Managementand Utilizatiion of Bamboo arid Rattan in Papua New Guinea

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I thank the International Development Research Centre and the International Network for Bamboo and Rattan for giving me the opportunity to prepare this report on the status of bamboo and rattan resources and their utilization in Papua New Guinea (PNG). The wholehearted cooperation of the officers in various departments in PNG greatly contributed to expediting the task of assembling the information that is presented in this report. I am particularly thankful to Mr. T. Warra, Director of PNG Forest Research Institute, and Mr. K. Pouru, Mr. A. Tagamasan, Mr. Ismel Lebitino and Mr. D.K. Kari of the Forestry Department headquarters. .

FOREWORD

There are three aspects that make a study of the forestry sector in Papua New Guinea (PNG) interesting: (1) more than 70% of the country has forest cover, much of it in pristine condition; (2) the numerous tribes and clans in PNG have had an enduring and mutually sustaining relationship with forests; and (3) all the forests in the country are owned by the people. The last two aspects mentioned are of special interest to socio-economists, ethnobotanists and development practitioners.

The Network's association with PNG began during the days when it was an informal network functioning under the auspices of the International development Centre (IDRC). An IDRC-sponsored study on rattan resources conducted in the mid-1980s still remains one of the most comprehensive of its kind in the country. In the following decade, the PNG bamboo and rattan sector has undergone a sea of change and INBAR thought it timely to launch an investigation into the socio-economics of the sector so that appropriate development interventions could be drawn up for the sustenance and growth of the sector.

This study on the bamboo and rattan sector in PNG forms part of an ongoing INBAR Working Papers Series that focus on the socio-economics of production-to-consumption systems. The series is composed of studies that identify various stakeholders in the system, understand their decision-making facilities and constraints, and suggest suitable intervention programs for selected target groups in the system.

Management and Utilization of Bamboo and Rattan in Papua New Guinea was prepared by Prem Srivastava, formerly the Director of the PNG Forest Research Institute and currently a forestry consultant. We hope this report will serve to create a better understanding of the bamboo and rattan sector in PNG, and' form the basis for launching development programs that will benefit the sector and those dependent on it for their social and economic needs.

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1 INTRODUCTION

Papua New Guinea (PNG), situated east of Indonesia and north of Australia between the Equator and 120 South latitude, is the largest island nation in South Pacific. It comprises the eastern half of the island of New Guinea (the other half is Irian Jaya, Indonesia), plus the great islands of Bismark-Archipelago and North Solomon Group, besides 600 smaller islands. It has an area of about 465 000 km^2. The island nation supports a range of equatorial environments — from sea level to high alpine peaks, which experience occasional snowfall (being one of the two islands in the equatorial zone in the world experiencing snowfall). The variations in climate, soil and altitudinal parameters are responsible for an unparalleled biodiversity — probably one of the richest flora and fauna in the world for the same size of the land area. There are about 9 000 species of higher plants, including 1 500 tree species. Today, over 70% of land area is covered with forest, varying in types from the swamps and species-rich lowland forests (including about half a million mangrove forests in all their pristine glory) of coastal plains to alpine vegetation and moss forests at higher altitudes. In the middle ranges, the forest is dominated by Araucaria, and the southern hemisphere by beech (Nothofagus) and oak (Castonopsis).

During the last 5 000 years, the natives of PNG have lived within numerous tribes and clans with diverse customs. They have, however, shared one invaluable friend — the forest. The forest has met all their basic needs: a place to live and make 'gardens'[1]; materials for houses and dresses; various types of food, including wild animals and fish to supplement their carbohydrate-rich diet with protein; and special materials for adornment, including plumage of birds (especially bird of paradise). Even today, majority (about 90%) of the 4 million population lives in and around the forest, largely dependent on it for sustenance. It may be noted that ownership of all the land in PNG, along with the resources (minerals, oil, gas, forests, etc.), is customary; they belong to the people. The government purchases the rights from the people to develop a particular resource. The importance of non-timber forest products (NTFPs) must be viewed in this context.

The Forestry Sector

The forestry sector is among the important economic sectors. It earned 181 .l million and 165 million Kina in 1994 and 1995, respectively, from log export.[2] It employs about 7 500 people, representing approximately 4% of total formal sector employment (Anonymous 1996a). As a result of major structural changes effected in the Tropical (National) Forestry Action Plan during 1992-93, the Department of Forests was converted into the Forest Authority (PNGFA), a statutory body with a Managing Director as head of the Institution for improving the management of the forest resources. The Managing Director is supported by an

1. In PNG, 'garden' means land cleared for growingsubsistence crops.
2. Approximate exchange rate is 1 Kina = US$1.02.

Advisory Board, and Directorates of Research, Policy, Resource Management Operations,' Human Resource Development and Finance and Administration. The Authority bases its'existence and operations on the National Forest Policy 1991 (Anonymous 1991a), Forestry Act 1991 and its amendments in 1993 and 1996 (Anonymous l99lb), and Forestry Regulations 1996.

Present management plans and projects are heavily oriented towards log production. Current estimate of total sustainable production potential from forestry projects is 3.13 million m^3 per annum. In addition, 2.6 million m^3 of logs can be harvested annually from clear-felled forest areas for conversion to agriculture. This would provide for a potential annual log harvest (from forestry and conversion projects) of approximately 5.7 million m^3.

2 POLICIES AND **ACTS**

Papua New Guinea's Goals and Directive Principles as set out in the Constitution provide the basis for forest policy, and forest policy formulation, in particular, is guided by and draws strength from the Fourth Goal that states:

> "...for Papua New Guinea's natural resources and environment to be conserved and used for the collective benefit of us all, and to be replenished for the benefit of future generations."

The National Forest Policy on forest management states, in relation to rattan and bamboo, that the country's forest resources, including non-timber products, will be managed for continuous production on provincial basis with the aim of maintaining, at the earliest practical time, a desirable net growth which is in balance with harvest.

The policy also states that appropriate measures shall be taken to promote the marketing of lesser used species and non-timber products. It further states that the National Forest Service will provide an advisory service to persons engaged in the development of small-scale forest-based industries (e.g. rattan). Since no harvest of rattan (and bamboo) is being carried out currently, it is presumed that Timber Authorities will be issued for commercial exploitation of rattan (or bamboo) under Sections 87, 88, 89 and 90 of the Forestry Act when this industry is revived.

3 BAMBOO

Species Diversity

To date, a total of 27 species belonging to 5 genera have been reported from the island of New Guinea (Irian Jaya and Papua New Guinea). These include Bambcusa (11 species), Nastus (7 species), Racemobambos (4 species), Schizostacbyum (4 species) and *Buergersiochloa* (1 species) (Table 1). In Papua New Guinea, 23 species (85%) from all the five genera are present, 13 of which (57%) are considered endemic. The bamboo species occurring in PNG include *Bambusa (9* species), *Nastus (7* species), *Racemobambos (3* species), *Schizostacbyum (3* species) and *Buergersiochloa* (1 species). Holttum (1967) accepted the 11 species of

Table 1: Distribution of bamboo in New Guinea

Species	Papua New Guinea	Irian Jaya (Indonesia)
Bambusa amabussana		x
B. atra	x	x
B. brevispiclata		x
B. fbrbesii	x	x
B. 'fruticosa	x	x
B. 'birsuta	x	?
B. macrolemma	x	-
B. microcepbala	x	-
B. riparia	s	-
B. solomonensis	x	-
B. vulgaris	x	x
Scbizostacbyum alopecurus		x
S. brachytb vrsus	x	-
S. lima	x	x
S. wbitei	x	-
Racemobambos congesta	x	-
R. *hirsuta*	x	-
R. multiramosa	x	-
R. shultzei		x
Nastus elatus	x	-
N. booglandii	x	-
N. longispicula	x	x
N. obtusus	x	x
N. productus	x	x
N. rudimetifer	x	x
N. scblecbteri	x	-
Buergersiochloa bambusoides	x	

Bambusa and 4 species of Nastus identified by earlier researchers. However, in his revision, he placed under the genus Bambusa the two species described by earlier researchers as Schizostacbyum brassii and Bambusa brassii, naming them as B. riparia and B. microcephala, respectively. The genus Buergersiochloa was later added by Pilger (1914) for the single species Buergersiochloa bambusoides. Buergersiochloa macrophylla was added later on, but Fizten (1975) revised the genus and accepted only Buergersiochloa bambusoides.

Holttum's revision of New Guinea genera was based on the vegetative characters, especially the spikelets at the nodes, which he considered most significant features as they are species-specific and easily observed. It is, however, felt that collection, documentation and taxonomic studies are still incomplete in New Guinea island. In 1994, a scientist from Herbarium Bogorensis was funded by the International Development Research Centre (IDRC) to continue the work. The work is yet to be published.

Distribution and Ecology

Bamboos occur from sea level to about 3 000 m. Generally, they thrive in disturbed forests, especially along the river banks, edge of Savannah grasslands and in moss forests. Often, the whole forest floor is covered by dense bamboo (Nastus sp.) after logging in Nothofagus-Castonopsis forests in the highlands, hampering the regeneration of timber species. Bamboos are also common in abandoned garden sites, where usually a single species is dominant, either growing naturally or through cultivation. In terms of altitudinal distribution, most species or even a whole genera appear to be restricted to an area. For example, Bambusa occurs commonly from sea level to 700 m elevation. Other genera found in' lowland rain forests are Schizostacbyum, which tends to be restricted to wet regrowth areas (such as river banks and edges of sago swamps), and Buergersiochloa, which generally occurs in the primary lowland rain forests. The last-mentioned species has been collected from only seven localities along the northern coast of New Guinea, from Irian Jaya (Indonesia) down to Milne Bay Province (PNG). It has not been reported in the southern part of New Guinea. The genera Racemobambos and ***Nastus*** are restricted to higher elevations, occurring in secondary forests from 2 200 to 2 900 m. More field surveys are needed to determine the distribution of bamboos in the country.

Utilization

Presently in PNG, bamboos are being used as traditional NTFPs by the rural communities. Their uses have not been commercialized partly because of the:

1. lack of information about their distribution, stocking and properties;
2. lack of logistic support to rural communities (training, funding, marketing, etc.); and
3. easy availability of alternative sources (other forest timber species) for various uses.

In PNG, bamboos are mostly used for house construction (as posts, beams, walls, flooring, doors, etc.), fencing of 'gardens', domestic animal houses, agricultural implements, musical instruments (such as flutes and drums), craft items, body decorations, fish baskets (traps), cooking utensils, land boundary markers, as shade trees around houses and 'gardens,' and as a source of food (young shoots). Not all the bamboos are, however, used by the people. The two most important genera from the view point of utilization in the lowlands are Bambusa and Schizostacbyum. In the highlands, Racemobambos is used extensively for fencing gardens and construction of house walls. Table 2 provides a list of major uses of different bamboo genera (Saulei and Kiapranis 1994) and Table 3 gives an idea of craft items made from bamboo in the Gulf Province (Semese and Wanaliu 1991).

Specific use of a genus or a species based on its properties is still lacking and there has not been any research in this direction. Hence, the potential of bamboos as an alternative source of timber, food, etc. for increased local use as well as export is yet to be realized.

Table 2: Major uses of bamboos in PNG

Genus	Uses
Bambusa	Housing (walls, floors), fencing, agricultural implements, hunting and fishing tools, cooking, food, fuel.
Schizostachyum	Fencing, house walls, musical instruments.
Racemobambos	Fencing and musical instruments.
Nastus	Ornamental uses.

Table 3: Bamboo craft products from Gulf Province, PNG

Articles	Price (Kina/unit)
Ashtray, with red & black designs and varnished	**1.20**
Comb, with red & black designs, coloured and varnished	**1.15**
Comb, hand-carved with traditional designs	**1.25**
Flower vase, with red & black designs, short, 5 inches diameter	**1.35**
Flower vase, with red & black designs, tall, 10 inches diameter	**1.95**
Letter opener, with red & black designs and varnished	**0.50**
Back scratcher, finger-shaped with fixed, carved handle	**1.00**
Plant holder, plain/ordinary	**2.00**
Plant holder, crocodile-shaped	**3.50**
Plant holder with "Ivovo" seed hanger	**2.80**
Pencil holder, with red & black designs	**1.35**
Toothpick holder, with red & black designs (2-piece)	**1.30**

Development Needs

Even though, presently, bamboos in PNG have only traditional uses, a cottage industry based on -bamboo resources that could generate income as well employment for the rural communities can be developed with active support from the Small Business Development Corporation (SBDC). Simultaneously, there is a need for (Srivastava 1994):

1. Extensive field collections of bamboos to cover the whole country and detailed taxonomic studies.
2. Resource inventory to ascertain density, quality and distribution pattern of different bamboo species.
3. Proper documentation of traditional uses of different species.
4. Study. of wood properties of important bamboo species (physical, mechanical and chemical) in relation to their present and potential uses.
5. Feasibility studies for establishing a cottage industry based on this resource.
6. Establishment of bamboo, arboreta at three altitudes — lowlands, mid-montane and highlands for their ex situ conservation.

4 RATTAN

Species Diversity

Generally Rattans in PNG are well distributed throughout the country from coastline to an altitude of 2 500 m in the highlands, although they find their best expression in terms of growth, density and species diversity in the seasonally flooded forest areas along the edge of mangroves and swampy grounds (such as in the Gulf and East Sepik Provinces). The species vary greatly in size and properties. They may range from 2 to 40 mm in diameter and 71 to 125 m in length. It is assumed that there may be 60-100 species in PNG belonging to three genera: *Calamus, Kortbalsia* and Daemonorops. As many as 49 species of Calamus have been identified, of which six are commercially important.

There have been very few taxonomic studies on PNG rattan. Hilderbrand (1958) developed a preliminary key to identify *35* species of *Calamus,* two of *Korthalsia* and one of Daemonorops in PNG. In recent years, Johns and Zibe (1989) and Johns and Taurereko (1989 a,b) conducted taxonomic studies on the plant specimens in different herbaria. Based on earlier works by Ziek (1969, 1976), Konabe and Niangu (1991), Niangu (1991) and Kabaru (1992) have described the distribution of different rattan species and their characteristics (Table 4). The distribution pattern of four commercially important species in the country is shown in Fig. 1.

It may be stated here that there is an urgent need for more taxonomic studies on PNG rattans. A large number of specimens collected during the IDRC-funded research project (see section on Recent Developments) are still lying unidentified in the herbarium of PNG Forest Research Institute (PNGFRI). Besides, many localities are yet to be explored and surveyed.

Properties

In the past, a commercially viable rattan industry could not be developed in PNG partly because of the non-availability of vital information on species characteristics and resource volume. The IDRC-funded project provided an opportunity to fill this gap. Besides the inventory of the resource in a few provinces, a number of physical, mechanical and anatomical studies on important species were conducted. The information has been put together in the Proceedings of the National Workshop on Rattan (Konabe and Sastry 1991). Some results are stated here to make this report more comprehensive.

In Calamus hollrungii stems, moisture content increases from base to the top in both nodal and internodal sections, and moisture content is slightly lower in nodes than internodes. In internodes, an average moisture content of 116.06% was recorded in the basal portion and 144.19% at the top. In nodal sections, the moisture content ranged from 106.96% at the base to 138.86% at the top. However, the case was reverse with specific gravity, which was lower at the base compared

Table 4: Distribution of Rattan in PNG

Area	Species	Quality	Dia. (mm)	Density	Location
Central Province					
Cape Rodney	*Calamus hollrungii*	Medium-good	18-22	LOW	Around sago swamp areas
	Unidentified 1		*6-8*	LOW	near Bomgyuba to Mori
	Unidentified 2		12-14	LOW	Rivers.
Rigo Sub-district	*C. warburgii*	Good	14-22	Abundant	Mountainous rain forests in
	Calamus sp.	Brittle	18-24	Abundant	the northern parts and
	Unidentified	Medium-good		Abundant	lowland forests bordering Kemp Welsh River.
Minari, Kokoda Trail	c. *hollrungii*	Good	Small	Moderate	Manari village.
	Siri	Medium	*3-6*	Cluster	Mt. Lobiri & Idawadana at 1 372 to 1 830 m.
	Sesena	Good	*3-8*	Cluster	Idawari River, Idawandana Baria & Mt. Lobiri.
	Para	Excellent	*3-8*		Manugunumu at 900 m.
	Nuria	Medium	*15*		South-east of Manari village & River Bai of secondary forests at 800 m.
Chimbu Province (highland province)	C. *hollrungii* (Kerowa)	-	10-14	Moderate	Mt. Karimui at 1 372 m and near creeks.
	C. schlech *terianus*	Poor		Moderate	High river gorges at lower altitudes.
	Korthalsia brassii	Poor		Moderate	
	Kirai		7	Shrub	
	Waiiang	Good flexible			Brought from Jimi Valley at 600 m and cultivated in the valleys for weaving.
West & South lands	C. hollrungii		20-30		Rouna River & Kambukam High-Village at 1 200 m.
	Unidentified 1		*13*		Baiyer River area.
	Unidentified 2		*25*		
	Unidentified 3		*6*		Parabuk
	Unidentified 4		*9*		Parabuk

Area	Species	Quality	Dia. (mm)	Density	Location
Gulf Province					
Kakora/Building	C. hollrungii		All sizes	Abundant	–
	K. brassii		16-18	Abundant	–
	C. warburgii		16-18	-	–
	C. *schlech terianus*				–
	Calamus sp. (Pokou)	Poor	40 (biggest in PNG)	-	–
Kerema/Murua Tauri River Lake Kamu	Baimuru/Kikori and 6 other unidentified species.			Richest in PNG	Mid-stream
Northern Province	Calamus sp.	Medium-good	8-10	Abundant	Mambar River Valley, 350 m.
	Saesa		16-24	Abundant	Moist sites.
	C. hollrungii (Jegine)		18-30	Abundant	Widely distributed in the area, Kokoda Valley, Popondetta, Musa River, Kumusi Tiber area, etc.
(Pu Dengoro)	K. brassii	Poor		Abundant	Kokoda Valley, Kumusi and Musa Rivers.
	C. warburgii		12-25	-	Slopes and dry sites.
	C. *schlech terianus*	Poor		Scarce	High slopes.
Kokoda Valley	Five species		–	–	–
Musa River lowlands	C. *hollrungii*	*Good*	Large	-	–
	C. warburgii		Large	-	–
	K. brassii			Abundant	–
Western Province					
Oriomo lowlands	C. hollrungii		20-30	Moderate	–
	K. brassii		10-18	Moderate	–
	Sobeddjok (Oriomo)	Medium-good	9-12	Rare	–
	Taka (Binaturi)		–	–	–
	Torok (Pahaturi)	-	–	–	

Area	Species	Quality	Dia. (mm)	Density	Location
Balimo River	C. hollrungii		20-30	Moderate	-
	C. warburgii (Aike)	-	12-24	Moderate	-
	K. brassii (Popodo)	-	10-20	Moderate	-
Kiunga	C. hollrungii			Moderate to abundant	-
	C. warburqii				
	K. brassii			-	-
Morobe Province					
Bulolo-watut area	Two Calamus spp.	-		Solitary cluster	Wau forest at 1 220 to 1 525 m.
Eddie Creek & Biaru	*calamus* sp. (Sin Sin)	Good-excellent .	3-7	Moderate	Biaru Valley, Kukukuku Watut to abundant and Maria.
East Sepik Province					
Yarapos	*Calamus* sp. (Wagun)	Poor and stiff	35	Solitary	-
	C. warburgii (Anjigur)	-	22	Abundant	-
	K. brassii		12-14		
	Calamus sp.		12-14		
Kairuru Island	*Calamus* sp. (Kolang)	Poor and brittle	6-10		At 550-670 m.
	wuk	Thick stem, densely nodded			At 300 m.
	Wuk Molau				
	Wuk Benin				
Madang Province	C. hollrungii		-	Moderate	Uniso and Karkar Islands.
	C. warburgii		30	Abundant	Gogol and Usino areas.
	K. brassii				
New Ireland Province					
Namatanai	*Calamus* sp.		12-15	Abundant	-
Hanover	Two Calamus spp.	-		Clusters	-
Djaul Island	Large cane				

Area	Species	Quality	Dia. (mm)	Density	Location
Milne Bay Province					
Misima Island	C. hollrungii (Kuwe)	–	–	Scarce	–
	Flagellaria indica	–	–	–	–
Rossel Island	Dhama dagobadi	–	–	–	–
	Dhama			–	–
Sudest Island	C. hollrungii (Kuwo/Kuwao)			–	–
Lawalawa	C. hollrungii (Kuwe)	Medium-good	Large	–	Swampy areas.
Watuk Creek &	K. zippelii			–	–
Waigani	K. brassii				–
Watun Creek	C. schlech terianus	–		–	Lowlands.
	C. hollrungii			–	
De' Entrecasteau	C. hollrungii			–	–
Lousiade Archipelago	C. bollrungii			–	–
Alotau	C. hollrungii			–	–
	C. warburlgii			–	–
	Kortbalsia spp.			–	–
Milne Bay	C. bollrungii		–	–	–
	C warburgii			–	–
	Kortbalsia spp.	–		–	–
Other Provinces	C. hollrungii		–	–	–
	C. warburgii			–	–
	Kortbalsia spp.			–	–
	Daemonorops spp.	–		–	–

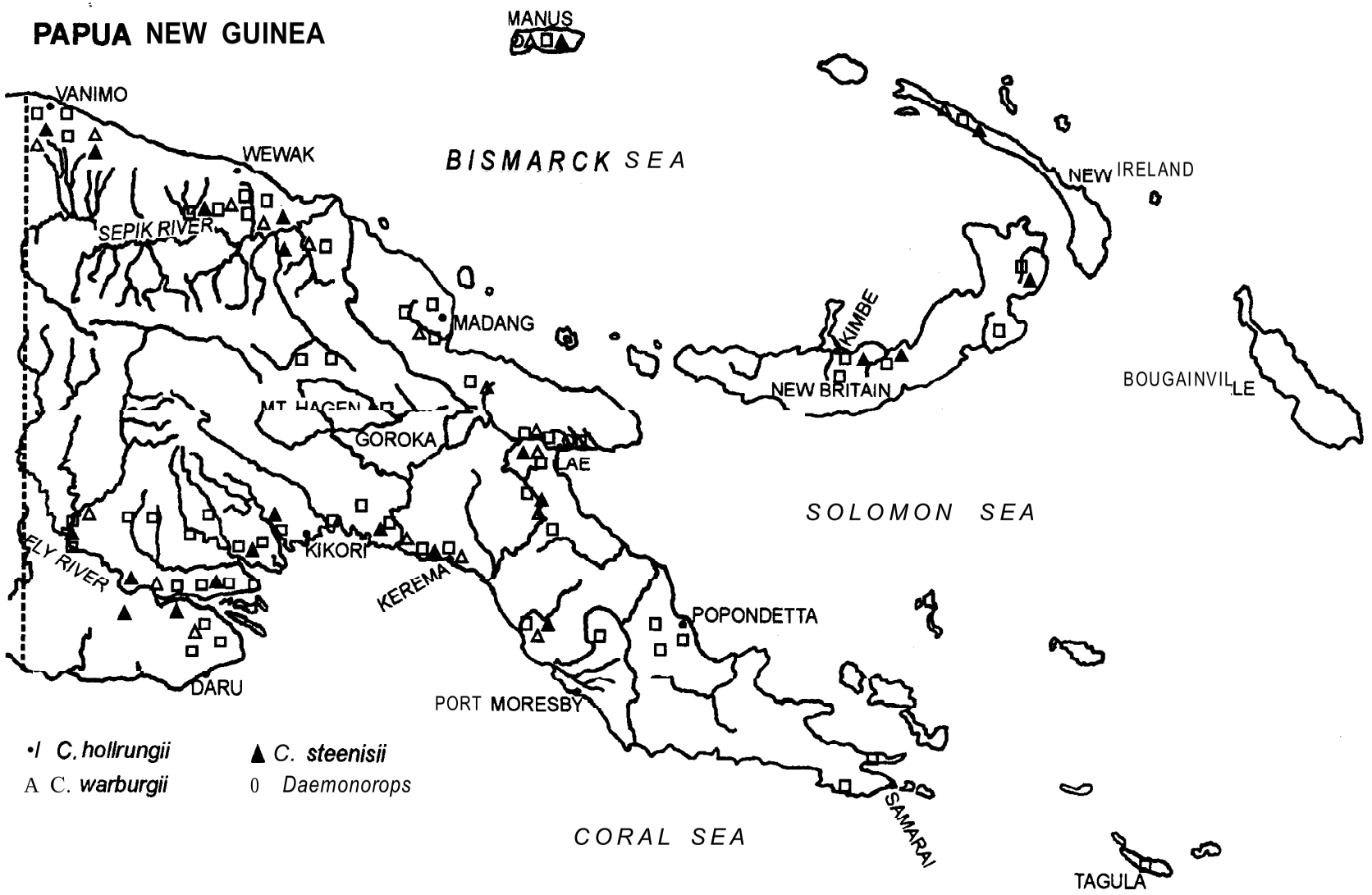

Fig. 1: Distribution of commercially important rattans in PNG

. to the top (Peki and Konabe 1991a). Furthermore, specific gravity was higher in nodal sections compared with internodal sections. It varied from 0.478 at the base to 0.413 at the top nodal portions, and from 0.456 at the base to 0.395 at the top of internodal sections.

A preliminary study of transverse sections of C. hollrungii and Daemonorops was carried out by Konabe and Peki (1994). They found the (1) presence of reflective bodies, (2) size of epidermis, (3) thickness of fibre wall, (4) fibres and (5) epidermal ground tissues as important diagnostic features. Both C. hollrungii and Daemonorops have feflective bodies but the latter has very thick fibre wall with elongated epidermis.

These studies were extended under a twinning arrangement with the Taiwan Forest Research Institute, which studied the anatomy of C. hollrungii, C. steenisii, C. warburgii, Daemonorops sp. and Korthalsia brassii through scanning electron microscopy and energy-dispersive X-ray spectrometry (Chung and Chen 1994). The study noted that the anatomical structural differences in the five species depended upon cell components, cell dimensions, cell contents, pattern of cell arrangements and even the morphology of a single cell.

Resource Stock

A survey of rattan resource was conducted in the early 1960s by UN experts (Prior 1960, Jordan 1964) when the country was still a territory of Australia. The objective was to establish a rattan-based industry in the country. The team also surveyed the situation in Malaysia, Singapore and the Philippines. The following data were quoted from Papua and New Guinea (as it was called then).

Average = 1 cwt/plant – total 360 ft
Average = 50 plants/acre – 10 yd x 10 yd
= 32 000 plants/mile*
= 1 600 t/mile^2 (green poles)
= 800 t/mile^2 (dry poles)

On the basis of the above figures, the survey mentioned a few localities as containing significant amount of commercial-grade rattan.

Gogol Valley (20 mile^2)	: 16 000 t
Ramu Valley (300 mile^2)	: 240 000 t
Naveave Valley (200 mile^2)	: 160 000 t
New Britain (200 mile*)	: 160 000 t
Brown River (4 mile*)	: 3 200 t
Vanapa Valley (20 mile^2)	: 16 000 t
Sepik River (300 mile^2)	: 240 000 t

The report also. stated that the above figures represented only a fraction of the total volume/weight of rattan present in the country.

Reichert (1986) and Vali (1986) also supported the view that an economically viable industry based on rattan is possible. Recently, Saulei and Aruga (1994) have backed this view.

Apparently, the above studies did not stimulate commercial utilization of rattan in PNG, although some interest in this group of species was kept alive in the Forest Products Research Branch of the Department of Forests (now Forest Authority) as an important mindr forest product. Some preliminary resource surveys were conducted by Ziek (1979) in a few localities. Later, as part of the activities of the IDRC-funded project, detailed quantitative surveys were carried out by Kabaru and Niangu (1990) and Niangu (1991) in the Gulf and East Sepik Provinces, which are considered the richest in rattan resource in the country.

Conducting an inventory of the rattan resource with a high degree of accuracy is not easy. The plants are climbers, have their crowns entangled with the support plant, are thorny, and almost invariably multi-stemmed at the base. Nur Supardi (1992) discussed various methods of rattan survey. In Peninsular Malaysia, Aminuddin (1990) usedc 1uster sampling method, in which 236 randomly located clusters were assessed. Each cluster consisted of 12 plots measuring 50 x 50 m each. The inventory required a team of eight people. On the other hand, Micosa-Tandug (1986) recommended strip (10% intensity) sampling method in virgin or secondary forests of the Philippines. In Indonesia, Siswanto and Soemarna (1988, 1990) and Siswanto (1991) tested systematic strip sampling and line plot sampling designs in a 16-ha plot. In the first, continuous line sampling of 10 and 20 m width was carried out at three sampling intensities (l0%, 20%, 30%). In the second treatment, fixed line plots of 10 x 10 m and 20 x 20 m were used at 10% and 20% sampling intensities. Strip sampling method with a strip of 10 m and a sampling intensity of 20-25% was found to be adequate. The ASEAN Institute of Forest Management carried out a comparative study of three different procedures. (point sampling, fixed plot sampling and strip sampling) (Samsudin and Hutchinson 1990). They found point sampling procedure as the most efficient method. In this method, number and types of rattan were recorded in a 5-m radius fixed plot.

In PNG, Niangu (1991) and Kabaru (1992) followed a strip method as employed by Ziek (1979). A strip of 2 km x 10 m was established with plot areas of 10 x 10 m along the strip line. All mature canes were counted along with their lengths and diameters. At the same time, the number of immature stems and seedlings were also recorded.

Gulf Province

In the first area — covering Pie, Ivo and Purari River Basins — three species of *Calamus* and one species of Korthalsia were predominant. C.. warburgii was the most common species, representing 59% of the stock. It was followed by C. hollrungii with 27%, Korthalsia with 12% and an unidentified Calamus species with 2%. In the second site — 'which included Eia, Era and Wapo — 66% was accounted by the two Calamus species and 37% by K. brassii. The reason for the higher density of K. brassii in the second site could be the topography: it is a low-lying area frequently inundated by river floods and ocean tides. Average figures for

important species are given in Table 5. Stem lengths of the species occurring in the two areas were about the same except for Calamus species and ***K. brassii*** found in Eia, Era and Wapo areas. The average commercial lengths of ***C. warburgii*** and C. *hollrungii* were estimated at 40 m (Table 6). Most of the mature cane lengths in the areas assessed were found to be more than 80 m. This indicates that the rattan resource in Baimuru area has hardly been disturbed, except for limited traditional use by the villagers.

Table 5: Number and percentage of rattan in the sample plots in Baimuru, Murua and Karama (Gulf Province)

Species	Seedlings		Mature		Immature		Total	
	No.	%	No.	%	No.	%	No.	%
C. hollrungii	1 778	23.33	843	18.65	103	6.26	2 724	19.76
C. warburgii	4 030	59.92	1 858	41.10	228	17.51	6 180	44.82
C. *steenisii*	526	6.90	464	10.26	494	30.03	1 484	10.76
Calamus spp.	682	8.95	1 020	22.56	618	37.57	2 320	16.83
K. *brassii*	602	7.90	336	7.43	142	8.63	1 080	7.83
Total	7 622	100.00	4 521	100.00	1 645	100.00	13 788	100.00

Table 6: Average marketable length and diameter of rattan poles in Baimuru, Murua and Karama (Gulf Province)

Species	Length (m)	Diameter (mm)
C. hollrungii	40	22.5
C. warburgii	40	23.3
C. *steenisii*	35	12.0
K. brassii	31	15.3
Calamus sp.	30	16.3

In the third locality, the distribution of rattan varied between Murua and Karama. *C. hollrungii,* the large diameter cane of commercial importance, did not occur in high density. The probable reasons for this are extensive utilization of the species in the area or the recent entry of the species, together with K. brassii, into the local ecosystem. Other species had a reasonable number of seedlings as well as young plants, but hardly any marketable stems. A total of 10 rattan species was recorded in the area surveyed: C. hollrungii, C. steenisii, C. warburgii, K. brassii and six unidentified Calamus species. Included in the six unidentified species were two known as the "King* and the "Queen" because they were clearly distinguishable by their bright orange-red spines and yellow leaf sheaths. Both had flagella exceeding 15 m and stems of large diameters. The Other four calamus species differed in their vegetative characters, but all had small stem diameters ranging from 6 mm to 12 mm, not only at their base but also along their. middle portion.

The diameter of individual canes of C. hollrungii and C. warburgii varied from the base to the top. The former had a base diameter of 35 mm or more, averaging 22.5 mm at 2-3 m from the base. C. warburgii had an average diameter of 12 mm at 4-5 m from the base.

Considering Ziek's (1979) method of determining the quantity of rattan in a given area,. the total area assessed in the. first two localities was 240 000 m^2 or 2.4 ha. Since the number of mature C. hollrungii and C. *warburgii* per hectare was 501, the estimated total for each cane of 40 m length and 20 kg weight will be 10 020 kg of green canes. Therefore, the estimated total weight of green canes for 25 000 ha in Baimuru will be 250 000 tons.

In the third locality, the total area surveyed was 2.6 ha, with an average 55 mature stems per hectare of C. hollrungii and C. *warburgii.* Therefore, a total of 1.1tons of green cane per hectare was available. With an area of approximately 15 000 ha for both Murua and Karama, the estimate for the locality is 16 500 tons of cane.

East Sepik Province

The distribution of rattan varied among the three sites in East Sepik Province where the assessment was carried out. In Yambi area, rattan did not appear as abundant as in Jama and Burui. Rattans in Yambi had a patchy distribution, while in the other two localities they were quite dense and extended to Manja area through Ambunti and Sepik Rivers.

Yambi has an undulating topography with lowland rain forests that do not provide ideal conditions for the growth and survival of rattan. On the other hand, in Jama and Burui, the land is low-lying with scattered swampy patches that are flooded during the rainy season.

In the overall survey, as many as six rattan species were recorded: *calamus* hollrungii, C. warburgii, C. steenisii**,** an unidentified *Cakamus* species, a *Daemonorops* species and Korthalsia brassii. The most dominant species was C. warburgii, followed by C. hollrungii**.** Surprisingly, C. steenisii was rare in the area. The percentage values of different species in terms of seedlings, and mature and immature stems are given in Table 7 Marketable length and diameter of the stems are given in Table 8.

In the 4.05 ha surveyed, 38 stems of mature C. hollrungii and 330 stems of mature C. warburgii were found. It was estimated that a total of 5.89 tons of green canes per hectare was available. Within an area of 18 000 ha with 30% already exploited, it is estimated that a total of 74 214 tons of rattan could be harvested.

Table 7: Number and percentage of rattan in the sample plots in Jama, Burui and Yambi (East Sepik Province)

Species	Seedlings		Mature		Immature		Total	
	No.	%	No.	%	No.	%	No.	%
C. hollrungii	1 753	85.60	154	9.67	499	17.56	2 406	37.12
C. warburgii	169	8.25	1 337	83.98	1 513	53.24	3 019	46.58
C. steenisii	10	0.49	10	0.63	32	1.13	52	0.80
Calamus sp.			–	–	4	0.14	4	0.06
K. brassii	68	3.32	78	4.90	741	26.07	887	1.76
Daemonorops sp.	48	2.34	13	0.82	53	1.89	114	13.68
Total	2 048	100	1 592	100	2 842	100	2 842	100

Table 8: Average marketable length and diameter of rattan poles in Jama, Burui and Yambi (East Sepik Province)

Species	Length (m)	Diameter (mm)
C. hollrugii	32.3	25.3
C. warburgii	33.3	14.7
C. steenisii	15.0	10.0
K. brassii	19.0	17.0
Daemonorops sp.	25.7	11.0

Oro Province

bother survey by Kabaru (1992) in Oro Province (Sinapa) recorded five species: *Calamus hollrungii, C. steenisii, Calamus* sp. "King", an unidentified *Calamus* sp. and *Korthalsia brassii.* Tables 9 and 10 indicate the various parameters for these species in the province.

Table 9: Number and percentage of rattan in the sample plots in Sinapa (Or0 Province)

Species	Mature		Immature		Total	
	No.	%	No.	%	No.	%
K. brassii	1 012	43.90	3 800	61.21	4 812	52.77
Calamus sp. King	940	32.69	464	7.47	1412	15.49
C. bollrungii	336	11.59	720	11.61	1 056	11.58
C. steenisii	512	17.65	1112	17.91	1 624	17.81
Calamus sp.	92.	3.17	112	1.80	214	2.35
Total	2 900	100.00	6 208	100.00	9 118	100.00

Table 10: Average marketable length and diameter of rattan poles in Sinapa (Or0 Province)

Species	Length (m)	Diameter (mm)
C. hollrungii	30	22
Calamus sp. King	30	21
K. brassii	25	20
C. steenisii	15	60
Calamus sp.	15	6

The most abundant species in the area surveyed was *K. brassii* (Kiwa), followed by *Calamus* sp. "King" (Rishi) and C. *hollrungii.* The total number of plants was 2 900, of which 2 298 were of the three major species with diameters of 20 mm and above. They made 70% of all harvestable mature stems in the assessed area. However, of the three species, *K. brassii* is listed as a non-commercial species. *Calamus* sp. "King" (Rishi) and C. *hollrungii* are thus the only two commercial species found in the area, representing about 44% of marketable quantity.

One hectare of land is estimated to contain approximately 321 mature canes of the two commercial species. Each cane averaging 30 m will have an average green weight of 15 kg, give an overall yield of 4 815 kg/ha. Since the total rattan producing area in the-province is about 6000 ha, the total green rattan yield would be 30 000 tons.

Utilization

Small-scale industry

Till 1985, there was little effort to develop rattan industry mainly because of the focus on timber resources, and lack of information on rattan distribution, quality, properties and markets (both within and outside the country). Nevertheless, rattan was being used by the rural communities for making various articles. A few Provincial governments (East Sepik, Gulf and Milne Bay) had made attempts to develop a rattan small-scale industry by recruiting instructors from other countries (mainly the Philippines) for training young people. Some of the products manufactured by small-scale industrial units in various provinces are given in Tables 11 and 12. Most of these ventures failed or could not be run profitably because of the following reasons (Semese and Wanaliu 1991, Nimo 1991):

1. High production cost, partly owing to lack of infrastructure and proper equipment.
2. Lack of qualified technical expertise for the development of a cottage industry.
3. Inadequate financial resources.
4. Lack of support from the Department of Trade and Industry (DTI).

5. Lack of proper guidelines on how the industry should be developed and run by the Provincial Forestry Divisions or DTI (Commerce)
6. Lack of adequate knowledge on rattan resource (species, properties, harvesting and processing).
7. Lack of knowledge on harvesting and treatment of rattan.
8. Lack of market outlets for the finished products.
9. Poor quality of products.

Table 11: Rattan articles manufactured in Milne Bay Province (1991 prices)

Article	Dimensions (cm)	Price (Kina)
Tropical lounge suite consisting of 1 two-seater settee, 2 single chairs and a coffee table	Table top 114 x 76	243.00
Tropical dining suite consisting of 1 table and 4 matching chairs	Table top 114 x 76	180.00
Video stand/TV stand in different sizes and designs; size depending of TV screen size	Large 63.5 x 45 x 53.5	70.00
	Small 46 x 32 x 36	50.00
Bar stool with round top and tapa cloth covering	30 (dia.) x 43	25.00
Book shelf	80 x 100 x 30	12.00
Planter	N.A.	12.00
Child's chair	N.A.	12.00
Dressing table	114 x 54 x 77	N.A.
Bedside table	50 x 44 x 70	40.00
Minor frames	80 x 60	N.A.
Bar trolley	50 x 44 x 70	N.A.
Chest of drawers	114 x 54 x 77	N.A.

Source: Nimo 1991

Table 12: Rattan furniture manufactured in Gulf Province (1991 prices)

Article	Price (Kina)
Mini stool, tapa-topped, for children	9.00
Short stool, tapa-topped	12.00
Bar stool, octagonal seat, 28 inches high	20.00
Bar stool, 12 inches square seat, tapa-topped, 28 inches high	20.00
Bar stool with back and arm rests, 16 inches round, tapa-topped	20.00
Side table, for bed room or office, with shelves, tapa-topped	30.00
Coffee table, round, tapa-topped, straight legs	30.00
Coffee table, round, curved legs	35.00
Coffee table, rectangular, tapa-topped, 36 x 24 x 17 inches	45.00
Dining table, 1/2 inch thick plywood covered with tape, 60 x 36 x 28 inches, heavy canes and reinforced bindings	150.00
Dining chair, all-cane, with reinforced bindings	30.00
Lounge chair, all-cane, with woven arms	45.00
Lounge chair, with woven arms	65.00

Article	Price (Kina)
Lounge chair, three-seater, all-cane, with woven arms	95.00
Baby's high chair, with small, folding, feeding table	32.00
Office table 5/8 inch thick plywood topped with tapa, 60 x 36 x 28 inches, with shelves underneath	166.00
Garden chair, basket type, with solid cane seat	30.00
Garden chair, basket type, with woven cane seat	45.00
Foot stool, all-cane, highly polished	15.00
Lawn lounge chair, all-cane, round seat, solid cane	32.00
Partition stand	15.00

Source: Semese and Wanaliu 1991

Major industries and enterprises

With the depletion of rattan stocks in major rattan producing countries (the Philippines, Thailand), and total ban on raw rattan export by Indonesia and Malaysia, rattan industries in Singapore, Hongkong and Taiwan started looking for raw material from PNG. This resulted in a spurt of companies engaged mainly in export of raw or 'dressed' rattan. Majority of the companies was foreign-owned; a few of them floated by the resource owners with funding from foreign partners. In 1988, when export of rattan peaked, there were over 50 companies spread all over the country, engaged in rattan harvesting, treatment, export, processing, training of locals, etc. A survey of these companies was carried out by Konabe **(1991)** and h'is co-workers through questionnaire and personal visits. Results are summarized in Table **13.**

Table 13: Rattan processing industries and practices

Industry	Operating provinces	Harvesting	Transport	Treatment	Seasoning	Grading
Company A	Central, W. Sepik, E. Sepik	Adequate	Vehicle	Good	Good	Adequate
Company B	Gulf	Poor	Canoe	Poor	Poor	Poor
Company C	Gulf	Adequate	Canoe	Good	Good	Adequate
Company D	Morobe	Adequate	Vehicle	Good	Adequate	Adequate
Company E	Morobe	Poor to adequate	Vehicle	Good	Adequate	Adequate
Company F	Madang	Poor	Vehicle	Poor	Poor	Poor
Company G	E. Sepik	Adequate	Vehicle	Good	Adequate	Adequate

Rattan harvesting is almost exclusively carried out by the landowners (villagers). Extraction of rattan is not a simple and easy process as 'the plant is a climber whose crowns are entangled in tree crowns. It requires some skills in tasks such

as the selection of proper species and mature plants,. cutting, pulling and transportation. Basically, harvesting is done by pulling the stem manually and cutting with a bush knife. Sometimes, when the stem cannot be pulled free beyond a certain length, it has to be cut at the maximum length by climbing on to the support tree. The harvested rattan is then cut into 6-m long poles and bundled (5-10 poles/bundle) for transport.

A large amount of rattan is wasted in the process because, in many cases, immature and non-commercial plants are harvested. The landowners, therefore, need an intensive training in identification of mature plants of commercial species to avoid wastage. It should be the company's responsibility to educate the landowners about the required species, quality and quantity.

In majority of the cases, rattan poles are transported by power-driven canoes. Where processing units are situated along the roadside, transportation is by vehicles. The villagers bring the bundles to the roadside or the point where canoes are available. The major problems associated with transportation are:

1. Delay by a few days or even up to two weeks, resulting in the deterioration of rattan quality because of insect, fungal or algal attacks.
2. Damage to rattan poles from improper bundling or handling.

Both these problems can be avoided with a little care from the company and landowners.

Normally, each company bargains and pays the minimum possible price to the villagers. The price, as indicated below, depends mainly on the diameter of the poles, and other grading characters are not taken into consideration:

5-17 mm = 15 toea/b m length (100 toea = 1 Kina)
18-27 mm = 20 toea/ m length
28-40 mm & above= 25 toea/6 m length

Following an extensive study, a UN Volunteer, while working on the "Guidelines for Rattan Resource Management", came up with the following price structure for a 6-m pole of green rattan:

40 mm and above	=	50 toea
30-39 mm	=	30-40 toea
25-29 mm	=	25-30 toea
20-24 mm	=	20-25 toea
15-19 mm	=	15-20 toea
l0-14 mm	=	l0-15 toea
10 mm and less	=	5-10 toea

Green rattan poles are treated as soon as they arrive in the treatment plant. Almost every company in rattan export business had treating tanks of varying. sizes and types, made of either steel sheet or welded halves of 200-litre steel drums. The

tanks are more than 6 m in length and vary in capacity. They are embedded into the ground where a fireplace is dug under the tank. Rattan poles are immersed in 100% diesel oil and boiled for l0-30 minutes (the boiling time is not standardized). Laboratory studies by Peki and Konabe (1991b) on suitable treatment medium (diesel, or diesel-kerosene mixture in 75:25 or 50:50 ratio) and timings (10, 15 or 20 minutes) indicated that the rattan poles treated with 100% diesel for 20 minutes at the boiling temperature (90-105°C) yielded the best results in terms of colour (creamy white) and lustre.

After treatment, the rattan poles are removed from the tank and air-dried in the open for at least one week. After drying, the poles are washed under running water (sometimes mixed with sand) to remove dirt and improve the visual quality. The washed poles are dried for a day or two in the open and bundled.

Many companies do not follow a proper drying technique — dry the treated poles on raised racks under a cover — to avoid defects such as:

1. Discolouration and shrinking owing to excessive direct sunlight;
2. Possible fungus and insect attack, especially in wet weather and if the treatment is poorly done; and
3. Prolonged drying period owing to overgrown vegetation under the drying poles, and consequent biodegradation.

In PNG, no grading system is followed. The seasoned poles are normally graded on the basis or diameter alone. No consideration is given to .the presence/absence of defects such as visual quality, fungal stains, etc. As a result, much of the rattan exported is sub-standard and fetches low prices in the international market. This factor needs to be taken into consideration when attempting to revive the industry.

Even during the peak of rattan resource exploitation in PNG, no detailed studies were conducted on the employment and wage structure. However, during a survey of the rattan industry by Konabe (1991), it was recorded that Aupa Business Group (Madang Province) employed 30 people and Mini Rattan Company (East Sepik) had 39 workers. If we consider, on an average, 20 employees in each of the 50 plus companies, it can be surmised that the rattan industry employed around 1 000 people during 1989-90. This tentative figure excludes the landowners who are responsible for harvesting rattan as they are not company employees. Even with this conservative estimate, it can be concluded that the sector has a large potential for generating employment and income if developed and managed properly.

No statistics are available on the annual production of rattan, except the amount and value of exported material (Table 14). Even during the peak years, there was no strict mechanism in the Department of Forests for getting annual returns from the companies engaged in rattan industry. As is evident from Table 14, rattan export peaked in 1988 with 891 tons, earning Kina 442 000 (approximately US$450 840) in foreign exchange. A document in the relevant file shows that in 1992, only 100 tons of rattan worth Kina 75 000 FOB were exported and in 1993, Kina 140 000 was earned through rattan exports besides Kina 14 000 in export

taxes (Ismael Lebitino, pers. comm.). It appears that, there was no export of finished products during this period.

Table **14:** Data on export of raw rattan

Year	Volume (t)	FOB value ('000 Kina)
1988	891.0	442.0
1989	M.A.	N.A.
1990	65.0	40.3
1991	394.2	226,2
1992	108.5	75.8

Source: Timber Digest, 1988-92

There has been no significant progress in downstream processing of rattan in the country. A few provincial governments (Gulf, East Sepik, Milne Bay), through their business arms, established rattan processing units in their respective capital towns in mid-1980s. In most cases, Filipino instructors helped in training and manufacture of simple articles. However, as stated earlier, most of these well-meaning initiatives closed down owing to a number of problems.

According to the Department of Trade and Industry (DTI), PNG should meet the following criteria -and conditions for developing a modern rattan industry with value-added products manufactured in the country at internationally competitive costs (Jumogot and Win 1991).

1. Systematic harvesting and pretreatment of green rattan and proper grading of good quality raw rattan for the industry.
2. Design development to attract customers.
3. Training of operators to improve workmanship.
4. Research and development activities to improve designs of products to meet the needs of diverse markets at competitive prices.
5. Sales promotion activities to have more business contacts and raise awareness.
6. Marketing surveys and services to make products affordable to common people, tourists, exporters, etc.
7. Efficient management for successful manufacturing of high quality products with reasonable production costs and also successful marketing of rattan products, both in domestic and export markets.

Some of the constraints for establishing a viable cottage industry based on rattan resource are Jumogot and Win 1991);

1. Law and order situation;
2. Careless harvesting of green rattan and lack of replanting, resulting in depletion of rattan resource;
3. Financial difficulties to support rattan industry projects;

4. Export tax, which was raised from 10% to 30% for rattan;
5. Lack of rattan processing machinery and skilled operators; and
6. Tough export competition from other. countries such as the Philippines,. Singapore and Taiwan where productivity and quality are higher;

DTI has solicited various aid agencies (Commonwealth Development Council, Commonwealth Fund for Technical Cooperation, United Nations Industrial development Organization, United Nations Development Programme, etc.) to meet the following requirements:

1. To conduct feasibility studies on rattan industry projects.
2. The provision of technical assistance, such as experts for selection, layout, plan preparation, construction and installation of industrial units, and provision of training for local operators.
3. Identifying suitable overseas join venture partners.
4. Evaluation of rattan industry project supports and recommendations.
5. Provision of incentive packages for export, such as duty exemption/ reduction, tax holiday, pioneer industry status, etc.
6. Arrangements for obtaining information on overseas markets, contact, exhibitions.
7. Provision of project support for obtaining bank loans for projects.

Adcording to DTI the rattan industry, when fully developed, will provide substantial direct and indirect employment to youth and much-needed additional income to resource owners, besides earning foreign exchange from export of finished products.

Recent Developments

During 1985-90, a number of initiatives took place to encourage the proper development of a rattan-based cottage industry. These are listed below.

A The IDRC-funded a project at the PNGFRI to carry out an inventory of rattan resources at least in two provinces and case studies on socio-economic aspects, and study properties of important rattan species. The project prompted the collection of valuable information for the first time in the country and created a spurt in the exploitation of this resource during this period. However, owing to lack of expertise, socio-economic aspects could not be studied. The information collected is assembled in the proceedings of a Workshop (Konabe and Sastry 1991) and forms the backbone of this report. There were no studies of this nature reported by an individual or institution before or after the conclusion of this project.

B On the request of the Department of Forests, the Food and Agriculture Organization (FAO) fielded a UN Volunteer to formulate guidelines for the proper management, conservation and utilization of rattan resource. This expert studied the situation of rattan-based industry and came up with exhaustive guidelines (See Annexe). Some highlights are:

1. Certain activities — such as harvesting, initial treatment and transport of rattan — will be handled by the resource owners (landowners, village communities) who will be trained for the purpose.
2. A proper registration of all companies engaged in. rattan exploitation.
3. Revision of royalty rates (minimum selling price) for landowners and minimum export price.
4. Raising of export duty on raw rattan from 10% to 30%.

The last-mentioned recommendation was implemented by the National Executive Council on 30 August 1988. This was, however, vehemently opposed by companies because of high production cost and high sea freight charges.

C. DTI commissioned two studies to advise the government on proper development of a viable rattan industry, based mainly on downstream processing. The conclusions of the Netherlands-based Environmental Forestry Development (EFD) consultants were as follows (Igara 1991):

1. There is little information on the growth, yield and extent of rattan resource in Papua New Guinea;
2. Preliminary estimates show the potential for harvesting commercial rattan of 4 m length at 248 000 tons per year;
3. In the areas surveyed, 8 rattan species were dominant, of which two species — *Calamus warburgii* and *Calamus hollrungii* — can be classified as commercially viable while two other species — *Calamus steenisii* and *Calamus* sp. — need further studies to confirm their commercial significance;
4. Uncontrolled logging could endanger the habitat of rattan;
5. Rattan resource grows on traditionally owned land;
6. Ninety-five percent of all export shipment of rattan consisted of "dressed" green canes still to be treated at final destination;
7. Serious decline in overseas supply of rattan owing to overcutting of natural stands in traditional sources, such as the Philippines and Indonesia;
8. World demand for rattan cane and rattan products has increased; and
9. Value addition in rattan processing is very high.

The report, therefore, recommended that the country formulate a national strategy for:

1. Conservation of parent material in reserve areas.
2. Promotion of participation of nationals in the development and establishment of small-scale industries, such as processing and furniture making.
3. Proper utilization, management and development of natural resource by a combination of forest management and rattan plantation development.
4. Promotion of fundamental and applied research on rattan.

The report also recommended two areas for pilot rattan plantation development, Jama District in East Sepik and Navo 2 in West New Britain. It concluded that investment in both village-based and plantation rattan cultivation would show substantial results.

Present Situation

With DTI's expectations that an economically viable rattan-based cottage industry can be developed, the government imposed a total ban on the export of raw rattan in 1993. The policy was adopted as part of efforts by the government to encourage down-stream processing, as well as to promote manufacture of value-added products in the country. The additional rationale was to enhance the development of an industry that would be geared towards maximum domestic production for local and international market. This would lead to increased job opportunities, especially for the youth and school dropouts.

Unfortunately, increase in export tax to 30% and ban on the export of raw rattan resulted in the total collapse of the industry within a couple of years. Presently, not a single company is engaged in the exploitation of rattan in PNG. The provincial government projects (Gulf, East Sepik and Milne Bay) also closed down partly because experts (instructors) were not available and product marketing met with several problems.

In 1993, with support from the PNGFA, a submission was made by the Department of Foreign Affairs and Trade to the National Executive Council to lift the ban on export of raw rattan. At the time of writing this report, a decision on it is pending.

Conservation Efforts

Fig. 2: Rattan in PNGFRI Botanical Garden (note the diameter)

Presently, and in the near future, the rate of rattan harvest will be very low, although various reports indicate that the natural forests, especially the lowland forests, have the resource in abundance. There is one danger though. The rate at which Timber Permits are being awarded, most of the mature rattan may be destroyed in logging operations unless it is utilized before tree felling begins in a concession area. However, in majority of the cases, the logging is selective only trees with a certain minimum diameter belonging to a few selected species are being harvested. Hence, if the logging operations are controlled, most rattan plants supported by the non-commercial species can be saved. The present logging code of the PNGFA (Anonymous 1996b), however, does not contain any clause in this respect. The future of rattan resource in PNG is, therefore, uncertain at the moment.

As for the gene pool conservation, rattan arboreta have been established, as one of the activities of the IDRC-funded project, in PNGFRI Botanical Garden (Kabaru 1930) and Nasuapum, at about 35 km west of Lae. In the Botanical Garden, 200 wildlings of Calamus species were planted. The wildlings were collected from Morobe, Gulf, Milne Bay, Central and Manus Provinces. Apart from the wildlings, about 4 *000* seeds of *Calamus* species were tested for germination and growth studies, and vegetative propagation of the species was attempted (Kabaru 1991). About 300 seedlings raised from seeds were planted in the Botanical Garden. At the same time, over 700 seedlings of C. *hollrungii* were planted at Nasuapum.

After the discharge of all the staff engaged in rattan studies (the whole Forest Products Branch was removed from PNGFRI during 1994-95), the progress of the arboreta/trial plot in the Botanical Garden and at Nasuapum is not being monitored. The planted species are still growing well in the Botanical Garden (Fig. 2).

Current Projects and Future Plans

The only project on rattan resource development that has survived is the Cane Weaving Centre located in the National Capital District (Port Moresby). The Centre was established in 1986 under the South Pacific Appropriate Technology Foundation with funding from the Chinese government. The Centre has a fairly big double-storey building with a few simple machines (mainly for peeling and sanding a residential quarter, and a large backyard with a treatment tank and a place to season and store rattan poles. The Centre is currently headed by a Project Manager, who is assisted by a volunteer who is an expert in rattan furniture making. Presently, this purely training centre is a part of the Small Business Development Corporation. No commercial production is undertaken, although items such as bar stools, easy chairs and pot stands of fairly good quality are manufactured *by* the trainees on orders from different organizations (Fig 3) The maximum number of trainees is 10 per batch for a lo-month course. The trainees are paid Kina 40 per fortnight out of the sale of products made. The Centre is not receiving any financial support from the government or any other agency, and is facing financial problems (at the time of this report) as it lacks the marketing expertise required to profitably sell the products made.

Fig. '3: Products of the Cane Weaving centre, NCD

The Centre gets its raw material from natural forests of Central Province. Harvesting and initial treatment of

rattan poles are done by the landowners. The Centre pays 40-60 toea for a pole 4-5 m in length.

At the time of writing this report, there is no record of a trainee from the Centre . having been able to use the expertise gained to establish a rattan-based enterprise. This could be because of the lack of support facilities.

The Centre 'has the potential for developing as a regional training centre for the South Pacific if adequate inputs (funds, machinery, marketing assistance, post-training assistance, etc.) are provided.

Development Needs

1. Strengthening of policies and acts for sustainable development of NTFPs such as rattan.
2. Immediate removal of the ban on the export of raw rattan.
3. Definite plans in the National Forest Guidelines and National Forest Plans for the development of rattan resource in the concession areas.
4. Inventory of rattan in each concession area to assess the economic viability of rattan resource development before it is destroyed in logging and other developmental activities.
5. Study of taxonomy,. ecology and properties of different rattan species.
6. Training of resource owners and youths in (a) proper harvesting, treatment and grading aspects, and (b) manufacture of rattan products at competitive cost to generate employment in economically depressed areas.
7. Sustenance of such programs with active involvement of SBDC with adequate funding, technology transfer, and remuneration to the landowners.
8. Concerted efforts to popularize the use of rattan furniture and other products in the country.
9. Proper development of infrastructure and training modules for increasing down-stream processing of export-oriented rattan products.
10. Strong support to the Cane Weaving Centre and its products.
11. Continued expansion and management of rattan arboreta for ex *situ* conservation.
12. Plantation trials of commercial rattan species in the already established timber tree plantations.

REFERENCES

Aminuddin, M. 1990. Ecology and silviculture of *Calamus manan* in Peninsular Malaysia. Ph.D. thesis. University College of North Wales, Bangor, Malaysia.

Anonymous. 1991a. National forest policy 1991. Ministry of Forest, Port Moresby, Papua New Guinea.

Anonymous. 1991b. Forestry Act 1991 of the independent state of Papua New Guinea (incorporates subsequent Forestry (Amendment No. 1) Act 1993 and Forestry (Amendment No. 3) Act 1996. PNG Forest Authority, Port Moresby, Papua New Guinea.

Anonymous. 1996a. The Papua New Guinea forestry sector: status and development. IMF-PNG, Port Moresby, Papua New Guinea.

Anonymous. 1996b. Key standards for selection logging in Papua New Guinea. PNG Forest Authority, Port Moresby, Papua New Guinea.

Chung, H.H.; Chen, Y.S. 1994. Anatomical properties of Papua New Guinea rattan. Taiwan Forest Research Institute, Taipei, Republic of China. 83 pp.

Fizten, F. 1975. A taxonomic revision of *Buergersiochloa* Pug. (Graminae). Blumea, 22(3), 415-418.

Hildebrand, R.F. 1958. Preliminary key to 35 rattan species from New Guinea. (Unpublished).

Holttum, R.F. 1967. Bamboos of New Guinea. Kew Bulletin, 21, 262-292.

Igara, R. 1991. Keynote address. *In* Konabe, C.; Sastry, C.B. ed., Proceedings of the National Rattan Workshop, Lae, Papua New Guinea, 22-26 July 1991. Forest Research Institute, Lae, Papua New Guinea. pp. ix-xi.

Johns, R.J.; Taurereko, R. 1989a. A preliminary check list of the collection of *Calamus* and *Daemonorops* from the Papuasia region. Rattan Research Report No. 2/1989. PNG University of Technology, Lae, Papua New Guinea.

Johns, R.J.; Taurereko, R. 1989b. A guide to the collection and field description of *Calamus* (Palme) from Papuasia. Rattan Research Report No. 3/1989. PNG University of Technology, Lae, Papua New Guinea.

Johns, R.J.; Zibe, S. 1989. **A** check list of the species of *Calamus* and *Korthalsia* in Papuasia. Rattan Research Report No. l/1989. PNG University of Technology, Lae, Papua New Guinea.

Jordan, J.A. 1964. A survey report on rattan industry. Report of the U.N. technical consultant.

Jumogot, G.; Win, T. 1991. Downstream processing and marketing of rattan products. *In* Konabe, C.; Sastry, C.B. ed., Proceedings of the National Rattan Workshop, Lae, Papua New Guinea, 22-26 July 1991. Forest Research Institute, Lae, Papua New Guinea. pp. 32-39.

Kabaru, M. 1990. Establishment of rattan arboretum. IDRC-PNG Rattan Project Report No. 7. PNG Forest Research Institute, Lae, Papua New Guinea.

Kabaru, M. 1991. Rattan propagation. In Konabe, C.; Sastry, C.B. ed., Proceedings of the National Rattan Workshop, Lae, Papua New Guinea, 22-26 July 1991. Forest Research Institute, Lae, Papua New Guinea.

Kabaru, M. 1992. Rattan resource assessment in Sinapa-Oro Province. FRI Consultancy Report for ANZDEC and Dal.

Kabaru, M.; Niangu, M. 1990. Rattan resource assessment in the Gulf Province: Baimuru area. IDRC-PNG Rattan Project Report No. 5. PNG Forest Research Institute, Lae, Papua New Guinea.

Konabe, C. 1991. Perspectives of rattan harvesting and processing in Papua New Guinea. *In* Konabe, C.; Sastry, C.B. ed., Proceedings of the National Rattan Workshop, Lae, Papua New Guinea, 22-26 July 1991. Forest Research Institute, Lae, Papua New Guinea. pp. 10-11.

Konabe, C; Niangu, M. 1991. Review of rattan species and their distribution in some regions of Papua New Guinea. *In* Konabe, C.; Sastry, C.B. ed., Proceedings of the National Rattan Workshop, Lae, Papua New Guinea, 22-26 July 1991. Forest Research Institute, Lae, Papua New Guinea. pp. 1-5.

Konabe, C.; Peki, M. 1994. Rattan final report. IDRC-PNG Rattan Project Final Report. PNG Forest Research Institute, Lae, Papua New Guinea.

Konabe, C.; Sastry, C.B. ed. 1991. Proceedings of the National Rattan Workshop, Lae, Papua New Guinea, 22-26 July 1991. Forest Research Institute, Lae, Papua New Guinea.

Niangu, M. 1991. Resource assessment of rattan in Gulf and East Sepik Provinces. *In* Konabe, C.; Sastry, C.B. ed., Proceedings of the National Rattan Workshop, Lae, Papua New Guinea, 22-26 July 1991. Forest Research Institute, Lae, Papua New Guinea. pp. 6-9.

Nimo, W. 1991. State of rattan resource and industry in the Milne Bay Province. *In* Konabe, C.; Sastry, C.B. ed., Proceedings of the National Rattan Workshop, Lae, Papua New Guinea, 22-26 July 1991. Forest Research Institute, Lae, Papua New Guinea. pp. 26-28.

Nur Supardi, M.N. 1992. Rattan inventory: an overview of methods. Rattan Information Centre Malaysia Bulletin, 11(2), 1-3, 17.

Peki, M.; Konabe, C. 199la. Evaluation of moisture content and specific gravity. *In* Konabe, C.; Sastry, C.B. ed., Proceedings of the National Rattan Workshop, Lae, Papua New Guinea, 22-26 July 1991. Forest Research Institute, Lae, Papua New Guinea. pp. 23-25.

Peki, M.; Konabe, C. 1991b. Treatment, seasoning and grading of rattan. *In* Konabe, C.; Sastry, C.B. ed., Proceedings of the National Rattan Workshop, Lae, Papua New Guinea, 22-26 July 1991. Forest Research Institute, Lae, Papua New Guinea. pp. 18-22.

Pilger, R. 1914. Neue und weniger bekannte Gramineen aus Papuasien. Bot. Jahrb., 52, 167468.

Prior, R.J. 1960. Some notes on development of rattan industry in Papua New Guinea. Department of Education, Port Moresby, Papua New Guinea.

Reichert, C. 1986. Promotion of minor forest products in Papua New Gaines. FAO FO: DP/PNG/84/001, Field Document No. 4. Food and Agriculture Organization, Rome, Italy.

Samsudin, M.; Hutchinson, D. 1990. Comparative sampling study, Peninsular Malaysia. Asian Institute of Forest Management, Kuala Lumpur, Malaysia. (Unpublished).

Saulei, S.M.; Aruga, J.A. 1994. The status and prospects of non-timber forest products development in Papua New Guinea. Commonwealth Forestry Review, 73(2), 97-105.

Semese, K.; Wanaliu, M. 1991. Rattan industry in the Gulf Province. In Konabe, C.; Sastry, C.B. ed., Proceedings of the National Rattan Workshop, Lae, Papua New Guinea, 22-26 July 1991. Forest Research Institute, Lae, Papua New Guinea. pp. 29-31.

Siswanto, B.E. 1991. Metode mventarisasi rotan di Kelompok Hutan Sungai Aya-Hulu, K.P.H. Hulu Sungai, Kalimantan Selatan (Rattan inventory method in the Sungai Aya-Hulu Forest Complex, Hulu Sungai District, South Kalimantan). Bulletin Penelitian Hutan (Forestry Research Bulletin), 503, 1-11.

Siswanto, B.E.; Soemarna, K. 1988. Methods inventarisasi rotan di K.P.H. Pontianak, Kalimantan Barat (Rattan inventory method in Pontianak Forest District, West Kalimantan). Bulletin Penelitian Hutan (Forestry Research Bulletin), 503, l-1 1.

Siswanto, B.E. and K. Soemarna 1990. Metode inventarisasi rotan di Kelompok Hutan Sungai Tapen/Biangan, K.P.H. Barito Selatan, Kalimantan Tengah (Rattan inventory method in Sungai Tapen/Biangan Forest Complex, Forest District of South Barito, Central Kalimantan). Bulletin Penelitian Hutan (Forestry Research Bulletin), 527, 9-20.

Srivastava, P.B.L. 1994. Non-wood forest products of Papua New Guinea. FORSPA Occasional Paper 23. Forestry Research Support Programme for Asia and the Pacific, Bangkok, Thailand. 29 pp.

Micosa-Tandug, L. 1986. How to inventory rattan. Ecosystem and Development Bureau, College, Laguna, the Philippines. 6 pp.

Vali, B. 1986. Minor forest products investigation duty tour to Gulf, East Sepik and Madang Provinces with FAO consultant. Forest Products Research Branch Technical Report No. 26. Forest Research Institute, Lae, Papua New Guinea.

Ziek, J.F.U. 1976. Rattan cane preparation for furniture making and export. Forest Products Research Centre Research Notes. Department of Forests, Port Moresby, Papua New Guinea.

Ziek, J.F.U. 1979. Rattan inventory in Veikabu. Minor Forest Products Section publication. Department of Forests, Port Moresby, Papua New Guinea.

ANNEXE

Guidelines for Rattan Resource Management

I Objectives

1 To promote and replenish the natural resource of rattan through proper harvesting, utilization and regeneration.

2 To protect the interest of the landowners (who have rattan in their forest) through proper price structure; appropriate volume of rattan harvest for sale, and adequate amount of payment in suitable time.

3 To restrict the foreign companies to approved activities.

4 To initiate training program for nationals in rattan technology.

5 To encourage and develop product range of rattan in the country.

6 To launch research on various aspects of rattan.

7 To promote and develop markets for rattan and rattan products in the country and abroad.

II Company Registration

1 Established process of registration of companies for timber projects should be followed also for rattan resource development.

2 A list of such companies is to be prepared by the Department of Trade and Industry and circulated to the Provinces and other related Departments.

3 The proforma for company registration is appended.

III Management

1 Provinces and landowners will deal with registered companies only.

2 A Deed of Agreement shall be signed between the seller and the buyer witnessed by the Provincial Forest Officer (PFO).

3 Only specified rattan requirements shall be harvested and paid for in full by the company before leaving the premises.

4 An. officer should be appointed in the respective Provincial Forest Department to exclusively monitor rattan activities in the province.

5 Proper techniques of rattan harvesting and processing should be followed.

6 The company shall record all rattan harvested in tally sheets and lodge monthly returns to the PFO with a copy to the Department of Forests (DOF) by the 10th of each succeeding month.

7 The company shall ensure at all times that its operations do not impose unnecessary inconvenience, delays or setback to the timber operations if the timber authority to harvest rattan forms part of the timber rights purchase operation In such a situation, it would be preferred that rattan is harvested before the logging operations.

8 The company shall ensure that its processing plants are kept clean and healthy at all times.

9 The company shall, unless otherwise advised by the resource owners, pay compensation for any damage to crops, gardens or food trees destroyed in the course of its operations as assessed by the PFO.

10 The company shall ensure that its operations satisfy the Forestry Acts and Regulations and the Environment, Water Resources and Customs Acts.

Iv Investment Priority

1 Rattan harvesting should be restricted to the landowners only.

2 Processing (treatment, drying and grading) of rattan can be carried out by nationals as well as foreign companies in a joint venture.

3 If a foreign company proposes to manufacture cane products in the country, it could buy raw rattan from landowners.

4 The companies – national or joint ventures – are encouraged to develop on-shore manufacturing capabilities of cane products.

5 The foreign companies should go into joint ventures with national companies for the purpose.

6 The foreign companies must train the nationals in all aspects of rattan processing and manufacturing.

7 Specific equipment used in rattan processing and manufacturing are to be exempted from, import duty to encourage downstream processing.

8 A flow chart for proper management and utilization of rattan resource is appended.

V Issuance of Authority to Operate

1 The landowners or the companies wishing to harvest rattan on commercial scale are to acquire a timber authority from the PFO under the current Forestry Act which would include harvesting, treatment, cleaning, drying and grading.

2 The authority will not permit the company to engage or commit itself in any other form of timber operation except those approved under its terms of registration.

3 The PFO would collect a registration fee related to types of activities applied for at the time of registration.

VI Rattan Royalty/Minimum Selling Price

1 The Forestry Act (Chapter 216) Regulation for royalty on rattan 10 toea/100 kg or Kina 1/metric ton is too low.

2 The Minister for Forest can however raise the royalty up to Kina 2/metric ton which is also too low.

3 In order to avoid the problems of having weighing machines, and lifting, recording of weight and differences owing to variation in moisture content

of rattan poles, the following selling prices, based on a 6-m pole, are suggested:

40 mm and above	= 50 toea
30-39 m m	= 30-40 toea
25-29 mm	= 25-30 toea
20-24 m m	= 20-25 toea
15-19 mm	= 15-20 toea
l0-14 m m	= l0-15 toea
10 mm and less	= 5-10 toea

4 The company shall, at the end of each month, furnish copies of payments record or receipts 'to the PFO and DOF.

5 The current Minimum Export Price (MEP) Committee for log export will be empowered to review the MEP for rattan. If the export price stated by the exporter is above the MEP, it is the prerogative of the DOF to recommend issuance of an export license at the current market price.

6 The rattan MEP Will be reviewed by the MEP Committee as soon as significant price changes occur in the international market.

7 The company shall not enter into any sales, purchase contract or other agreements similar in nature without prior approval of the PFO.

VII Rattan Development Levy

1 A 2% levy (on FOB) payable to the province is suggested.

2 The levy would be utilized for strengthening or monitoring and development of rattan resource within the province.

VIII Minimum Export Price

1 The minimum export price will be fixed by the MEP Committee.

IX Export Duty

1 The -National Executive Council has raised export duty on raw rattan from 3% to 10% from 30 August 1988 which should be retained.

2 Finished rattan products will be exempted from export duty.

X Export Permit

1 An export permit shall be issued by the PFO upon the company's honouring the Deed of Agreement (the agreement for sale and purchase of green rattan), payment of development levy and export duty, and meeting of other requirements and guidelines.

2 The company shall comply with all requirements of export of processed cane under existing policies and laws.

XI Compliance with Customs Provision

1 The Custom Officer and PFO would ensure that all legal procedures have been satisfactorily fulfilled by the exporting *company prior to shipment of the consignment.