Local Tools, Equipment and Technologies for Processing Bamboo & Rattan

An Illustrated Manual
LOCAL TOOLS, EQUIPMENT, and TECHNOLOGIES for PROCESSING BAMBOO • RATTAN

An Illustrated Manual

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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 organizations 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 utilization; 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.

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FOREWORD

In social, economic and ecological terms, bamboo and rattan are two of the most important non-timber forest products of the developing countries, especially so in Asia where these two plants form part of traditions that are several centuries old. The close relation between people and these plants resulted in numerous processing technologies being developed, several of them specific to the associated place, people and end-use. These technologies, together with their tools, form one of the oldest body of traditional technical knowledge that is representative of the culture and life-style of people in several regions of Asia.

Some of these technologies have remained unmodified over long periods of time, while others have seen alterations to suit changing requirements. As South-South sharing of technical know-how is emphasized in INBAR’s Technology Transfer Program, it was felt that documentation of this traditional knowledge is vital for two reasons:

1. It will facilitate the identification and sharing of appropriate and value-adding technologies between participating countries of the Network; and

2. It will ensure that this valuable body of knowledge is preserved, at least in part, in written form and would form the basis for further enhancement.

Local Tools, Equipment and Technologies for Processing Bamboo and Rattan by R. Gnanaharan and A.P. Mosteiro is the result of this INBAR initiative. Although not an exhaustive account of the subject, it is hoped that this amply illustrated publication would serve to kindle interest among all those associated with bamboo and rattan sectors.

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INTRODUCTION

Bamboo and rattan are important non-timber forest products, particularly in Asia. These commodities have contributed significantly to the livelihood security of millions of indigenous peoples in the region who have adopted numerous practices to harvest and process the raw materials, employing simple hand tools. These traditional technologies and tools have been passed on from generation to generation, and have undergone some modifications and refinement. Because of the eco-friendly, labour-intensive nature of these processes, their relevance has remained strong to the present day.

Information on such local technologies, however, is restricted, localized and largely unpublished, and hence not easily accessible to other interested groups. This publication, although by no means exhaustive, is intended to fill this gap and help in the wider dissemination of the knowledge for the benefit of the rural poor, particularly women who are generally engaged in processing and finishing the products.

Linking of practices and tools in different regions will open up opportunities to merge elements that save cost, time and drudgery, and help develop new technologies, or replace an inefficient technology or tool in one place by a more efficient alternative from elsewhere. This will not only result in improving the living standards of people but also in reducing wastage of bamboo and rattan raw materials.

It was against this background that the need to prepare this document was conceived at an INBAR Planning Networkshop in 1993. As information gathered in this
publication is not complete, it is likely that there are several more technologies and tools which are not documented here. Nevertheless, it is hoped that this study will activate interest on little-known technologies and tools among a wider audience. It is further hoped that partners in the INBAR network will develop simple hand-outs, pamphlets, etc. in local languages, describing technologies and tools documented in this publication for the benefit of their bamboo/rattan workers and artisans.

A special mention must be made of Take Kogai, a Japanese publication describing bamboo processing, downstream products, as well as the tools employed in processing and production. Relevant information from this as well as a Japan-Philippines collaborative study on Philippine bamboo processing (1987) has been incorporated in this document. Reference is also made to the classical study by McClure (1953).

The text is organized in two parts: Bamboo and Rattan. Bamboo and rattan have to undergo a number of processing operations before they are converted into different products. Some processes are common for most of the products. This book contains information on the sequence of operations involved in harvesting, processing and finishing in each case, followed by description of tools used and technologies employed.

In the case of bamboo, after harvest (felling), the branches are removed and culms cut to required lengths. This is the primary preparation. If required, starch and gummy substances may be removed at the initial stage itself. Then depending on the end-product, a primary processing step such as splitting or bending is carried out. For certain products, the bamboo parts are subjected to a secondary processing
Fig. 1: Sequence of operations in processing bamboo
like bleaching or dyeing. The products are finally finished using a series of other processes. The sequence of operations is shown in Figure 1.

The sequence of operations for rattan is shown in Figure 2. After rattan is harvested, the cane (stem) is deglazed to remove leaf sheaths and silica (in some species) or waxes (in other species) on the surface. To increase the value of products, rattan is fumigated, bleached or oil-cured so that the cane is of a uniform, pleasing colour and does not have blemish. This is followed by drying. Further operations vary, depending on whether the cane is to be used in round or split form. Finally, the different components are jointed and finished.
BAMBOO
1. HARVESTING

A number of countries, or states within countries, have laid down rules or recommendations related to harvesting. The purpose of these is to avoid wholesale depletion of the bamboo resource. For instance, in India, the following rules are prescribed for harvesting bamboo:

1a. No cutting of clumps should be allowed in the year of their flowering. However, once the seeds have been shed, they may be cut;

1b. No shoots produced as a result of the last rains may be cut;

1c. At least three healthy, mature and fairly erect culms of not less than 3 m in height have to be left in each clump, in addition to the shoots of the last rains;

1d. No digging or extraction of rhizomes may be allowed;

1e. Shoots may be cut only at a height of 150 to 300 mm above the ground, except where clumps have become congested, in which case cutting should be at the lowest possible point;

1f. The use of sharp implements is insisted upon in order to avoid tearing and splitting the stumps of the culms; and

1g. Cutting may not be allowed in two operations.

One of the most widespread local myth in diverse bamboo-growing countries is that there is a correlation between the phase of the moon during which bamboo is felled and its liability to later attack by borer beetles. This myth has no scientific basis.
Felling of bamboo does not pose any major problem. However, it is not always easy to remove mature culms from the central part of the clump. If the clumps have not been managed, they might have become congested, making the cutting of an individual culm difficult. In thorny bamboos, it is wise to remove thorny branches before felling the culm to avoid physical hazard to the harvester.

The tools used for felling are a small axe (with a very sharp edge) or a relatively short, straight-edged machete (Anonymous 1975). McClure (1953) suggested the use of long, fairly heavy blades for the machetes.

**Delimming**

Knives are used to remove branches. The knife should be drawn upward to remove the branches so that no damage is done to the culm. The right way of doing it is shown in Figure 3, reproduced from Kallapur (1989). Even though hacksaws or hand saws will do the work better, they are not popular because they take more time.

---

*Fig. 3: Right and wrong ways of delimming bamboo*
2. PREPARATION

Primary Preparation

The culms are cross-cut to required lengths. In India, use of knives for this purpose results in material wastage and uneven cut ends. Saws are also employed, and hacksaws give better service than hand saws. McClure (1953) recommended large-sized hacksaws with molybdenum steel blades and 7-10 teeth per 10 mm for general use in felling, removing branches and primary preparation.

For certain end-products such as furniture, any bulging of material at the nodes needs to be removed. In India, this is done using a rather heavy knife (Figure 4). In Japan, either a plane with curved blade or a knife with

Fig. 4: Removal of bulging node
a curved blade is used (Kallapur 1989). The Japanese method speeds up the work and does less damage to the culm.

**Secondary preparation**

This involves extraction of gummy substances and reduction in starch content. The purpose of removing gummy substances is to achieve an even colour, while removal of starch reduces later attacks by fungi and insects.

To achieve an evenly lustrous ivory colour to bamboo, Japanese craftspersons extract the gummy substances by two methods – dry and wet (Anonymous n.d). In the dry process, green bamboo is evenly heated at 120°C. This causes the gummy substances and water to emerge and they are wiped off with a dry cloth. In the wet process, the bamboo is kept immersed in boiling water for 1-2 hours or in caustic soda (0.2-0.8%) or sodium carbonate (0.2-1.2%) solution for 10-15 minutes. After immersion, the surface of the bamboo is wiped with a dry cloth.

Different methods are used to leach out starch. One widely practised method is to keep the bamboo immersed in water for a period of up to 90 days (Sulthoni 1987). The water may be stagnant or slushy. A method practised by the people in Dandakaranya region in India is to fell the culms with branches intact and keep them standing upright under the sun for two weeks. The branches are then removed and the culms stood upright in shade for two months (Kaley et al. 1993).

The traditional methods mentioned above are only a few of the non-chemical methods employed. Chemical methods are described elsewhere.
3. PRIMARY PROCESSING

After preparation, the culm is ready for primary processing. For use in woven products, the culm has to be split into strips, and then the strips further processed to get splits and slivers.

**Splitting into strips**

Simple techniques have been developed in different countries. Figure 5 shows a set of devices used for splitting culms (McClure 1953). A cross of iron or hardwood bars (about 25 mm thick) is supported by posts (100 mm cross-section and 900 mm high) firmly set in the ground (Figure 5a). Two pairs of slits are made at right angle to each other at the top end of the culm, and the slits are held open with wedges until the...
culm is placed in position on the cross. Then the culm is pushed and pulled by hand until it is split. A steel wedge (Figures 5b, c) can be used for splitting quartered culms. Figure 5d shows a block with single and paired steel wedges for mounting on a heavy bench.

Fig. 6: Splitting moderate-sized culms

Fig. 7: A contrivance employed in splitting
Depending on the thickness of the wall, different contrivances (Figures 6, 7) are used. For fairly thick culms, two cuts perpendicular to each other are made at one end of the culm, and a plus-shaped contrivance (Figure 6) is placed on the cuts made and pushed down gradually by hammering lightly with the back of a knife (Maharathi 1961). For thin-walled culms, a small rod or a cross-shaped rod is used as shown in Figure 8.

Fig. 8: Splitting a thin-walled culm

A radial knife (Figure 9) can also be used, either by hand or in a machine. Depending on the diameter of the culm and the width of the required strips, knives with different numbers of blades are used. The manual use of a radial knife in Colombia is described by Hidalgo (1992).

A knife or a machete can also be used for splitting. It should have a broad blade made of hardened steel (Maharathi 1961), and should be heavy and sharp.
Fig. 9: A radial knife for splitting bamboo
enough to split the bamboo with one stroke. One such
machete is shown in Figure 10 (McClure 1953).

Fig. 10: A machete for splitting bamboo

Processing strips into splits and slivers

The strips are further divided into splits and the splits into slivers. The splits may be made radially or
tangentially (Figures 11b, c). While making tangential
divisions, any pithy, inner portion is usually discarded.
A long-handled knife with the blade bevelled on one side (Figure 11a) is suggested for these operations (McClure 1953).

The artisans in Assam, in north-eastern India, use a dao or broad-bladed knife, while the artisans of Manipur, also in north-eastern India, use flat-bladed knives of different sizes (Figure 12) known locally known as sangai (small blade) and thangjou (wide blade) (Ranjan et al. 1987).

Fig. 11: A knife (a) for making radial (b) and tangential (c) splits

Fig. 12: Knives used by artisans of Manipur for making splits and slivers
To make the thickness of the splits as uniform as possible, different methods are employed. In one method, a thick cloth is spread on the thigh and the split is placed over it. Then the split is pulled while pressure is applied on it with the edge of a shaving knife (Figure 13). Maharathi (1961) describes this knife:

Fig. 13: One method of making bamboo splits of uniform thickness

length of the sharp edge - 180 mm; width - 33.5 mm; thickness - 3 mm; length of the handle - 120 mm;

Fig. 14: Another method of making bamboo splits of uniform thickness
weight - 225 to 300 g. In another method, the split is kept over a wooden block and pulled over a knife (Figure 14). The knife used for this purpose is shown in Figure 15.

![Knife used for making bamboo splits of uniform thickness](image)

Fig. 15: Knife used for making bamboo splits of uniform thickness

A gadget used for making the width of the split uniform is shown in Figure 16. Another method to size the width is to use a pair of knives (Figure 17). The knives are fixed on to a wooden block, with the gap between them set according to the width of the

![A gadget for making bamboo splits of uniform width](image)

Fig. 16: A gadget for making bamboo splits of uniform width
split required. The oversized split is pushed through with the left hand while the other end is pulled by the right hand (Maharathi 1961).

Fig. 17: Sizing knives and method of using them for making bamboo splits of uniform width

Fig. 18: A gadget for making bamboo splits of uniform thickness and the knife used for it
A device used for making the thickness of the split uniform and the knife used in the gadget are shown in Figure 18 (Maharathi 1961).

To give a finishing touch to the splits, different chamfering knives (Figure 19) are used. Alternatively, a knife plate fixed to a wooden block may be used for the purpose (Figure 20).

Fig. 19: Chamfering knives for giving finishing touch to bamboo splits

**Processing splits into rounds and chopsticks**

In India, manually operated equipment is available to make bamboo rounds for the manufacture of incense sticks (see Appendix). Mechanized equipment is available also for making chopsticks.

For making thin ribs out of splits, a simple gadget – a strong steel plate with holes of different diameter – is used (Figure 21).
Fig. 20: Chamfering knife plate affixed on a wooden block

The split is pulled through a larger hole first and later passed through successively smaller holes. This makes the rib round, even and attractive.

Fig. 21: A steel plate for making rounds
An improvised method to make thin ribs up to 3 mm, as suggested by the Bamboo and Cane Development Institute, Agartala, India, is to use tin sheets (Figure 22).

Fig. 22: A simple tin sheet for making thin rounds

Straightening whole culm

For straightening bamboo, different contrivances are used depending on culm size. For small-diameter culms, simple wooden blocks with hole/notch are used (Figure 23a). For large-sized culms, metal contrivances should be fixed firmly (Figure 23b) (Kallapur 1989).

Bending round culm

Bending a green round culm is much easier than bending a dried one. It is relatively easy to bend an immature culm, but it will revert to its original state within a very short time. For bending culms which are slender and thick-walled, heat should be applied at
Fig. 23 A: Contrivances used for straightening slender (a) and thick (b) culms

FOR SMALL BAMBOOS

Fig. 23 B: Contrivances used for straightening slender (a) and thick (b) culms

FOR BIG BAMBOOS
the point where it is to be bent. The heat should be just sufficient for bending. When the required bend is completed, the heated portion should be kept immersed in water till the water temperature reverts to ambient.

Chattopadhyay (1985) describes a local technique employed in Assam, India, for making umbrella handles. The culm is filled with sand and the ends are sealed with cow dung. This prevents the stick from cracking while bending under heat.

Normally a charcoal fire is employed to heat the culm. A spirit lamp can also be used for heating, especially if the culm is to be used in an art ware.

**Bending bamboo strips**

Bamboo strips are bent at the internodal portion. At the place of bending a small portion is hollowed out (Figure 24) and heat is applied there. An electrically-heated bar will speed up the bending and allow the heating time to be regulated. After bending, the heated portion is cooled by keeping it immersed in water (Kallapur 1989).

**Flattening**

The craft workers in the north-eastern states of India make containers using internodal portions of whole or half-split culms. Heat is used to flatten a bamboo culm into a sheet without letting it develop any cracks. Ranjan et al. (1986) detail the process, which is summarized below.

A section of the internode (about 900 mm in length) of a freshly cut culm is peeled to a wall thickness of 1-1.5 mm (Figure 25a) and split along its length
Fig. 24: A method of bending bamboo strip

Fig. 25: Different steps in flattening the culm as practised by Khoibu artisans of Manipur
A toxic resin, *kharu* obtained from *katong* tree, is mixed with water and applied on both surfaces. According to the Khoibu artisans of Manipur, this resin prevents the culm from developing cracks while being heated. Applying heat evenly along the length makes it pliable and it opens out (Figure 25c). A stick is used to press the culm flat on the ground (Figure 25d).

**Fig. 26: Method of jointing a bent bamboo sheet**

While the sheet is still hot, it is bent so that the inside surface of the internode forms the outside surface of the bent article. The joint is held in a split bamboo clamp, a very simple device made from a length of a thick culm partially split in half along its length (Figure 26). The overlapped ends of the sheet are held

**Fig. 27: A method of flattening bamboo as practised by Monpas of Arunachal Pradesh**
together by two rows of stitches made with cotton thread.

The Monpas from Arunachal Pradesh, India, have an interesting technique to flatten the culm. Freshly harvested one-year-old culm is flattened with the outer skin intact, and the internodes as well as nodes are opened out simultaneously. The culm is partially slit along the length after the outer nodal rings have been scraped off. The edge is heated, forced flat and held within a bamboo clamp (Figure 27a). The clamp is held in both hands, pressed and rolled on the ground, wrapping the flattened bamboo sheet around it. The culm is flattened little by little, by extending the slit to short distances at a time, heating that portion and rolling it onto the clamp (Figure 27b). At the node, the diaphragm is knocked out and the inside surface is scraped and scoured with a small knife. The flattening process is then continued along the length of the culm.

Hidalgo (1992) describes how a flat board is made in Colombia (Figure 28). In this method, no heat is applied but a spade is used for the operation. The spade should have a broad blade set at an angle to operate parallel to the surface of board and it should have a long handle (McClure 1953).

Slicing

Grewal et al. (1994) describe a simple hand-operated slicer that can slice bamboo splits into 0.2 mm thick slivers used in manufacturing fine basketry and novelty items. Detailed engineering drawings of the prototype are also included in the article.

Slotting

Bamboo has been used in the construction of screens
Fig. 28: A Colombian method of making flat board to remove fine sand and silt in wells in India and Bangladesh (Figure 29). Allison et al. (1978) describe a manually operated slotter developed at the University of Maryland, USA. Details provided are adequate to understand the operation of the slotter but not enough to make one.

Fig. 29: Slotted bamboo as well screens
4. SECONDARY PROCESSING

Bleaching

For art wares, and especially screens, the splits and slivers obtained from bamboo strips should be without blemish. Colouration from the presence of gums, resins or oily substances will mar the appearance. Bleaching is resorted to in these circumstances. Bisulphite bleaching is commonly employed in Japan (Kallapur 1989). Bleaching powder also can be used for bleaching. The immersion time should be regulated so that the strength of bamboo splits is not impaired.

Dyeing

Artisans have traditionally made use of vegetable dyes obtained from different plant materials available in their localities and because of this, the dyeing process is generally indigenously developed. The following indigenous methods are taken from Ranjan et al. (1986).

The artisans of Manipur, India, collect the bark of shai-kui tree, pound it and then boil it in water to release the dye. Bamboo splits are put in this boiling solution for a short while before taking them out for drying and smoking over a fireplace. This process produces a deep brown-black colour.

The Khiamngan Nagas use the leaves of ham tree. Fresh leaves are pounded and mixed with water. Bamboo splits are put into this and boiled for two to four days continuously, till both the leaves and the bamboo splits turn a deep yellow. When the required colour is obtained, the splits are removed and dried under shade.
To dye the yellow splits thus obtained red, the following method is used. Bark of *lungpai* tree, after scraping off the outer layer, is pounded to a very fine powder. Just enough water to cover the bark powder is added and allowed to stand for two to four days. When effervescence starts, the mixture is strained and the liquor retained. To this liquor the washed outer skin of the fibrous root of *wye* creeper is added. The yellow splits of bamboo are boiled in this mixture till the splits acquire the desired red colour.

Besides vegetable dyes, commercial dyes are also used for dyeing bamboo splits. Standard dyeing procedures have been developed for using these dyes. However, it is good to keep the following points in mind before dyeing. It is better to bleach the bamboo splits before dyeing as bleached splits will take the colour uniformly. The outer skin of bamboo splits should be completely peeled or else the dye will not adhere. The water used for dissolving the dye should be soft water and free from impurities. To ensure colour fastness, the dyed bamboo split should be washed with a warm acetic acid solution (Kallapur 1989). Finished bamboo articles can also be dyed using commercial dyes.

**Carbonization**

A method of carbonization, as practised in Japan, is explained below (Anonymous 1983b).

"While dyeing results in colouration, the colour is only on the surface and subsequent splitting, slicing or cutting exposes uncoloured portions. A technique for carbonizing bamboo has been developed which results in the bamboo attaining a rich brown colour throughout. Bamboo processed this way can be cut, sliced, veneered, etc."
In the process, whole or split bamboo is put inside a steam boiler for about 20-30 minutes at 5 kg/cm² (150°C). This results in the bamboo attaining a uniform brown colour.

**Colouring with acid**

A method practised in Japan is explained below (Anonymous 1983b).

“This is useful for colouring whole pieces of bamboo which are used for making flower vases, lamps, etc. The bamboo is cut into desired length and the outer skin thoroughly scraped off. Hydrochloric acid is then applied by brush and the bamboo placed in an oven. The colour will turn brown.”
5. FINISHING

Based on the type of end-use and the specific product, different finishing methods are used. These methods vary from place to place.

Smoking

The artisans of the Khiamngan Naga tribe of north-eastern India use outer splits for warp and scraped-off hard outer skin for weft in woven products. The finished product is subjected to prolonged smoking over a fireplace. The weft becomes a much darker brown and this results in dramatizing the weave structure (Ranjan et al. 1986).

Lacquering

A very old method of making bamboo lacquer-ware in Myanmar is explained by Kin (1933). A thick coating of thitsi (a black oleoresin from thitsi tree, Melanorrhoea asitata) mixed with bone ash is applied to the bamboo article. Bone ash and thitsi, when properly mixed, form a tough hard mass on drying. Bone ash is used because of its absorbent quality. After the mixture is applied, the article is rubbed vigorously with sandstone to make it smooth. This process is known in Burmese as the thayo-kaing process, which literally means 'handling with animal bones'. After thayo-kaing process, the articles are lacquered and placed in a dust-proof room for 8–10 days to dry.

Presently, artisans use ready-made synthetic lacquer available in the market. Lacquering is done either by spraying or by brushing. To get a special finish, cashew
lacquer (1 part cashew nut oil in 5 parts of turpentine thinner) is used (Anonymous 1983b).

Modern industrial lacquers are known for their brilliant and durable coatings. They contain a soluble cellulose compound, resins and plasticizers. These ingredients are dissolved in a mixture of volatile solvents and diluents (non-solvents). The plasticizers incorporated impart flexibility, while the resins give luster, adhesion, durability and water resistance. A careful balancing of solvents and non-solvents will ensure homogeneity during rapid drying. In coloured lacquers, besides pigments, stabilizers are also added to ensure colour fastness (Kallapur 1989).

Painting

Articles like screens, fans, lamp shades, etc. are finished with varnish readily available in the market. Polyurethane varnish is currently popular because of its durability and scratch resistance. Depending on the product, varnish can be applied by brushing or spraying.

Although some of the old indigenous methods of making varnish for finishing bamboo may not be relevant today, a few such methods are described here (Hasluck 1911) as they make interesting reading.

"A transparent varnish for bamboo is made by dissolving 3 oz. of white shellac in 10 fluid oz. of methylated spirit; this is applied to the bamboo with a camel-hair brush. Any good white shellac varnish is suitable, or the following will give good results: (1) dissolve 4 oz. of fine-picked gum sandarac in 1 pt. of methylated spirit, and, after straining, add 2 oz. of finest pale turpentine varnish; (2) dissolve 2 oz. of
powdered bleached shellac in two-thirds of a pint of methylated spirit, and then filter to arrest any impurities that were present in the shellac; then add very gradually one-third of a pint of methylated spirit. A cheap varnish suitable for bamboo work may be made with: common shellac, 8 oz.; gum thus, 2 oz.; resin, 2 oz.; and methylated spirit, 1 qt. This can be sponged on, instead of brushed on, if desired."

To increase the service life of bamboo articles, two methods of painting are followed by the artisans in the Dandakaranya region of India (Kaley et al. 1993). In one method, juice obtained from neem leaves by crushing and grinding is applied on the bamboo articles. This is believed to keep away borers.

In the second method, cotton cloth cuttings are charred, linseed oil (or oil of Semicarpus anacardium) is slowly added to it and the mixture is ground in a pestle and mortar. The sticky paste thus obtained is applied to utility articles working into all the crevices. This is believed to increase the service life of the articles.
6. TOOL KITS

Most of the Japanese tools described by Maharathi (1961) have been introduced in India and other countries. Sets of these tools (Figure 30) in a kit form, and other processing equipment, are available for purchase from the Office of the Development Commissioner (Handicrafts), Bangalore (see Appendix for address and catalogue).

Fig. 30: A set of tools for processing bamboo

The Japanese tools introduced in the Philippines have been described in a Philippine book (Anonymous 1987). Most of these tools have been described by Maharathi (1961) also. Tools not illustrated so far are reproduced here (Figures 31-39).

Fig. 31: Coping saw (for cutting curves and irregular shapes)
Fig. 32: Hole saw (for cutting round holes)

Fig. 33: Cleaver knife (a double-edged knife for splitting bamboo strips into slivers)

Fig. 34: Boring knife (a smaller knife for boring holes)

Fig. 35: Gouge chisel (for cutting round/oblong holes)

Fig. 36: Pair of scissors (for cutting splits and slivers)
McClure (1953) gives a list of tools, their use and specifications. Some of these tools have been described and illustrated in the text under different sections. The tools not described so far but used in different operations are given in Table 1.
Table 1: Some of the bamboo-working tools, and their uses and specifications

<table>
<thead>
<tr>
<th>Tool</th>
<th>Use</th>
<th>Recommended Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axe</td>
<td>Cracking the nodes of large culms to make boards.</td>
<td>Light-weight axe with narrow but thick, strong, wedge-shaped.</td>
</tr>
<tr>
<td>Hatchet or small axe</td>
<td>Cracking the nodes of smaller culms for making boards.</td>
<td>Similar to the axe, but smaller in size and fitted with a short handle.</td>
</tr>
<tr>
<td>Tripods or trestles</td>
<td>Elevating culms and holding them firm for sawing to length, cracking nodes.</td>
<td>May be made locally, following the pattern locally preferred.</td>
</tr>
<tr>
<td>Adze</td>
<td>Removing diaphragm fragments and excess soft wood at basal end of bamboo boards. A spade is more convenient, but adze is more generally available.</td>
<td>Standard design; made of best-quality steel.</td>
</tr>
<tr>
<td>Chisel</td>
<td>Making holes in culms to accommodate lashings for end-ties.</td>
<td>Made of best steel (molybdenum steel if available); 2 cm bit.</td>
</tr>
<tr>
<td>Drill'</td>
<td>Making holes to accommodate bamboo pins or dowels.</td>
<td>Hand- or power-driven drill; bits of best steel, in assorted sizes of 3-12 cm.</td>
</tr>
<tr>
<td>Wood rasps</td>
<td>Levelling prominent culm nodes.</td>
<td>Large size, with one flat side, one convex; coarse, medium and fine teeth.</td>
</tr>
<tr>
<td>Wire pincers</td>
<td>For handling wire used for lashings.</td>
<td>Conventional type with long, narrow jaws and wire-cutting feature.</td>
</tr>
<tr>
<td>Rods of reinforcing steel</td>
<td>Breaking out the diaphragms of unsplit culms.</td>
<td>Suggested minimum: one each of 20 mm x 3 m and 12 mm x 3 m. Other dimensions to meet special needs. Hardwood or bamboo pole may be substituted.</td>
</tr>
<tr>
<td>Whetstone</td>
<td>Sharpening edged tools.</td>
<td>Carborundum; coarse-grained on one side, fine on the other.</td>
</tr>
</tbody>
</table>

* The drill bits used for drilling hard metals leave the bamboo culm surface fuzzy after drilling. Brad-point drill bits are suggested for drilling bamboo (Figure 40). For drilling large diameter holes (25 to 75 mm), hole saw blades attached to an electric hand drill or a bench drilling machine are used.
In 1992, the National Small Industries Corporation of India brought out a tool kit for processing bamboo. Tools have also been brought out by the Technical Wing of the Development Commissioner (Handicrafts) Office, Bangalore, India.

The Cottage Industries Technology Centre (CITC), the Philippines, fabricates tools and equipment used specifically for bamboo furniture making.

The Delft Centre of International Cooperation and Appropriate Technology of the Netherlands has developed a wire lashing tool. Although the method of operation of the tool has been described by Sonti (1990), no information is provided on the tool.

Carpentry tools like a set of flat chisels (6 to 75 mm), a set of gouge chisels (12 to 75 mm curve), tri-square, tape measure, inside and outside calipers, wooden mallet, hammer, bar clamps, C-clamps, vice, brad-point drill bits (3 to 12 mm), set of hole saw blades (25 to 75 mm dia.), cross-cut saw, hack saw, and equipment like portable electric hand drill, portable electric planer, portable orbital sander, bench drilling machine, etc. are available in hardware and mill stores.
RATTAN
1. HARVESTING

Most harvested rattan comes from natural forests. Depending on the species, soil quality and climate, rattan reaches harvestable size or maturity in 6 to 12 years. This may even be as long as 15 years (Serrano 1984). The harvesting age of commercially useful rattans also varies widely depending on the species (Abd. Latif 1992). Mature rattan can attain lengths of up to 20 m, or even 50 to 100 m in the case of very slender ones. Harvesting is normally done during dry months; yet many people in Malaysia harvest during wet periods. Harvesting during dry months will facilitate rattan processing activities, such as application of fungicides and drying.

It is interesting to read from old records how rattan was harvested (Anonymous 1924). Little has changed since most harvesting is still done by local people.

"This (harvesting) is done by the local people, usually at considerable distances from the centres of population. The collectors are jungle dwellers, who may be Sakai or other simple and primitive people. The collector selects his plant because of its size, length, strength and colour, and often collects only a single kind of rattan. He cuts the stem off at the base and then, taking hold of the lower part of it, pulls the plant down from the tree or trees which support it. If the plant has many stems, he cuts only the mature ones. If immature stems are cut the plant may die. The leaves and the soft and useless upper part of the stem are cut away with a stroke of the parang, or freed of the leaf-sheaths which may adhere to its upper part by pulling it between two branches or about some rough surface. The stem
is next cut into lengths of about 16 feet, which are folded once and wrapped in bundles of about 50 to 100 pieces, which are carried to some central place, often a hut near the collector's house, where the rattan is kept until there is an opportunity to turn it over to some buyer. Frequently the jungle people make temporary camps for their rattan collecting in a particular neighbourhood.

Harvesting methods vary slightly from place to place and country to country. In general, the harvesting techniques are very wasteful (Anonymous 1983a). The stem is cut 0.3 to 2 m above the ground with a parang (machete) (Figure 41) and dislodged from the tree by tugging. Harvesting rattan is a hazardous task. The collector has to be extremely careful as the falling stem may bring with it all kinds of debris including dead branches, ants, wasps, nests, and clumps of epiphytes. If the stem gets stuck in the canopy, the collector has to climb a neighbouring tree to cut it free. If this cannot be done, the part of the rattan that cannot be reached is abandoned. In Pasir, Indonesia, collectors use a hook-like knife tied to the end of a long straight piece of bamboo to isolate climbing rattan and tug on them till it falls (Peluso 1991). In Karnataka, India, a sickle with a straight cutting blade of 300-450 mm length and a small bend at the tip is used for harvesting rattan (Yekantappa et al. 1990).

Jordon (1965) devised a gadget for pulling the rattan. It consisted of a small fish-hook type grapple spliced
to the end of a rope. The hook was placed in position by a simple extension stick and the rope was pulled by a drum winch (Nur Supardi 1992).

Harvesting of planted manau cane by mechanical method using a four wheel drive vehicle was reported from Malaysia by Sulaiman (1991) and described in more detail by Nur Supardi (1992). Similar studies have also been conducted in Indonesia.

Rattan harvesting is administered by forest departments and permits/licences are usually needed. Rules for felling across Asia have not been collated. Uniform harvesting rules are difficult to adopt because the species may be clustering or not, produce single cane or not, and may have thick or thin canes.
2. PRIMARY PROCESSING

Deglazing

The first step after harvesting rattan is deglazing, that is to remove the inner epidermis of the leaf sheaths adhering to the stem and the silicified epidermis. As deglazing of dried rattan is difficult, it is done when the rattan is still green. Different methods are used in different countries.

In Indonesia, which is rich in rattan resources, a number of methods for deglazing (lunti or runti) have been developed. Some methods are more efficient and some are more laborious than the others. One of the traditional methods used in Indonesia is to hit the sheathed and silicified rattan cane with a plaited wood. This method is not satisfactory as it does not effect the best possible cleaning.

The simplest, but most time-consuming method, is to twist the rattan by hand and rub it with fine sand, steel wool, coconut husk or sackcloth. This produces a very clean finish. Instead of twisting by hand, sometimes the rattan is wrapped around a tree trunk and rubbed back and forth.

In India, in Assam and West Bengal, rattans of larger diameter are rubbed with sand and sackcloth for deglazing (Anonymous 1980). In Papua New Guinea, the sticks are rubbed with fine steel wool, hessian or coconut husk (Zieck 1976).

After deglazing, the rattan canes are washed in water. Then they are air-dried and/or processed further. If
Further processing is not done, they are graded according to diameter, internode and defects, weighed, and tied into bundles. Further processing includes fumigation, bleaching or oil-curing, followed by drying.

**Fumigation**

Normally fumigation is done specifically on large-diameter canes, using sulphur fumes, to bring out the best of rattan’s colour and to kill any larvae of borers present.

After washing, fumigation is carried out in a chamber (a convenient size of the chamber would be 6 x 5 x 3 m) which is fitted with an external container for burning the sulphur and a flue leading into the chamber to carry the sulphur fumes. The rattan is smoked overnight, sometimes for 24 hours or more, till an even colour is obtained. Then it is air-dried and sorted into different grades.

**Bleaching**

Sodium hypochlorite or bleaching powder is used to bleach the canes. For quality bleaching, hydrogen peroxide is used.

In the case of hypochlorite, the canes are kept immersed in a 1% solution for about an hour. The immersion time will vary depending on the diameter of rattan. Prolonged immersion will affect the strength.

**Oil-curing (boiling)**

Deglazed canes, still in the green condition, can be oil-cured to remove the waxy layer and gummy
substances. Oil-curing results in: (1) reduction of moisture content, thereby protecting the cane from sap stain and fungal attack; and (2) achieving an ivory colour.

Until recently, different methods, some even conflicting with the objective, had been used. For example, in one method, after oil-curing the cane was suggested to be dried, washed once again with water and dried (Anonymous 1980).

Where facilities for oil-curing are not available, some indigenous methods are used. In Indonesia, *rotan asalan* is steeped in a thick mud solution, roasted over a low fire for about 24 hours, rubbed clean with coconut husk, dried in the sun for about a week, and then sorted and bundled (Rachman 1974). In Papua New Guinea, after thorough washing in water, the cane surface is strongly and thoroughly rubbed with fine steel wool and kerosene (Zieck 1976). Plastic gauntlets should be used to protect the skin against kerosene burns. In India, in Assam and West Bengal, large-diameter canes are rubbed with sand and sackcloth, treated with linseed oil, and heated over a fire for about a minute. The canes are then rubbed with sackcloth soaked in kerosene and dried upright in the sun for 10 days (Anonymous 1980). In Malaysia, the stems are dried over a slow fire, and coconut or other oils are worked into the stems during the operation (Hing 1982).

The essential step involved in oil-curing is to keep the rattan stems immersed in an oil medium just below boiling point for a certain amount of time – 5–10 to 30–40 minutes, depending on the species and diameter. During this process, waxy materials, gums and resins will be dissolved and therefore removed from the cane, and the moisture in the cane will be reduced. The
superfluous oil is immediately rubbed off from the cured rattan. Different materials like sawdust, sackcloth, rag waste, coconut fibre, steel wool or very fine sand are used for cleaning. Sawdust is however preferred because it will not only clean the surface faster and easier, but also absorb all the excess oil from the surface (Hing 1982).

Different oil mixtures have been suggested in the literature. One is a mixture of coconut oil and kerosene plus a small amount of aluminium sulphate (Simatupang 1978). Another is a mixture of diesel and coconut oil (Hing 1982; Yekantappa et al. 1990). A recent study conducted at the Kerala Forest Research Institute suggests using only kerosene (Dhamodaran and Bhat 1993).

It is possible to incorporate protection measures against fungal and insect attacks into the process. One method is to add fungicide and insecticide to the oil bath. However, to avoid disintegration of these chemicals because of heat, it would be better to immerse the warm oil-cured canes in the preservative solution kept in another vessel.

**Drying**

After deglazing and washing, the canes will have a high moisture content. If it is not dried immediately, it will be prone to attack by sap stain fungi, and the resulting discoloured rattan will lose its economic value.

Air-drying of rattan has its own problems. The drying rate is slow and not uniform. Drying time varies from 1 to 2 or even 3 weeks, depending on the species and climate. Drying during the rainy season will take more time and the possibility of fungal attack is greater.
Large-diameter canes, usually about 3 to 4 m long, are tied loosely at one end and stood upright with the untied basal ends spread out forming a cone (Figure 42). Canes of smaller diameter, in lengths of 8-9 m, are hung over wooden stands or bent double and leaned against such stands with their ends down.

Fig. 42: Method of air-drying large-diameter canes

The early trials for kiln-drying rattan canes were not successful. However, different driers with different heating media have been developed. Tesoro (1989) explains the different equipment developed in the Philippines. Mabesa and Mabesa (1956) constructed a furnace-type drier for commercial rattan species. Casin (1979) designed and tested a low-cost, furnace-type drier. It was fired by wood wastes, and the hot air was conducted into the kiln through flue pipes. Humidification was through a spray line situated below the flue pipes. The drier was able to reduce the moisture content of scraped poles from an initial moisture content of 114% to 15% in 8 days.

A portable, demountable drier was developed by Casin
(1985). The drier is in the shape of a frustum, 4 m in diameter at the base and 0.8 m at the top, and 3.8 m high. The ribs are made of telescoping aluminium tubes and the structure is covered with tarpaulin. Heat is provided by a charcoal drum kiln located at the centre of the structure. The temperature can go as high as 45°C. It has a capacity for drying 250 poles. Scraped *Calamus merrillii* poles can be dried from 80% moisture content to 15% in 72 hours.

A small-capacity, integrated steam-conditioning and drying system was developed by Cuaresma (1987). It consisted of a low-pressure, wood-waste fired steam generator, a steaming cylinder and a rattan pole drier. The heat requirement of the drier was met by the flue gases from the stack of the steam generator. The overall thermal efficiency of the system was 47.2%. The heat recovery could be increased if the number of flue pipes was increased or the drier was made to turn a number of times rather than a single pass.

Following drying, rattans are bundled and sent for further processing.
3. SECONDARY PROCESSING

The dried poles are subsequently scraped, straightened, cut to size and stored according to size and classification. In cottage industries, cross-cutting is done using a hand saw aided with a jig, and straightening is a manual process using wooden jigs. In mechanized units, machines are available for every operation. A cross-cut saw (Figure 43) is used for cutting rattan to the required length. A hydraulic straightening machine (Figure 44) is used for straightening the poles.

Fig. 43: A cross-cut saw

The diameter of the cane primarily determines the end use. Large-diameter poles (18 to 34 mm) are used almost exclusively for furniture frame making and
Fig. 44: Hydraulic straightening machine

small-diameter poles (12 to 18 mm) for non-structural and decorative purposes. Canes of still smaller diameters (< 12 mm) are used in round form or converted into peels.

The traditional tools used in processing canes are the flat chisel, gouge chisel, hammer, gimlet, shaving knife, splitting knife, saw, cutting pliers, etc. The artisans in the north-eastern India use a bill-hook type knife (dao) fixed on an A-shaped frame (Figure 45) for splitting rattan.

Steaming

Steam bending of cane has many advantages over blow torch bending. The major advantages are that the bent cane does not have burn marks or localized reduction of strength. Amin and Grewal (1989) describe a steam generator developed for the rattan industry in Malaysia. The equipment has the capacity to steam about 30 poles each 3 m in length.
The rattan poles should be steamed at 100°C for 20-30 minutes. The poles can then be bent to virtually to any curvature. Most artisans who cannot afford to have a steam generator still resort to using a blow torch for bending rattan poles.

Bending

Ranjan et al. (1986) describe one of the traditional ways of bending rattan as practised in north-eastern India:

"The Mizo craftsmen have discovered a unique way of bending cane. As freshly harvested cane is fairly flexible, a length of cane is wound around a cylindrical wooden post of selected diameter into a tight helix and left to cure in the sun. The cane is left in the sun for three or four days before being removed from the mould and cut to form rings of the required size. This concept of the use of solar energy to form cane components is interesting as it could find application in other cane harvesting centres through a transfer of technology."
In commercial production of rattan furniture, bending is a routine operation. Moulding benches with fixed moulds for various types of bends are used. The moulds are made of steel bars set up vertically and adjusted by screwing the bars into iron blocks (Hing 1982). The furniture components usually moulded include back legs, front legs, seat bows, arms, side braces, back braces, seat braces, back decoration and arm decoration (Anonymous 1983a). The canes softened by steam or a blow torch are put immediately into moulds, and left in this condition for about half to one day in order to ensure the desired shape is permanently formed.

**Splitting**

Rattan used for weaving and binding is peeled by removing the outer hard skin. The core is resplit into smaller sections. Splitting is done by hand or machine.

Thin canes are split into two halves with a fastened knife. Thicker ones will give four segments of peel. The remaining core is pulled through a round hole with sharp edges to get a "round core" (Simatupang 1978). Splitting machines are available for the production of peel and core (Figure 46). The skin and the core are used for basketry, mat making, binding, weaving and other purposes.

![Fig. 46: Rattan peels and core produced using a rattan splitting machine](image)

**Dyeing**

Dyeing of cane splits are mostly by indigenous methods...
developed in different localities for specialty products. For example, the Angami Nagas of north-eastern India use deep red-coloured splits to make their ceremonial headgear and leggings. The Wancho tribe of Arunachal Pradesh, India, wear loosely-coiled black cane belts around their waists (Ranjan et al. 1986).

**Sanding and buffing**

Straight poles are passed through a profile sanding machine. At least three profile sanders are used (coarse, medium and fine) so that components can be finished in one pass. Moulded and bent components are sanded on buffing machines using pneumatic cylinders and brush heads.

**Dowelling**

A major construction technique used extensively in rattan furniture production for connecting the components is to make dowel holes. Dowel holes are drilled by pneumatic or electro-pneumatic self-feed spindle heads, which are adjustable and can be set in accordance with the profile or shape of the component being drilled.

**Coping or scribing**

The most common jointing system is coping or scribing. Since all rattan sections are round, it is necessary to scribe some components to create a perfect fit during assembly. Scribing is done manually using a gouge chisel or by fitting a specially designed cutting bit to the drill.

**Drilling and grooving**

In preparation for final furniture assembly, sub-assemblies may have to be drilled. Grooving is necessary
for frames into which woven cane is being incorporated. It is done with either a router or drilling machine to which a special grooving bit has been fitted.

**Jointing and binding**

Figures 47–49 illustrate the various types of joints that are used in rattan frame and seat construction. The most widely used joint is the coping or scribing method, in which the horizontal rail is scribed around a vertical member and then nailed or screwed to it. Screwing is preferred to attain a stronger joint.

![Diagram of jointing and binding](image)

**Fig. 47: Structural joints for rattan frames**
Fig. 48: Some more joints for frames
After the components are jointed, binding is done to provide additional strength and to make the furniture attractive. Materials like rattan peel, leather strips, etc. are used. Figure 50 shows a variety of designs for binding the joints.
Fig. 50: Methods of binding rattan joints
4. FINISHING

Indigenous methods

Some of the interesting indigenous methods of finishing rattan products (Ranjan et al. 1986) are described below.

The Maring hill tribe of eastern Manipur, India, uses the bark of *shaikui* tree for dyeing the rattan components to a deep brown colour. The finished product is subsequently smoked to intensify the colour.

The craftspersons of Assam, India, use a simple indigenous device that can be made easily from locally available materials. A medium-sized terracotta pot, a part of its bottom knocked out, is filled with dried banana leaves and propped up on a bamboo tripod. The leaves inside the pot are lit with an oil lamp through the hole at the bottom of the pot (Figure 51). As the

![Fig. 51: An indigenous method of finishing a rattan container](image)
leaves begin to burn, a large quantity of dense white smoke billows out of the mouth. The leaves are not allowed to burn with a large flame and more leaves are stuffed into the pot as required. A container made of coiled cane is held over the mouth of the pot and rotated so that all sides are smoked evenly. As the coiled-cane container warms up an oil-like substance is deposited on the surface of the cane, and the colour of the product changes dramatically.

**Commercial method**

A base coat is sprayed on the components, sub-assemblies and fully assembled frames of cane in a spray booth on turntables. The coated components are then dried in a drying tunnel. After drying the base coat, they are sanded in order to smoothen the surface in preparation for the application of a final coat. Then final coat is sprayed and dried.
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Anonymous 1983a. Manual on the production of


Champion, F.W. 1923. Some aspects of the exploitation of bamboos in the U.P. Indian Forester, 49(4), 207-212.


Further Reading


APPENDIX

Suppliers and tools

1. Regional Design and Technical Development Centre (Technical Wing), Office of the Development Commissioner (Handicrafts), 32, Victoria Road, Bangalore 560 047, India. The Centre can supply the following tools and equipment:

   a. Tool kit for processing bamboo and rattan

      (A complete set of 21 various tools designed to suit all types of bamboo and rattan work - supplied in a wooden box) Rs. 1 200

   b. Bamboo splitting tool

      - with 8 blades Rs. 450
      - with 16 blades Rs. 575

   c. Bamboo splitting machine for agarbathi sticks

      - hand operated Rs. 4 800
      - power operated (without motor) Rs. 5 200

   d. Bamboo round sticks (3.5 mm dia.) making gadget (hand operated) Rs. 1 800

2. The Cottage Industries Technology Centre (CITC), 20 Russel Street, SSS Village, Marikina, Metro Manila, the Philippines. CITC fabricates tools and equipment used in bamboo furniture making. The list including specifications and approximate price is given here.
I a. Bamboo pole cutter - seesaw type (for cutting bamboo poles into desired length)

- Power : 220 V, 60 Hz Motor with overload protection: 1.5 hp, single phase
- Saw blade : 12 in (dia.), carbide tipped
- Main frame : 2 x 2 x 0.5 in (angle iron)
- Price : 12,000 Pesos

I b. Circular table saw (for cutting bamboo furniture component into actual length)

- Power : 220 V, 60 Hz Motor with overload protection: 1.5 hp, single phase
- Saw blade : 12 in (dia.), carbide tipped
- Table : adjustable up and down
- Main frame : 2 x 2 x 0.25 in (angle iron)
- Price : 23,100 Pesos

I c. Bamboo outer node remover (for removing the outer node of bamboo prior to splitting)

- Power : 220 V, 60 Hz Motor with overload protection: 1.5 hp, single phase
- Main frame : 2 x 2 x 0.25 in (angle iron)
- Other features: Cutter or grinding stone
  Sliding stock feeder frame with slanting roller bearing
- Price : 1,605 Pesos

I d. Double head disc sander (for cleaning the solid or laminated bamboo furniture component)
<table>
<thead>
<tr>
<th>Description</th>
<th>Specifications</th>
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<tr>
<td>Power, Motor, Disc dia.</td>
<td>220 V, 60 Hz, 1.5 hp, single phase, 12-14 in</td>
</tr>
<tr>
<td>Sanding table, Main frame</td>
<td>Adjustable 2 x 2 x 0.25 in (angle iron)</td>
</tr>
<tr>
<td>Price</td>
<td>12,720 Pesos</td>
</tr>
<tr>
<td>e. Double head air drum sander (for cleaning of solid or laminated bamboo furniture)</td>
<td>Power: 220 V, 60 Hz Motor with overload protection: 1.5 hp, single phase</td>
</tr>
<tr>
<td>Drum with air valve, Main frame, Price</td>
<td>120 x 250 mm (dia.), 2 x 2 x 0.25 in (angle iron), 9,845 Pesos</td>
</tr>
<tr>
<td>f. Solid drum sander (for sanding flat laminated bamboo component or with plywood backing)</td>
<td>Power: 220 V, 60 Hz Motor with overload protection: 1.5 hp, single phase</td>
</tr>
<tr>
<td>Drum, Sanding table, Main frame, Price</td>
<td>6 in (dia.) x 30 in (length), adjustable 2 x 2 x 0.25 in (angle iron), 13,255 Pesos</td>
</tr>
<tr>
<td>g. Bamboo shaver (to determine the uniform thickness of slot or bamboo weaver)</td>
<td>Price: 180 Pesos</td>
</tr>
<tr>
<td>h. Bamboo sizer (to determine equal length</td>
<td>Price:</td>
</tr>
</tbody>
</table>


and uniform width of bamboo weaver
Price : 180 Pesos

i. **Bamboo scraper** (to remove the outer skin of bamboo poles prior to splitting process)
Price : 180 Pesos

j. **Bamboo hand splitter** - 8/10 blades (to cut bamboo slot into the same size for lamination purposes with the plywood backing)
Price : 180 Pesos

k. **Bamboo chip cutter** (guillotine type)
Price : 3 500 Pesos

l. **Bamboo slicing machine** (to separate the skin of bamboo from the pith)
- Power : 220 V, 60 Hz Motor with overload protection:
  - 1.5 hp, single-phase induction motor
- Feeding Speed : 100 ft/min
- Thickness of material : 1 mm max.
- Width of material : 2 mm max.
- Slicing thickness : 0.5 mm min.
- Machine dimensions : 300 (W) x 900 (H) x 600 mm (L)
- Machine weight : 100 kg
Price : 52 450 Pesos
**Im. Bamboo splitting machine** (to make number of slat bamboo in one operation)

Power : 220 V, 60 Hz Motor with overload protection:
1.5 hp, single-phase induction motor, magnetic switch

Length
of bamboo : 2-9 ft

Dia.
of bamboo : 2-6 in

Splitting
blades : 4-15

Machine
dimensions : 700 (W) x 1,050 (H) x 4,100 mm (L)

Machine
weight : 450 kg

Production
capacity : 350 poles/h

Price : 59,850 Pesos

**In. Bamboo slitting machine** (to produce small pieces of bamboo slat on side skin process)

Power : 220 V, 60 Hz. Motor with overload protection:
1.5 hp, single-phase induction motor

Feeding Speed : 100 ft/min

Width
material : 40 mm

Machine
dimensions : 330 (W) x 850
(H) x 565 mm (L)
**Machine**

weight : 100 kg
Price : 52 450 Pesos

10. **Bamboo sizing machine** (to determine the uniform width of bamboo weaver in a fast operation)

Power : 220 V, 60 Hz Motor with overload protection: 0.5 hp

Feeding speed : 100 ft/min

Width of material : 14 mm

Thickness material : 3 mm

Machine dimensions : 500 (W) x 770 (H) x 690 mm (L)

Machine weight : 100 kg

13. A tool kit for bamboo and cane cottage industries is available from: National Small Industries Corporation Ltd., Prototype Development and Training Centre, Balitikuri 711 402, Howrah District, West Bengal, India. The kit costs Rs. 1 800.

14. The Bamboo Information Centre (China) brought out a Directory of Chinese Bamboo Processing Machines in 1992. The Directory can be obtained from: Bamboo Information Centre (China), Chinese Academy of Forestry, 100091 Wan Shou Shan, Beijing, China.

15. With bamboo becoming popular, tools for working with bamboo are available in other
countries also. One example is: Garrett Wade Australia, P.O. Box 1185, Collingwood, Vic 3048, Australia. Fax: +61 (3) 882 8710. Catalogue price A$7.50.

NOTE: The prices quoted are indicative only; current prices may vary.
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R. Gnanaharan
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Technical Report No. 9
Bamboo and rattan are important forest resources that contribute significantly to the livelihood security of millions of people. In different regions of the world, numerous practices to harvest and process the raw materials have been developed, employing simple hand tools. This publication is an important step towards making information on such technologies, which is localized and largely unpublished, more widely available for common benefit.