IV. GRADING RULES FOR UNSPLIT RATTAN: SMALL DIAMETER CANES

Scope

This standard covers the minimum requirements for trading small-diameter canes.

Terminology

For the purpose of this standard, the definitions given in Standard Terminology shall apply.

General requirements

- Canes shall have authentic botanical identity when specified by the buyer.
- Canes shall be mature and seasoned.
- Canes shall not break on bending or in any other processing stage.
- Canes shall be either oil-cured or chemically treated with anti-staining fungicide, bleached or fumigated as specified by the buyer.
- 'Plugging or covering of visible defects' shall not be permitted in any form.

Dimensional specifications

- 1) Length: Length of the canes shall be as specified by the buyer. It shall be taken as the shortest distance in meters from one extreme end to the other. Length shall be rounded off to the nearest lower 0.05 m. It shall be as specified by the buyer.
- 2) Diameter: The diameter of canes shall be below 18 mm. Diameter shall be determined in mid-internode of the small end. Following diameter classes shall be adopted for trading : 2 - 6 mm, >6—11 mm and >11 -17 mm.
- 3) Taper: The maximum taper shall not exceed 3 mm for a cane length of 4.5 m. Taper of the cane shall be determined by the difference between diameters measured in two extreme ends.
- 4) Internodal length: The minimum length shall be 50 mm. Internodal length shall be taken as the shortest distance from one node to another and expressed in mm.

Defects

Prohibited Defects

Defects such as decay, worm holes, breakage and shakes shall not be permitted.

Permissible Defects

Defects such as blemishes, scar, pinholes, checks and bruises to the extent specified for a specific grade shall be permissible.

Appearance

Canes shall also be inspected for colour and brightness or lustre.

Grading

Based on the quality consideration in terms of appearance and the extent of permissible defects four grades shall be recognised as follows.

Grade	Specifications
Super Quality	Entirely (100% of standard length) free from defects, ivory white, cream or yellowish, uniformly bright or lustrous, easily pliable, internodal length > 100 mm
I	Extent of permissible defects shall not exceed 15% of the standard length, ivory-white, cream or yellowish, easily pliable, internodal length > 100 mm
II	Extent of permissible defects shall not exceed 50% of the standard length, ivory-white, cream or brownish, internodal length > 100 mm
III	Extent of permissible defects shall not exceed 50% of the standard length, whitish, yellowish, brown or dark brown, internodal length > 50 mm

Inspection procedure

1. Unsplit canes shall be inspected and classified individually.
2. All small-diameter canes shall be chemically treated with anti-staining fungicides upon inspection.
3. A minimum of 10% of the lot shall be inspected at random to determine the size and uniformity.

Packaging and labeling

Canes shall be sorted, bundled and legibly marked according to diameter, length, grade and trade name. Each bundle of canes shall be labeled with the following information:

1. Trade name / vernacular name
2. Botanical name
3. Diameter/ length
4. Grade
5. Origin or source
6. Number of canes per bundle
7. Name and address of supplier
8. Date of supply

Grade	Specifications
I	Entirely free from defects, whitish in colour
II	Extent of permissible defects shall not exceed 15% of standard length, white, yellowish or brown in colour

Inspection procedure

1. Split canes shall be inspected and classified individually.
2. A minimum of 10% of the lot shall be inspected at random to determine size uniformity.

Packaging and labelling

Cane derivatives shall be sorted, bundled and legibly marked according to diameter/width and grade. Each bundle shall be labeled with the following information:

- 1 Trade name / vernacular name
- 2 Botanical name,
- 3 Size (diameter/width and thickness)
- 4 Grade
- 5 Origin or source
- 6 Name and address of supplier
- 7 Date of supply

Other conditions

- 1 The cane derivatives shall be coded according to the measurement e.g. round cores measuring 2 mm in diameter shall be labeled 'round core#2" or peels with 5 mm skin width shall be labeled "peels# 5".
- 2 If bleaching or any other special treatment is given, it can be specified to indicate the special quality to become a sub-classification of the particular grade.

CONCLUSIONS AND RECOMMENDATIONS

- 1) As a first step, model grading rules for rattan have been formalised, harmonizing to the extent feasible, existing grading rules and procedures and drawing relevant information from timber grading rules.
- 2) A standardised terminology conforming to widely used glossaries has been included as part of the grading rules.
- 3) Applying the parameters in the model grading rules, a proforma for classification of rattan has been designed and classification of Indian rattan according to this proforma provided as an example.
- 4) Although the model has been field tested in a limited number of situations, it requires to be tested widely in rattan producing and processing countries in the region, before the same is finalised and commended to governments to formulate country specific grading rules based on the model.

REFERENCES

- Anon. 1971. Terminology of Forest Science, Technology, Practice and Products. Multilingual Forestry Terminology Series No. 1 (ed. F. C. Ford Robertson), Soc. American Foresters, Washington D.C., 349p.
- Anon. 1988. Final Technical Report: Rattan (Indonesia) Project (1984-88), International Development Research Centre, Canada and Department of Forestry, Jakarta.
- Anon. 1989, Final Technical Report: Rattan (Thailand) Project (1986-89), International Development Research Centre, Canada and Faculty of Forestry, Kasetsart University, Bangkok.
- Anon. 1948. Standardisation and inspection of unsplit rattan and other purposes. Standards Admn. Order No. 103. Department of Commerce and Industry, Manila, 5p.
- Badhwar, R.L., Dey, AC. & Ramaswami, S. 1961. Collection and processing of canes. *Indian Forester* 87:257-26 1.
- Bhat. K.M. 1992. Classification of canes (rattans) according to properties and potential end-uses. *J.Timber. Dev. Asso. India* 38(4):23-32.
- Bhat. K.M. & Muraleedharan, P.K. 1990. Rattan trade and industrial development in India: future research strategies. Presented in XIX IUFRO World Gong., Montreal, Canada.
- Bhodthipuks, P. & Ramyarangsi, S. 1989. Past, present and future status of rattan in Thailand. In: Rao A.N. and Isara Vongkaluang (eds) *Recent Research on Rattans*, Kasetsart University, Thailand and International Development Research Centre, Canada. pp 11-1 2.
- Budiyono & Promono, 1994. Notes from the Ministry of Forest Products Standardisation and Quality Control, Jakarta, Indonesia.
- Choo, K.T & Singh, K.D. 1985. Rattan processing and utilization in Peninsular Malaysia. In K.M. Wong and N. Manokaran (Eds.) *Proc. Rattan Seminar*, Kuala Lumpur, 1984. The Rattan Information Centre, FRI, Malaysia, Kepong 155-161p.
- De Zoysa, N.D. & Vivekanandan, K. 1989. Recent progress in rattan research in Sri Lanka. In: A.N.Rao and Isara Vongkaluang (eds), *Recent Research on Rattans*, Kasetsart University, Thailand and International Development Research Centre, Canada. pp 25-32.
- Dhamodaran, T.K & Bhat K.M. 1992. Kerosene curing of Indian rattans. In S. Chand Basha and K.M Bhat (eds.) *Rattan Management and utilization*. KFRI, India and International Development Research Centre, Canada 259-265p.

Dransfield, J. 1979. A Manual of Rattans of the Malay Peninsula. Forest Department. Ministry of Primary Industries. Malaysia.

FAO 1982. Classification and definition of forest products.

Indian Standards Institution, 1976. Glossary of terms applicable to timber technology and utilization. IS: 707, 44p.

Karuasudirja, S. 1986. Grading rattan in Indonesia. Paper presented at the ASEAN Special Technical Workshop on Wood and Rattan Furniture. Jakarta, 21p.

Karuasudirja, S. 1988. A study on colour variation in some rattan species. In: Final Tech. Rept.: Rattan (Indonesia), IDRC, pp 142-146.

Lakshmana, A.C. 1993. Rattans of South India. Evergreen Publishers, Bangalore.

Manokaran N. 1990. The state of the rattan and bamboo trade. RIC Occasional Paper.NO. 7, FRIM, Kuala Lumpur, Malaysia, 39p.

Menon, K.D. 1980. Rattan: a state-of-the-art review. A report of a workshop held in Singapore, June 1979, IDRC, Canada.

Mohmod, A.L. 1992. Processing of rattans. In: A Guide to the Cultivation of Rattans (eds. W.R.W. Mohmod, J. Dransfield & N. Manokaran), pp 239-260, Forest research Institute Malaysia, Forest Record No. 35.

Mohmod, A.L.1990. Guidelines for the selection and preparation of rattan for industrial use. RIC Handbook No. 2, FRIM, Malaysia, 27p.

Peki, M. & Konabe, C. 1991. Treatment, seasoning and grading of rattan. In: C. Konabe and C.B. Sastry (eds.). Proc. of National Rattan Workshop, PNG. FRI, Papua New Guinea and International Development Research Centre, Canada. 18-22p.

PCARD, 1991, A beginner's sourcebook on Philippine rattan, Philippine Council for Agriculture, Forestry and Natural Resources Research & Development, Laguna, and International Development Research Centre, 65p.

PCARD, 1985, The Philippine Recommends for Rattan. PCARD Tech. Bull. Series No. 55, Laguna.

PCARD, 1990. Rattan (Proceedings of the National Symposium Workshop on Rattan, Ecotech Centre, Lahug, Cebu City, June 1-3, 1988). Book Series No. 99/1990, 182p.

Silitonga, T, 1989. The effect of several cooking oil compositions on Manau (calumus manan Miq.) canes. In: A.N. Rao and Isara Vongkaluang (eds.) Recent Research on Rattans, Faculty

- of Forestry, Kasetsart University, Thailand and International Development Research Centre, Canada, 178-181p.
- Silitonga, T. 1990. Supply of rattan for industrial use. Proc. A workshop on design and manufacture of bamboo and rattan furniture. March 1989, FAO, Kuala Lumpur.
- Tesoro, F.O. 1990. Rattan processing and utilization research in the Philippines. In: Proceedings of the National Symposium-Workshop on Rattan. Ecotech Centre, Lahug, Cebu City, June, 1988. Book Series No. 99/1990 182p.
- Tongacan, A.L. 1979. Grading of Philippine rattan, In: Proc, of a symposium/workshop on rattan. Book Series No. 1 PCARD, Los Banos, Laguna.
- Tongacan, A.L. 1985. Proposed Philippine grading rules for unsplit rattan and its derivatives. In: Proceedings of Rattan Seminar (eds. K.M. Wong & N. Manokaran) Oct.1984, Kuala Lumpur, Malaysia. RIC, Kepong Malaysia, pp169-178.
- UNIDO, 1983. Manual on the production of rattan furniture, United Nations, New York, 108p
- Wong, K.M. 1984. On the feasibility of an export-oriented rattan furniture industry in Bangladesh. RIC Occasional Paper. No. 1, FRIM, Kuala Lumpur Malaysia, 15p
- Yekantappa, K; Bhat, K.M. & Dhamodaran, T.K. 1991. Rattan processing techniques in India: a case study of oil curing. RIC Bull. 9(2): 15-21.
- Yudodibroto, H. 1985, Processing techniques applied by small-scale rattan manufacturing companies in Indonesia. In: Wong, K.M and N.Manokaran (eds.). ProRattan Seminar, Kuala Lumpur, Malaysia. RIC, FRI, Malaysia. 145-154p

APPENDIX I

Classification of Indian rattans according to their properties and end-uses					
Botanical name	Vernacular Trade name	Distribution	Diameter class	Average basic specific gravity	Strength class
(1)	(2)	(3)	(4)	(5)	(6)
(a) Furniture frames(in unsplit/ split forms)					
<i>Calamus an thospathus</i>	Griff. Gouri beth (Hin)	a	Large		
<i>C. andamanicus</i> Kurz.	Mota beth (Hin)	C	Large	0.4%	II
<i>C. dransfieldii</i> Renuka		b	Large	0.443	-
<i>C. gamblicus</i> Becc	Hasiru beth (Hin) Pachachural (Mal), Ponchural (Tam)	b	Large	0.599	I
<i>C. hookcrianus</i> Becc.	Vallichural (Mal) Kakkachural, Vanthal (Mal); Nagathali (Tam)	b	Large	0.444	II
<i>C. incrimis</i> T. Anders		a	Large		
<i>C. karnatakensis</i> Renuka & Lakshmana		b	Large	0.459	II
<i>C. khasianus</i> Becc		a	Large		-
<i>C. longisetus</i> Griff.		c	Large	0.468	I
<i>C. nagbettaii</i> Fer. et Dey	Nagabetha (Kan)	b	Large	0.410	I
<i>C. thwaitesii</i> Becc.	Handi betha (Kan); Pannichural, Thadiyanchural (Mal), Perappanakku (Tam)	b	Large	0.498	II
<i>Dacmonmops jenkinsiana</i> (Griff.) Mart.	Golak bet, Cheka bet, Dudhia bet, Dangri bet, Golla bet (Hin)	a	Large	0.400	I
<i>D. kurzianus</i> Becc.		C	Large	0.468	I
(b) Chair seats/back(s) in unsplit form/peelings)					
<i>C. brandisii</i> Becc.	Vanthal (Tam)	b	Small	0.499	
<i>C. guruba</i> Buch. Ham.	Jati beth (Hin)	a	Small		
<i>C. lakshmana</i> Renuka	Halu beth (Kan)	b	Small	0.462	
<i>C. latifolius</i> Roxb.	Pekhri beth (Hin)	a	Small		
<i>C. leptospadus</i> Griff.	Dhangri bet, Rab bet Mugri bet, Rani bet	a	Small	0.469	II

(1)	(2)	(3)	(4)	(5)	(6)
<i>C. pseudorivalis</i> Becc.	Safed beth (Hin)	C	Small	0.581	I
<i>C. pseudotenuis</i> Becc.	Perumperambu (Tam)	b	Small	0.463	II
<i>C. rdang</i> Linn.		b	Small	0.466	II
<i>C. s toloniferus</i> Renuka	Jeddu betha (Kan)	b	Small	0.455	-
<i>C. tenuis</i> Roxb.	Pani beth (Hin)	a	Small	-	-
<i>C. travancoricus</i> Becc.		b	Small	0.486	II
<i>C. viminalis</i> Willd. var. fasciculatus (Griff.)	Hasali beth Kiring beth (Hin)	a,c	Small	0.474	II
<i>C. vattayila</i> Renuka	Vattayila, Ottaman (Mal)	b	Small	0.533	
(c) Walking sticks, Umbrella handles, Sports goods, etc.					
<i>C. dransfieldii</i> Renuka	-	b	Large	0.443	
<i>C. gamblei</i> Becc.	Hasiru beth (Kan); Pachachural, Ponchural (Tam)	b	Large	0.599	I
<i>C. hookmianus</i> Becc.	Vallichural, Kakkachural, Vanthal (Mal); Nagathali (Tam)	b	Large	0.444	II
<i>C. karnatakensis</i> Renuka & Lakshmana		b	Large	0.459	II
<i>C. latifolius</i> Pekhri	beth (Hin)	a			
<i>C. longisetus</i> Griff		C	Large	0.468	I
<i>C. nagbettai</i> Fer. et Dey	Nagabetha (Kan)	b	Large	0.410	I
<i>C. pseudorivalis</i> Becc.	Safed beth (Hin)	C	Small	0.581	I
<i>C. pseudotenuis</i> Becc	Perumperambu (Tam)	b	Small	0.463	II
<i>C. unifarius</i> Wendl.		C	Small	0.397	II
<i>Korthalsia laciniosa</i> Griff.	La1 beth (Hin)	C	Small	0.461	II
<i>K. rogersii</i> Becc.		C	Small	0.448	II
<i>C. s toloniferus</i> Renuka	Jeddu betha (Kan)	b	Small	0.455	
<i>C. thwaitesii</i> Becc.	Handi betha (Kan); Pannichural, Thadiyanchural, Anachural, Vandichural (Mal); Thadiperambu, Perappanakku (Tam)	b	Large	0.498	II
<i>C. tenuis</i> Roxb.	Pani beth (Hin)	a	Small		
<i>C. vattayila</i> Renuka	Vattayila, Ottaman (Mal)	b	Small	0.533	
<i>C. viminalis</i>	Hosali beth (Hin)	a & b	Small	0.474	II

(1)	(2)	(3)	(4)	(5)	
(d) Handicraft/novelty items (in unsplit/flat and oval core/peelings)					
<i>C. brandisii</i> Becc.	Vanthal (Tam)	b	Small	0.499	
<i>C. dransfieldii</i> Renuka		b	Large	0.443	
<i>C. gamblei</i> Becc.		b	Large	0.599	I
	Hasiru betha (Kan); Pachachural, Ponchural (Tam)				
<i>C. gracilis</i> Roxb.	-	a	Small	0.549	
<i>C. hookerianus</i> Becc.	Vallichural, Kakkachural, Vanthal (Mal); Nagathali (Tam)	b	Small	0.444	II
<i>C. karnatakensis</i> Renuka & Lakshmana		b	Large	0.459	II
<i>C. lakshmana</i> Renuka	Halu betha (Kan)		Small	0.462	
<i>C. longisetus</i> Griff.		c	Large	0.468	I
<i>C. nagbetta</i> Fer. et Dey	Nagabetha (Kan)	b	Large	0.410	I
<i>C. pseudotenuis</i> Becc.	Perumperambu (Tam)	b	Small	0.463	II
<i>C. rotang</i> Linn.		b	Small	0.466	II
<i>Korthalsia laciniosa</i> Mart.	La1 beth (Hin)	c	Small	0.461	II
<i>K. rogersii</i> Becc.		e	Small	0.448	II
<i>C. s. toloniferus</i> Renuka	Jeddu betha (Kan)	b	Small	0.455	
<i>C. thwaitesii</i> Becc.	Handi betha (Kan); Pannichural (Mal), Thadiperambu (Tam)	b	Large	0.498	II
<i>C. travancoricus</i> Becc.		b	Small	0.486	II
<i>C. vattayila</i> Renuka	Vattayila, Ottaman (Mal)	b	Small	0.533	
(e) Baskets (in unsplit form/flat and oval core/peelings)					
<i>C. brandisi</i> Becc.	Vanthal (Tam)	b	Small	0.499	
<i>C. erectus</i> Roxb.		a	Large	0.360	III
<i>C. floribundus</i> Mart. var. <i>depauperatus</i> Becc.	Moksoma kyein (Kan)	a	Small	0.337	
<i>C. gracilis</i> Roxb.		a	Small	0.549	
<i>C. hookerianus</i> Becc.	Vallichural, Kakkachural, Vanthal (Mal); Nagathali (Tam)		Large	0.444	II
<i>C. karnatakensis</i> Renuka & Lakshmana		b	Large	0.459	II

APPENDIX II

Nomenclature of commercial rattans of different countries

Species	Vernacular Name	Diameter Large	Small
BANGLADESH			
<i>Calamus guruba</i> Buch. Ham.	jati beth		x
<i>C. tenuis</i> Roxb.	jati beth		X
<i>C. uiminalis</i> var. <i>fasciculatus</i> Griff.	bara beth		X
<i>D. jenkinsiana</i> (Griff.) Mart.	horna beth		
INDONESIA			
1. Jawa			
<i>Calamus heteroideus</i> Bl.	korod		
<i>C. javensis</i> Bl.	cili, cacinig		
<i>C. melanoloma</i> Mart.	leuleus	x	
<i>C. ornatus</i> Bl.	senti	x	
<i>C. renwardtii</i> Mart.	dedek	x	
<i>C. rhomboideus</i> Bl.	dawuhllin		X
<i>C. viminalis</i> Wendl.	glatik, cacing	x	
<i>Daemonorsop rubra</i>	Pelah		X
2. Sumatra/Kalimantan			
<i>Calamus axillaris</i> Becc.	sago-air		x
<i>C. blumei</i>	lilin		x
<i>C. caesus</i> Bl.	sago		x
<i>C. diepenhorstii</i> Miq.	batu		x
<i>C. flabelloides</i> Becc.	rumo		x
<i>C. hispidus</i>	buluh		x
<i>C. javensis</i> Bl.	cili, cacinig		x
<i>C. leiocaulis</i>	Jermasin, ronti		x
<i>C. manan</i> Miq.	manau	x	
<i>C. marginatus</i> Mart.	manau padi, besi		X
<i>C. muroratus</i> Becc.	melikut, tunggal		X
<i>C. ornatus</i> Bl.	tulang minong		X
<i>C. optimus</i> Becc.	buyung, selutup	x	
<i>C. retrophyllus</i> Becc.	tunggal, lilung		X
<i>C. rhomboideus</i> Bl.	lilin		X
<i>Calamus</i> sp.	putih	x	
<i>C. sachys tacan thus</i> Bl.	dandan		X
<i>C. scipionum</i> Burr.	semambu	x	
<i>C. spectabilis</i> Bl.	katip, udang, paladas		x
<i>C. trachycoleus</i>	Becc. irit		X

<i>Daemonorops angustifolia</i> (Griffith) Martius	jernang, getah	x	
<i>D. crinitus</i> Bl.	jernang, getah		x
<i>D. didymorphyllus</i> Becc.	jernang		x
<i>D. jissus</i> Bl.	latung		x
<i>D. longipes</i> (Griffith) Martius	tanah		
<i>D. sabut</i> Beccari	cincin		x
<i>Kmthalsia scaphigera</i> Mart.	semut		x
<i>K. flagellaria</i>	dahanan	x	

3. Sulawesi

<i>C. didymnocarpus</i>	uwe rongo, lauro, hoa		x
<i>C. inops</i>	tohiti	x	
<i>C. insignis</i> Griff.	batu, C.lamprolepis		
<i>C. lamprolepis</i>	sabut, lita	x	
<i>C. minahasae</i>	lauro anduru, tikus, batu	x	x
<i>C. mnatus</i> Bl.	londo, wuku	x	
<i>C. symphysipus</i>	ombol, hoa	x	
<i>C. zol lingerii</i> Becc.	hango wata, merah	x	

MALAYSIA

<i>Calamus caesius</i>	Blume saga		x
<i>C. conirostris</i> Becc.	kerai		x
<i>C. insignis</i> Griff	batu		x
<i>C. javanensis</i> Blume	lilin		x
<i>C. manan</i> Miquel	manau	x	
<i>C. ornatus</i> Bl.	dok	x	
<i>C. scipionum</i> Loureiro	semambu	x	
<i>Calamus</i> spp	tanah	x	
<i>C. tumidus</i>	manau tikus		
<i>Kmthalsia</i> sp.	dahan	x	
<i>Kmthalsia</i> sp.	udang	x	
<i>Plectocomia</i> spp.	mantang	x	

PHILIPPINES

<i>Calamus caesius</i> Blume	sika		x
<i>C. filispadix</i> Becc.	tagiktik, pangan-pangan	x	
<i>C. merrillii</i> Becc.	palasan		
<i>C. microsphaerion</i> Becc.	kurakling		
<i>C. mindorensis</i> Becc.	tumalim		
<i>C. ornatus</i> var. philippinensis	limuran	x	
<i>C. ramulosus</i> Becc.	panlis		

<i>C. reyesianus</i> Becc.	lukuan		
<i>C. scipionum</i> Lour	malacca cane	x	
<i>C. spinifolius</i> Becc.			
<i>Daemonorops mollis</i> (Blco) Merr.	ditaan		
<i>D. pedicellaris</i> Becc.	rogman		
SRI LANKA			
<i>Calamus digitatus</i> Becc.	kukulu we1	x	
<i>C. ovoideus</i> Thw.ex	Trim.thuda	x	
<i>C. pseudotenuis</i> Becc.	hangala, heen		X
<i>C. rdarg</i> BL.	wewel	x	
<i>C. thwaitesii</i> Bacc	wanduru we1	X	
<i>C. zeylanicus</i> Becc	thambotu we1	X	
THAILAND			
<i>Calamus blumei</i> Becc.	kuphung		x
<i>C. caesius</i> Bl.	takathong		x
<i>C. densiflorus</i> Becc.	keereh		x
<i>C. javensis</i> Blume	lek		x
<i>C. longistatus</i> Griffith	kampuan	x	
<i>C. manan</i> Miquel	kordam	x	
<i>C. rudentur</i> Bour	keesean	x	
<i>Calamus</i> sp.	namphung	x	

(Source: Wong 1984; Bhodthipuks and Ramyarangsi 1989; De Zoysa and Vivekanandan, 1989; Silitonga, 1990; Tesoro, 1990; Mohmod, 1992.)

INBAR PUBLICATIONS

Priority species of bamboo and rattan.

INBAR Technical Report No 1. INBAR/IPGRI. New Delhi. 68p.

Nursery techniques for rattan.

INBAR Technical Report No 2, INBAR/FRIM. New Delhi. 47p

Bamboo preservation techniques - A review,

INBAR Technical Report No 3. INBAR ICFRE. New Delhi. 59p

Methodologies for trials of bamboo and rattan.

(Report of a consultative meeting jointly sponsored by INBAR/UPM, February).

INBAR Technical Report No 4. INBAR/UPM. New Delhi. 78p.

Constraints to production of bamboo and rattan,

(Report of a consultative meeting co-sponsored by INBAR and Khoday Biotek, Bangalore, 9-13 May, 1994).

INBAR Technical Report No 5. INBAR New Delhi. 245p.

A manual for vegetative propagation of bamboos.

INBAR Technical Report No 6. INBAR/FORTIP/BFRI. New Delhi.

Genetic enhancement of bamboo and rattan.

INBAR Technical Report No 7. INBAR/FORTIP/BFRI. New Delhi.

A state of the art review on the socio-economics of the bamboo and rattan sector in South-East Asia.

INBAR Working Paper No. 1. INBAR. New Delhi, 31p.

Socio-economic information- on rattan in Indonesia.

INBAR Working Paper No. 2. INBAR. New Delhi. 18p.

Bending strength of Guadua bamboo - comparison of different testing procedures.

INBAR Working Paper No. 3. INBAR. New Delhi. 24p.

Bamboo and rattan production-to-consumption systems: A framework for assessing development options.

INBAR Working Paper No. 4. INBAR. New Delhi. 12p.

Domestication and improvement of rattan.

INBAR Working Paper No. 5. INBAR/ FORTIP. New Delhi. 28p.

Rattan resources of China and current status of conservation.

INBAR Working Paper No. 7. INBAR. New Delhi.

Diversity and distribution of new world bamboos with special emphasis on the Bambuseae.

INBAR Working Paper No. 8. INBAR. New Delhi.

Research needs for bamboo and rattan to the year 2000.

IDRC/INBAR. New Delhi.

A guide to collection of bamboo.

(Translation of paper originally published in Chinese in the journal Ko Hsueh (Science) (194 1).

IDRC/INBAR. Singapore.

Propagation of bamboo and rattan through tissue culture.

IDRC/INBAR. New Delhi.

Bamboo as an engineering material - An annotated bibliography.

IDRC/INBAR. Singapore.