GUYANA FORESTRY COMMISSION
TRAINING MANUAL

THE USE OF 15 LESSER USED SPECIES

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Table of Contents

Foreword 2

Acknowledgements 3

Glossary 4

Module 1: Traditional wood use in Guyana: 9

a) Topics to be covered
b) Session Goal/learning Objective
c) Competency objectives
d) Training methods
e) Equipment & practical aids

Module 2: Common Wood Utilization Practices 17

a) Topics to be covered
b) Session Goal/learning Objective
c) Competency objectives
d) Training methods
e) Equipment & practical aids

Module 3: Properties of eight LUS: 23

a) Topics to be covered
b) Session Goal/learning Objective
c) Competency objectives
d) Training methods
e) Equipment & practical aids

Module 4: Properties of seven LUS: 27

A) Topics to be covered
b) Session Goal/learning Objective
c) Competency objectives
d) Training methods
e) Equipment & practical aids

References 30

Annexes 31

Foreword

It is widely accepted in Guyana that harvesting 20m^3/hectare on a 60 year cycle allows for the sustainable use of local timber resources. A perusal of the registers of the GFC (and of logging companies) indicate that very few loggers achieve harvests of more than 10m^3/hectare when the mean stocking of all species is estimated at about 300m^3/hectare. If loggers can harvest more volume per hectare, they would derive more value per hectare and the harvesting costs per hectare would be less.

All loggers plan their harvesting operations on species that are popularly used by consumers. Loggers do not harvest timber they cannot sell because the costs of harvesting merchantable timber and non-merchantable timber are the same. If consumers would place a demand for the lesser used species, loggers would be happy. In addition, If more timber is harvested per hectare, the rate of increase of *logged over* forests (or the rate of utilization of virgin forests) would decrease because loggers would harvest each block more efficiently.

One strategy used by the GFC to encourage such harvesting efficiency is to promote the use of the lesser known species. Traditionally, consumers of timber have used timbers with which they are more comfortable because they know the properties of the timber very well. More knowledge of the lesser known species could lead to more use of those species.

Local timbers vary in two main properties: the nature of the extractives in the timber and the thickness of the cell wall (reflected in the density of the timber).These properties in turn produce the utilization parameters of interest to the consumer: physical properties which determine the structural (load bearing use of the timber); chemical properties which determine the durability and degree of treatment of the timber; and the degree to which those two properties could be managed-for example through seasoning, preservation or pre-boring.

One reason for the occurrence of lesser used species is the fact that their occurrence within the forest is relatively low (which is the case of the vast majority of species anyway). This is not a problem: in this manual we simply encourage the harvest of species as they are encountered.

The training to promote the use of the fifteen species is presented in four modules: Module 1 deals with the traditional use of local timbers linked with the knowledge of their properties and their abundance in local forests; Module 2 sets out in detail, the properties of timber that foster common utilization practices; and Modules 3 and 4 present the key utilization parameters for eight and seven of the LUS targeted respectively. A glossary and three annexes support the manual.

Acknowledgements

The author wishes to acknowledge the strategic thinking by the GFC in actually implementation work leading to the use of a larger number of species. The staff of the GFC provided most of the ideas for this training manual, with some collaboration from staff of the Forestry Training Centre Incorporated.

The role of ITTO in recognising and co-funding the preparation of this training manual is also acknowledged.

The pioneering spirits of some entrepreneurs and the drive by many policy makers to increase the value per unit area have inspired this work.

Finally, the role of myriad joinery establishments in their experiments to innovate in the production of furniture and artefacts is hereby acknowledged. Special thanks are due to Mr. David Persram.

Glossary

Air-dried lumber: Lumber with an equilibrium moisture content (EMC) of 12 to 18%. (Lumber dried by exposure to outside air without artificial heat.

Anisotropic: Refers to the fact that wood has very different properties parallel to the grain versus the transverse direction. (These contrasts with materials like metals, plastics and cement products isotropic- ie., have the same properties in each direction).

Baulk: A piece of sawn or hewn wood 10 x 10 cm to 30 x 30 cm.

Board foot: A unit of timber measurement equivalent in volume to a piece having nominal dimensions of one foot (length) by twelve inches (width) and one inch (thickness). This unit is abbreviated to FBM (feet board measure) or simply BM.

Bole: Trunk, stem of a tree 20cm and up, sound, straight (2.5m) long and up.

Burls: Defects appearing on the outside of a tree created by cluster knots or from healing of a dead knot.

Cant: Piece of sawn wood with bark on two sides.

Checks: Longitudinal separation of the fibres in wood that do not go through the whole cross section. Checks result from tension stresses due to too rapid seasoning (drying).

Compressive Strength Parallel to Grain: Maximum stress sustained by a compression parallel-to-grain specimen having a ratio of length to least dimension of less than 11.

Compressive Stress Perpendicular to Grain: Reported as stress at proportional limit. There is no clearly defined ultimate stress for this property.

Cubic metre: The volume of timber equivalent to a cube with sides measuring 1 metre in length. The standard of timber measurement under the metric system. Equals 424 FBM.

Degrade: Loss of value due to drying defects. Degrade also occurs through poor storage, transport or handling when additional defects are developed in timber which would not have been permitted during initial grading.

Density: Weight per unit volume. Density of wood is influenced by rate of growth, percentage of late wood and in individual pieces, the proportion of the heartwood.

Dimensional Stability: A term that describes whether a section of wood will resist changes in volume with variation in moisture content (other term: movement in performance).

Dressed timber: Timber which has been planed to remove the marks of sawing on one or more faces.

Dry Lumber: Lumber having 19% or less moisture content.

Equilibrium moisture content (EMC): State of balance with the atmospheric conditions within which wood is stored or used. The MC at which wood neither gains nor loses moisture when surrounded by air at a given relative humidity and temperature.

Fibreboard: A sheet material manufactured from fibres or other lingo-cellulose materials. A bonding agent or other materials may be added during manufacture to increase strength or resistance to moisture, fire, insects, or decay.

Fibre Saturation Point (FSP): When the cell cavity is completely empty but the cell wall remains saturated with the more tightly bound water; usually taken as approximately 30% MC based on oven dry weight.

Figure: The pattern produced in a wood surface by annual growth rings, rays, knots, deviations from regular grain, such as interlocked and wavy, and irregular coloration.

Fracture: Configurational strain-physical separation of wood fibres: specific types are checking and splitting.

Grain: The direction, size, arrangement, appearance, or quality of the fibers in sawn wood. Straight grain is used to describe lumber where the fibers and other longitudinal elements run parallel to the axis of the piece.

Green: Freshly cut wood; may have an MC varying between 30% and 250%.

Growth ring: Layer of wood added to a tree during a single growing season...made up of early wood and latewood.

Gum Pocket: An excessive local accumulation of resin or gum in the wood.

Hardness: Generally defined as resistance to indentation using a modified Janka hardness test, measured by the load required to embed a 11.28 mm (0.444 in.) ball to one-half its diameter. Values presented are the average of radial and tangential penetrations.

Hardwood: A description applied to all timbers of the broad leaved tree species. The structure of hardwoods is different (fibres and vessels) to that of softwoods (tracheids). The forests of Guyana consist of tropical hardwoods.

Heartwood: The inner layers of wood in growing trees that have ceased to contain living cells. Heartwood is generally darker than sapwood in colour due to pigment deposits in the vessels, which also increases resistance to insect and fungal attack. In some species, sapwood and heartwood are not always clearly differentiated.

Hewn timber: Timber which has been squared from a log by an axe or adze rather than by sawing. Often used for heavy engineering timbers.

Impact Bending: In the impact bending test, a hammer of given weight is dropped upon a beam from successively increased heights until rupture occurs or the beam deflects 152 mm (6 in.) or more. The height of the maximum drop, or the drop that causes failure, is a comparative value that represents the ability of wood to absorb shocks that cause stress beyond the proportional limit.

Kiln-dried lumber: Lumber used in furniture manufacture, usually having from 6-8% moisture content. Lumber dried in a kiln with the use of artificial heat.

Knots: Hard, cylindrical regions marking locations of branches that have been encased by later growth of the tree.

Longitudinal shrinkage: Shrinkage along the grain (vertical direction in a standing tree).

Lumber: Wood sawn lengthwise from logs.

Lumen: The cell cavity.

Mineral streaks: Olive or greyish markings caused by such environmental factors as trace elements in water or soil.

Modulus of Elasticity: An imaginary stress necessary to stretch a piece of material to twice its length or compress it to half its length. Values for the individual species are given in mega pascals (MPa - equivalent to N/m2), and are based on testing small clear pieces of dry wood.

Modulus of Rupture: Reflects the maximum load-carrying capacity of a member in bending, and is proportional to maximum moment borne by the specimen. Modulus of rupture is an accepted criterion of strength, although it is not a true stress because the formula by which it is computed is valid only to the elastic limit.

Moisture Content (M.C.): The weight of water contained in wood expressed as a percentage of the weight of the oven dry wood. Green timber freshly sawn may contain 70 to 100% moisture, shipping dry timber 20 to 30% and air seasoned timber about 12 to 16%. For furniture and joinery products most timber will need to be kiln dried to a final moisture content of between 9 to 12% depending on environmental conditions.

Piling: Logs or long straight pieces of lumber usually destined to be driven into the ground by impact and used for the construction of piers, wharves, bridges and buildings.

Pith Flecks: Pith-like irregular discoloured streaks of tissue in wood, due to insect attack on the growing tree.

Plain-Sawn: Plain-sawn hardwood boards are produced by cutting tangentially to a tree's growth rings, creating the familiar "flame-shaped" or "cathedral" pattern. This method also produces the most lumber from each log, making plain-sawn lumber a cost effective design choice. Plain-sawn lumber will expand and contract more than boards sawn by other methods. However, it performs just as well when properly kiln-dried, when the job site is properly prepared and when the hardwood products are acclimated to the home before installation. (See Managing Expansion & Contraction, Moisture Content).

Plywood: Consists of 3 or more (5, 7, 9, 11, etc.), sheets of wood glued and pressed together; disposed so that the grain of each layer is at an angle to the adjoining layers.

Poles: Straight pieces of debarked round wood, three meters in length and up and used to support telephone, telegraph, and electrical transmission lines or scaffolding.

Quarter-sawn: Quarter-sawing means cutting a log radially (90-degree angle) to the growth rings to produce a "vertical" and uniform pattern grain. This method yields fewer and narrower

boards per log than plain sawing, boosting their cost significantly. Quarter-sawn boards are popular for decorative applications such as cabinet faces or wainscoting. They will expand and contract less than boards sawn by other methods.

Radial direction: The direction measured from the pith along a radius of the cross section of log or tree stem.

Radial shrinkage: Shrinkage perpendicular to or across the annual growth rings.

Rift-sawn: Rift-sawing at a 30-degree or greater angle to the growth rings produces narrow boards with accentuated vertical or "straight" grain patterns. Rift-sawn boards are often favoured for fine furniture and other applications where matching grain is important. This type of lumber is available in limited quantities and species.

Sapwood: The outer zone of wood in a tree, next to the bark. Sapwood is generally lighter in colour and weight than heartwood.

Scantling: sawn timber more than 25mm thick and 75mm wide of end section and less than about 280 square centimetres; usually intended for use in construction and building work.

Shear Strength Parallel to Grain: Ability to resist internal slipping of one part upon another along the grain. Values presented are average strength in radial and tangential shear planes.

Shrinkage: The contraction of wood fibers caused by drying below the fiber saturation point (usually around 25-27% M.C.). Values are expressed as a percentage of the dimension of the wood when green.

Specific Gravity: The relative weight of a substance compared with that of an equal volume of water. The specific gravity of water is 1.0 at 4°C at normal pressure; 1m3 of water weighs 1,000 kilograms. The S.G. of wood is usually based on the green volume and oven dry weight. Any timber with a specific gravity greater than 1 is denser than water, and those with a specific gravity less than 1 are less dense than water. (Density and specific gravity have very similar, but not quite identical definitions: *density* is the mass of material per unit volume; specific gravity is a ratio of the mass of a material to the mass of an equal volume of water at 4°C).

Sleepers: Sawn or hewn pieces of wood used to support the rails on the rail bed.

Split: Separation of the fibers in a piece of wood from face to face (other term: end-split).

Stain: Materials used to impart colour to wood.

Staves: Elements used for the production of barrels and casks.

Stickers: The strips of wood placed at regular intervals between each layer of timber when it is stacked for seasoning to permit free circulation of air.

Tangential direction: The direction in a cross section of a piece of timber at right angles to the medullar rays and parallel to the growth rings where they are present.

Tangential shrinkage: Shrinkage parallel to the annual growth rings.

Tensile Strength Perpendicular to Grain: Resistance of wood to forces acting across the grain that tends to split a member. Values presented are the average of radial and tangential observations.

Texture: Determined by relative size and distribution of the wood elements. Described as coarse (large elements), fine (small elements) or even (uniform size of elements).

Tolerance: A portion of the length, width, or thickness of log or timber provided to maintain its nominal length as specified in a standard, usually given as a plus and minus amount. For example sawn wood of size 2.5 m ± 25mm, would be acceptable as long as it measures 2.5 m plus an additional allowance of between 0 and 25mm (between 2.5 m and 2.75m).

Undressed lumber: Sawn lumber which has not been smoothed by planning to a regular dimension.

Veneer sheets: Thin sheets of plywood of uniform thickness, cut sliced or sawn for use in plywood furniture, veneer containers, boxes and baskets.

Warp: Distortion in lumber causing departure from its original plane usually developed during drying. Warp includes cup, bow, crook and twist.

Weight: The weight of dry wood depends upon the cellular space, the proportion of wood substance to air space.

Work to Maximum Load in Bending: Ability to absorb shock with some permanent deformation and more or less injury to a specimen. Work to maximum load is a measure of the combined strength and toughness of wood under bending stresses.

Module 1: Introduction to timber and its use in Guyana:

Topics to be covered

- Course introduction
- Brief introduction to wood
- History of wood use in Guyana
- Common commercial species in Guyana
- Common wood products on the local market
- Markets for Guyana's timbers

Session Goal/learning Objective

- To understand the traditional use of timber in Guyana
- To understand why there is selective use of timbers in Guyana

Competency objectives:

At the end of the session, the trainees should be able to:

a) Describe the history of the use of local timbers
b) Describe the range of timber products and the selective use of timbers
c) Appreciate the value of utilizing a larger number of the lesser used species available in local forests

Training methods

Lecture (Power point presentation), questions and answers, examples and illustrations

Equipment & practical aids

- Classroom
- Chalkboard
- Copy of Manual of 15 lesser used species
- Specimen of local timber products (shingle, sawn lumber, ply-board, paling post, artefact/furniture)
- Photographs of wooden structures

Assessment

Simple question and answer sessions on the main points raised

References

1. Course introduction

It is widely believed that the forestry sector has considerable potential for making a greater contribution to national development. One way of accomplishing this is to harvest more species per hectare. Another way is to add value to the maximum extent possible to all timber harvested. This manual presents information that could contribute to more efficient timber harvests (more value per hectare and lower costs per hectare) and better use of selected timbers by a knowledge of their properties and peculiarities.

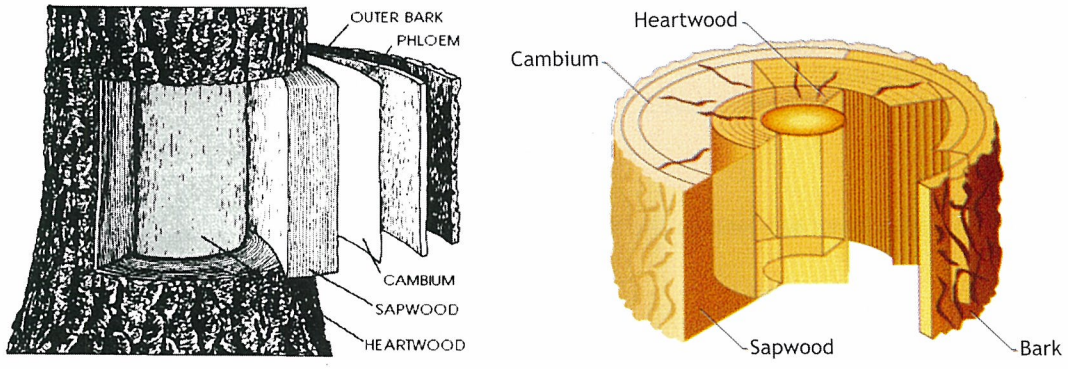
2. Introduction to wood

2.1 Sources of wood

Wood comes from trees, shrubs and lianas. Wood consists of tiny cells that generally cannot be seen without the use of a magnifying glass or microscope. At the micro-level, wood is basically made up of organic and chemical compounds. The organic compounds are cellulose, lignin, ash-forming minerals and extractives while the chemical compounds are carbon, hydrogen and oxygen.

The proportion of these components and differences in cellular structures are responsible for the differences between species. In fact even in the same tree, one may find differences in wood taken from different vertical positions in the tree; we also know that the youngest (most recently formed) wood is nearer the bark and is generally lighter in colour than the older timber nearer the centre of the bole of the tree. Some woods are heavier, some lighter, some stiffer, and more flexible, some harder, some softer and some easier to work with than others. Some have resins, oils, waxes, or salt crystals. Trees of course stay at one site during their development; consequently they endure a variety of environmental impacts including the mechanical effects of strong winds and physiological effects due water scarcity or flooding, that in turn lead to various internal stresses and other modifications such as the deposition of various chemical substances at the cellular level. It is these differences that make woods unique. Figure 1 shows two sections of a tree trunk, revealing the source and developmental stages of wood.

Figure 1: Bole sections showing the basic plant tissues used as wood



2.2 Wood anatomy

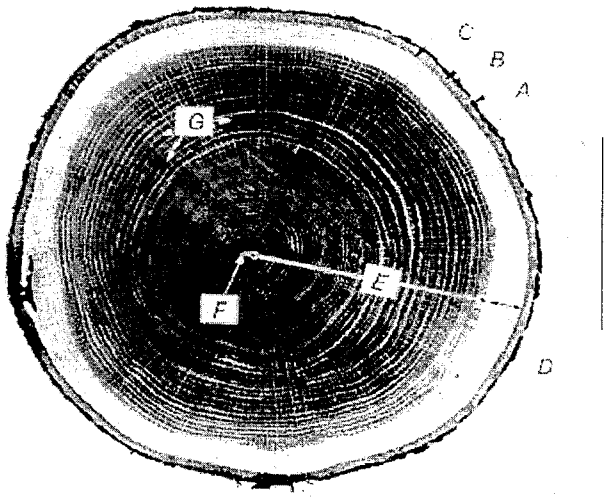
Bark, Wood, Branches and Cambium

A cross section of a tree, see Figure 2, shows the following well defined features from the circumference to the centre of the bole:

- Bark-consists of a dead outer corky layer of dead cells and a thin inner layer of live cells which conduct nutrients from leaves to other parts of the plant;
- Wood -in juvenile and mature trees is generally clearly differentiated into sapwood and heartwood;
- Pith -a small core of tissue at the very centre of the stem;
- Wood rays -horizontally oriented tissues through the radial plane of the tree (rays connect various layers of from pith to bark for the transfer and storage of food);
- Cambium -a layer of cells inside the inner bark which forms wood cells on the inside and bark cells on the outside.

Figure 2: Cross-section of a stem showing key tissues:

A-outer bark (dry dead tissue), B-inner bark (living tissue), C-cambium, D-sapwood, E-heartwood, F-pith, G-wood rays



As a tree grows in height, branching is initiated by lateral bud development. Lateral buds are inter-grown with the wood of the trunk as long as they are alive. After the branch dies, the trunk continues to increase in diameter and surrounds the portion of the branch projecting from the trunk when the branch died. If the dead branches drop from the tree, the dead stubs become overgrown and clear wood is formed.

Growth in thickness and bark is caused by cell division in the cambium; no growth in diameter takes place in wood outside the cambial zone; new growth is purely the addition and growth of new cells, not the further development of old ones.

Thus new wood is laid down on the outside of old wood and the diameter of the bole increases.

In most species, the existing bark is pushed outward by the formation of new bark, and the outer bark layers become stretched, cracked, wrinkled, or ridged and finally it sloughs off.

Sapwood, Heartwood and Extractives

Sapwood is located between the cambium and the heartwood. Sapwood contains both living and dead cells and functions mainly in the storage of food and transportation of water and sap. Sapwood varies in thickness from 4-6 cm in radial thickness. Generally tropical woods have thicker sapwood; for example, Locust (*Hymenea courbaril*) may have sapwood 8-15 cm or more in thickness. As a rule, the more vigorous the growth of the tree the more wide is the sapwood. All sapwood is susceptible to decay and rot by virtue of the starch and other nutrients it contains.

Heartwood consists of inactive cells that do not conduct water or store food. The transition from sapwood to heartwood is accompanied by an increase in extractive content which tends to darken the heartwood and give species such as Purpleheart (Peltogyne spp) their characteristic colour. Extractives could make heartwood resistant to fungi and insects, but all dark coloured heartwood is not resistant to decay. However no sapwood is resistant to decay. The main function of the heartwood is to provide central support for the tree.

Extractives refer to a large number of chemical substances (oils, resins, waxes, etc.) that occur in wood and are responsible for their colour, odour, taste and durability. Extractives deposited in the heartwood may also affect wood by:

- Reducing permeability, making the heartwood slower to dry and more difficult to impregnate with chemical preservatives.
- Increase the stability of the wood under changing moisture conditions.
- slightly increase the weight.

Wood cells

The cells that are the structural elements of wood tissue are of various sizes and shapes (see Figure 3) and are quite firmly cemented together. Dry wood cells may be empty or partly filled with deposits, such as gums and resins. The majority of wood cells are elongated and pointed at the ends and are commonly referred to as fibres. The length of fibres is highly variable within a tree and among species averaging about 1mm (softwood fibres range from 3 to 8mm).

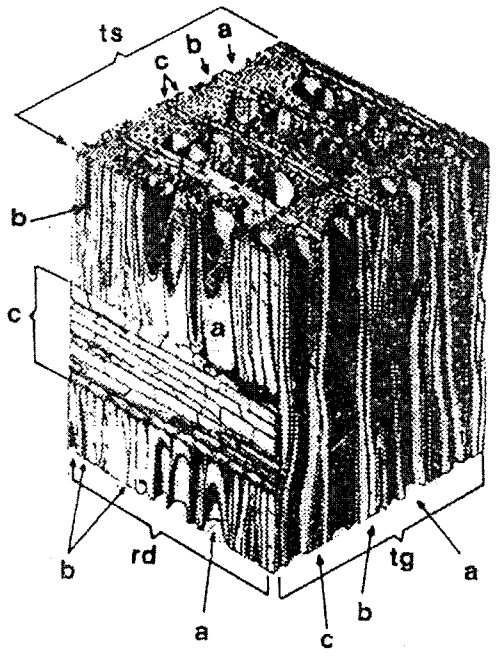
In addition to fibres, hardwoods have cells of large diameters known as vessels or pores which are the main conduits for the movement of sap. Rays are groups of cells that conduct sap radially across the grain of the wood between pith and bark.

Chemical components of wood

Dry wood is made up mostly of cellulose, lignin, hemi-cellulose and about 5 to 10% of other materials. Cellulose, the major component of wood constitutes approximately 50% of wood substance by weight. Hemi-cellulose is associated with cellulose and is important for fiber to fiber bonding and comprises about 20 to 35% of wood substance. Lignin constitutes 16 to 25% of (hard) wood substance. Lignin is the cementing agent that binds individual cells together.

Some organic materials in wood takes the form of extractives which contribute to such wood properties as colour, odour, taste, decay resistance, density, hygroscopicity, and flammability of wood. For example, Wallaba (Eperua spp) burn easily because of the resinous extractives in the wood. Extractives include colouring matter, oils, fats, resins, waxes, gums and other such substances. They are called extractives because they can be removed with solvents such as (warm) water and alcohol. Extractives constitute up to 25% of wood substance, depending on the species. The production of charcoal entails the elimination of extractives, hence the partial burning of wood.

Figure 3: Common tissues in wood observed from three different planes (Petrucci, 1987) [a-Vessels, b-fibres, c-rays rd -radial plane tg tangential plane , ts transverse plane]



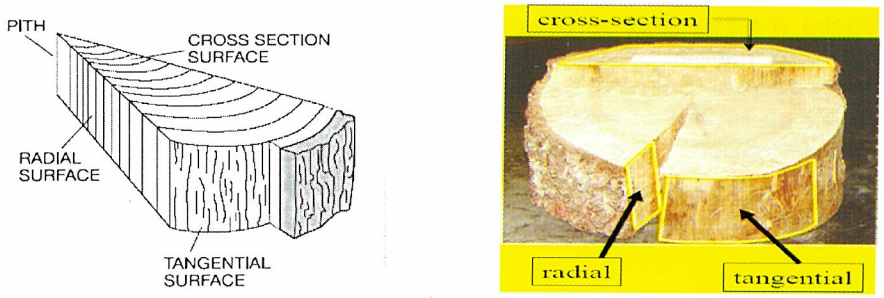
Other components in wood include inorganic materials (0.2 to 1% of wood substance) including elements such as calcium, potassium and magnesium. It is these materials that comprise ash when we burn wood.

2.3 Common features of wood

- ***Longitudinal, radial and tangential surfaces:*** The three surfaces of wood are important because wood structures appear very different depending on which surface is being viewed.

  Due to the way cells are formed in the tree, wood has three structural directions (see Figure 4). When you look at the end of a log the surface is the cross section or transverse section. If you then peel off the bark of a log what you see is the tangential section. If you cut out a pie-shape wedge you would expose the radial section as you cut towards the centre through the radius of the log. These surfaces are important when identifying the macroscopic characteristics of wood.

Figure 4: Bole sections showing the various surfaces of wood



• ***Colour*** - This is different between the kinds of wood and within species. The heartwood colour is important in wood identification. This is also important for the kind of uses that the species could to put.

• ***Texture*** - This is the variation in the amount and size of the wood elements. Coarse texture can result from the presence of wide bands of large vessels and broad rays. Fine texture results from the presence of small vessels and narrow rays.

• ***Density*** - this is the single most important indicator of the strength of wood and can be used to predict such characteristics as hardness, nailing resistance and ease of machining. Dense wood generally shrink and swell more than light woods. In addition, the densest wood makes the best fuel.

• ***Grain*** - This refers to the direction of alignment of wood elements such as fibres, parenchyma cells and vessels (see Figure 5). When all the elements are aligned longitudinally, the grain is said to be **straight grain**. When the elements are not align with the longitudinally axis, this result is **cross grain**. **Spiral grain** is referred to the spiral arrangement of the elements. The log or trunk with spiral grain has a twisted appearance after the bark is removed. Lumber with spiral grain is low in strength and stiffness and may tend to twist as it dries. If the orientation of the spiral is reversed at more or less regular intervals along a single stem, the grain is said to be **interlocked**. Species with interlock grains are difficult to split. Interlock grain is a desirable characteristic from an appearance standpoint.

Figure 5: Illustrations of examples of grain orientation

3. History of wood use in Guyana

Average standing volume of timber in local forests for all tree species vary from 116m^3/hectare to 312m^3/hectare while for commercially exploited species, the values vary from 6m^3/hectare in dry-evergreen forests to 134m^3/hectare in seasonal forests (NFAP, 1989).

Many of the buildings in Georgetown (the Law Courts for example) contain *Pinus spp.* leading to the conclusion that large volumes of the species were actually imported into Guyana during the colonial period. Historians believe that since 1669 the species Letterwood (*Piratinera guianensis*) was the first local species harvested on a commercial scale, while the trade in (hewn) Greenheart has been recorded since the early 1770.

Up until 1990, Greenheart and Wallaba have virtually dominated the local timber trade being together responsible for more than 60% of total timber production. From 1824 to 1980 the primary timber products remained the same (see section 4 below).

In June 1980, the Kissoon Group of Companies established a small ply-board mill at Coverden, East Bank Demerara, the first such mill in Guyana. In 1983, Nagasar Sawh Limited established a mechanical shingle making machine at Bartica, and in 1992, Barama Company Limited set up a factory to produce ply-board, mainly for export. The ply-board production was unique in that it set the stage for the utilization of a species previously little used, Baromalli (*Catostemma spp*). Meanwhile, there is still a large proportion of species that are not utilized (see section 4).

4. Key commercial species and their respective proportions

Production by species for the period 2005-2007 indicates that just six species contribute 51.1% of timber production:

Species	% *Production by volume 2005-2007*
Baromalli	14.8
Bulletwood	1.8
Crabwood	1.1
Greenheart	26.6
Mora	6.4
Wallaba	0.4
Other species	**48.9**

It is apparent that nearly half of the species in our forests are not exploited to any significant extent, although it is appreciated that species such as Wallaba and Greenheart not only occur in the very accessible parts of Guyana, but they also have a peculiar clumped distribution that makes it possible to obtain large volumes in a relatively small area.

5. Key wood products: primary, processed

The main primary timber products in Guyana are:

Primary products

- Logs
- Piles (greenheart, Kakaralli)
- Sawn Lumber
- Shingles
- Staves
- Wallaba Poles
- Wallaba Posts

Other products

- Furniture
- Pallets
- Artefacts
- Doors
- Decking
- Parquet flooring

6. Main markets for Guyana's timbers

The value of Guyana's timber exports in 2007 was US$61m. The key markets were:

- Asia (India, China, Vietnam)
- Caribbean
- EU
- UK
- USA
- New Zealand

Module 2: Common wood utilization practices:

Topics to be covered

1. Introduction
2. Wood as a construction material
3. Important properties of timber
4. Common wood utilization practices

Session Goal/learning Objective

- To understand the basic properties of timber as a raw material
- To review common considerations and practices employed in the use of wood

Competency objectives

By the end of the session, the trainees should be able to

- Describe the basic utilization parameters of timber
- Understand the need for certain utilization practices
- Appreciate that all wood could be used for some purpose once its properties are known

Training methods

Lecture (Power point presentation), questions and answers, examples and illustrations

Equipment & practical aids

Classroom
Chalkboard
Copy of Manual of 15 lesser used species
Specimen of local timber products (shingle, sawn lumber, ply-board, paling post, artefact/furniture)
Photographs of wooden structures

Assessment

None

1. Introduction

Wood has been used by mankind as long ago as man's history is recorded. If we consider all the natural materials mankind has utilized for his various uses, wood is probably the material first utilized. An entomologist discovered that wasps have been using wood for nest construction and this attests to the versatility of the material.

2. Wood as a construction material

Wood has several advantages as a construction material:

a) It may be obtained in large quantities at relatively low cost and since forest resources are renewable when properly managed, wood can be available as a raw material indefinitely;

b) Wood may be easily broken down into very small thin pieces very quickly and safely;

c) Wood may be worked with relatively simple tools and a piece of wood could be re-used many times;

d) Wood has a relatively low specific density and at the same time high mechanical resistance;

e) Wood allows for the use of several different kinds of connections or attachments;

f) Wood absorbs shocks and vibration that could rupture other materials;

g) Wood does not conduct heat;

h) Wood presents itself in a wide variety of colours, tones, grain and;

In relation to other construction materials, wood has some peculiarities:

a) Wood is heterogeneous (because it contains many different types of tissues that vary from juvenile to mature and the proportion of carbohydrate versus extractives);

b) Wood is anisotropic-it presents different properties depending on the plane (tangential, radial, longitudinal);considered;

c) Wood is flammable;

d) Wood is sensitive to ecological factors such as light and humidity. Wood is also subject to attack by beetles and termites in particular but also by a variety of fungi; and

e) The dimension of wood is limited by the form and dimensions of the bole.

These peculiarities are major challenges for wood technologists and engineers: Item c) can be remedied by impregnation with fire retardant substances; technologists impregnate wood with pesticides to prevent attacks by insects; and one reason for the popular use of plywood is to guarantee wooden panels with dimensions not possible from simply sawing logs.

When we communicate about any species, we need to make sure that everyone we speak to knows what we are talking about given the tendency for people even in the same region of a country to address trees by different names.

As we approach the use of any species of wood, especially those with which we are not familiar, we are curious about the occurrence and distribution of the species and a number of basic properties of the timber.

Once we have determined that a species is useful, we want to know how much of that species is available and in what sizes. One of the reasons why Greenheart and Wallaba are used so widely is due to the fact that they show clumped distribution and the trees grow to sizes that meet commercial requirements; for example for supporting transmission lines, Guyana Power and Light Inc may require poles with an average diameter of 20 cm at the smaller end of the pole (the tip) and a height of 18m. That is why, the manual on the use of the lesser used species commences with a 'tree description'.

3. Important properties of timber

- **Weight and Density**

The weight of wood depends on the density of species and the proportion of water within the wood.

The density of a species is probably the most important property of any timber since it is related to all the physical and mechanical properties that impact on the use of wood.

We use density to classify timbers. According to Binek (1973), timbers may be classified as follows:

i. Very heavy timbers≥1040kg/m^3 (65lbs/ft^3)
ii. Heavy: 880-1024 kg/m^3 (55-64lbs/ft^3)
iii. Medium/moderate: 720-864 kg/m^3 (45-54lbs/ft^3)
iv. Light: 560-704 kg/m^3 (560-704 lbs/ft^3).

Heavy timbers contain more mass per unit volume and are therefore stronger and can support more weight; heavy timbers are therefore used extensively in construction work.

Weight and density are also important in computing payloads for logging trucks and ships; for example a typical pay load of a large logging truck is 35m^3 which for fresh Darina logs translates into 42,350 kg and for fresh Tonka bean logs into 42,000 kg.

- **Moisture content and shrinkage**

The moisture content of wood is expressed, in percent, as the weight of water recedes in wood divided by the weight of dry wood substance. For example 10 kg board which contains 2kg of water would have a moisture content of [{2/ (10-2)}x100] 25%.

The engineering uses of wood, its resistance to biological and the dimensional stability are all affected by moisture content. All wood not in direct contact with water gains or loses moisture until the moisture content reaches a state of equilibrium with the relative humidity of the surrounding air-this state is referred to as the *equilibrium moisture content* (EMC). In the construction industry, kiln-dried lumber refers to wood with a moisture content ≤15%.

The loss of moisture from wood leads to dimensional changes in lumber and where the loss occurs too rapidly, degrade of the lumber is likely to occur.

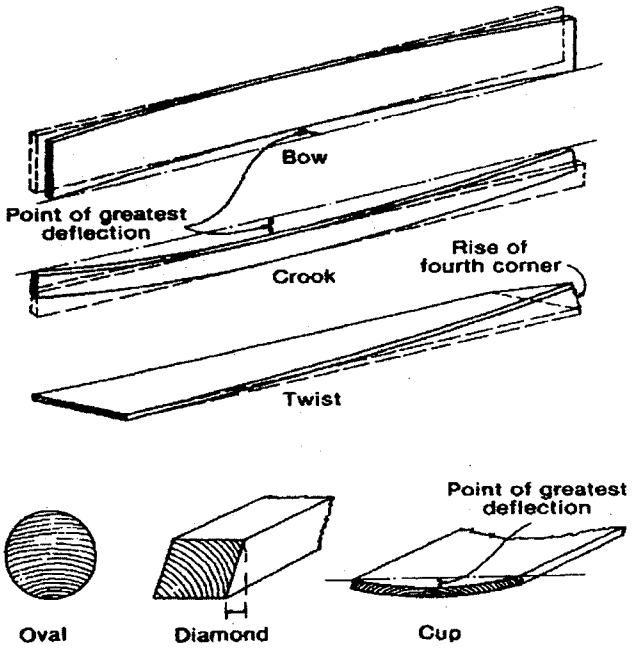
Wood exhibits different shrinkage rates in radial and tangential planes respectively. Shrinkage parallel to the annual growth rings (tangential shrinkage) is frequently nearly twice that of

shrinkage perpendicular to or across the annual rings. Rapid changes in moisture content could produce stresses which lead to distortion in the dimensions of the lumber (see Figure 6).

- **Decay resistance in wood**

Due to density and the nature of extractives in wood, some woods decay rapidly while some are very durable, lasting many years in use. Some woods work well indoors but not outdoors (where it is subject to sunlight and rain).

Figure 6: Examples of seasoning defects in timber (Bousquet, 2000)



4. Common wood utilization practices

4.1 Sawing logs

In a well managed timber harvesting operation, sound trees with good form are selected and felled and skidded to avoid the least damage possible. This ensures that logs of good quality are delivered to sawmills

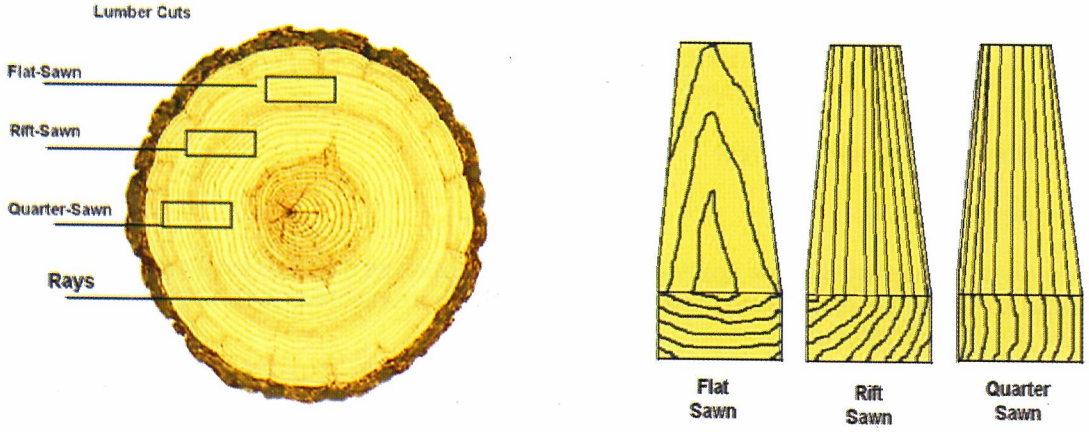
A sawmill's operation allows for log inputs at one end and dimensional lumber at the other end.

A sawmilling operation has several phases:

- **Decking** involves the sorting logs by species, size and end use;
- **Washing** removes sand and other particles from the log, minimizing damage to the saw blades;
- **Debarking** (if practiced) removes the bark from the logs;

- **Scanning:** a metal scanner (scanning may be used to detect metal in logs (hunters leave the occasional pellet in trees when they miss game);
- **Breaking down**-the head saw, head rig or primary saw breaks the log into cants;
- **Edging** removes or trims irregular edges, leaving four-sided lumber;
- **Trimming** (with cross-cut saws) squares the ends at specified lumber lengths;
- **Seasoning** (drying) removes moisture from wet lumber;
- **Planing** smoothes the surface of the lumber leaving a uniform width and thickness;
- **Moulding** adds a profile to lumber (for example groove and tongue);

The desire to add value to logs may result in the sawmiller taking a great deal of care in the way the breakdown of the logs occurs (see Figure 7).



Not all logs are sawn; for example some may be used to produce ply-board or crushed to produce particle board (see Figure 8)

Figure 8: Specimen of a veneer produced by a rotary peeler

Wood is basically packages of fibres and these fibres could be reorganized to produce paper or various kinds of fibre boards and composite panels made from a mixture wood fibre and other materials.

4.2 Seasoning timber

In the use of wood, moisture conditions are managed to prevent shrinkage or stresses that could damage structures, mechanically and aesthetically. For products such as panel doors, windows and parquet flooring for example, it is very important to season lumber.

The reasons for using well seasoned lumber include:

- *Minimizing changes in dimension*: dimensional changes in well seasoned wood are frequently not perceptible
- *Improving strength properties*:
- *Prevent stain and decay*: apart from dry wood termites and some beetles, other organisms are unlikely to attack wood at moisture contents less than 20%.
- *Prepare timber for further treatment* including

i. The use of glues
   ii. Treatment with preservatives
   iii. Treatment with fire retardants
   iv. Treatment with paints and varnishes

- *Reducing wood/product weight*

4.3 Preserving timber

Wood left untreated in many outdoor applications becomes subject to degradation by a variety of natural causes. Wood preservatives applied at recommended retention rates achieve satisfactory penetration and increase the life of wood structures.

There is some concern over the environmental impacts of preservatives which leach into the natural environment through soil and water.

4.4 Processing peculiarities

Each species of timber has its own processing peculiarities. For example one may observe then that some species split easily, some are difficult to saw due to the presence of salt crystals that damage saw blades, and some have so much oil or resin that they do not take paint too well.

The bottom line is that we when we peruse the details on any species, we look for the main features cited above and explore mechanisms to manage whatever peculiarities we observe. What we are sure about is that all timbers may be used for some purpose or the other. For now, we have many choices, but we recognize that by using a larger number of species we could generate and sustain more value from our forests.

Module 3: Properties of eight lesser used species:

Species to be covered

1) Black Kakaralli
2) Burada
3) Dalli
4) Darina
5) Fukadi
6) Futui
7) Iteballi
8) Itikiboraballi

Session Goal/learning Objective

To elaborate the main characteristics of eight lesser used species

Competency objectives

At the end of the session, participants will have a working knowledge of the fifteen species and their peculiarities.

Training methods

Lectures (power point presentation) and practical demonstrations with wood samples; discussions

Equipment & practical aids:

- Classroom
- Chalkboard
- Copy of Manual of 15 lesser used species
- Specimen of local timber products (shingle, sawn lumber, ply-board, paling post, artefact/furniture)
- Photographs of wooden structures
- Audio-visual equipment

Introduction

Four aspects of the species are presented here: a notion of its abundance a description of the timber, its density and its common uses.

1. Black Kakaralli *Eschweilera spp.* Lecythidaceae

A tree about 25m tall with heavy oval crowns; unbuttressed or slightly buttressed; bole form moderately good, 12-16m long and diameter 0.3-0.6m. It is frequent to abundant in Rain and Seasonal forest, but enjoys general distribution.

Wood light to dark brown, occasionally black streaked; cold to touch; texture fine; grain straight; very hard and compact; very tough and strong; contains appreciable amount of silica; highly resistant to decay and Teredo; difficult to work, but finishes smoothly and polishes well, dulls tools very quickly, splits easily.

Density at 12% moisture content: 1070kg/m^3.

Used locally for piling; suitable for house framing, posts and sleepers.

2. Burada *Parinari spp.* Chrysobalanaceae

A tree up to 40m tall with plank buttressed to 5m high; the bole reaches a height of 15m and a diameter of 0.45m to 0.70m. Occasional to locally common in Rain and Seasonal forest on sands and loams especially in Mahaicony-Berbice area; occasional in Marsh and Mora forest (*P. campestris*). Generally distributed.

Wood yellowish-pinkish-brown, heavily charged with silica, close textured; straight grained; very hard, brittle; moderately resistant to decay; difficult to work, dulls tools quickly, turns poorly, but finishes smoothly.

Density at 12% moisture content: 890kg/m^3.

Useful for marine applications, house framing, bridging and sleepers.

3. Dalli *Virola surinamensis* (Rolander) Warb Myristicaceae

A tree reaching a height of 35m with flat or square crown; horizontal branching; with spreading plank buttresses to 5m high; occasionally stilt rooted; the bole length reaches 20m and the diameter is 0.4-0.6m. It is frequent to locally common in Riparian, Mora and Marsh forest throughout Guyana.

Wood pale cream with brown flecks; medium texture; straight grained; perishable; works easily without splitting absorbs glue well, can be stained, varnished and polished, with good results; does not warp or check in drying.

Density at 12% moisture content: 560kg/m^3.

Used locally for match boxes, coffins, and inside boarding. Suitable for general carpentry, packing cases, plywood, slack cooperage chip board and concrete shuttering.

4. Darina *Hymenolobium spp.* Fabaceae

A tall tree, commonly reaching heights of 35m, with cylindrical bole and bole height of up to 24m and diameter of 0.3-0.65; the species is found mostly in mixed forests.

The heartwood is dark yellow brown to light brown while the sapwood is light cream to light brown. The wood has straight to interlocked grain, coarse textured.

Density at 12% moisture content: 750kg/m^3

The species has been used for heavy construction, panelling, turnery, boxes and crates, furniture components.

5. Fukadi *Terminalia sp.* Combretaceae

Bole form moderately good, buttressed to 2m high, and sometimes fluted higher; tree height up to 45m; length of bole 18-21m; diameter; *T dichotoma* is frequent in Riparian, Mora; and Marsh forests; *T. amazonia* in Seasonal and Wallaba forests; occasional in Rain, and Mora forest; generally distributed.

Heartwood yellowish to golden brown to brown; lustre high; texture medium, grain roey; moderately hard; not very easy to work, finishes moderately well.

Density at (12% mc): 950kg/m^3

Suitable for house framing, flooring, constructional work, railway sleepers, and plywood.

6. Futui *Jacaranda copaia Bignoniaceae*

Tree with light, open, flat, rounded crown; unbuttressed, basally swollen, tapering and reaching a height of 20-30m; the bole reaches a height of 18-24m with a diameter of 0.3-0.8.The species is frequent to locally common in secondary forest on sandy soils; occasional to frequent in Rain and Seasonal forest throughout Guyana.

Wood oatmeal to dingy white in colour; somewhat lustrous, texture medium to coarse, uniform; straight grain; soft, perishable; easily worked but saws woolly when fresh, finishes smoothly; holds nails well.

Density at 12% moisture content: 430kg/m^3.

Used locally for coffins, box shooks, matches, concrete shuttering, and interior construction. Suitable for plywood.

7. Iteballi *Vochysia spp.* Vochysiaceae

Heavy crowned trees with poor to good stem form with tree heights of around 35m; bole height varies from 21-24m and diameters from 0.3-0.65m; *V. surinamensis* occurs in small reefs in Seasonal forest on light coloured sands east of the Essequibo River; *V. tetraphylla* frequent to common in Mora and Riparian forest; general distribution.

Wood pinkish, lustre high, strong in proportion to weight, texture medium, grain somewhat roey, non-resistant to decay; easily worked finishing attractively; very high moisture content when green; liable to collapse in seasoning.

Density at 12% moisture content: 600kg/m^3

The species is used locally for canoes and interior work; suitable for general carpentry and furniture.

8. Itikiboraballi *Swartzia spp.* Fabaceae

This is a small crowned canopy tree with height varying from 27-34m, with low buttressed or unbuttressed bole and bole height of 15-18m and diameter of 0.3-0.6m. The species occurs in Wallaba and Rain forest.

Wood purple-brown or pale reddish-purple, very fine textured, straight grained, hard, strong, compact, brittle, highly resistant to decay; works well but hard, finishes smoothly, polishes well, turns well, takes nails badly.

Density at 12% moisture content: 890kg/m^3.

Useful for inlay, turnery, cabinet work, walking sticks, and tool handles.

Module 4: Properties of seven LUS:

Topics to be covered

Species:

1) Kurokai
2) Limonaballi
3) Morabukea
4) Muniridan
5) Suya
6) Tonka Bean
7) Wadara

Session Goal/learning Objective

To elaborate the main characteristics of seven lesser used species

Competency objectives

At the end of the session, participants will have a working knowledge of the seven species and their peculiarities.

Training methods

Lectures (power point presentation) and practical demonstrations with wood samples; discussions

Equipment & practical aids:

- Classroom
- Chalkboard
- Copy of Manual of 15 lesser used species
- Specimen of local timber products (shingle, sawn lumber, ply-board, paling post, artefact/furniture)
- Photographs of wooden structures
- Audio-visual equipment

9. Kurokai *Protium decandrum* Burseraceae

Trees of height 15-25m with heavy rounded crowns and flange-buttressed to 1m high; a white aromatic resin is present in all parts; the bole has a height of up to 18m and a diameter of 0.35-0.70m; occasionally, the bole is fluted. The species occurs frequently in Marsh forest and most types of dense forests.

Wood medium hard, pinkish-brown, lustrous, texture uniform, fairly fine; grain straight; works easily with all tools except saw sawing fresh hampered by the resin; finishes very smoothly.

Density at 12% moisture content 640kg/m^3.

Suitable for masts and spars, house framing and plywood.

10. Limonaballi *Chrysophyllum pomiferum* Sapotaceae

A canopy tree with heavy rounded crown and low buttresses; tree height up to 40m, bole height up to 24 m, diameter 0.6-0.9m; occasional to frequent in Rain forest on heavy soils; general distribution.

Wood yellowish brown; texture fairly fine; grain straight to roey; hard and strong; slightly resistant to decay; works reasonably and finishes fairly smoothly.
Density at 12% moisture content: 950km/m^3.

Suitable for fuel and possibly heavy construction.

11. Morabukea *Mora gonggrijpii* Caesalpiniaceae

Canopy tree of around 45 m in height with heavy, rounded crown; buttressed to 2m high; the bole is cylindrical with a height of up to 24m and a diameter of 0.4 -0.8m. It is the dominant species in Morabukea forest, usually on slopes on heavy soils; occasional in other types of Rain forest; mostly in the near interior, rare in North West District.

The wood is reddish-brown, with a slightly bitter taste; texture medium; grain straight to very irregular; very hard and tough, highly durable. Works hard but well, takes a high polish.

Density at 12% moisture content 1030kg/m^3.

Used for heavy construction, sleepers, flooring and siding, heavy furniture, boat timbers, truck bodies; as good as or better than Mora.

12. Muniridan *Qualea rosea* (Aublet) Monimiaceae

A tree of about 45m, with straight boles with height of up to 25m, and light to heavily buttressed; its diameter varies from 0.6-1.0m.

The species is distributed right across the Guianas, Venezuela, Brazil & Suriname and is found primarily in the Pakaraima Districts.

The heartwood is pink to red brown, occasionally olive brown while the sapwood has pale yellow to light brown colour.
The density at 12% moisture content is 630kg/m^3.

The species is used interior and exterior joinery, mill work, flooring, furniture, veneer and plywood.

13. Suya *Pouteria speciosa* (Ducke) Baehni Sapotaceae

A heavy crowned tree 35m high, unbuttressed, cylindrical, little taper; the bole normally reaches 20m with diameter of 0.4-0.6m high; the species occurs in small reefs in dense forests, rocky hills, or seasonal forest on light coloured sands in the East and North East Districts, West to Mazaruni River and also the Rupununi District

Wood pinkish-cream, occasionally pale purple flushed; moderately fine textured; straight grained; moderately firm and strong, non-resistant to decay. Works easily to a smooth finish with all tools.

Density at 12% moisture content: 710kg/m^3.

Used locally for interior boarding and carpentry; suitable for plywood.

14. Tonka Bean *Dipteryx odorata* Fabaceae

A tree of height 30-48m with a heavy rounded crown, unbuttressed; bole 18-24m long, cylindrical with broad buttresses and with diameter 0.3-0.75m. The species enjoys general distribution across Guyana.

Wood variegated red-brown, banded with yellow-brown, bright, oily; texture medium fine; grain irregular; extremely hard and strong, very tough, very durable; moderately difficult to work but takes a high polish. Density at 12% moisture content: 1070kg/m^3.

Useful for heavy carpentry, cogs and shafts; fishing rods.

15. Wadara *Couratari spp.* Lecythidaceae

Tall, predominant trees with large spreading crowns reach a height of 50m; plank buttressed to 2.5m high; good bole form with bole length up to 30m; diameter 0.60-0.85m; occasional in Rain and Riparian forest throughout the country.

Wood creamy, sometimes pink tinged, lustre medium, medium texture; straight or roey grain; firm, tough, strong non-resistant to decay; easy to work, finishes fairly smoothly.

Density at 12% moisture content: 620 kg/m^3.

The species is suitable for interior work, packing cases, wheelwright work and plywood.

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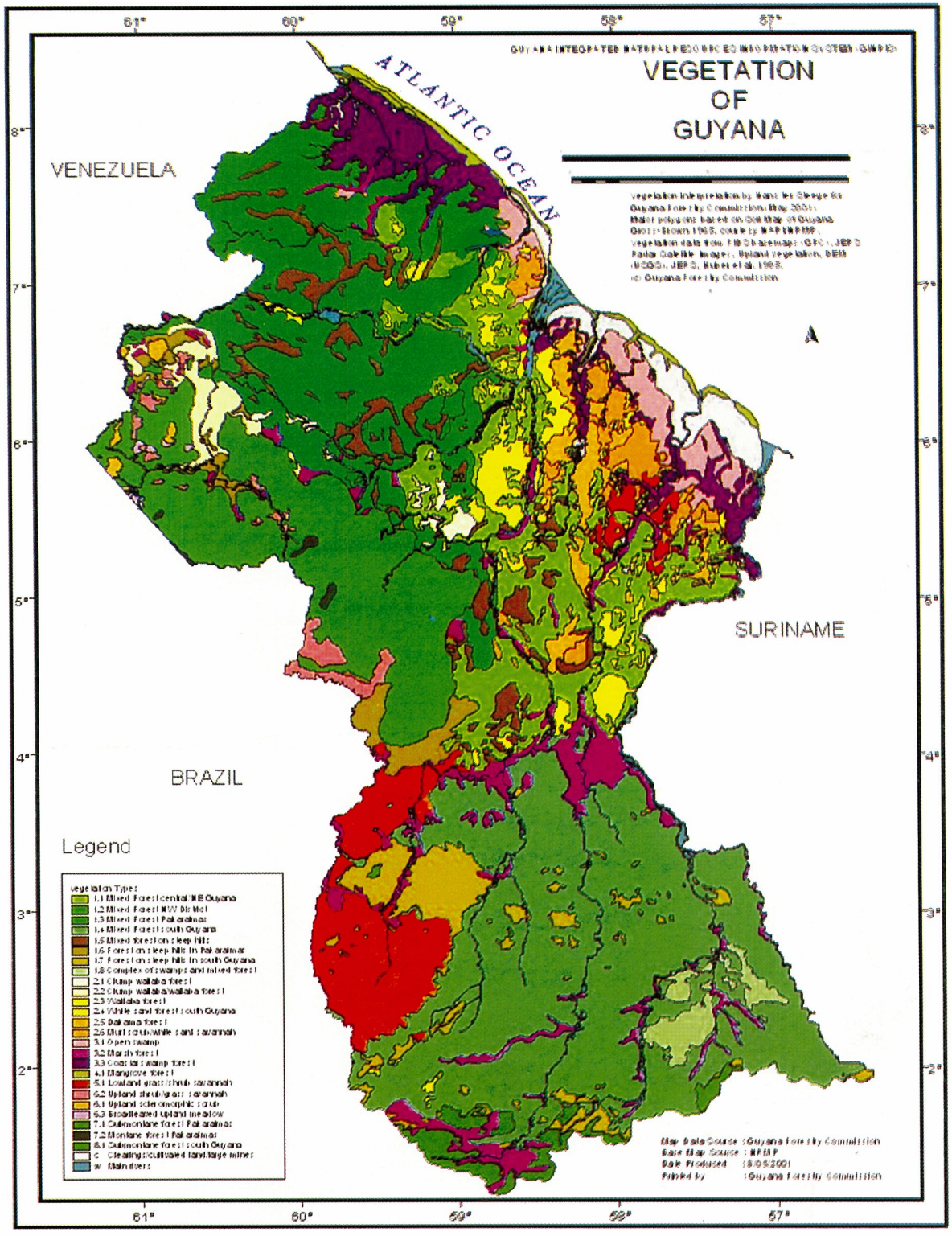
Annex 1: Indicative Vegetation Map of Guyana



Annex 11: Illustrations of some local woods

Annex 111: Illustrations of Products made from local woods