NON-WOOD FOREST PRODUCTS

10/Rev.1

Tropical palms

2010 revision

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CONTENTS

TABLES

FIGURES

FOREWORD

Tropical palms, originally published in 1998, has been updated in 2010 by the author to include the most recent information and developments regarding the conservation status and use of various tropical palm species. The deteriorating conservation status of several tropical palm species, particularly in the rattan group, as well as recent developments regarding the use of palm products in the food, bioenergy and fibre processing industries, for example, required a thorough review of the first edition.

For the reader's comfort, as well as to make it easy to identify where updates took place, the revised edition follows the same format and chapter sequence as in the original publication, including by following as much as possible the same order of tables, graphs and illustrations and by adding new ones where applicable.

Palms are among the most common plants in tropical countries, where they often dominate the rural landscape. An example is the massive expansion of industrial oil-palm plantations for food or bioenergy in the past 10 years in Southeast Asian countries.

Palms belong to the Arecaceae family, which comprises some 2 450 species, distributed mainly throughout the tropics and subtropics. The palm family is highly variable and exhibits a tremendous morphological diversity. Palms are found in a wide range of tropical and subtropical ecological zones, but they are most common in the understorey of tropical humid forests.

Since ancient times, humankind has derived an impressive assortment of products from palms for food, construction, fibre and fuel. Given their frequent occurrence in tropical forests and the vast array of products derived from them, increased attention to the conservation or re-introduction of palms is warranted in the design and implementation of forest management or reforestation plans.

ACKNOWLEDGEMENTS

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This report derives its basic information on the conservation status of palms from the plants database of the United Nations Environment Programme/World Conservation Monitoring Centre, Cambridge, U.K. The assistance of Harriet Gillett of UNEP/WCMC is gratefully acknowledged. The preparation of this report also draws upon data collected by the World Conservation Union/Species Survival Commission (IUCN/SSC) Palm Specialist Group in the course of preparing an action plan on palm conservation and sustained utilization.

Thanks go to Ms Susy Tafuro for the formatting and layout.

1 INTRODUCTION

Palms are monocots, included in the section of Angiosperms characterized by bearing a single seed leaf. Scientifically, palms are classified as belonging to the family Palmae (the alternative name is Arecaceae), are perennial and distinguished by having woody stems.

According to Dransfield[1] *et al* (2008), the palm family consists of five subfamilies, each representing a major line of evolution. The Calamoideae is the subfamily with the most unspecialized characters. It is followed by the, Nypoideae, Coryphoideae, Ceroxyloideae and Arecoideae; subfamilies; the last exhibiting the greatest number of specialized characters. The foregoing names are based on the genus originally thought to be most characteristic of each subfamily, all of which have species of economic importance. These are: the rattan palm (*Calamus*), nipa palm (*Nypa*), talipot palm (*Corypha*), Andean wax palm (*Ceroxylon*) and betel nut palm (*Areca*).

About 183 palm genera are currently recognized. The number of palm species is much less precise because of conflicting concepts by palm taxonomists as to what constitutes a distinct species, and the need to revise a number of genera. According to Govaerts and Dransfield (2005), incorporating on-line updates (www.kew.org/monocotchecklist/) there are about 2,450 palm species.

Natural history information on the palm family can be found in Corner (1966). Palm anatomy and structural biology have been the subjects of studies by Tomlinson (1961; 1990). Palm horticulture is treated in detail by Broschat and Meerow (2000). Illustrated books which provide general information on the more common palms of the world include McCurrach (1960), Langlois (1976), Blombery and Rodd (1982), Lötschert (1985), Del Cañizo (1991), Stewart (1994), Jones (1995), Riffle and Craft (2003) and Squire (2007).

Growth Habit

The stem or trunk is a principal means of describing and identifying palms. There are five basic stem types: solitary, clustering, aerial branching, subterranean branching and climbing. The first two types are not mutually exclusive; in some instances the same species may exhibit either a solitary or clustering habit.

Solitary palms. (Figure 1-1, C). The single-stemmed growth habit is very common and is characteristic of many of the palms cultivated for ornamental and economic purposes. Great variability exists in both the height and diameter of solitary palms. At one extreme is the ornamental potato-chip palm (*Chamaedorea tuerckheimii*) which has a stem no larger than the shaft of a pencil and may reach a height of only 30 cm. At the other extreme are the Chilean wine palm (*Jubaea chilensis*) with a stem diameter up to 2 m and the Andean wax palm (*Ceroxylon alpinum*) which may reach a height of 60 m. The economic disadvantage of solitary palms is that they must be propagated by seed and are vulnerable to fatal damage to the single growing tip.

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1 *Genera Palmarum,* revised edition 2008, is the best source of scientific information about the palm family to the generic level. It also defines technical terms associated with describing palms and provides illustrative line drawings and photographs. However, it contains little in the way of detailed information about individual palm species.

Clustering palms. (Fig. 1-1, B). Multiple-stemmed palms are also quite common. From a common root system, the palm produces suckers (basal offshoots) at or below ground level; the suckers growing to maturity and replacing the oldest stems as they die. Clustering palms may be sparse or dense; in the latter they may form thickets. Numerous examples of clustering palms are found among the popular ornamental species of the genus *Chamaedorea*; another is the date palm (*Phoenix dactylifera*). However, the date palm, in formal cultivation, typically has its suckers removed giving it the appearance of a solitary palm. Many clustering palms can be propagated by separating and transplanting young suckers, making them easier to cultivate.

Aerial branching palms. (Fig. 1-1, A). Aerial branching in palms is unusual and only found naturally in species of the genera *Hyphaene* and *Dypsis*, as well as in the rattan genera *Korthalsia* and *Laccosperma*. Branching occurs by equal forking (dichotomous branching) at the growth point and, in *Hyphaene compressa*, may occur as many as five times. Because of sublethal damage to the growing point by insects or a physical force such as lightning, aerial branching can occur abnormally in solitary palms. Examples of this are found in the coconut (*Cocos nucifera*) and palmyra (*Borassus flabellifer*). No technique has yet been devised to induce abnormal aerial branching for economic purposes.

Subterranean branching palms. (Fig. 1-1, D). Subterranean branching occurs by at least two processes. Nipa palm (*Nypa fruticans*) is an example of dichotomous branching; the salak palm (*Salacca zalacca*) is representative of lateral branching and is similar to the type of branching which takes place in dicots with branches developing from the growth of lateral meristems. Palms producing subterranean branches by either process can be vegetatively propagated by separating and transplanting individual branches.

Climbing palms. (Fig. 1-2). Over 500 species of palms in some 14 genera have a climbing growth habit. Most noteworthy is the genus *Calamus*--the largest genus in the palm family with approximately 374 described species--source of nearly all commercial rattan. The majority of climbing palms are also clumping palms, sending out new shoots from the root system.

Initially erect, the slender stems seek out trees for support and climb up into the forest canopy by means of recurved hooks and spines growing on the stem, leaves and inflorescences. In all climbing palms the leaves are pinnate and grow along the stem instead of forming a dense crown. The stems of climbing palms, more often referred to as canes, are solid in contrast to bamboo poles which are almost always hollow.

Leaves

Palm leaves are as variable as palm growth habits. In a forest setting, the leaves of palms are generally large and in many instances spectacular, making them a key aspect of identification. Palms typically bear their leaves, frequently referred to as fronds, in a crown at the top of the stem. Some exceptions to this leaf arrangement occur, such as in the ornamentally-popular lady palms (*Rhapis* spp.) which have leaves distributed along the upper stem. Among the acaulescent (stemless) palms, leaves may appear to be emerging from the root system but are in fact growing from the subterranean stem.

Four basic forms are characteristic of palm leaves: pinnate, palmate, bipinnate and entire

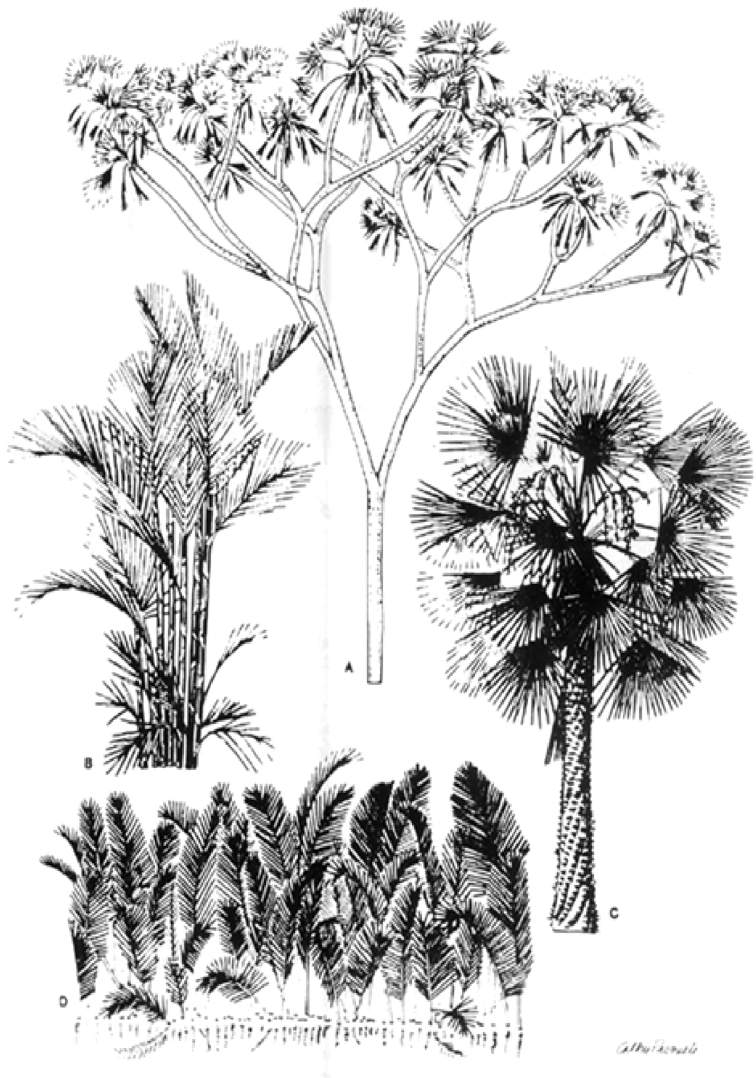

Figure 1-1 ***Palm Growth Habits I.*** *A.* ***An aerial branching palm, the doum palm (*****Hyphaene thebaica*****).*** *B.* ***A clustering palm, the sealing wax palm (*****Cyrtostachys renda*****).*** *C.* ***A solitary palm, the carnaúba wax palm (*****Copernicia prunifera*****).*** *D.* ***A subterranean branching palm, the nipa palm (*****Nypa fruticans*****).***

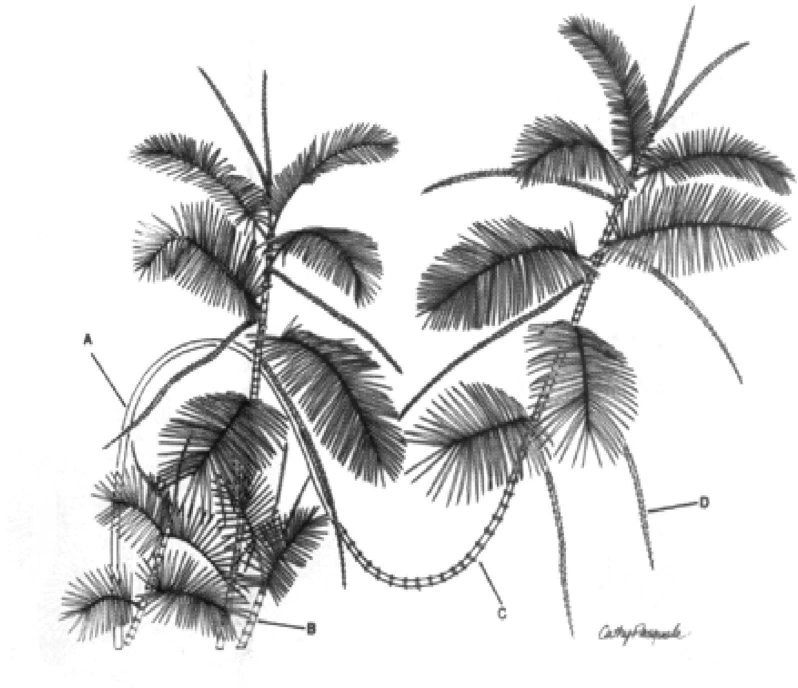

Figure 1-2 Palm Growth Habits II. A climbing palm, the rattan palm (*Calamus *sp.). A. Bare section of old stem. B. Young shoot. C. Spiny leaf sheath. D. Flagellum. Redrawn from Jones, 1995.

Pinnate leaves. (Fig. 1-3, D) Pinnate leaves are the most common type found in the palm family. They are divided into leaflets attached to a central leaf axis (the rachis) and often resemble a feather; hence palms bearing such foliage are often referred to as being feather-leaved or simply feather palms. Pinnate leaves exhibit an extreme size-range in the Palmae, varying from (including the petiole) well under 1 m in length in species of *Chamaedorea* to 25 m long in *Raphia regalis*. The latter is reputed to be a world record for the plant kingdom. All five major economic palms have pinnate leaves: coconut (*Cocos nucifera*), African oil palm (*Elaeis guineensis*), date (*Phoenix dactylifera*), betel nut palm (*Areca catechu*) and pejibaye (*Bactris gasipaes* var. *gasipaes*).

Palmate leaves. (Fig. 1-3, A) These are also known as fan-leaved or fan palms. Palmate leaves have extended leaf parts (lamina) which are circular or semi-circular, divided into segments and radiate out from the point where they are attached to the petiole. Laminae may be slightly divided to being divided nearly to the leaf base. In size, leaves may be not much larger than a human hand in the lady palms (*Rhapis* spp.), to a maximum of 5 m across such as in the talipot palm (*Corypha umbraculifera*). The most important economic palm with palmate leaves is the palmyra palm (*Borassus flabellifer*). A variation of the palmate leaf form occurs in some genera, such as *Sabal*. The midrib or costa is short and gives the leaf a somewhat V shape, described as "costapalmate."

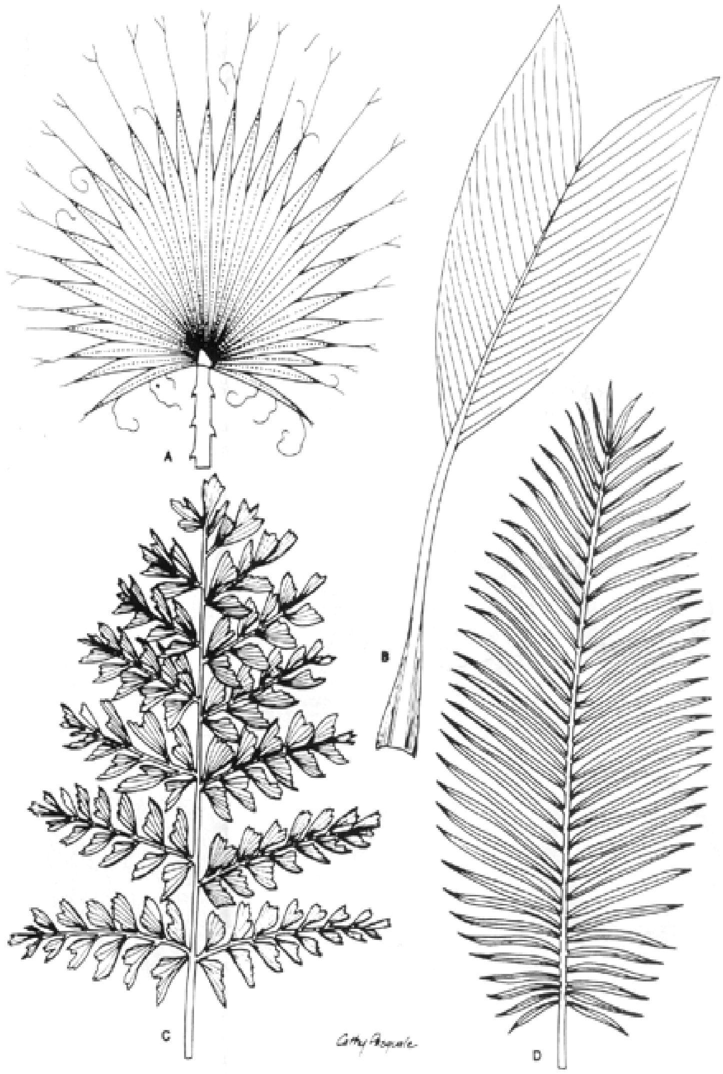

Figure 1-3 ***Palm Leaf Types. A. A palmate leaf, as in the Mexican fan palm (Washingtonia robusta). B. An entire leaf, as in the necklace palm (Chamaedorea geonomiformis). C. A bipinnate leaf, as in the fishtail palms (Caryota spp.). D. A pinnate leaf, as in the nipa palm (Nypa fruticans).***

Bipinnate leaves. (Fig. 1-3, C) Bipinnate means twice-divided and gives leaflets (pinnules) a resemblance to a fishtail. This leaf type is rare in the Palmae, apparently restricted to *Caryota* spp., the fishtail palms. Individual fronds are as much as 4 m long and 3 m wide, depending upon the species.

Entire leaves. (Fig. 1-3, B) Entire leaves have a basic structure that is similar to pinnate leaves except that they are simple and undivided. Only about five palm genera have species with entire leaves; the largest and most spectacular is the diamond-shaped leaf of *Johannesteijsmannia magnifica*.

Fruits

In the palm family as a whole, from as little as two years to 40 years or more are required before individual palm species reach maturity and begin to flower and produce fruit.

Examples of rapid sexual maturity are found among *Chamaedorea* spp., whereas the buri palm (*Corypha utan*) is one of the slowest to mature.
Figure 1-4 demonstrates the variability of fruits in the palm family. Illustrations A through F depict a representative fruit from each genus which gives its name to a palm subfamily. (Note that Fig. 1-4 represents the earlier division of the palm family into six subfamilies, before *Phytelephas* was reclassified as belonging to the Ceroxyloideae.) In terms of weight and size, palm seeds exhibit extreme differences. An individual seed of the popular ornamental parlor palm (*Chamaedorea elegans*) weighs only 0.23 g, as compared to the massive seed of the double coconut (*Lodoicea maldivica*) which weighs as much as 20 kg. The double coconut has the distinction of bearing the largest seed in the plant kingdom.

A cross-section of a palm fruit is provided in Figure 1-4, G. It serves to introduce the terminology associated with the different parts of the palm fruit to be employed in subsequent discussions.

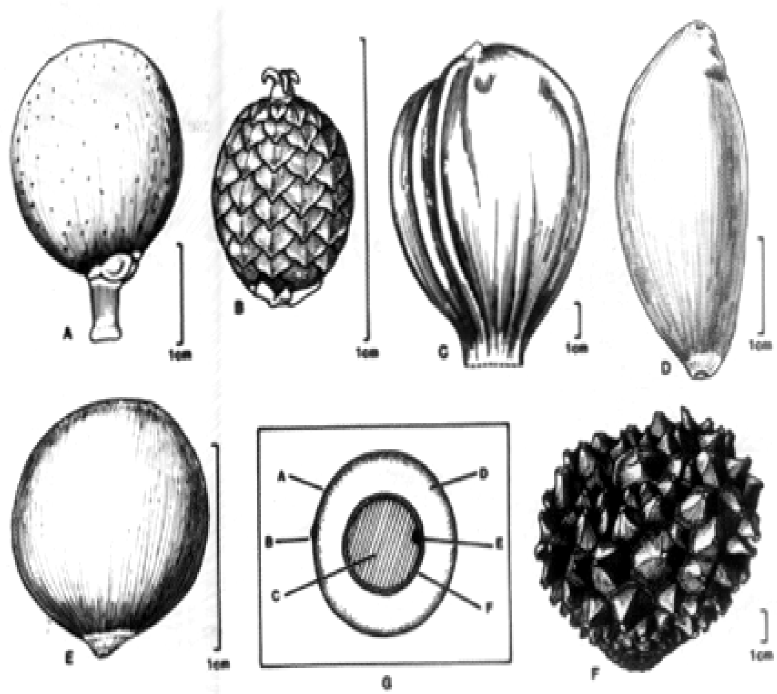

Figure 1-4 ***Palm Fruit Types.*** *A.* **Corypha,** ***Coryphoideae subfamily.*** *B.* **Calamus,** ***Calamoideae subfamily.*** *C.* **Nypa,** ***Nypoideae subfamily.*** *D.* **Ceroxylon,** ***Ceroxyloideae subfamily.*** *E.* **Areca,** ***Arecoideae subfamily.*** *F.* **Phytelephas,** ***Phytelephantoideae subfamily. G. A Palm Fruit in Cross-section. A. Epicarp. B. Hilum. C. Endosperm. D. Mesocarp. E. Embryo. F. Endocarp.***

Habitats

Geographically, palms can be found in habitats ranging from southern France where the European fan palm (*Chamaerops humilis*) naturally occurs at 44o north latitude, to Chatham Island, New Zealand, at 44o south latitude, where the shaving brush palm (*Rhopalostylis sapida*) is native. However, despite this impressive spread of latitude, the overwhelming majority of palm species are native to the tropical regions of the earth. Dowe (1992) estimated that only about 130 palm species occur naturally beyond the tropical latitudes (23.5o N. & S.).

Detailed data do not yet exist on a global basis as to the precise habitat of each palm species, and therefore it is somewhat difficult to discuss palms in terms of common habitat types. Nevertheless, on the basis of what we do know, palm habitats can be generalized into five types: forest habitats; montane habitats; grassland and scrubland habitats; desert habitats; and unusual soil-type habitats.

Forest habitats. Included here are both closed forest and open forest. Palms are predominantly forest species, as evidenced by two studies in South America. According to a habitat characterization of native Peruvian palms, 90 percent of the species occur in forests (Kahn and Moussa, 1994); across the continent in the Brazilian state of Espírito Santo, part of the Atlantic Forest, Fernandes (1993) did a similar study and found that 27 of the 30 native palms (90 percent) also were forest species.

Within tropical forests, individual palm species may be tall enough to be emergent and to form a part of the canopy or they may be understory species of short stature adapted to shady conditions. From the standpoint of forest degradation or destruction, it is the understory species which seldom survive, whereas some emergent species may appear actually to thrive as a result of disturbance.

The tropical forest habitat is not homogenous. Apart from the lands of adequate drainage, there are some areas subject to poor drainage or periodic flooding. Such areas are characterized by distinct vegetation associations with palms often playing a principal role. In South America, for example, the moriche palm (*Mauritia flexuosa*) forms extensive almost pure stands where conditions are swampy. To cite an example from Africa, the wine palm of West Africa, *Raphia hookeri*, is abundant in coastal freshwater swamps. And in Southeast Asia, the nipa palm (*Nypa fruticans*) forms dense stands in estuaries of brackish water.

Well-drained coastal areas forming a part of the tropical forest habitat likewise have some distinctive palm communities. The best example of this is the coconut palm (*Cocos nucifera*).

Montane habitats. Tropical montane habitats are generally defined as being above 1,000 m. Any combination of lower temperatures caused by altitude, extremely wet conditions due to clouds and complex topography creates unique ecological niches to which certain palm species have become adapted. The Andean wax palms (*Ceroxylon* spp.), for example, are found only in montane forests. In Africa, the Senegal date palm (*Phoenix reclinata*) occurs both in lowland and montane forests. The montane forests in Asia do not appear to have any palm genera unique to the habitat but do have numerous species of genera common in the lowlands, such as the rattans (*Calamus* spp.)

Grassland and scrubland habitats. There is less palm species diversity in grasslands and scrublands, but the palms that do occur may be present in fairly large populations. Examples are the carnaúba wax palm (*Copernicia prunifera*) of northeastern Brazil, the vegetable ivory palm of Africa (*Hyphaene petersiana*) and the palmyra palm (*Borassus flabellifer*) of Asia. In apparently all instances, palms in these habitats are found in association with some water source, e.g. stream valleys, perched water tables or the like.

Desert habitats. These dry habitats are generally defined as areas receiving less than 254 mm of annual rainfall and represent true desert. Palms in a desert habitat are often referred to as oasis palms. The occurrence of palms in such dry habitats may, in some cases, represent relict distributions from previous geologic periods of more favourable rainfall conditions. Examples of oasis palms are the date palm (*Phoenix dactylifera*), California fan palm (*Washingtonia filifera*) and the Central Australian cabbage palm (*Livistona mariae*).

Unusual soil-type habitats. Soils derived primarily from limestone can produce extremely basic soils which support a distinctive flora. The same is true of very acidic soils rich in heavy metals (chromium, iron, copper or manganese), which are often referred to as being ultrabasic or serpentinic soils. Certain palm species tolerate such extreme soil conditions. A number of palms in the Caribbean region are adapted to limey soils, such as the thatch palms (*Thrinax* spp.). In the Pacific island of New Caledonia, to cite another example, ten of the native palm species are found only on serpentinic soils.

False Palms

The term "palm," correctly-applied, refers to plants which are members of the Palmae, but by popular usage has also been applied to plants which resemble palms in some ways. At least seven plants have a common name which includes the word "palm," but which are not palms in the scientific sense. It is useful to clear up this confusion and dispense with the false palms as being beyond the scope of this study.

Traveler’s palm. (Fig. 1-5, A) *Ravenala madagascariensis*, Strelitziaceae family, is a woody tree with a palm-like stem. It is native to Madagascar and widely cultivated as an ornamental throughout the tropics. Individual leaves bear greater resemblance to a banana plant (to which it is related) than a palm; they are arranged in two distinct ranks in the same plane forming a fan-shaped head. Flowers of the traveler’s palm are similar to those of the bird-of-paradise plant. The vernacular name of the traveler’s palm is said to derive from the fact that the cup-like leaf bases hold water which travelers could drink.

Sago palm. (Fig. 1-5, B) Major confusion is associated with this common name because it refers to the true palm *Metroxylon sagu* as well as to the palm-like Asian cycad *Cycas revoluta*, in the family Cycadaceae. Both the stem (which is sometimes branching) and the terminal crown of pinnate leaves of *Cycas revoluta* are similar to those of a true palm. However, *Cycas revoluta* leaves are stiff and borne as a rosette not singly as in palms; the male inflorescence resembles a cone, a key identifying character. *Cycas revoluta* is the most widely cultivated cycad. Edible starch, "sago," can be extracted from the stem of both *Metroxylon sago* and *Cycas revoluta*, which explains the shared common name.

Palm lily or ti palm. (Fig. 1-5, C) The popular ornamental plants *Cordyline australis* and *C. terminalis* of the Laxmanniaceae and Liliaceae families, respectively, bear these common names. They are native to, respectively, New Zealand and East Asia. The branching habit gives the palm lily a resemblance to the branching palm *Hyphaene*, but has sword-like leaves crowded together at the end of the branches. These two species of *Cordyline* also resemble plants in the genus *Dracaena*, with which they are often confused.

Screw palm. (Fig. 1-5, D) This common name is applied to *Pandanus spiralis* and other species in the genus of the Pandanaceae family. Native to the Old World tropics, its morphology somewhat resembles the branching *Hyphaene* palm. The screw palm's sword-like leaves form tufted crowns and the tree bears large pineapple-like fruits. Where *Pandanus* spp. occur, leaves are widely used for weaving mats, baskets and so on.

Palm fern. This plant is indeed a fern and not a palm. Its scientific name is *Cyathea cunninghamii*, originating from New Zealand and Australia, and it is a member of the tree-fern family, Cyatheaceae. This tall, slender plant has a single stem and pinnate leaves somewhat resembling those of a true palm.

Palm grass. The specific name for this perennial Asian grass, *Setaria palmifolia*, is an indication that the entire leaves resemble those of certain palms. It is classified as belonging to the grass family, Poaceae/Gramineae.

Panama hat palm. This plant is a monocot like a palm but is a member of the Cyclanthaceae family and bears the binomial *Carludovica palmata*. With its palmate leaf, this stemless understory plant of the lowland forests of Central and South America is often mistaken for a true palm. The common name comes from the use of the fiber of young leaves to weave high-quality hats.

Bottle palm. In this case the name is applied to an actual palm (*Hyophorbe lagenicaulis*) and to a member of the Ruscaceae family, *Nolina recurvata*; both plants having a swollen base. The name "pony tail palm" also is sometimes given to *Nolina*, because of its foliage.

Objectives, Coverage and Format

The purpose of this report is to provide basic information about palms as non-timber forest products. The prospective audience includes forestry technicians, international development workers, policy makers and international conservation and development agencies. Guiding principles of this report are: 1) to identify and describe palm products; 2) to link the product to the palm species being exploited as well as to the conservation status of that species; 3) to give citations within the technical literature to more detailed sources of information if needed. Strictly ornamental use of palms is not considered in this report, except for a very few relevant references. Through the use of this report, it will be possible to assess the role palms and their products can play within integrated forestry, agriculture, conservation and natural resource management activities.

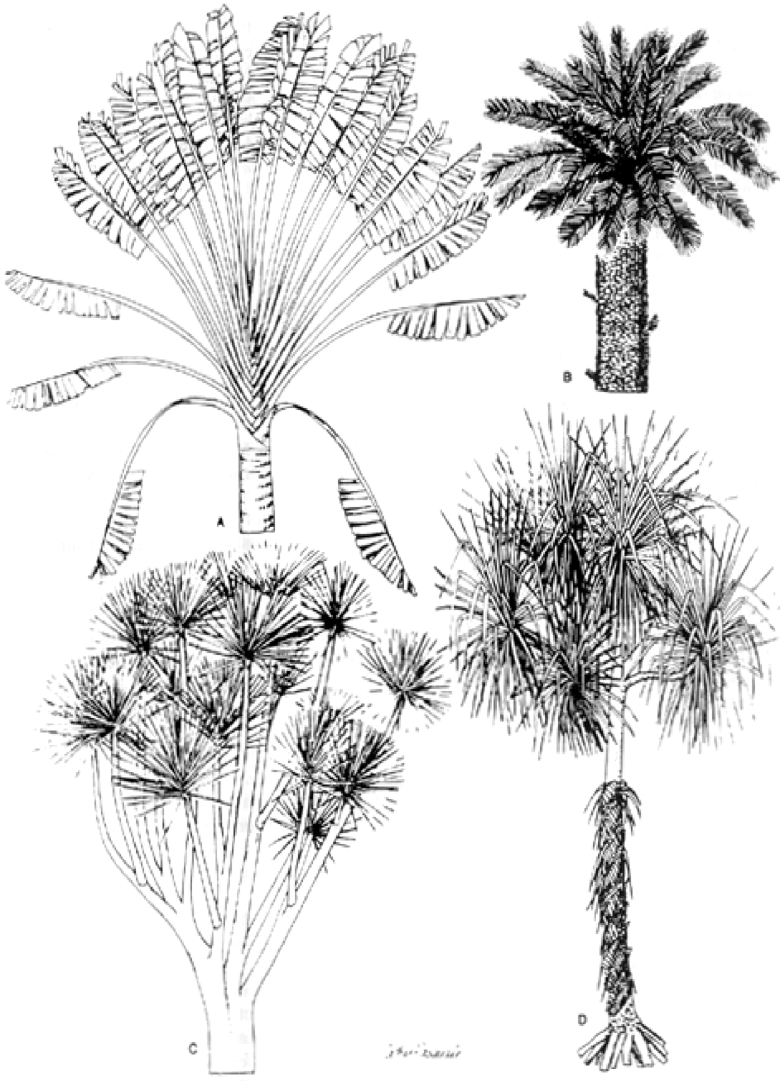

Figure 1-5 ***False Palms. A. The traveler's palm (*****Ravenala madagascariensis*****). B. The sago palm (*****Cycas revoluta*****). C. The palm lily or ti palm (*****Cordyline*** ***spp.). D. The screw palm (*****Pandanus spiralis*****).***

This report concentrates on the tropics where the great majority of palm species are to be found. In a few instances, where it seems practical, information is included on native palms which occur beyond the tropics. In as much as this report deals with forest products and the impacts of their exploitation, the focus is on native palms as they occur in the wild. Exotic palm species are of course present throughout the tropics, being grown casually as ornamental species or on plantations as in the case of major economic species. In a few instances, exotic palms have become naturalized and are able to grow on their own in their new habitat. Domesticated palms are discussed because of the examples they represent in terms of the ways in which their products have been used and developed. To achieve full coverage of palm products, palm stem wood is included in this report, despite the "non-wood" designation.

Three distinct parts constitute this report. Part one consists of the first three chapters. This first chapter provides a general introduction to palms as the diverse group of plants they represent. It is followed by an examination of the ways in which historically human societies have made use of palm products. Case studies of indigenous palm use and short summaries of the characteristics of the major domesticated palms are included. Chapter 3 focuses on contemporary palm products and provides a means to classify products and their processing requirements.

Part two provides regional examinations of utilized native palms in Asia, the Pacific, Latin America and Africa. The same general approach is used in Chapters 4-7: to consider native utilized species on the basis of their conservation status in the wild, either "threatened" or "non-threatened." Selected local palm names are included in the tables. Chapter 8 attempts a pantropical review of palm products and addresses the issue of which species have the most development potential and how a coordinated effort could be beneficial for sustainable palm utilization and development.

The final third of the report includes a section devoted to an assemblage of tables on the technical properties of palm products. Other sections consists of a lengthy list of cited references, a compilation of other palm information sources, a directory of palm specialists and a list of the most threatened palms in the world.

2 HISTORICAL ROLE OF PALMS IN HUMAN CULTURE

Pre-industrial indigenous people of the past as well as of the present have an intimate and direct relationship with the renewable natural resources of their environment. Prior to the Industrial Age, wild and cultivated plants and wild and domesticated animals provided all of the food and most of the material needs of particular groups of people. Looking back to those past times it is apparent that a few plant families played a prominent role as a source of edible and nonedible raw materials. For the entire world, three plant families stand out in terms of their past and present utility to humankind: the grass family (Gramineae), the legume family (Leguminosae) and the palm family (Palmae). If the geographic focus is narrowed to the tropical regions, the importance of the palm family is obvious.

The following discussion sets out to provide an overview of the economic importance of palms in earlier times. No single comprehensive study has yet been made of the historical role of palms in human culture, making this effort more difficult. A considerable amount of information on the subject is scattered in the anthropological and sociological literature as part of ethnographic treatments of culture groups throughout the tropics. Moreover, historical uses of products from individual palm species can be found in studies of major economic species such as the coconut or date palms. It should also be noted that in addition to being highly utilitarian, palms have a pivotal role in myth and ritual in certain cultures.

Three different but complementary approaches are taken to elucidate the historical role of palms in human culture. An initial approach is to look at ancient and traditional palm products, which deals mostly but not exclusively with subsistence palm uses. Next, case studies of indigenous groups and their particular array of palm uses are presented. Finally, the subject of palm domestication is addressed.

Ancient and Traditional Palm Products

The assortment of products that have been derived from palms at some time or another is indeed impressive. Although now somewhat dated, one of the best and concise summaries of palm usage can be found in Dahlgren (1944). Balick and Beck2[2] (1990), in their excellent bibliography, compiled a list of 388 keywords to describe palm products. The bibliography editors broke down these many products into a dozen major classes, as follows: beverages; building materials; chemicals and industrial products; cosmetics and hygiene; feeds; fertilizers; food; fuel; handicrafts; medicines and rituals; ornamental plants; and structure and shelter. Handicrafts represent the largest class with 162 products and is divided into nine subclasses.

As a means of demonstrating some of the oldest human palm uses, the foregoing product classes are followed and one or more individual examples cited within each class, except in the instance of handicrafts where subclasses are included. It is not the intention here to describe in detail the processing of particular palm products, but instead to give a historical perspective through examples that will aid in better understanding the current situation and the potential for palm product development, subjects to be dealt with in future chapters of this report. In choosing the examples presented below, preference was given, whenever possible,

[2] Useful Palms of the World: A Synoptic Bibliography, represents the most comprehensive single source of information on palm utilization. It provides abstracts of 1,039 publications.

to traditional products directly used by local populations. Selected bibliographic references are provided.

Beverages. Palm wine or toddy is an ancient beverage derived from the sap of a number of different palm species, and serves as an appropriate example of a beverage. The sap is obtained by tapping and collecting the liquid in a receptacle from the inflorescence of the tree employing sophisticated techniques that must have required considerable trial-and-error experimentation. Tapping the stem or felling the tree is also a means of obtaining sap that are much simpler. There is no difference in the quality of the sap obtained from the different methods. Because of the presence of naturally-occurring yeast, the sweet palm sap ferments within hours into a mild alcoholic beverage.

Palm tapping for beverage purposes is a pantropical practice, but has its greatest historical depth in Asia and Africa. In Asia, several palm species are traditional sources of palm wine; among them are the coconut (*Cocos nucifera*), the palmyra (*Borassus flabellifer*), the wild date (*Phoenix sylvestris*) and nipa (*Nypa fruticans*). Hamilton and Murphy (1988) describe tapping of nipa palm in Southeast Asia. The African continent has a long tradition of palm wine production, for example from the African oil palm (*Elaeis guineensis*), the doum palms (*Hyphaene* spp), and the raffia palms (*Raphia* spp.), as well as the Senegal date palm (*Phoenix reclinata*). Essiamah (1992) provides a description of palm wine production in West Africa from the African oil palm; Cunningham (1990a,b) reports on the tapping of *Hyphaene coriacea* and *Phoenix reclinata* in southeastern Africa. Tapping palms for the production of palm wine in Latin America and the Caribbean also has a long history, but the practice is uncommon today. Two examples of wine palms in South America are the moriche palm (*Mauritia flexuosa*) (Gumilla, 1963) and the Chilean wine palm (*Jubaea chilensis*) (Grau, 2006).

Building Materials. Within this class of products is one of the oldest and most ubiquitous palm products of all: thatch. Palm thatch is widely used for temporary and more permanent structures. The leaves of virtually all palms can be used for thatch, whether they are pinnate, palmate or entire in shape. This palm use is so widespread that there is almost no need to give examples of particular geographic areas or palm species. Bomhard (1964) provides a good summary of the various ways palms are utilized in building houses. An annotated bibliography of palm leaf and stem use was compiled by Killmann *et al*. (1989). Leaf sheath fiber may also be used for thatch. *Arenga pinnata*, for example, is a source of very durable thatch of this type, lasting 50 years or more (J. Dransfield, pers. com.)

Utilizing palm thatch is simple. Leaves are cut from the palm, generally selecting leaves that are younger and more flexible. Transported to the construction site, the leaves are attached individually to a roof frame in an overlapping fashion beginning at the lowest point. When a palm is exploited that has small leaves, the leaves may be attached to a stick in the form of a panel before being affixed to the roof. The small understory Amazonian palm *Lepidocaryum tenue* is used in this manner. A palm-thatched roof is light-weight and, if tightly made, remarkably waterproof. But at the same time it is porous, allowing air movement and the escape of cooking-fire smoke. A roof will last for a few years, the length of time depending upon the local climate and the type of palm leaf used.

Chemicals and Industrial Products. Clearly this class of products is modern. Nevertheless an original traditional palm product can be mentioned. Dragon's blood is the common name for the red resinous exudation which occurs on the scales of fruits of the Southeast Asian rattans *Daemonorops didymophylla, D. draco* and related species. (The original source of dragon's blood was Dracaena spp. in the Ruscaceae family). This resinous substance was a dye source for coloring cloth, woven mats and the like among indigenous peoples and in the 19th Century was adopted for industrial use in Europe as both a varnish and dye. In the traditional medicine of Southeast Asia, dragon's blood was used to treat stomach ailments, a use carried over into European medicine for a time (Burkill, 1966). Apparently dragon's blood continues to be of industrial use as a resin and is commercially available (Merlini and Nasini, 1976). Its therapeutic uses were studied by Gupta *et al*. (2008).

Cosmetics and Hygiene. Palm oils in general have a wide variety of household and industrial uses (see Hodge, 1975). An example within this product class can be cited from Madagascar where mesocarp oil of the raffia palm (*Raphia farinifera*) has been employed as a traditional hairdressing (Sadebeck, 1899).

Feeds. Cattle can be fed fresh young palm leaves if there is a shortage of better forage, as occurs in tropical areas subject to a protracted dry season. Leaves are cut and brought to the cattle and may or may not be chopped into smaller pieces to make them easier to consume. If the palms are of low enough stature, cattle and other livestock may forage on them directly. In Paraguay, leaves of the mbocaya palm (*Acrocomia aculeata*) provide forage (Markley, 1953). Palm fruits in general are eaten by swine.

Fertilizer. Traditional palm exploitation indirectly produces quantities of organic matter such as waste fruit parts, leaves and stalks suitable for incorporation into garden soil as fertilizer.
Food. This class of palm products represents the most important in economic terms since it includes the vegetable oils. Best known are the coconut (Cocos nucifera) and the African oil palm (Elaeis guineensis), both now commercially cultivated as sources of oil throughout the tropical realm. In addition, there are a number of Neotropical oil palms of lesser importance (see Balick, 1979a).

There are two types of oil derived from the palm fruit: mesocarp oil and endosperm (kernel) oil. Both types have a long history of pre-industrial utilization for culinary and other purposes throughout the tropics. The African oil palm is a good example because it is a source of both oil types; the mesocarp and the kernel each contain about 50 percent oil. In this palm, oil can be extracted from the fleshy mesocarp most easily. Fruits are fermented for a few days, pounded to remove the pulp which is boiled in water and the oil skimmed off. Mesocarp oil remains liquid at ambient temperatures in the tropics. Extraction of kernel oil requires crushing the kernels and mechanically pressing the resultant cake to express the oil.

Some lesser-known palm food items include: 1) eating young male inflorescences of the Central American pacaya palm (*Chamaedorea tepejilote*), Castillo Mont *et al*. (1994); 2) salt (potassium chloride) derived from burning palm leaves (Karlansky, 2002); 3) purple pollen from male flowers of *Eugeissona utilis*, used by the Penan of Borneo as a condiment (Kiew, 1977); 4) makapuno, a special type of coconut which has its shell filled with a soft, jelly-like endosperm, rather than coconut water and coconut meat. Makapuno endosperm has a unique flavor and in the Philippines is esteemed for use in sweet dishes and even ice cream (Ohler, 1984).

In recent years, the positive role of antioxidants (e.g. vitamins C and E) in human health has prompted reassessment of fresh fruits as dietary sources. Fruit of the açaí palm (*Euterpe oleracea*) of Brazil was found to be extraordinarily rich in antioxidants (Schauss, 2006). Açaí juice, as a result, has become a new product on the United States market. There are other fleshy palm fruits known to be rich in antioxidants including date palm (Rock *et al*., 2009), peach palm (*Bactris gasipaes var. gasipaes*) (Jatunov *et al*., 2009) and salak (*Salacca zalacca*) (Aralas *et* al., 2009). These new developments provide opportunities for promoting palm fruit commercialization.

Fuel. The simplest fuel usages of palms are exemplified by the burning of dry palm leaves, petioles, stem wood and fruit husks of some species such as the coconut. Often such fuels represent using by-products of the extraction of some other palm product. This palm use is ubiquitous.

Handicrafts. This class of palm products is exceedingly large and for that reason has been subdivided into nine subclasses.

Agricultural Implements. Climbing loops are traditional devices often made from palm leaf fiber, midribs or petioles. They are employed as an aid in climbing palms to harvest fruit, leaves or to tap the tree for sap; loops are, of course, used to climb trees other than palms for similar purposes. There are a number of different styles of climbing loops across the tropics. A type employed in West Africa is made from the petiole and leaf fiber of the African oil palm. It encircles both the tree trunk and the climber, permitting him to have his hands free to tap, in many cases, the same palm species which has provided materials for the climbing loop.

Clothing. The classic example of this palm use is a hat made from palm leaf material, a use found throughout the tropics. Young pinnate and palmate leaves of virtually any palm species serves for hat making. The weave may be coarse or fine depending upon how thin the leaflets are stripped and the amount of time invested by the artisan. Leaf fiber can also be woven into cloth and made into clothing. **Raphia** fiber is used extensively for this purpose in Madagascar even today (J. Dransfield, pers. com).

Furniture. Hammocks represent an article of furniture often made from fiber extracted from young palm leaves. In South America, the pinnate-leaf chambira palm (*Astrocaryum chambira*) is the preferred palm fiber source (Wheeler, 1970). The fiber is made into string and then woven into an open mesh hammock. The word *hammock* is Amerindian in origin and the weaving and use of hammocks appears to be restricted to the Neotropics as an ancient practice.

Coconut wood has many uses, including making furniture and building products (Weldy, 2002).

Games and Toys. A variety of simple objects for children to play with in the tropics are fashioned from palm leaves and petioles. Certain games involve palm products. In Southeast Asia, for example, hollow balls made of wound rattan strips are kicked in a game played by children and adults. Historically, in Sri Lanka, a variety of coconut was cultivated with an exceptionally thick shell (endocarp) for a game called "fighting coconuts." The game involves two competitors each clutching one of these special coconuts. The contest entails striking the coconuts together until one breaks, the holder of the intact nut being the winner.

Household Items. Sieves represent examples of ubiquitous household items made from palm fiber throughout the tropical regions. Thin strips of leaflets are woven in a square or diagonal pattern to produce a rectangular or round sieve. Wood sticks are often incorporated into the edge to prevent fraying and make the sieve easier to handle.

Jewelry. Among many cultural groups in the tropics necklaces traditionally are made by stringing small palm seeds. The hard endosperm of the Caroline ivory nut palm (*Metroxylon amicarum*), native to the Caroline Islands in the Pacific Ocean, is carved into beads and buttons. In Tropical America the tagua palm (*Phytelephas macrocarpa*) bears seeds with a hard endosperm which is fashioned into jewelry and other decorative objects; it is often referred to as "vegetable ivory."

A mythical palm product is appropriate to this heading: coconut pearls. Alleged to have been found inside coconuts, they have been touted for their rarity and even displayed in museums. However, despite a number of historical references to coconut pearls, no modern reports exist to support their validity. Analysis of some so-called coconut pearls has revealed that they are composed of calcium carbonate, which does not occur in any appreciable quantity in the coconut fruit (Child, 1974; Ohler, 1984).

Musical Instruments. In addition to the use of palm fiber to make strings for musical instruments, drums can be made from hollowed-out palm stems. The palmyra palm (*Borassus flabellifer*) has reportedly been used for this latter purpose in parts of Asia.

Stationery and Books. Palm leaves were an ancient writing material in India, perhaps as old as written language itself. Segments of the palmate leaves of the talipot palm (*Corypha umbraculifera*), as well as some other palms, were written upon with a metal stylus. Examples of these palm leaf manuscripts are preserved in museums.

Weapons and Hunting Tools. Palm wood is widely used for this purpose. For example, indigenous people in the Philippines utilize the hard outer wood of the palms in the genus Livistona to make bows and spear shafts (Brown and Merrill, 1919).

Medicines and Ritual. Throughout their range palms are sources of folk medicines and are a part of rituals. Dragon's blood resin (see above) is burned as incense in witchcraft rituals in the United States and is sold in shops specializing in products associated with witchcraft and magic.

An example combining medicinal and ritual use is found in the betel nut palm (*Areca catechu*). Large numbers of people in Asia and Polynesia have for millennia chewed betel seeds mixed with fresh betel pepper leaf and a bit of slaked lime; it is the classic Asian masticatory. The betel nut contains an alkaloid that is mildly narcotic (see Table 9-1).

Ornamental Use. Flowers are universally used as decorations for many types of rites and ceremonies. In the tropics, branches of palm inflorescences are often employed. Sprigs of coconut flowers, for example, are used in India and Sri Lanka for wedding decorations. Leaves of wild *Chamaedorea* palms in Mexico and Central America are collected, exported and sold for cut foliage in floral arrangements (see Table 6-1).

Palm leaves have a traditional role in the three major world religions. For example, white date palm leaves are produced commercially in Elche, Spain and Bordighera, Italy, especially for use in ceremonies during Holy Week in the Christian world. Leaves are prepared by wrapping new leaves to protect them from light; the result after about one year is a fully developed pale nearly white leaf. White leaves are sold within Spain and Italy and exported to other countries (Gómez and Ferry, 1999).

Structure and Shelter. This is another huge class of palm products. A couple of the less common uses are the rigging of sailing vessels with thin rattans rather than rope in Indonesia, and the use of entire stems of the caranday palm (*Copernicia alba*) as utility poles in Paraguay. Hollowed out palm stems have a variety of uses. Small diameter stems can serve as blow guns and water pipes; the swollen portion of some large diameter palms have been used to make canoes (Johnson and Mejia, 1998) and even coffins.

The product classes employed in this section portray the great variety of palm products, past and present, and cover every aspect of material culture. But that does not explain everything about palms and human culture. Apart from their value as a source of useful products, palms are also of general interest simply because of their beauty and symmetry, which may help to explain the role of palms in religion and folklore.

Case Studies: Indigenous Groups and Their Use of Palms

Shifting away from a product approach to a focus on specific indigenous groups and their utilization of palms provides another dimension to this discussion. For this purpose, accounts of palm use have been taken from studies in Asia, the Pacific, Africa and Latin America. Criteria for selection of the case studies were as follows: focus on a particular indigenous group, local as well as scientific names of the utilized palms were known and palm use was described in some detail. Moreover, an attempt was made to have the case studies represent widely separated geographic regions and a diversity of local palm species diversity. The four case studies chosen describe the Iban of Sarawak, the Shipibo of Amazonian Peru, the Kwanyama Ovambo of Namibia and the Trukese of the Caroline Islands of Micronesia in the Pacific. The grammatical present tense is used in this section to refer to both past and present palm uses.

The Iban

This first case study focuses on the Iban, an indigenous group in southwestern Sarawak, East Malaysia. The Iban inhabit an area of largely undisturbed natural forest, with heavy rainfall, varied terrain and an attitudinal range of sea level to 760 m. Kubah National Park occupies about 2,230 ha in the area. Pearce (1994) studied the palms of the park and its immediate environs and gathered excellent data on the identity of the palms as well as their utilization by the Iban people. Pearce relied on earlier systematic studies by J. Dransfield, when she did field work in 1990. Southwestern Sarawak is considered to have one of the richest palm floras in the world, as evidenced by the cataloging of 99 palms in and around the park.

The 47 native palms used by the Iban are listed in Table 2-1. The predominance of the rattan palm genera (*Calamus, Daemonorops, Korthalsia, Plectocomia* and *Plectocomiopsis*) is striking as they together account for 31 of the 47 palms.

Table 2-1 Iban, Sarawak, Malaysia, Utilization of Native Palms

Scientific Name/Iban Name	**Uses**
Arenga hastata, mudor	down on stem as tinder
Calamus blumei, wi kijang	baskets
Calamus caesius, sega	many uses, the best split rattan
Calamus conirostris, rotan	basket spars and weaving; general uses
Calamus corrugatus, wijanggut	many uses, as good as *Calamus caesius*; smallest diameter of local cane
Calamus crassifolius, witakong	binding basket edges and parangs (bush knives); sewing atap (thatch)
Calamus flabellatus, wi takung	baskets; various other uses
Calamus gonospermus, sega ai	baskets, split or whole
Calamus hispidulus, rotan	cane can be used
Calamus javensis, wi anak	baskets, split or whole
Calamus laevigatus var. *laevigatus*, rotan lio	baskets, mats, tying
Calamus laevigatus var. *mucronatus*, rotan	good cane
Calamus marginatus, wi matahari	sold as *Calamus caesius*
Calamus mattanensis, rotan lemba	baskets; many other uses
Calamus muricatus, rotan putch	baskets, rough temporary; tying; good split or whole
Calamus nematospadix, rotan tunggal	baskets; various other uses; sewing atap (split)
Calamus paspalanthus, rotan tingkas	edible palm heart, sour fruit; cane
Calamus pilosellus, rotan anak	binding
Caryota mitis, mudor	edible palm heart; stem down for tinder

Scientific Name/Iban Name	**Uses**
Ceratolobus discolor, danan	basket spars, weaving
Ceratolobus subangulatus, rotan janggut	baskets, tying, etc.
Daemonorops acamptostachys, rotan duduk	fishing baskets from petiole skin
Daemonorops cristata, wi getah	fruit exudate as gum; fruit eaten by children
Daemonorops didymophylla, wi getah, rotan jernang	baskets, especially earth baskets; sarcotesta sweet and juicy
Daemonorops fissa (none)	basket spars, weaving; fruit slightly sweet, edible; palm heart edible, sold locally
Daemonorops periacantha, wi empunok	basket edges, mats, chairs; palm heart and fruit edible
Daemonorops sabut, wi lepoh	basket spars, weaving
Eugeissona insignis, pantu kejatau	petiole pith for dart plugs, petiole skin for baskets; palm heart and young fruit edible
Korthalsia cheb, danan semut	furniture and general utility
Korthalsia echinometra, wi seru	cane used
Korthalsia ferox, danan kuning	baskets, furniture, many other uses.
Korthalsia flagellaris, danan	baskets, weaving, many other uses
Korthalsia rigida, danan tai manok	baskets, chairs, various other uses
Korthalsia rostrata, danan wi batu	baskets, chicken coops; sewing (split); tying logs
Licuala bintulensis, biru	leaflets for hats, wrapping; petiole skin for weaving winnowing baskets
Licuala orbicularis, biru bulat	leaves for wrapping, making hats, umbrellas and atap
Licuala petiolulata, gerenis	petiole skin for making baskets

Scientific Name/Iban Name	Uses
Licuala valida, pala	petiole skin for winnowing baskets; leaflets for wrapping; palm heart edible
Oncosperma horridum, nibong	bark for floors and walls; palm heart edible
Pinanga cf. *ligulata*, pinang	stem for lance shaft
Pinanga mooreana, pinang murind	walking sticks; fruit eaten
Plectocomia mulleri, rotan tibu	baskets, chairs, etc; good split
Plectocomiopsis nov. sp., belibih	many uses; very useful because nodes are flat
Salacca affinis, ridan	petiole for fishing rods; petiole skin for baskets; leaves for camp shelters; fruit edible
Salacca vermicularis, lamayung	petiole skin for weaving baskets; fruit edible
Salacca nov. sp., lekam	fruit (sweet-sour) edible

Source: Pearce, 1994.

The Shipibo

The Shipibo of Peru serve as a second case study. These Amerindian people occupy tropical lowland forest land on the central Ucayali River, a tributary of the Amazon, near the Peruvian city of Pucallpa. Bodley and Benson (1979) made a detailed study of the Shipibo which focused on the utilization of palms in everyday life. Field research was carried out in 1976-1977. In vegetation surveys, the authors found within the Shipibo reserve and adjoining areas a rich palm flora of at least 24 species. Data were collected on the contemporary utilization of palms and products identified to their species of origin. Table 2-2 lists 19 different local palms utilized by the Shipibo.

As Table 2-2 shows, considerable use is made of palms for building materials, food and handicrafts. It is interesting to note that the Shipibo have taken their tradition of making bows and arrows from palm wood and turned it into crafting souvenirs to sell to tourists visiting the area.

Table 2-2 Shipibo, Peru, Utilization of Native Palms

Scientific and Shipibo Common Names	Uses
*Astrocaryum huicungo**, páni	new pinnate leaves to make women's spinning basket; stems as house posts
Astrocaryum jauari, yahuarhuanqui	stems as house posts; petioles to make burden baskets; ripe fruit as fish bait
*Attalea bassleriana**, cansín, shebón	pinnate leaves for thatch; new leaves to make sitting mats, small baskets; leaf pinnae to make brooms; edible fruit
Attalea tessmannii, conta	leaf pinnae to make brooms
Bactris concinna, shiní	edible fruit
Bactris gasipaes var. *gasipaes*, juani	cultivated for edible fruit; stem wood made into bows, arrow points, lances, awls, clubs, spindles, loom parts
Bactris maraja, taná	edible fruit; stems as house floor supports, rafters
Chelyocarpus ulei, bonká	palmate leaves as sitting mats, umbrellas, bush meat wrapper
Euterpe precatoria, paná	stems as house posts; stem slats as house walls; edible palm heart; fruit mesocarp oil as women's hair dressing
Geonoma deversa, quebón juani	stems to support mosquito nets
*Iriartea deltoidea**, tao	stem wood for house flooring, shelving, rafters, support beams, harpoon staves, arrow points, roof ridge pins; swollen stem for temporary canoe
Mauritia flexuosa, vinon	edible fruit; petioles for loom parts; split petioles woven into sitting mats
Maximiliana venatorum (unplaced name), canis	split petioles woven into sleeping mats; spathe made into hanging storage basket
Oenocarpus bataua var. *bataua**, isá	edible fruit; leaf pinnae made into brooms
*Oenocarpus mapora**, jephue isá	stem wood for bows and arrows sold to tourists; edible fruits; stems as house posts
*Phytelephas macrocarpa**, jephue	pinnate leaves for roof thatch; petiole made into tray-like storage basket; edible immature fruit endosperm

Scientific and Shipibo Common Names	Uses
Socratea exorrhiza, sino	stem wood for flooring, bows and arrow for tourists; spiny roots as graters
Syagrus sancona, shuhui	stem wood for loom parts

Note: * Binomials changed to currently accepted names.
Source: Bodley & Benson, 1979.

The Kwanyama Ovambo

Case study three is from Africa where palm species diversity is low, but palm populations often significant; in such cases palm utilization may be high and varied, but focused on a few species.

The Kwanyama live in Ovamboland which lies in north-central Namibia bordering Angola to the north. The latitude is approximately 17.5O south, elevations average about 1,000 m and annual rainfall is 520 mm. Namibia has only two native palms. The most prevalent is the African ivory nut palm, common name omulunga, *Hyphaene petersiana* ; this species of *Hyphaene* is single-stemmed and does not branch. The second palm is the Senegal date palm, vernacular name omulunga wangolo, *Phoenix reclinata*.

Rodin (1985) published a detailed ethnobotanical study of the Kwanyama based upon field work in 1947 and 1973. More recently, Konstant *et al*. (1995) and Sullivan *et al*. (1995) studied exploitation of *Hyphaene petersiana* in the same general area. Table 2-3 summarizes palm utilization based on these references.

Table 2-3 Kwanyama Ovambo, Namibia, Utilization of Native Palms

Palm Product Classes*	Uses of African ivory nut palm, *Hyphaene petersiana*, except as noted
beverages	palm wine by fermenting mesocarp pulp and from sap by tapping flower bud; palm wine distilled into spirits
building materials	leaves for thatch; leaf fiber made into rope; petioles for hut construction, fencing
chemicals and industrial products	vegetable ivory (hard endosperm) carved into buttons, ornamental objects
cosmetics and hygiene	shredded leaves dyed for wigs
feeds	cattle, goats and donkeys rely on palms for fodder
fertilizer	likely, but not specifically stated in references cited

Palm Product Classes*	**Uses of African ivory nut palm, *Hyphaene petersiana*, except as noted**
food	edible palm heart, raw fibrous fruit mesocarp; fruits of *Phoenix reclinata* eaten fresh or preserved by drying
fuel	petioles, flower stalks for cooking fires
handicrafts (all types)	leaves used to weave baskets, mats, hats; petioles made into hunting bows, carrying poles, stirring spoons; leaflets woven into special beer strainer; fused twin seeds as children's' dolls
medicines and ritual	leaves used to shape headdresses and bridal hats; skirts, necklaces and bracelets braided from leaf blades during female puberty rites
ornamental use	shade tree, likely, but not specifically stated in references cited
structure and shelter	stems hollowed out for cattle water troughs

Note: * After Balick & Beck, 1990.
Sources: Rodin, 1985; Konstant *et al*., 1995; Sullivan *et al*., 1995.

Palm use is recorded within each of 12 product classes developed by Balick and Beck (1990), and all originate from the African ivory nut palm, except for limited food use of the fruits of the Senegal date palm, a rare tree in the area. No medicinal use of this palm is reported despite its intensive exploitation and the fact that other species of *Hyphaene* play a role in medicine. Rodin (1985) asserts that the ivory nut palm is the most useful of all the native plants in Ovamboland; he further states that it is illegal to cut down the palm because of its exceptional value to the local people.

The Trukese

The final case study is from the Pacific Ocean region. Geographically Truk designates a group of islands which form a part of the Caroline Islands, which are located about 680 miles southeast of Guam. The inhabitants, the Trukese, are Micronesians.

Despite its equatorial latitude, Truk has very poor palm species diversity. According to Moore and Fosberg (1956), only three species of palms occur naturally in the Truk Islands; namely *Clinostigma carolinensis*, an endemic palm under threat of extinction, the Caroline ivory nut palm, "os" in the local language, (*Metroxylon amicarum*) and the nipa palm (*Nypa fruticans*). The coconut palm, locally-called "ny," (*Cocos nucifera*) is naturalized and widely cultivated on Truk. Other reported introduced species in the islands are the betel nut palm (*Areca catechu*) and the African oil palm (*Elaeis guineensis*).

LeBar (1964) conducted a study of the material culture of Truk which revealed the extent to which the local people make use of floral resources to provide their needs. Field research was done in 1947-1948. Using the categories in LeBar's study, information on palm use was excerpted and is presented in Table 2-4.

Table 2-4 documents the utilization of only the coconut and ivory nut palms, but the diversity of coconut palm use, with examples in every material culture category, is impressive. The significance of the coconut palm among the Trukese may have been enhanced during the years of Japanese control of the islands (1914-1945) when coconut growing for copra production was encouraged. The absence of hat making from palm leaves is because of the presence and use of pandanus for that purpose.

The four preceding case studies demonstrate how very important palms are, for subsistence and commercial purposes, to indigenous peoples throughout the tropics. Most revealing about the case studies is that palm utilization is equally intense in areas of high and low palm species diversity. A major difference appears to be that local people have a choice of different palms to exploit for the same end use where high palm species diversity occurs; for example, leaves for thatching or weaving.

Table 2-4 Trukese, Caroline Islands, Pacific Ocean, Utilization of Palms

Material Culture Category	**Uses of coconut *(Cocos nucifera),* except as noted**
tools and utensils	fiber cord as polisher; leaflet midrib made into needle; shell flask made with coconut fiber handle; dry husks or old palm leaf basket as cushion; leaf sheath fiber to hold grated coconut meat to be pressed; fiber cord made into tree climbing loops
Cordage	coir fiber for cordage
plaiting	leaflet plaited into mats: single wall mat, double wall mat, canoe mat; leaflet baskets: temporary field basket, semipermanent field basket, woman's fish basket, woman's weaving basket; leaflet fans; cord baskets
weaving	ivory nut palm midrib to make loom parts; coconut fiber sling for loom
chemical industries	coconut shell molds used for dye cake; netted fiber bag to store shell molds; coconut water base used to rinse fabrics before dyeing; grated coconut meat rubbed on dyed fabric to produce sheen; coconut oil base for perfume; spathe ash added to lime in making cement
agriculture	coconut a major crop, many varieties recognized; copra provides cash income
hunting and fishing	half coconut shell containing bait used in bird snare; leaflet midrib used in making crab snares; coconut cloth used to wrap fish poison; coconut leaf sweeps used to drive fish into weirs and nets; dried leaf torches used in night spear fishing and harpooning sea turtles; leaflet used to tie knots as part of divination in turtle fishing; coconut water drunk as part of ritual before bonito fishing; leaflet midribs used to make fishing kite; dried midrib leaflet made into netting needle; ivory nut palm leaf midrib used as net mesh gauge; coconut fiber lines to catch sea turtles; dry coconut meat gratings tossed in water to attract fish

Material Culture Category	Uses of coconut *(Cocos nucifera),* except as noted
food and stimulants	coconut cream used extensively in cooking; coconut meat gratings burned in smudge fire to repel mosquitoes; dry husk or shredded leaf base fiber used a tinder; half coconut shells used in food preparation and as drinking cups; fresh coconut water as beverage; sweet and fermented toddy from palm sap
housing	leaf matting and fronts used for walls on temporary shelters; ivory nut palm leaves made into thatch sheets for roofing; coconut frond midrib strips are used to tie ivory nut palm leaves to binding rods; fiber cord used to tie thatch sheets to rafters; fiber ropes used in pole-and-sling operation to carry large house timbers; palm fronds used to cover earthen house floors; coconut shell flask of perfume kept in storage box to impart sweet scent to clothing
canoes	fiber cord used to attach and decorate end pieces and attach outrigger booms; young leaflets are strung on coconut fiber cord around outside of gunwales of large paddling canoes for decoration; shell halves used for bailing
clothing	plaited coconut fiber used to make reef shoes
ornaments	coconut shell made into small beads to decorate belts, bands and to make necklaces and pendants; burning spathe applied to sea turtle shell to loosen shell; turtle shell softened by boiling in mixture of coconut milk and sea water; coconut shell pieces used for ear piercing and made into ear rings; shell used in making comb handles; palm leaf midrib used to apply pigment in tattooing; glowing end of coconut leaflet midrib used in scarification
weapons	coconut wood used to make spears; fiber cord to make slings
recreation objects	coconut meat used to close end of nose flute

Source: LeBar, 1964.

Palm Domestication

A final perspective on the historical palm use can be realized through examination of the subject of palm domestication. Domestication of a particular palm species represents the end-point of a continuum that begins with utilization of wild palms (Clement, 1992). Over time, utilization leads to some level of management of wild populations; in turn this can result in the palm being brought into cultivation. At the point where cultivation begins, true selection also is assumed to begin for the cultivator will gather for propagation fruit or suckers from plants which have certain desirable qualities such as rapid growth, large fruit size or the like. Over many plant generations cultivated palms will come to exhibit morphological and genetic characters markedly different from their wild relatives; they are then deemed to be domesticated.

Five well-known palm species are clearly domesticated and all are currently major economic species: betel nut palm (*Areca catechu*), coconut palm (*Cocos nucifera*), date palm (*Phoenix dactylifera*), African oil palm (*Elaeis guineensis*) and pejibaye or peach palm (*Bactris gasipaes* var. *gasipaes*).

An unusual example of a noncommercial domesticated palm is the coco cumbé palm (*Parajubaea cocoides*) of South America. It is known only as an ornamental tree in Andean cities and towns of Ecuador and Colombia. Moraes and Henderson (1990) postulate that coco cumbé probably originated from the wild *P. torallyi* which is endemic to Bolivia.

On the path to domestication is the aguaje palm (*Mauritia flexuosa*) of the Amazon Region (Delgado *et al*., 2007).

The palm domestication process is driven by an economic interest in one key product, as is generally the case in plant domestication. The principal product is in some instances mutually exclusive to another palm use; in other instances the predominance of the key economic product may overshadow other useful products of the same palm and preclude development of the palm in a more integrated fashion. This situation can be remedied by promoting greater understanding of the inherent multipurpose character of already-domesticated palms as well as those with domestication potential. For present purposes, it is useful to review the domestication of the five major palms and their multipurpose character.

Betel Nut Palm (Areca catechu)

This palm appears to have been domesticated for its hard dried endosperm which contains the alkaloid arecoline and is chewed as a mild narcotic. Similar to the chewing of tobacco, betel nut use poses serious health problems. Betel nut has a number of reported medicinal uses. The origin of the betel nut palm is unclear because of its long history of use, the fact that a definitely wild population has never been found and that it is but one of about 47 species distributed in South and Southeast Asia and the Pacific. In India it has been in cultivation for as many as 3,000 years, but is considered to have been introduced from Southeast Asia at an earlier time (Bavappa *et al*., 1982).

India is the leading world producer of betel nut; in 2003 there were some 290,000 ha under cultivation on plantations and small farms with production amounting to 330,000 t (http://www.plantcultures.org/plants/betelnut_production__trade.html). Bavappa *et al.* (1982), in the most comprehensive study of this palm, devoted a chapter to alternative uses of betel nut. The endosperm contains tannin obtained as a by-product of preparing immature nuts for chewing and also fat comparable to coconut oil (see Table 9-1). Currently in India the husk is used as fuel or mulch although it is a source of fiber material suitable for hard board, paper board and pulp for paper. Leaf sheaths have traditional uses to make containers and represent a raw material with industrial applications to manufacture plyboard as well as disposable cups and plates. Betel nut palm leaves are used for thatch and organic manure and the stem wood made into a variety of articles such as waste paper baskets. The palm heart is the only food product from this palm.

Additional technical information on the betel nut palm can be found in a 1982 symposium proceeding (Shama Bhat and Radhakrishnan Nair, 1985). An extensive bibliography on the subject has also been published (Joshi and Ramachandra Reddy, 1982).

Coconut Palm (Cocos nucifera)

This is the most ubiquitous palm of tropical coastal areas and a species with which nearly everyone is familiar. Origin of the coconut has long been a matter of debate; some evidence (Schuiling and Harries, 1994) suggests that the coconut originated in Malesia (the region between Southeast Asia and Australasia), where wild types have been found. New DNA research results trace the origins of *Cocos* to the Oligocene (ca. 37 MYBP) in Eastern Brazil, with its divergence from Syagrus at about 35 MYBP. This new evidence of the phylogenetic history of the coconut should not be confused with the very much more recent domestication of the palm (Meerow, *et al*., 2009).

Domesticated coconuts were dispersed by humans and by ocean currents, for the nut will float and remain viable for three months or more. The chief criterion used in selecting coconuts for cultivation appears to have been larger nuts with a greater quantity of useable endosperm (coconut meat). A secondary factor may have been more rapid germination. Exactly when and where the coconut first was domesticated is a difficult question to answer. Child (1964) cites evidence that coconuts were in India some 3,000 years ago but may, like the betel nut palm, have been introduced.

The coconut is often referred to as the "tree of life" because of its multitude of subsistence and commercial uses (Ohler, 1984; Persley, 1992). Figure 2-1 attempts to capture the remarkable utility of the coconut palm[3]. Table 9-10 through Table 9-14 provide technical information on the major coconut products.

FAOSTAT production data for 2007 show that Indonesia, Philippines and India are the world's leading producers of coconuts; together they account for about 75 percent of world production. The coconut's primary commercial product is edible oil, derived from the endosperm, which is one of the world's most important vegetable oils. The Philippines is the largest producer of copra and coconut oil. In 2006 the Philippines provided just over 50 percent of world coconut oil exports. Coconut is grown under plantation conditions but remains an important tree crop of the small farmer who often cultivates the palm in combination with other annual and perennial crops, and with livestock raising.

A new development plan in the Philippines to plant up to 400,000 ha of coconuts to produce biofuel for diesel cars could have a large impact on the coconut industry in Southeast Asia. The project was announced in June 2009 by Pacific Bio-Fields Corporation of Japan and would utilize abandoned agricultural land in northern Luzon. A portion of the biofuel produced would be exported to Japan www.reuters.com/article/GCA.../idUSTRE55H1WJ20090618).

Numerous other studies on coconut have been published. A selection of technical information sources includes the proceedings of two international symposia (Nayar, 1983; Nair *et al*., 1993); a lengthy monograph (Menon and Pandalai, 1958); a technical guide written for small landholders (Bourgoing, 1991); a study of the combining of cattle raising and coconut growing (Reynolds, 1988); an edited volume on modern coconut management (Ohler, 1999); a comprehensive new study of coconut cultivation and coconut products (NIIR, 2008) and an examination of coconut polyculture (Rethinam and Sivaraman, 2008). Information about world markets for coconut oil, coconut meat and husk fiber (coir) is available in a series of studies (see: Chapter 11, Additional Information Sources).

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[3] A number of other palms could similarly be represented as "trees of life," among them are the date palm, African oil palm, palmyra palm, babaçu palm and pejibaye palm.

Date Palm (Phoenix dactylifera)

This may represent the oldest domesticated palm, having originated most likely in Mesopotamia (modern Iraq) 5,000 to 10,000 years ago. The earlier time period would place the date palm among the most ancient of domesticated plants. Recent research on the date palm's origins reveal that the cultivated form is closely related to wild and feral date palms in the Near East, Middle East and North Africa, and that they are considered to be the same species (Zohary and Hopf, 2000).

In cultivation there exist numerous date varieties named for the fruit characteristics. Nutritional data on one of the date varieties is provided in Table 9-26. The date palm is also a multipurpose species, greatly relied upon for an array of products in its desert environments of limited vegetation resources (Dowson, 1982; Barreveld, 1993). The three leading date-producing countries in 2007 were Egypt, Iran and Saudi Arabia; combined they represented 46 percent of world production (FAOSTAT).

Other sources of technical information on the date palm include the following. Dowson and Aten (1962) describe date processing in detail; Munier (1973) wrote a general study of the palm; a lengthy bibliography of date palm was compiled by Asif and Al-Ghamdi (1986) and there have been published proceedings of two recent international conferences on date palm held in Abu Dhabi (ECSSR, 2003; Zaid *et al*., 2007). The current standard reference on all aspects of date cultivation is by Zaid (2002).

Figure 2-1 ***The coconut palm (Cocos nucifera); the tree of life. Examples of end-products, clockwise. Trunk - construction, wood, timber, plywood, furniture, picture frames, charcoal. Leaf Sheath - bags, hats, caps, slippers. Sap - toddy, arrak, vinegar, yeast. Meat -oil, desiccated coconut, copra cake, candy, coconut water, coconut cheese, coconut milk, jam. Heart - fresh and pickled palm heart, animal feed. Leaves - mats, hats, slippers, midrib brooms, draperies, bags, toothpicks, roof thatch, midrib furniture, fencing, fans, fuel, fodder. Shell - trays, buttons, jewelry, trinkets, charcoal, activated charcoal, wood preservative, bowls, fuel. Coirdust - coirdust coke, plasterboard, blocks, insulation, potting mix. Husk - rope, yarn, coir mat, coir fiber, brushes, cushion and mattress stuffing, compost, fuel. Roots - dyestuff, medicine, fuel.***

African Oil Palm (Elaeis guineensis)

The African oil palm represents the most recently domesticated major palm. Within the past century this palm was brought into formal cultivation and developed to increase its mesocarp oil productivity through breeding of high-yielding hybrids. The oil palm is unsurpassed in yield of oil per unit area (Corley and Tinker, 2003). Unlike the three preceding examples, this palm exists in wild, semi-wild and cultivated states in West Africa where it originates, and also in Madagascar and East Africa. It is likewise cultivated extensively in Southeast Asia and to some degree in the New World tropics.

In 2007, Malaysia was the leading nation in production of this vegetable oil, closely followed by Indonesia; these two countries accounted for over 80 percent of world oil palm fruit production (FAOSTAT). More studies have been published on the African oil palm than any other single palm. A sampling of titles includes: an economic study (Moll, 1987); a volume on research (Corley *et al*., 1976); a general book on the palm (Surre and Ziller, 1963); and an example of one of several conference proceedings from Malaysia (Pusparajah and Chew Poh Soon, 1982). Corley and Tinker (2003) have produced the standard reference on all aspects of oil palm. Information about world markets for African oil palm as well as babassu can be found in a series of studies (see: Chapter 11, Additional Information Sources).

Apart from being an outstanding plantation crop, the oil palm remains a multipurpose tree among local populations in Africa. It is a traditional source of cooking oil, palm wine and other useful products. Nutritional data on the fruit and oil are given in Table 9-17 and Table 9-18. The African oil palm has potential for multipurpose utilization within the same areas where it is grown on plantations.

Pejibaye (Bactris gasipaes var. gasipaes)

The only example of a major domesticated palm from the American tropics is the pejibaye. Pejibaye may have originated from a wild relative or relatives (*Bactris gaspiaes* var. *chichagui* is closely related, and has similar but smaller fruits) possibly as a hybrid, in the southwestern portion of the Amazon Basin and has been widely dispersed by humans in South and Central America (Clement, 1988; Mora-Urpí, 1996). The palm was domesticated for either its mesocarp starch or oil; both mesocarp and endosperm are edible after being boiled. Table 9-2 and Table 9-3 provide nutritional information on the fruit. The palm produces basal suckers that can be separated for propagation, or it can be grown from seed. Pejibaye has been under cultivation since ancient times in humid tropical areas at elevations from sea level to about 1,200 m.

Pre-Columbian uses of pejibaye were documented by Patiño (1963). In addition to the food uses already mentioned, the palm heart is eaten; the mesocarp pulp is fermented into an alcoholic beverage (chicha); male flowers are used as an ingredient in flavorings; leaves are employed for thatching and basketry; spines are made into needles; stem wood is cut to fashion bows, arrows, fishing poles, harpoons as well as flooring and paneling for houses; the roots have medicinal use as a vermicide.

Pejibaye has been the object of considerable development in Central and South America focused on improving fruit quality for human and animal consumption; it is also under cultivation as a commercial source of palm hearts. An international conference on the biology, agronomy and industrialization of pejibaye was held in 1991 in Peru (Mora-Urpí *et al.*, 1993). Mora-Urpí *et al*., (1997) and Mora Urpí and Gainza, (1998) are two excellent sources of information on this palm. Costa Rica is said to be the leading country in pejibaye cultivation, but data on area and production levels are lacking. To date, pejibaye has not been cultivated commercially outside the Americas.

3 CURRENT PALM PRODUCTS

The emphasis in this and subsequent chapters will be on products currently known to be derived from palms. (Examples of the array of artisanal palm products are shown in Figure 3-1, Figure 3-2 and Figure 3-3.)

With respect to more important economic species, some production statistics are available; however, as regards most of the minor palms no data are obtainable and anecdotal information must suffice. Focusing on present-day usage screens out exotic and outdated utilizations and permits a closer look at those palm products which have stood the test of time and remain of either subsistence or commercial value and hence have the greatest economic development potential. It needs to be stated that keeping a focus on palm products promotes re-examination of the current species as product sources as well as encouraging assessment of new potential species not currently being exploited.

At this point, some observations regarding contemporary palm products are appropriate and some terminology needs to be introduced to give clarity to the discussions in this and future chapters. Obviously, not all of the possible products can be derived from a particular palm all of the time because one product typically precludes another in practical terms, or some products are mutually exclusive. All of the major domesticated palms, for example, are chiefly cultivated for products derived from their fruits; also, fruits are the most important product of a number of wild palms. Therefore, if fruit production is the prime objective, any other product extraction from the same tree that would retard or reduce fruit production should be avoided.

A clear example of a practice that will directly and adversely affect fruit production is tapping the inflorescence for sap; also, cutting leaves for basketry can impair the normal growth of the tree and reduce its resistance to pests and diseases.

Palm Product Categories

In assessing and evaluating palms for the many products they can and do provide it is instructive to consider the individual products as falling into three different general categories: primary products, secondary or by-products and salvage products4[4].

Primary Products. These are the chief commercial, or in some cases subsistence, products derived from a palm. Generally, primary product processing occurs at a point removed from actual harvesting. Vegetable oil obtained from a palm fruit, for example; or palm stem starch. An entire plant can represent the primary product when a palm is dug up in the wild and sold as a live ornamental plant.

Secondary and By-products. As defined and used here, by-products refer to useful items directly generated by processing of the primary product. Secondary products are those which require one step of processing from the primary product to reach the desired end product. Examples of by-products are coir fiber from the coconut mesocarp and press cake remaining after extracting seed oil, which can be fed to livestock. Some by-products, however, are of

[4] An alternative more detailed classification method has been devised by Chandrasekharan (1995) to cover forest products in general other than wood.

little if any economic value and even pose disposal problems if unsuitable for use as fertilizer or fuel. Arrak is an example of a secondary product; naturally fermented palm wine, the primary product, must first be produced before it can be distilled to produce arrak.

Salvage Products. This terminology characterizes those palm products that are indirectly generated as a result of harvesting the primary product. Products in this category are typically discarded at the harvesting site and are not transported to another location as part of primary processing. Extracting a palm heart from a wild tree kills it; any products subsequently used such as stem wood or leaves, are by this definition salvage palm products.

Salvage palm products may also derive from other activities such as the cutting of palms for some land-use related reason, replacement of senescent palms in plantations or palm damage or destruction due to natural causes such as a tropical cyclone. Living ornamental palms removed from a site to be cleared to save them from being destroyed would, under such circumstances, be considered salvage products.

As revealed in the foregoing discussion, either a primary product or a by-product may be considered to be a salvage product if it was indirectly generated. Distinctions of this type are worth making because of the information they provide about the origin of the raw material and the stability of their supply.

A second group of palm product terms is proposed to characterize the extent of processing a newly-harvested raw material requires to transform it into a commercial item. From the simple to the most complex, four stages of raw material processing were chosen for use in this study: immediate use, cottage-level processing, small-scale industrial processing and large-scale industrial processing.

Immediate Use. Products in this category require little if any processing before being utilized. Examples include palm fronds cut for use in thatching, coconut water drunk from the nut, palm heart consumed fresh and entire palm stems used in construction. The only tools needed to generate immediate-use products is an ax or machete.

Cottage-level Processing. Those products requiring a modest amount of processing fall into this category so-named because the activities typically are carried out in or near the residence of the individuals involved. The physical location where palm processing activities is carried out also functions as living space or for other purposes when the processing is not actively being carried on; there is no designated processing area exclusively devoted to cottage-level processing. Traditional extraction of palm mesocarp oil, weaving of mats and other leaf products, drying of date fruits and carving of vegetable ivory into toys are examples. Very few tools are required for this level of processing.

Small-scale Industrial Processing. The use of the term "industrial" in designating this category connotes some specialized equipment, a dedicated locality or structure where processing takes place and a number of skilled or trained workers. Actual processing activities may be manual, semi-mechanized or mechanized depending upon their requirements and the level of investment. Canning of palm hearts, distillation of palm wine to produce arrak and extraction of coconut oil from copra exemplify this category.

Figure 3-1 ***Artisanal Palm Products I. A. Hat woven from palmyra palm (Borassus flabellifer) leaf fiber, Tamil Nadu, India. B. Spider figure carved from seed of South American vegetable ivory palm (Phytelephas macrocarpa), Ecuador; 7.5 cm in diameter. C. Palm climbing belt made from African oil palm (Elaeis guineensis) petiole and leaf fiber, Guinea-Bissau; 108 cm long, 30 cm wide as illustrated. D. Shoulder bag with strap woven from chambira palm (Astrocaryum chambira) leaf fiber, Ecuador; 38 cm wide, 25 cm high.***

Figure 3-2 ***Artisanal Palm Products II. A. Woven basket with attached overlapping lid, made of palmyra palm (Borassus flabellifer) leaf fiber, Casamance, Senegal; 20 cm high (closed), 24 cm wide. B. Head figure (a sadhu, a devotee who has renounced the world and gone to live in a remote area) made of the carved seed and mesocarp fiber of palmyra palm (Borassus flabellifer), Tamil Nadu, India; 10 x 10 cm. C. Chopsticks and case, chopsticks made of palmyra palm (Borassus flabellifer) stem wood, case raw material undetermined, Thailand; chopsticks 23 cm long. D. Turned bowl made of coconut palm (Cocos nucifera) stem wood, Philippines; 7.5 cm in diameter. E. Palm leaf writing (Buddhist bible), made of talipot palm (Corypha umbraculifera) leaflets, Thailand; 51 cm long, 4.5 cm wide.***

Large-scale Industrial Processing. This category is distinguished from the preceding in terms of the greater physical size of the processing facility, a higher level of sophistication in the processing itself through more complicated mechanical devices and certain highly skilled workers to operate and maintain equipment. Examples which can be cited are African palm oil factories, the processing of export quality sago starch and integrated processing of fresh coconuts.

A number of palm products are associated with more than one of these four categories, depending upon local traditions and economic conditions. Salak fruits (*Salacca* spp.) are sold as fresh fruit (category 1) and preserved in tins or jars (category 3); rattan furniture making can be done on a small scale in the home (category 2) or in a small industrial facility (category 3); palm oil extraction can take place in the home (category 2) as well as in small- or large-scale factories (categories 3 and 4).

At this juncture, it is worthwhile to return to the major classes of palm products developed by Balick and Beck (1990) and discussed in Chapter 2. The authors presented a list of 388 palm products, which they broke down into 12 major classes. Selecting the leading palm products from the longer list permitted a reduction of the number to 97 principal products. Adhering to the organization into 12 major classes, they are presented in Table 3-1.

Table 3-1 lists palm products which are not far removed industrially from the original raw material and are most likely to be encountered in natural resource management and development activities. A linkage exists between the product and the palm. Many manufactured products are omitted which have in their makeup some palm raw material, but the raw material has ceased to be recognizably from a palm. Palm oils, for example, are ingredients in the manufacture of hundreds of food and industrial products. To include such a wide spectrum of products in the current discussion would diverge from the intended focus on palms themselves as providers of useful commodity, in the original sense of the latter term.

Table 3-1 Principal Palm Products

Beverages arrak (distilled spirit) milk substitute palm wine (toddy) soft drink flavorings sweet sap **Building Materials** fiber parquet flooring rattan thatch timber weaving material wood **Chemicals/Industrial Products** activated charcoal dye/resin fiber (coir) industrial oils paper pulp particle board polishes textile finishes upholstery stuffing vegetable ivory wax **Cosmetics/Hygiene** hairdressing soap	**Feeds** fodder forage press cake **Fertilizer** biofertilizer **Food** antioxidant (açaí, etc) candy edible oil fruit ice cream/sherbet inflorescence (pacaya) kernels palm hearts preserves starch/sago sugar/jaggery syrup vinegar **Fuel** charcoal fuel oil fuelwood **Handicrafts** **Agricultural Implements** nets ropes	**Clothing** clothes hats **Furniture** hammock lamp shades mats rattan wickerware **Games/Toys** balls (rattan) chess pieces palm leaflet balls **Household Items** bags baskets brooms brushes cigarette papers coat hangers cups fans ladles purses twine walking sticks **Weapons/Hunting Tools** bows spears	**Jewelry** beads miniature carvings bracelets, rings and ear rings **Medicines/Rituals** dragon's blood folk medicines masticatory religious symbols/totems **Ornamental Use** cut foliage houseplants ornamental tree seeds shade tree **Structure/Shelter** bridges canoes coffins fences floors nursery shade pilings posts rafters roofs utility poles walls

Source: after Balick & Beck, 1990, with modifications.

Palm Product Matrix

A matrix of principal palm products is presented in Table 3-2. The contents of Table 3-1 were evaluated in terms of the general product categories and the processing categories to construct the matrix. Products were entered into the matrix in the same order as they appear in Table 3-1. Roman numerals across the top and letters along the left side permit shorthand reference to the products. The decision as to where within the matrix to place each product was made by taking into account the most common type of processing currently in practice; in a number of cases a product is placed in more than one box. For example, fiber is included in I-A, I-B, III-A and III-B, depending upon its source and end use; palm timber is placed in III-C and III-D since it is typically a salvage product requiring a small or large mill; edible oil appears in I-B, I-C, and I-D because it can be processed by various means depending upon the end use.

This matrix is provided with the hope it can serve to highlight the respective products in a way which conveys the relationship between product and processing levels.

Recent Related Development Trends

Beginning in the 1980s three new international development approaches arose which have fortuitously directed more attention to palm products. The three subjects are: agroforestry, non-wood (or non-timber) forest products and integrated product development. Because the future development of palm products needs to be linked to such broader issues, a brief discussion of each is appropriate.

Agroforestry

The emergence of agroforestry as a new international development approach is to help small farmers. It involves working to improve the overall productivity of mixed production systems which include various combinations of annual crops, perennial crops and livestock. Palms are common tree species in mixed small farming systems and agroforestry tends to favor such multipurpose trees; agroforestry's multidisciplinary approach has also been effective in emphasizing the broadest possible product use of palms (as with all plants and animals within the particular systems) for subsistence and commercial end uses.

Palms and their potential within agroforestry have been the focus of a number of research studies. Among them, Johnson (1983) did a general assessment of 52 multipurpose palms suitable for agroforestry systems; Liyanage (1983) studied the agroforestry role of the coconut palm in Sri Lanka; May *et al*. (1985) examined the babaçu palm's (*Attalea speciosa*) potential in Brazil; Clement (1989) produced a study of the pejibaye palm (*Bactris gasipaes* var. *gasipaes*) in agroforestry systems; and Flach and Schuiling (1989) reviewed the cultivation of the sago palm (*Metroxylon sagu*) as an agroforestry tree.

Table 3-2 Matrix of Principal Palm Products

General Categories Processing Categories	I. Primary Products	II. Secondary Products/ By-Products	III. Salvage Products
A. Immediate Use	palm wine, sweet sap; fiber; thatch; fruit; kernels; bridges; nursery shade; pilings; posts; rafters; roots; utility poles	fodder; forage; press cake; biofertilizer; fuelwood; fences	fiber, thatch; fuelwood; house plants; shade trees; bridges; fences; pilings; posts; rafters; roofs; utility poles
B. Cottage-level Processing	milk substitute; folk medicines; fiber; rattan; weaving material; wood; upholstery stuffing; edible oil; fruit; kernels/copra; nets; ropes; hats; hammocks; lamp shades; mats and rugs; rattan balls; chess pieces; bags; baskets; brooms; cups; fans; ladles; purses; twine; walking sticks; beads; miniature carvings; bows; spears; masticatory; cut foliage; religious symbols; seeds (ornamental); floors; walls	sugar/jaggery; syrup; charcoal	fiber; weaving material; wood; floors; walls
C. Small-scale Industrial Processing	Soft drink flavor; antioxidants (açaí, etc.); industrial oils; upholstery stuffing; vegetable ivory; wax; hairdressings; soap; edible oil; edible inflorescence (pacaya); palm hearts; preserves; starch/sago; sugar/jaggery; syrup; hammocks; lamp shades; rattan wickerware; brushes; cigarette papers; coat hangers; bracelets; finger rings/ear rings	arrack (spirits) ; parquet flooring; activated charcoal; sugar/jaggery; syrup; charcoal; fiber (coir); candy; ice cream/sherbet; vinegar	parquet flooding; timber; palm hearts
D. Large-scale Industrial Processing	dye/resin; industrial oils; paper pulp; particle board; polishes; textile finishes; wax; soap; edible oil; starch/sago; fuel oil	fiber (coir)	parquet flooring; timber

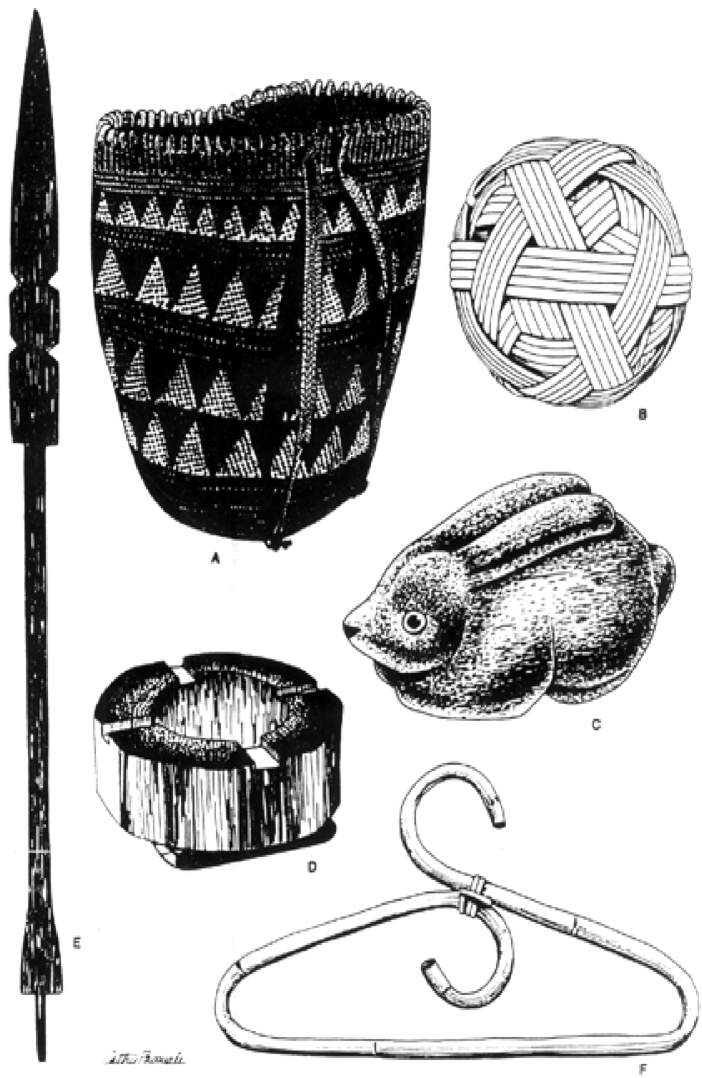

Figure 3-3 ***Artisanal Palm Products III. A. Rattan palm (likely Calamus sp.) shoulder bag, Sarawak, Malaysia; 36 cm high, 21 cm in diameter. B. Rattan palm (likely Calamus sp.) ball, Peninsular Malaysia; 12 cm in diameter. C. Coco bunny, made of coconut palm (Cocos nucifera) husk, Guyana; 17 cm long. D. Ashtray, made of Bactris sp. stem wood, Ecuador; 12 cm in diameter. E. Spear made of Bactris sp. stem wood, Peru; 102 cm long. F. Rattan palm (likely Calamus sp.) coat hanger, country of origin unknown; 41 cm wide, 23 cm high.***

Non-Wood Forest Products

Non-wood forest products as an international development issue derives from attempts to transform traditional high grading of tropical timber into sustainable forest management. Sustainable forest management is only feasible if wood and non-wood products are given full consideration and local needs are acknowledged to be as important as timber or lumber exports. Although the designation "non-wood" appears to exclude them, palm wood, rattans, and bamboo are typically included among non-wood forest products because they are not considered by foresters to be either traditional wood or timber.

Pantropically, non-wood forest products are of local importance as food and raw material sources. An excellent overview of the subject can be found in Nepstad and Schwartzman (1992). Palms represent one of the most important plant families of non-wood forest products. Two examples of studies containing good information on palms as forest products are by Beer and McDermott (1989), who point out the importance of rattans and edible palm products in Southeast Asia; and Falconer and Koppell (1990) who document the significance of palms among the forests products in West Africa.

Integrated Product Development

Integrated product development, as used here, refers to an industrial approach which views primary products, by-products (including waste products) together in seeking ways to achieve greater overall productivity and profit.

As demonstrated in this chapter, individual palm parts are sources of one or more raw materials which can be used in various ways for commercial purposes; therefore, an integrated approach to product development and processing should follow a whole fruit processing approach and include the valorization of by-products to the greatest extent possible. To a major degree, attention has been drawn to integrated product development for practical reasons, with the agroindustries associated with the major domesticated palms taking the lead.

Processing the whole fruit of any of the cocoid palms, the oil palms[5], is an excellent case in point because oil extraction has the potential of generating several useful end products. Depending upon the individual species of oil palm, products include: edible oil, edible starch, mesocarp pulp, edible kernels, industrial oil, dry distillation of husks to obtain acetates, press cake for livestock and shells for conversion to activated charcoal or directly for fuel.

A model of potential applicability to certain of the other oil palms is represented by modern coconut processing technology. This technology takes a whole fruit approach and adopts a wet processing procedure for coconut endosperm which eliminates the traditional intermediary step of making copra prior to producing coconut oil (Hagenmaier, 1980).

In Malaysia, the African oil palm industry is going a step farther and considering the entire palm. In the late 1990s, as Malaysia began replanting extensive areas oil palm, the industry has had to deal with huge quantities of dead oil palm stems and fronds resulting each year from replacement of ageing palms. Studies have been done on their conversion into lumber, fuel, pulp and paper, reconstituted board and animal feed (Khoo *et al*., 1991; Shaari *et al*., 1991). Technologies developed to solve this problem of the African oil palm will have implications throughout the palm family.

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[5] Cocoid palms are those which, according to Dransfield et al. (2008), belong to the Cocoseae tribe within the Arecoideae subfamily. All of the key oil-bearing palms are included, among them the coconut (Cocos nucifera), African oil palm (Elaeis guineensis), pejibaye (Bactris gasipaes var. gasipaes) and babaçu (Attalea speciosa).

Major date growing countries are also considering date palm cultivation in a broader product context. The book by Barreveld (1993) on the date palm devotes an entire chapter to traditional palm products other than date fruits.

To conclude this discussion of recent development trends relative to palm products, it can be restated that numerous palm tree species already provide, or have the potential to provide, more than one subsistence or commercial product; such trees are appropriately referred to as multipurpose palms. Within the framework of natural resource management, sustainable forest management or regional development efforts, it is imperative that the full spectrum of useful palm products from any one palm tree species be taken into account. In that way commercially-valuable and subsistence products can be generated for industrial enterprises and for the benefit of local peoples.

4 ASIAN REGION

The Asian region is an immense area containing the greatest palm species diversity in the world along with the oldest and most assorted types of palm utilization. For the purpose of this chapter, Asia is defined geographically as stretching from Pakistan on the west to Indonesia on the east and north to include China.

Across the region, the level of knowledge about palm systematics and documented examples of particular palm products ranges from excellent to fragmentary. Malaysia represents a country in the former category, Vietnam one of the latter. A World Wide Fund for Nature Asian palm project which focused on India, Indonesia, Malaysia and the Philippines summarized old and generated much new information on conservation and utilization (Johnson, 1991b). Additional investigations are needed to include more countries.

Chapter 4 has been broken down into three separate but interrelated parts to simplify dealing with such a large number of palms. The first part is concerned with the palms of South Asia, i.e. India, Bangladesh, and Sri Lanka; and to a minor degree with Pakistan, Nepal, Bhutan and Sikkim. Part two covers Southeast Asian palms and includes the countries from Myanmar eastward to Indonesia and the Philippines, and southern China. These two regional treatments exclude rattans which are dealt with as a group in a separate third section of this chapter.

The approach in this and the following regional chapters links together utilization and conservation because without such a linkage sustainable resource use can never be achieved. The conservation status of a utilized wild palm is a vital piece of information in any consideration of continued or expanded exploitation. For convenience, palm species are considered to be in one of three conservation categories: threatened, non-threatened or unknown. Except for rattans in this chapter, utilized palms with an unknown conservation status are not discussed because they lack as well reliable information on utilization.

South Asia

The utilized native palms of this region, excluding rattans, were divided into two groups based on their conservation status.

Threatened South Asian Palms

Thirteen species of native South Asian palms were found to be both under threat in the wild and utilized by local people; there are undoubtedly many more. Information on these palms is presented in Table 4-1. The strong relationship between sensitive island habitats and threatened palms is in evidence in Table 4-1 where half the species included occur on islands. One island endemic is also monotypic (i.e. a genus with a single species): *Loxococcus rupicola* in Sri Lanka.

Discussion

Perusal of the palm products in Table 4-1 shows that leaves, petioles and stems are exploited for a variety of end-uses; and fruits, sap and starch provide edible products. All these existing patterns of utilization are for subsistence purposes alone.

Table 4-1 Threatened South Asian Palms with Reported uses (excluding rattans)*

Scientific Names	**Selected Local Names** [1]	**Distribution** [2]	**Products/Uses**
Areca concinna	lenteri	Sri Lanka (endemic)	nuts as betel substitute
Arenga wightii	dhiudasal. alam panel	India: Karnataka, Kerala, Tamil Nadu (endemic to India)	peduncle tapped for sap; stem starch
Bentinckia nicobarica	Nicobar bentinckia palm	India: Great Nicobar Island (endemic)	leaves for thatching and stems as hut pillars
Corypha umbraculifera	condapana; tala	India: Kerala; Sri Lanka	leaves used as umbrellas; edible starch from stem; seeds to make beads; formerly, leaf blades as writing material
Hyphaene dichotoma	oka mundel (Indian doum palm)	India: Gujarat. Maharashtra (endemic to India)	fibrous fruit mesocarp (see Table 9-20 for composition) & unripe kernel eaten; leaves for thatching: stem wood for posts, roof beams & fuel
Licuala peltata	selai pathi, mota pathi	Bangladesh; India: Andaman Islands, Northeast; Sikkim	leaves for thatching & as rain hats. split leaf blades woven into baskets, mats, etc.; stems as pillars
Livistona jenkinsiana	toko pat, takau-araung	India: Northeast; Sikkim	fresh nuts used as masticatory; leaves for thatching & rain hats, stems for hut construction
Loxococcus rupicola (monotypic)	dotalu	Sri Lanka (endemic)	edible palm heart
Oncosperma fasciculatum	katu-kitul	Sri Lanka (endemic)	stem wood for construction ?

Scientific Names	Selected Local Names [1]	Distribution [2]	Products/Uses
Phoenix rupicola	cliff date palm ?	India: Arunachal Pradesh, Meghalaya; Sikkim	starch extracted from stem as famine food
1. *Pinanga dicksonii;* 2. *P.maniii*		1. India: Kerala, Tamil Nadu (endemic to India); 2. India: Andaman & Nicobar Islands (endemic)	1 & 2. stems used for fencing & posts; leaves for thatching; nuts used as betel substitute
Wallichia disticha	tashe	Bangladesh; Bhutan; India: Arunachal Pradesh, West Bengal;, Sikkim	edible stem starch

Notes:

* See also Table under Chapter 13.

1. Other local names are given in some of the sources below.
2. Distribution is within the South Asian region as defined; some species also occur elsewhere.

Sources: Basu. 1991; Basu & Chakraverty, 1994; Blatter, 1926; De Zoysa, 1996; Henderson, 2009; Jolla & Joseph, 1962; Mahabale, 1982; Malik. 1984; Manithottam, 2004; Mathew & Abraham 1994; Renuka, 1999; Sree Kumar & Coomar, 1999

From a utilization standpoint, it should be possible to reduce the exploitation of these threatened palms inasmuch as there are inexpensive alternative sources of the palm products, either from other palm species or other plants.

A combination of utilization and habitat destruction appears to have led to the extinction in the wild of the tara palm (*Corypha taliera*) endemic to West Bengal, India. Leaves were formerly used for tying rafters of houses and leaf blades employed as writing material. Although no longer found in its natural habitat, the tara palm is under cultivation in botanic gardens, affording an opportunity for a reintroduction effort.

On a more positive note, recognition in Thailand of the overexploitation of the naturalized talipot palm (*Corphya umbraculifera*) has led to its inclusion in a list of the protected non-wood forest products. Under forest regulations, small amounts of protected NWFPs can be harvested for subsistence needs, but any commercial exploitation requires a permit (Subansenee, 1995).

Non-threatened South Asian Palms

About the same number of economic palms are not under threat in South Asia. *Nypa fruticans* is included as one of the dozen species in Table 4-2 despite the fact that it is threatened in Sri Lanka and should be given protection there. Sri Lanka represents the western limit of the palm's natural range, where it occurs only in a small estuarine area of the island.

Discussion

The small number of species in Table 4-2 should not be construed as an indication that palms are of minor significance in the region. To the contrary, palms are quite important and provide a great range of different products for subsistence and commercial purposes.

Arenga pinnata, Borassus flabellifer and *Phoenix sylvestris* are all multipurpose species that individually approach the coconut palm in terms of overall utility. One product common to the three palms is sap which is consumed in the form of soft or fermented and distilled alcoholic beverages, made into vinegar or boiled down (when fresh) to yield palm sugar which is comparable chemically to cane, beet or maple sugar. Over many centuries, tapping techniques have been developed which enhance sap flow while minimizing the negative impact on the individual tree. The monotypic *Nypa fruticans* is also a source of sweet sap but it is not as important in South Asia as it is Southeast Asia.

With the exception of *Areca triandra*, all the palms in Table 4-2 are exploited for leaf products of one kind or another. Cottage industries producing hats, bags, mats and other products woven from pliable young palm leaves are common in South Asia and the products are of the highest quality.

The importance of non-wood forest products is officially recognized in Bangladesh where *Nypa fruticans* and *Phoenix paludosa* harvest requires permits from the Forest Department (Basit, 1995).

Two recent studies of *Phoenix sylvestris* in Bangladesh looked at sustainable approaches to sap production, which is an important seasonal subsistence to yield a sweet sap beverage or reduced by boiling to syrup; cottage industry fermented and distilled alcoholic beverages also are made (Chowdhury *et al*., 2008; Halim *et al*., 2008).

Stem starch derived from *Caryota urens* in India represents a food source among some tribal peoples (Anila Kumai and Rajyalakshmi, 2000; Manithottam, 2004). This product is quite similar to the starch from sago palm (*Metroxylon sagu*) in Southeast Asia.

It is obvious that many if not most of these non-threatened palms could be brought under better management and the production of palm products increased on a sustainable basis. Research along these lines is being carried out in South India at the Kerala Forest Research Institute where a project focused on the palm resources of Kerala, their conservation and utilization is ongoing and has produced several excellent publications.

Table 4-2 Non-threatened South Asian Palms with Reported Uses (excluding rattans)

Scientific Names	**Selected Local Names1**	**Distribution2**	**Products/Uses**
Areca triandra	*bon gua*	*India: Andaman Islands, Northeast*	*nuts used as betel substitute*
Arenga pinnata	*gomuti (sugar palm)*	*Bangladesh; India: Andaman Islands, Eastern; Sri Lanka*	*multipurpose palm; sap for sugar & other products; edible immature seed (fresh mesocarp of ripe fruit is filled with irritant needle crystals); edible starch from stem; edible palm heart; leaf base fiber for fish nets, etc., leaflets for weaving baskets, etc., stem wood for various uses*
Borassus flabellifer	*tal, palmyra*	*Bangladesh; India; Sri Lanka*	*multipurpose palm: sap for toddy & sugar; edible mesocarp pulp; edible unripe endosperm, edible palm heart; leaves for thatching; leaflets for weaving, stem wood for construction & fuel, see Table 9-5 and Table 9-6 for composition of sap & sugar*
Caryota mitis; *C. urens*	*2. bherli mad, kittul*	*India: Andaman Islands:* *Bangladesh; India; Nepal; Sri Lanka*	*1. edible starch from stem; leaves for thatching, weaving & decoration, ripe fruits contain irritant poison,* *2. leaf-sheath fiber to make rope, etc.; edible starch from stem; sap for toddy & sugar. edible palm heart; seeds as masticatory & to make beads*
Licuala spinosa	*jungli selai*	*India: Andaman Islands*	*leaves for thatching & clothing*
Livistona jenkinsiana	*?*	*Bangladesh; India; Sikkim;*	*leaves for thatch & hats; edible palm heart*
Nypa fruticans (monotypic)	*golpata*	*Bangladesh; India: Andaman Islands, Orissa, West Bengal; Sri Lanka*	*leaves for thatching, sap from inflorescence for beverage or sugar; mature seeds suitable for vegetable ivory*

Scientific Names	Selected Local Names1	Distribution2	Products/Uses
Phoenix acaulis; *P .loureiri;* *P. paludosa;* *P. pusilla;* *P. sylvestris*	*1. khajur;* *2. khajoor;* *3. hantal;* *4. indi;* *5. thakil (sugar date palm)*	*1. India: Meghalaya, Uttar Pradesh; Nepal; Sikkim;* *2. India: Kerala, Uttar Pradesh; Nepal; Pakistan;* *3. Bangladesh; India: Andaman Islands, Bengal, Orissa; Bangladesh;* *4. India:Tamil Nadu; Sri Lanka;* *5. India (common); Nepal*	*1. edible fruit, heart & stem starch; leaf fiber for ropes, leaves for thatching;* *2. leaves woven into mats & to make brooms; edible fruit; starch from stem; medicinal use of palm heart;* *3. stem wood for construction, leaves for thatching & to make brooms, leaf fiber to make rope, edible fruit?;* *4. edible fruit, leaves woven into mats and baskets; split petiole to make baskets; edible starch from stem;* *5. multipurpose palm: sap from stem as beverage & to make sugar, edible fruit: leaves made into brooms or woven into baskets & mats; stem wood for fuel*

Notes:

1. Other local names are given in some of the sources cited.

2. Distribution is within the South Asian region as defined; some species also occur elsewhere.

Sources: References for Table 4-1 and in addition: Anila Kumai, & Rajyalakshmi, 2000; Basit, 1995; Chowdhury et al., 2008; Davis, 1972, 1988; Davis & Johnson, 1987; Davis & Joel, 1989; De Zoysa, 1992; Dissanayake, 1986; Dowe, 2009; Francis, 1984; Ghosh & Ghose, 1995; Halim, et al., 2008; Kovoor, 1983; Miller, 1964; Padmanablian & Sudhersan, 1988; Pongsattayapipat & Barfod, 2005; Renuka, 1999; Seneviratne et al., 2007

If information were available on its conservation status, the useful mazari palm (*Nannorrhops ritchiana*), a monotypic palm, would probably be included in Table 4-2. This monotypic palm is native to arid portions of northwestern India, Pakistan and westward to the Arabian Peninsula, and has a variety of uses. For example: leaves are woven into mats and baskets, made into fans and brushes, and have medicinal use; stems, leaves and petioles serve as fuel; young leaves and inflorescences, as well as the heart and fruit are eaten; and seeds are made into beads. Gibbons and Spanner (1995) described this palm and its utilization in Pakistan.

Southeast Asia

Native palms currently reported to be exploited in Southeast Asia also have been broken down into threatened and non-threatened species lists. Considerable knowledge gaps exist about palms in this very diverse area, especially in Myanmar, Thailand, the countries of the former Indochina and the Indonesian province of Papua on the island of New Guinea.

Threatened Southeast Asian Palms

A total of 22 palm species, belonging to 13 genera, are listed in Table 4-3. More than one-half of these species are endemic palms and most countries in the region are represented. They are, therefore, fairly representative of the situation.

Three genera are among the largest non-rattan palm genera in Asia: *Licuala* about 134; *Pinanga* has around 131 and *Areca* approximately 47 species. Each genus has numerous species for which conservation data are lacking and there is justifiable concern that when data are available the results will be alarming and show that most are also threatened. The reason for this concern is that the habitat of all three genera is the undergrowth of tropical forests, and Southeast Asian forests are under intense pressure from logging, shifting cultivation and conversion to permanent agriculture or grazing, resulting in deforestation and degradation on a massive scale.

Another aspect of the genera in Table 4-3 is that several species of *Areca, Arenga, Caryota, Eugeissona, Licuala, Livistona, Phoenix* and *Pinanga* also appear in Table 4-4 among the listing of non-threatened palms. Inasmuch as palm genera have distinctive individual habitat requirements, the linkage between threatened and non-threatened congeneric species needs to be kept in mind in promoting palm products. In other words, it is not sufficient to know that an individual species is not threatened; taking into account other species (which often yield similar products) is the safest approach to follow.

Discussion

Food and non-food products are about equally represented in Table 4-3 and appear to be solely for subsistence purposes. Some palm utilizations are relatively benign, such as collecting the fruits of *Pinanga* spp. and other *Areca* spp. as a substitute for the cultivated betel nut (*Areca catechu*). Leaf harvest for thatching and other end uses may or may not be of concern, depending upon the intensity of the practices.

Table 4-3 Threatened Southeast Asian Palms with Reported Uses (excluding rattans)*

Scientific Names	**Selected Local Names1**	**Distribution2**	**Product/Uses**
1. Areca hutchinsoniana; 2. A. ipot; 3. A. macrocarpa; 4. A. .parens	*1. bunga; 2. bungang-ipot; 3. bungang-lakihan; 4. takobtob*	*1. Philippines: Mindanao, 2. Luzon, 3. Zamboanga, 4. Luzon (each species in endemic)*	*nuts as occasional betel substitute; edible palm heart*
Arenga hastata	*mudor*	*Borneo; Malaysia: Peninsular*	*leaf sheath as knife sheath*
Borassodendron borneense	*bidang*	*Borneo (endemic)*	*edible palm heart & immature fuit endospcrm; stem sawn into boards for house construction*
1. Carvota no; 2. C. rumphiana	*1. entibap mudol; 2. takipan*	*1. Borneo (endemic); 2. Indonesia; Moluccas, Papua; Philippines: Luzon;*	*1. edible stem starch & palm heart leaf-sheath fiber for tinder & to make fishing line, etc.; 2. edible palm heart*
Eugeissona brachystachys	*tahan bertam*	*Malaysia: Peninsular (endemic)*	*edible stem starch; leaves for thatching; edible immature endosperm; petioles to make darts etc.*
Heterospathe elmeri		*Philippines: Camiguin (endemic)*	*nuts as betel substitute; edible palm heart*
Johannesteijsmannia altifrons; J. lanceolata, J. magnifica, J. perakensis	*1. sal*	*1. Indonesia: Sumatra; Malaysia: Peninsular, Sarawak; Thailand 2. Malaysia: Peninsular (all endemic)*	*1. leaves for thatching roots & walls; fruits in medicine, 2. seed collected for ornamental planting*

Scientific Names	Selected Local Names1	Distribution2	Product/Uses
Licuala fatua; *L. orbicularis*	*1. cay trui;* *2. biru balat*	*1. Vietnam: Ila Nam Ninh, Tua Thien (endemic);* *2. Malaysia: Sarawak (endemic)*	*1. stems to make tool handles;* *2. leaves for wrapping, making hats, umbrellas & thatching*
Livistona robinsoniana		*Philippines: Polillo (endemic)*	*leaves for thatching, stems as posts*
Orania sylvicola	*iwul*	*Indonesia: Java, Sumatra; Malaysia: Peninsular, Sarawak; Thailand*	*stem wood for construction poisonous heart & fruit (said to apply to all Orania species)*
Phoenix loureiroi var. loureiroi	*voyavoy*	*Philippines: Batanes Islands*	*leaves to make thatched raincoat; leaflets woven into mats*
Pholidocarpus kingianus; *P. macrocarpus*	*2. serdang*	*Malaysia: Peninsular (endemic);* *Malaysia: Peninsular; Thailand*	*1 & 2. stems for pilings & timber; leaves for thatching*
Pinanga cochinchinensis; *P. duperreana;* *P. punicea var. punicea*	*cao cuóc cluóc;* *sla condor*	*1. Vietnam (endemic);* *2. Cambodia; Laos; Vietnam;* *3. Indonesia: Moluccas, Papua*	*1. fruit used as fish bait, leaves to make mats & sails;* *2. edible palm heart; nuts as betel substitute;* *3. leaves to make mats & sails*

Notes:

* See also Table under Chapter 13.

1. Other local names are given in some of the sources cited.

2. Distribution is within the southeast Asian region as defined; some species also occur elsewhere.

Sources: Brown & Merrill. 1919; Burkill, 1966; Davis, 1988; Dransfield et al., 2008; Fernando, 1990; Gagnepain, 1937; Guzman & Fernando,1996; Henderson, 2009; Kiew 1991; Madulid, 1991a.b; Mogea, 1991; Pearce, 1991,1994; Whitmore, 1973.

The spectacular umbrella leaf palm (*Johannesteijsmannia altifrons*) is a case in point. Sometimes referred to as nature's answer to corrugated iron, the very large undivided leaves are up to 3 m long and 1 m wide. Highly prized for thatching roofs and walls (which last 3-4 years) the leaves are cut and sold for this purpose in Peninsular Malaysia. As long as 2-3 leaves are left on each plant, the practice may be sustainable (Kiew, 1991). However, little is known about the flowering and fruiting characteristics of palms in this genus; periodic leaf harvest could, over time, adversely affect fruit production and lead to a decline in natural regeneration. This biological factor is apart from habitat destruction; these palms require an understory forest habitat. In addition, illegal seed collection and export of these highly-desirable ornamental palms is having detrimental effects on the wild populations in Peninsular Malaysia.

The most destructive exploitation of threatened palms occurs in extracting edible palm hearts and edible stem starch for the trees are destroyed in the process. In some instances it appears that palm heart extraction is associated with felling a tree for some other purposes such as to obtain stem wood or starch; it is therefore sometimes a "salvage" product, to use the term introduced in Chapter 3.

By and large, the products derived from palms in Table 4-3 are for subsistence needs and alternative sources could and should be suggested where the current exploitation is having a serious negative impact on wild palm populations.

Non-threatened Southeast Asian Palms

The full range of palm utilization in Southeast Asia is represented in Table 4-4 which lists 40 species in 18 genera. Geographic coverage is complete as every country in the region is included, although with varying completeness. The table is a clear indication of the fact that Southeast Asia has both the highest palm species diversity and the greatest variety of palm utilization of anywhere in the world.

Arenga, Phoenix, Pinanga and *Salacca* species account for around one-half of the entries in the table. The palm genera *Eleiodoxa* and *Eugeissona* occur only in Southeast Asia.

Discussion

Table 4-4 includes six major economic palm species, each one worthy of individual attention. They are: *Arenga pinnata, Borassus flabellifer, Corypha utan, Metroxylon sagu, Nypa fruticans* and *Salacca zalacca*. These and additional species are discussed further in Chapter 8 as candidates for greater management and/or outright domestication.

Arenga pinnata. The aren or sugar palm is a multipurpose solitary palm species which finds its greatest utility in Southeast Asia. Miller (1964) provides an excellent summary of the economic uses of the palm. Known chiefly as a source of sap derived from tapping the inflorescence to make sugar and a provider of edible starch from the trunk, the sugar palm grows in humid forest areas and under drier conditions. The fruit of the sugar palm fruit merits special attention because although the immature endosperm is edible, the mesocarp pulp of ripe fruits contains irritating needle crystals which make them inedible. Black coarse leaf-base fiber is used for a variety of subsistence and commercial uses, such as rope and fishnets, because of its durability and resistance to the action of sea water. Recently, the physical properties of fiber have been studied for their use in reinforced epoxy composites, with encouraging results (Sastra *et al*., 2005, 2006).

The growth habit of the sugar palm is notable with respect to its products. The palm is hapazanthic, i.e. it flowers at about 10 years of age and dies. The harvestable quantities of sap and starch represent the tree's stored nutrients for the protracted flowering and fruiting which extends over a period of about two years.

Table 4-4 Non-threatened Southeast Asian Palms with Reported Uses (excluding rattans)

Scientific Names	**Selected Local Names**	**Distribution'**	**Products/Uses**
Areca macrocalyx; *A. triandra*	*2. cau rung (Viet)*	*1. Indonesia: Papua;* *2. Cambodia; Indonesia; Lao; Malaysia: Peninsular; Myanmar; Philippines; Thailand; Vietnam*	*1. (inferred) nut as betel substitute; edible heart; leaves for thatch:* *2. nut as betel substitute*
Arenga microcarpa; *A. obtusifolia;* *A. pinnata;* *A. tremula;* *A. undulatifolia*	*2. langkap (Pen Mal.)* *3. aren;* *4. dumayaka (Phil);* *5. aping*	*1. Indonesia: Papua;* *2.;Indonesia: Java, Sumatra; Malaysia: Peninsular;* *3. widespread;* *4. Philippines: Luzon;* *5. Borneo; Indonesia: Sulawesi; Philippines: Sulu*	*1. edible palm heart;* *2. edible palm heart & endosperm;* *3. multipurpose palm: sap for sugar & other products; edible immature seed (fresh mesocarp of ripe fruit is filled with irritant needle crystals) edible stem starch, palm heart leaf-base fiber for fish nets, in composition board etc.; leaflets for weaving baskets, etc.; stem wood for various uses* *4. petiole split to make baskets;* *5. edible stem starch (Sarawak) & other products*
Borassus flabellifer	*lontar*	*widespread as native & cultivated species*	*multipurpose palm: sap for toddy & sugar; edible mesocarp pulp; edible unripe endosperm; edible palm heart; leaves for thatching; leaflets for weaving, stem wood for construction & fuel*

Scientific Names	**Selected Local Names**	**Distribution'**	**Products/Uses**
Caryota mitis; *C. rumphiana*	*1. mudor (Sar);* *2. sagu moro (Irian)*	*1. Brunei; China: Hainan Island (where it is threatened); Indonesia: Java, Sulawesi; Malaysia: Peninsular, Sarawak; Myanmar; Thailand; Vietnam;* *2. Indonesia: Moluccas, Papua*	*1 & 2. edible palm heart & stem starch*
Corypha lecomtei; *C. utan*	*1. la buong (Viet);* *2. gebang, hurt*	*1. Thailand; Vietnam* *2. Indonesia: Java, Kalimantan, Sulawesi, Sumatra; Malaysia: Peninsular, Sabah; Philippines*	*1. leaves for thatching & weaving mats, sails and bags; petiole to make arrows & walking sticks; edible stem starch: fruits as fish poison,* *2. stem starch as food & medicine; sap from inflorescence for wine & sugar; edible palm heart; edible fruit (see Table 9-14 for nutritional composition); leaves for thatching & weaving mats, baskets & fans*
Eleiodoxa conferta	*kelubi*	*Brunei; Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Singapore; Thailand*	*fruit used to make pickles & relishes; edible palm heart; leaves for thatching & to make mats*
Eugeissona tristis; *E. utilis*	*1. bertam;* *2. nanga*	*Malaysia: Peninsular; Thailand;* *Borneo*	*1. leaves for thatching & to make fish traps; edible immature fruit;* *2. stem starch; edible palm heart, purple flower pollen used as condiment; leaves for thatching, split petiole to make darts*

Scientific Names	Selected Local Names	Distribution'	Products/Uses
Hydriastele costata	*limbun*	*Indonesia: Moluccas, Papua*	*stems for floor and wall boards; inflorescence used as brush; leaf sheath of crown shaft folded to make buckets & baskets and to wrap food*
Licuala peltata; *L. spinosa*	*1 & 2. palas (Indon)*	*1. Myanmar; Thailand* *2. Brunei; China; Indonesia: Java, Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Philippines; Thailand*	*1 & 2. leaves for thatching & to wrap food*
Livistona rotundifolia	*serdang*	*Borneo; Indonesia: Moluccas, Sulawesi; Philippines*	*leaves for thatching and to wrap food*
Metroxylon sagu	*sagu*	*Indonesia: Moluccas, Papua; Philippines: Mindanao*	*stem starch; leaves for thatching, petioles & stem wood for construction, etc.*
Nypa fruticans (monotypic)	*nipah, atap*	*widespread in coastal areas*	*leaves for thatching & weaving; sap from inflorescence for beverage, sugar or alcohol; immature seeds edible, mature seeds suitable for vegetable ivory; leaflet epidermis to make cigarette wrapper; leaf powder as corrosion inhibitor of zinc*

Scientific Names	**Selected Local Names**	**Distribution'**	**Products/Uses**
Oncosperma horridum; *O. tigillarium*	*1. bayas (Malay), bayeh (Indon),* *2. nibong (Malay)*	*1. Brunei; Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Philippines; Thailand* *2. Brunei; Cambodia; Indonesia: Java, Kalimantan. Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Philippines; Vietnam*	*1 & 2. whole stems resistant to sea water, used in construction; stems split into strips to make fish traps, floor & wall coverings, etc.; leaves to weave baskets; nuts as betel substitute; edible etc.; leaves to weave baskets; nuts as betel substitute; edible palm heart*
Phoenix acaulis; *P. loureirii;* *P. paludosa;* *P. sylvestris*	*2. bua cha la (Viet);* *3. cay cut chut (Viet)*	*1. Myanmar; Thailand; Vietnam;* *2. China; Thailand;* *3. Indonesia: Sumatra; Malaysia: Peninsular; Thailand; Vietnam;* *4. Myanmar*	*1. edible fruit leaf fiber for ropes leaves for thatching;* *2. edible fruit; other uses likely;* *3. edible fruit and palm heart; leaves for temporary fencing;* *4. (inferred) multipurpose palm sap from stem as beverage & to make sugar: edible fruit; leaves made into brooms or woven into baskets & mats; stem wood for fuel*
Pigafetta filaris	*wanga*	*Indonesia: Moluccas, Papua, Sulawesi*	*whole stems used in construction, split or sawn into flooring & hollowed for water pipe, to make furniture*
Pinanga, caesia; *P. coronata;* *P. crassipes;* *P. mooreana;* *P. scortechinii;* *P. simplicifrons*	*Pinarig, in general*	*1. Indonesia: Sulawesi (endemic);* *2. Indonesia: Java, Sumatra;* *3. Malaysia: Sabah, Sarawak;* *4. Brunei; Malaysia: Sarawak;* *5. Malaysia: Peninsular; Thailand;* *6. Brunei; Indonesia: Sumatra Malaysia: Peninsular, Sarawak*	*(in general) leaves for thatching; stems as laths, nuts sometimes chewed as betel substitut*

Scientific Names	**Selected Local Names**	**Distribution'**	**Products/Uses**
Salacca affinis; *S. glabrescens;* *S. vermicularis;* *S. wallichiuna;* *S. zalacca*	*1. salak, ridan (Sar);* *2. salak;* *3. kepla;* *5. salak*	*1. Brunei; Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular. Sabah, Sarawak;* *2. Malaysia: Peninsular; Thailand;* *3. Borneo;* *4. Cambodia; China; Lao; Malaysia: Peninsular; Myanmar; Thailand; Vietnam ;* *5. Indonesia: Java, Sumatra*	*1. edible fruit & palm heart; flexible end of rachis as fishing rod;* *2. edible fruit;* *3. edible fruit and palm heart;* *4. fruit used in curry; petioles for fishing rods;* *5. edible fruit (see Table 9-25 for nutritional composition) leaves for fencing & decoration*
Trachycarpus fortunei	*chusan*	*China (endemic)*	*leaf-base fiber to make rope, mats, brushes; leaves for thatching & to weave fans, hats, chairs; fruit wax to make polishes, etc., seed source of hemostatic drug; roots, leaves & flowers contain medicinal compounds; stems as house pillars, edible flowers; seeds as animal fodder*

Notes:

1. Other local names are given in some of the sources cited.

2. Distribution is within the Southeast Asian region as defined; some species also occur elsewhere.

Sources: References for Table 4-3 and in addition: Ashari, 2002; Barrow, 1998; Davis, 1988; Davis & Kuswara, 1987; Davis et al., 1990, Dransfield, 1977; Dransfield & Johnson, 1991; Ellen, R., 2004; Essig, 1982; Essig & Dong, 1987; Fong, 1989,1991: Fox, 1977; Hay, 1984; House, 1983; Kovoor, 1983; Lubeigt, 1977; Miller, 1964; Mogea et al., 1991, O'Brien & Kinnaird, 1996, Orubite-Okorosaye & Oforka, 2004; Rotinsulu, 2001; Ruddle el al., 1978; Sastra et al., 2006; Sastrapradja et al., 1978; Schuiling, 2009; Yaacob & Subhadrabandhu, 1995.

Borassus flabellifer. The lontar palm is a multipurpose species, also a solitary palm, in Southeast Asia just as it is in South Asia. However, its uses do not quite reach the diversity found in South Asia. This is documented by Fox (1977) who studied two different culture groups which make considerable use of the palm on the Indonesian islands of Roti and Madura. As a sugar source, lontar has been studied in great detail by Lubeigt (1979) in central Myanmar. The lontar is a palm of dry environments and is tolerant of poor soils. Its major drawback as an economic palm is that it is a single-stemmed species.

Corypha utan. This palm has a very wide distribution in Asia, most often in drier more open areas. It typically is found in association with settlements, suggesting that humans may have contributed to its current geographic range. A large single-stemmed tree, the gebang palm shares with the sugar palm a terminal-flowering habit and also its main economic products of sweet sap and stem starch. The gebang has very large fan-shaped leaves with numerous uses.

Metroxylon sagu. The sago palm is most notable in the region as a subsistence source of stem starch in areas of its occurrence in Indonesia and the Philippines. A tropical peat swamp palm, sago occupies a largely undesirable habitat as far as competing land use is concerned. Centuries ago, sago was introduced from farther east to Borneo and Malaya, apparently by migrating peoples. Today it can be found in a semi-wild or cultivated state where suitable habitat exists. Anyone seeing the extensive sago areas in Sarawak, and the dependence of local people on it for starch and various other projects, would find it difficult to believe that the palm is not native. This hapazanthic suckering palm is discussed in more detail in Chapter 5.

Nypa fruticans. Nipa is solely a mangrove palm and its distribution is centered in Southeast Asia. Although sago and nipa occupy somewhat similar habitats, the former grows in fresh water swamps, the latter brackish water environments along the coast. Major economic products are sap for sugar or alcohol and leaves for thatching. Panels of nipa thatch (atap) are in common use wherever the palm occurs. Hamilton and Murphy (1988) studied the general use and management of nipa over its broad range and Fong (1992) has done field studies on nipa management in Peninsular Malaysia and tapping in Sarawak (Fong, 1989). Nypa apears to have some industrial use as well, as evidenced by research showing that an extract from the leaves inhibits zinc corrosion (Orubite-Okorosaye and Ofokra, 2004).

Salacca zalacca. The salak palm is a forest undergrowth species primarily important for its edible fruit, which is obtained from wild and cultivated plants. As indicated in Table 4-4, several other species also have edible fruits, but fruit from *S. zalacca* is the largest and sweetest. Salak fruit is very popular in Indonesia where it is consumed fresh and is canned for domestic and export markets. According to Mogea (1991) 15 local trade names exist for salak fruits based upon quality and fruit characteristics. In Thailand, clones of what is believed to be *S. wallichiana* are under cultivation (Yaacob and Subhadrabandu, 1995). Ashari (2002) provides excellent information on the agronomy and botany of salak. The preceding references provide detailed information on cultivating salak which is recommended for home gardens. A new study has shown that salak fruits have antioxidant properties, which could be a boon to promoting the fruit (Aralas, *et al*., 2009).

As for the remaining palms in Table 4-4 the use pattern is similar to that of Table 4-3 in that food and non-food items have about equal weight. *Eugeissona utilis* is what might be termed a minor multipurpose palm as indicated by the variety of uses listed in Table 4-4. However, they represent predominantly subsistence uses by indigenous peoples who sometimes (in Sarawak) plant the palm near their houses.

In addition to being used for thatching and to weave a variety of products, certain fan palm leaves provide cheap food-wrapping material. *Licuala peltata*, one form of which has undivided leaves, and *Livistona rotundifolia*, with shallowly-divided leaves, are good examples. Almost everywhere that palm leaves are cut from wild plants, for whatever end use, there is a tendency to harvest an excessive number of leaves per plant, in large part to minimize walking distances.

The effect of leaf harvest of *Livistona rotundifolia* was the subject of a study in North Sulawesi, Indonesia. The study confirms assumptions about the adverse impact of over-harvesting of leaves. Research results showed that leaves on harvested plants grew faster but reached a smaller final leaf size than on unharvested plants. A census of harvested and unharvested palm populations showed that palm density was twice as high and there were ten times as many reproductive-sized palms in unharvested areas (O'Brien and Kinnaird, 1996).

Together the four members of the genus *Phoenix* in Table 4-4 occur widely in Southeast Asia and are common sources of food and non-food subsistence items. These palms persist in many areas because they are adapted to disturbed habitats, can grow on drier sites with poor soils and produce basal suckers which are a major factor in their natural regeneration.

The wanga palm (*Pigafetta filaris*) is a somewhat unusual palm in that it is a pioneer species which colonizes disturbed habitats where it is native in Indonesia and Papua New Guinea. Although its chief economic value is a source of stem wood for construction and to make furniture (Rotinsulu, 2001) , *P. filaris* is also esteemed as an elegant ornamental palm. Davis and Kuswara (1987) studied the biology of this palm in Indonesia.

Trachycarpus fortunei is well known as an ornamental palm grown in the middle latitudes because of its cold tolerance. The palm also turns out to be a drug source in China as well as the origin of several other products (Essig and Dong, 1987).

As more information becomes known about the use of palms in southern China (and the former Indochina), other examples can be expected to be added to any future list of economic palms.

Asian Rattans

Rattans are first and foremost important as commercial and subsistence sources of cane, the rattan stem. The stem, after stripping off its leaf sheaths, provides the raw material for the cane furniture industry. Depending on the species, the diameter of canes is from about 3 mm to 60 mm or more. In the rattan industry, canes are graded on the basis of seven basic factors: diameter, length of cane, color, hardness, defects and blemishes, length of nodes and uniformity of thickness (UNIDO, 1983).

Another way to characterize rattans is based solely on their diameter: canes are referred to as "large" if they have a diameter above 18 mm; "small" canes are those below that diameter. Large canes are used whole to make the frames of cane furniture. Whole small canes are also used as struts in some furniture, but more often they are split and used to weave the chair back (Dransfield, 1988).

Three desirable properties characterize rattan canes. One, they are solid (unlike bamboo which are typically hollow) and hence very strong. Two, by the application of heat, most rattans can be bent into and will hold various shapes without deformation. Three, canes can be lacquered to preserve their natural light color or can also be stained or painted.

In addition to its use in furniture making, split cane furnishes material for handicraft and cottage industries to make baskets, mats, bags, hats, fish traps and a host of other products. Rattans are also employed as cordage for tying and binding. The case study (Chapter 2) of the Iban in Sarawak, Malaysia demonstrates how very useful rattans are to indigenous people.

The rattans of Asia belong to the following nine genera: *Calamus, Ceratolobus, Daemonorops, Korthalsia, Myrialepis, Plectocomia, Plectocomiopsis, Pogonotium* and *Retispatha*. Around 533 rattan species have been described, with *Calamus* and *Daemonorops* representing about 90% of the total. These figures include useful and not used canes.

Nearly all rattan canes continue to come from wild plants. However, in the coming years rattan cultivation, along with some form of rattan management, is playing an increasing role in providing sources of raw canes and in turn relieving pressure on threatened wild populations.

Rattan canes represent the palm family's most valuable non-wood forest product. At the same time rattans, as a group, are exceedingly difficult to generalize about because of incomplete data on distribution patterns and conservation status as well as the confusion which exists between local or trade names on the one hand and scientific names on the other.

Following the general approach used for South and Southeast Asia palms, rattans are divided into two groups on the basis of whether they are known to be threatened or not threatened in the wild. Utilization information on these rattans is incomplete, but it was deemed best in include them when there was some doubt, with the assumption that some present or future utility was likely. This approach seemed to be a better alternative than omitting many rattan species altogether.

A rough count shows that three out of four rattans lack information about their conservation status. Dozens of these species are known to have utility as cane sources. In order to include and consider all such rattans, a third group was created consisting of rattans known to be utilized but with an unknown conservation status.

Threatened Asian Rattans

As climbing palms, rattans need trees for support and hence deforestation leads to their destruction. But most rattans can and do survive in areas of timber harvesting or partial land clearing where some tree cover remains. Secondary forest supports rattan growth, but the rattans do not reach their maximum length and diameter, as they do in primary forest.

Cutting wild rattans is a destructive exploitation comparable to felling palms for stem starch, construction wood or palm heart. Exploitation of rattans for commercial and subsistence purposes appears to be a major factor which has placed so many species at risk.

At least 127 rattan species are known to be threatened in the wild and these are presented in Table 4-5 below.

Table 4-5 Threatened Asian Rattans*

Scientific Names	**Selected Local Names1**	**Distribution2**
Calamus adspersus	*?*	*Indonesia: Java, Sumatra*
*Calamus andamanicus**	*mofabet*	*India: Andaman Islands (endemic)*
Calamus asperrimus	*rotan leulues*	*Indonesia: Java*
*Calamus bacularis**	*wi tulang*	*Malaysia: Sarawak (endemic)*
Calamus bicolor	*lasi, rasi*	*Philippines: Mindanao*
Calamus brandisii	*vanthai*	*India: Karnataka, Kerala, Tamil Nadu (endemic)*
Calamus ceratophorus	*ui sông*	*Vietnam: Phu Khanh*
*Calamus ciliaris**	*hoe cacing*	*Indonesia: Java, Sumatra*
Calamus cockburnii	*?*	*Malaysia: Pahang, Peninsular (endemic)*
Calamus conjugatus	*wi janggut*	*Malaysia: Sarawak (endemic)*
Calamus corneri	*rotan perut ayam*	*Malaysia: Peninsular (endemic)*
Calamus crassifolius	*wi takong*	*Malaysia: Sarawak (endemic)*
*Calamus cumingianaus**	*douung-douung*	*Philippines: Luzon*

Scientific Names	**Selected Local Names1**	**Distribution2**
Calamus delessertianus	*ottamoodan*	*India: Southwest*
Calamus delicatulus	*nara wel*	*Sri Lanka (endemic)*
*Calamus densiflorus**	*rotan kerai*	*Malaysia: Peninsular; Singapore; Thailand*
Calamus digitatus	*kukulu wel*	*Sri Lanka (endemic)*
Calamus dilaceratus	*?*	*India: Andaman Islands (endemic)*
*Calamus dimorphacanthus**	*lambutan, tandulang-montalban*	*Philippines: Luzon*
Calamus dioicus	*rani*	*Vietnam*
*Calamus discolor**	*halls, kumaboy*	*Philippines: Luzon*
Calamus dongnaiensis	*long-tchéou*	*Thailand; Vietnam: south*
Calamus dransfieldii	*?*	*India: Kerala*
Calamus endauensis	*?*	*Malaysia: Peninsular (endemic)*
Calamus filipendulus	*rotan batu*	*Malaysia: Peninsular (endemic)*
Calamus foxworthyi	*?*	*Philippines: Palawan*
Calamus gamblei	*pacha chural*	*India: Southwest*
Calamus godefroyi	*phdau tuk*	*Cambodia; Thailand; Vietnam*
*Calamus grandifolius**	*saba-ong*	*Philippines: Luzon*

Scientific Names	**Selected Local Names1**	**Distribution2**
Calamus guruba	*?*	*Bangladesh; Bhutan; Cambodia; China; India; Lao; Malaysia: Peninsular; Myanmar; Thailand; Vietnam;*
Calamus harmandii	*?*	*Lao; possibly Thailand; Vietnam*
Calamus henryamus	*than-moï*	*Vietnam: Ha Bac, Lang Son*
Calamus hepburnii	*?*	*Malaysia: Sabah (endemic)*
Calamus holttumii	*rotan perut ayam*	*Malaysia: Peninsular (endemic)*
Calamus hookerianus	*velichural*	*India: Southwest*
Calamus hypertrichosus	*?*	*Indonesia: Kalimantan; Malaysia: Sarawak.*
*Calamus inops**	*rotan tohiti*	*Indonesia: Sulawesi*
Calamus jenningsianus	*lagipi*	*Philippines: Mindoro*
Calamus karuensis	*rotan penjalin rawa*	*Indonesia: Sumatra*
Calamus kjellbergii	*?*	*Indonesia: Sulawesi*
*Calamus koordersianus**	*rotan boga*	*Indonesia: Sulawesi*
*Calamus laevigatus var. serpentinus**	*rotan tunggal*	*Malaysia: Sabah (endemic)*
Calamus laxissimus	*?*	*Malaysia: Peninsular (endemic)*
*Calamus longispathus**	*rotan kunyung*	*Malaysia: Peninsular (endemic)*

Scientific Names	**Selected Local Names1**	**Distribution2**
Calamus manan#	*rotan manau*	*Borneo; Malaysia: Peninsular; Indonesia: Sumatra; Thailand*
*Calamus megaphyllus**	*banakbo*	*Philippines: Leyte*
Calamus melanoloma	*rotan gelengdage*	*Indonesia: Java*
*Calamus melanorhynchus**	*dalimban*	*Philippines: Mindanao*
Calamus merrillii#	*palasan*	*Philippines: Luzon*
Calamus metzianus	*ela wewel*	*India: Southwest; Sri Lanka*
*Calamus minahassae**	*datu*	*Indonesia: Sulawesi*
Calamus minutus	*?*	*Malaysia: Peninsular (endemic)*
*Calamus mitis**	*matkong*	*Philippines: Babuyan, Batanes*
Calamus moorhousei	*?*	*Malaysia: Peninsular (endemic)*
*Calamus moseleyanus**	*sarani*	*Philippines: Basilan, Malanipa*
*Calamus multinervis**	*balala*	*Philippines: Mindanao*
Calamus nagbettai	*nag betta*	*India: Southwest*
Calamus nicobaricus	*tchye*	*India: Great Nicobar Island (endemic)*
Calamus nielsenii	*?*	*Malaysia: Sarawak (endemic)*
Calamus ovoideus#	*thudarena*	*Sri Lanka (endemic)*
Calamus pachystemonus	*kukulu wel*	*Sri Lanka (endemic)*

Scientific Names	**Selected Local Names1**	**Distribution2**
Calamus padangensis	*?*	*Malaysia: Peninsular (endemic)*
Calamus palustris	*rong*	*Cambodia; India: Anadaman Islands; Lao; Malaysia: Peninsular; Thailand; Vietnam*
Calamus penicillatus	*rotan batu*	*Malaysia: Peninsular (endemic)*
Calamus poensis	*?*	*Malaysia: Sarawak (endemic)*
Calamus poilanei	*u pôn*	*Lao; Thailand; Vietnam: Lam Dong, Phu Khanh*
Calamus pycnocarpus	*rotan kong*	*Malaysia: Peninsular (endemic)*
Calamus radiatus	*kukulu wel*	*Sri Lanka (endemic)*
Calamus radulosus	*?*	*Malaysia: Peninsular; Thailand*
Calamus rhabdocladus	*r'sui*	*China; Vietnam: Dong Nai, Lam Dong, Phu Khanh; Lao*
Calamus ridleyanus	*rotan kerai*	*Malaysia: Peninsular; Singapore (endemic to Malay Peninsula)*
Calamus robinsonianus	*?*	*Indonesia: Moluccas*
Calamus rotang	*cheruchural*	*India: Southern; Sri Lanka*
*Calamus scortechinii**	*rotan demuk*	*Malaysia: Peninsular (endemic)*
*Calamus sedens**	*rotan dudok*	*Malaysia: Peninsular; Thailand*
*Calamus semoi**	*wi tut*	*Malaysia: Sarawak (endemic)*
Calamus senalingensis	*?*	*Malaysia: Peninsular (endemic)*

Scientific Names	**Selected Local Names1**	**Distribution2**
Calamus setulosus	*rotan kerai*	*Malaysia: Peninsular (endemic)*
*Calamus simplex**	*rotan kerai gunung*	*Malaysia: Peninsular (endemic)*
Calamus spectabilis	*ombol*	*Indonesia: Java, Sumatra*
Calamus spectatissimus	*rotan semut*	*Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular; Thailand*
*Calamus symphysipus**	*rotan umbol*	*Indonesia: Sulawesi; Philippines: Bucas Grande, Catanduanes*
Calamus tanakadatei	*rotan tekok*	*Malaysia: Peninsular (endemic)*
Calamus thwaitesii	*pannichural*	*India: Southwest; Sri Lanka*
Calamus thysanolepis	*cây mai*	*China; Vietnam: Thanh Hoa*
*Calamus trispermus**	*?*	*Philippines: Luzon*
Calamus usitatus	*?*	*Philippines: Nueva Vizcaya; Pangasi*
Calamus vattayila	*vattayila*	*India: Southwest*
*Calamus vidalianus**	*yantok*	*Philippines: Luzon*
Calamus vinosus	*yaming*	*Philippines: Mindanao*
Calamus walkeri	*may dang*	*China; Vietnam*
*Calamus warburgii**	*?*	*Papua New Guinea*
Calamus whitmorei	*?*	*Malaysia: Peninsular (endemic)*
Calamus wightii	*soojibetha*	*India: Tamil Nadu (endemic)*

Scientific Names	**Selected Local Names1**	**Distribution2**
Calamus zeylanicus	*thambotu wel*	*Sri Lanka (endemic)*
Ceratolobus glaucescens	*rotan beula*	*Indonesia: Java*
Ceratolobus kingianus	*rotan jere landak*	*Malaysia: Peninsular (endemic)*
Ceratolobus pseudoconcolor	*rotan omas*	*Indonesia: Java, Sumatra*
Daemonorops acamptostachys	*daun wi, rotan dudok*	*Malaysia: Sabah, Sarawak; Indonesia: Kalimantan*
Daemonorops affinis	*bag-bag*	*Philippines: Mindanao*
*Daemonorops clemensiana**	*?*	*Philippines: Mindanao*
*Daemonorops curranii**	*pitpit*	*Philippines: Palawan*
*Daemonorops leptopus**	*rotan bacap*	*Malaysia: Peninsular; Singapore; Thailand*
Daemonorops loheriana	*?*	*Philippines: Luzon*
*Daemonorops longispatha**	*wi tibu*	*Borneo*
Daemonorops macrophylla	*rotan cincin*	*Malaysia: Peninsular; Thailand*
Daemonorops margaritae var. palawanica	*ka-api*	*Philippines: Palawan*
Daemonorops oblonga	*song mat*	*Vietnam*

Scientific Names	**Selected Local Names1**	**Distribution2**
Daemonorops oligophylla	?	*Malaysia: Peninsular (endemic)*
Daemonorops pannosa	*sabilog*	*Philippines: Leyte*
Daemonorops sepal	*rotan getah gunung*	*Malaysia: Peninsular; Thailand*
Daemonorops unijuga	?	*Malaysia: Sarawak (endemic)*
Daemonorops urdanetana	*sahaan*	*Philippines: Mindanao*
Korthalsia junghuhnii	*rotan bulu*	*Indonesia: Java*
Korthalsia lanceolata	*rotan dahan*	*Malaysia: Peninsular (endemic)*
Korthalsia merrillii	?	*Philippines: Palawan (endemic)*
Korthalsia rogersii	?	*India: Andaman Islands (endemic)*
Korthalsia tenuissima	*rotan daha tikus*	*Malaysia: Peninsular (endemic)*
Plectocomia billitonensis	?	*Indonesia: Belitung Island; Sumatra*
Plectocomia dransfieldiana	*rotan mantang ilang*	*Malaysia: Peninsular (endemic)*
Plectocomia elmeri	*binting dalaga*	*Philippines: Mindanao, Mt. Apo*
Plectocomia longistigma	?	*Indonesia: Java, east*
Plectocomia lorzingii	?	*Indonesia: Sibolangit, Sumatra*
Plectocomia pygmaea	?	*Indonesia: Kalimantan, Pontianak, Sei Poetat*

Scientific Names	Selected Local Names1	Distribution2
Plectocomiopsis wrayi	*rotan pepe*	*Malaysia: Peninsular; Thailand*
Pogonotium moorei	*?*	*Malaysia: Gunung Gaharu, Sarawak (endemic)*
Pogonotium ursinum	*rotan bulu*	*Brunei; Malaysia: Peninsular, Sarawak*

Notes:

* See also Table under Chapter 13.

1. Other local names are given in some of the sources cited.

2. Distribution is within the Asian region as defined; some species

also occur elsewhere.

Major commercial species, as defined by Dransfield & Manokaran, 1993.

* Minor commercial species, as defined by Dransfield & Manokaran, 1993.

General sources: Alam, 1990; Amatya, 1997; Avé, 1988; Basu, 1992; Boonsermsuk et al., 2007; De Zoysa & Vivekanandan, 1994; Dransfield, 1979, 1982, 1984, 1992, 1997; Dransfield & Manokaran, 1993; Evans et al., 2001; Gagnepain, 1937; Guzman & Fernando, 1986; Henderson, 2009; Hodel, 1998; Johnson, 1991b; Khou, 2008; Kurz, 1874; Lakshmana, 1993; Liao, 1994; Madulid, 1981; Mathew et al., 2007; Pearce, 1994; Peters et al., 2007; Rattan Information Centre Bulletin, various issues; Renuka, 1992, 1995; Renuka & Bhat, 2002; Siebert, 1989.

Non-threatened Asian Rattans

On the basis of current knowledge, only 24 Asian rattans are not under threat from exploitation and deforestation. Table 4-6 identifies these species. Why these rattans are not threatened is unclear. The answer probably lies in some combination of factors such as their greater natural populations, in some cases broader geographic ranges, adaptability to forest disturbance and the clustering grown form which characterizes about three-fourths of the species listed.

Table 4-6 Non-threatened Asian Rattans

Scientific Names	**Selected Local Names1**	**Distribution2**
*Calamus burckianus**	*howe belukbuk*	*Indonesia: Java*
Calamus exilis#	*rotang gunung*	*Indonesia: Sumatra; Malaysia: Peninsular; Thailand*
Calamus formosanus	*(Formosan cane)*	*Taiwan*
Calamus gregisectus	*?*	*Myanmar*
*Calamus heteroideus**	*howe cacing*	*Indonesia: Java, Sumatra*
Calamus javensis#	*rotan opot*	*Brunei; Indonesia: Kalimantan, Java, Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Philippines: Palawan; Singapore; Thailand*
Calamus pseudotenuis	*perumperambu*	*India: Deccan Peninsula, Western Ghats; Sri Lanka*
Calamus reinwardtii	*rotan dedek*	*Indonesia: Java (endemic)*
Calamus trachycoleus#	*rotan itit*	*Indonesia: Kalimantan*
*Daemonorops calicarpa**	*lumpit*	*Indonesia: Sumatra; Malaysia: Peninsular*
*Daemonorops crinita**	*?*	*Indonesia: Sumatra, Kalimantan*

Scientific Names	**Selected Local Names1**	**Distribution2**
*Daemonorops didymophylla**	*rotan tunggal*	*Brunei; Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular, Sabah; Sarawak; Singapore; Thailand*
*Daemonorops fissa**	*rotan kotok*	*Brunei; Indonesia: Kalimantan; Malaysia: Sabah; Sarawak*
*Daemonorops grandis**	*rotan sendang*	*Malaysia: Peninsular; Singapore; Thailand*
Daemonorops macroptera	*?*	*Indonesia: Sulawesi*
*Daemonorops oblonga**	*rotan pitik*	*Indonesia: Java*
*Daemonorops rubra**	*teretes*	*Indonesia: Java*
Korthalsia echinometra#	*uwi hurang*	*Brunei; Cambodia; Indonesia: Kalimantan, Sumatra; Lao; Malaysia: Peninsular, Sabah, Sarawak; Singapore*
Korthalsia laciniosa#	*rotan dahan*	*India: Andaman & Nicobar Islands; Indonesia: Java, Sumatra; Lao; Malaysia: Peninsular; Myanmar; Philippines; Singapore; Thailand; Vietnam*
Korthalsia zippelii	*inuwai*	*Indonesia: Papua*

Scientific Names	Selected Local Names1	Distribution2
*Myrialepis paradoxa**	*rotan kertong*	*Cambodia; Indonesia: Sumatra; Malaysia: Peninsular; Lao; Myanmar; Singapore; Thailand; Vietnam*
Plectocomia elongata var. elongata	*wi*	*Brunei; Cambodia; Indonesia: Java, Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Thailand; Vietnam*
Plectocomia mulleri	*rotan tibu*	*Brunei; Indonesia: Kalimantan; Malaysia: Peninsular, Sabah, Sarawak*
*Plectocomiopsis geminiflora**	*ialis, rotan pa*	*Brunei; Cambodia; Indonesia: Kalimantan, Sumatra; Lao; Malaysia: Peninsular, Sabah, Sarawak; Myanmar; Thailand; Vietnam*

Notes: 1. Other local names are given in some of the sources cited.

2. Distribution is within the Asian region as defined; some species also occur elsewhere.

Major commercial species, as defined by Dransfield & Manokaran, 1993.

* Minor commercial species, as defined by Dransfield & Manokaran, 1993.

Sources: Same as Table 4-5.

Asian Rattans with Unknown Conservation Status

Dransfield and Manokaran (1993) documented utilization of 135 rattan species (30 major and 105 minor). Table 4-5 and Table 4-6 account for some but not all of that total. The remaining species from that study, which lack information about their conservation status, are included in Table 4-7, along with additional species from later published sources. That we know nothing about the in situ status of the 105 rattans in Table 4-7 is alarming.

Table 4-7 Asian Rattans with Unknown Conservation Status and Reported Uses

Scientific Names	**Selected Local Names1**	**Distribution2**
Calamus acanthophyllus	*wai tia*	*Cambodia; Lao; Nepal; Thailand*
Calamus acanthospathus	*Wai hom*	*Bhutan; China: Yannan; India: Northeast; Lao; Myanmar; Nepal; Tibet*
*Calamus albus**	*rotan putih*	*Indonesia: Moluccas, Papua*
Calamus amplijugus	*?*	*Brunei; Malaysia: Sabah, Sarawak*
*Calamus aruensis**	*?*	*Indonesia: Moluccas*
*Calamus arugda**	*arugda*	*Philippines: Cagayan, Luzon*
*Calamus axillaris**	*rotan sega air*	*Brunei; Indonesia: Sumatra; Malaysia: Peninsular, Sarawak; Thailand*
Calamus bimaniferus	*wai noi*	*Lao*
*Calamus blumei**	*rotan tukas*	*Brunei; Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Thailand*
*Calamus boniensis**	*tomani*	*Indonesia: Sulawesi (endemic ?)*
Calamus caesius#	*rotan sega*	*Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Philippines: Palawan; Thailand*
*Calamus castaneus**	*rotan cucor*	*Indonesia: Sumatra; Malaysia: Peninsular; Thailand*
*Calamus conirostris**	*rotan dago kancil*	*Brunei; Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular, Sabah, Sarawak*
*Calamus didymocarpus**	*nue waatang*	*Malaysia: Sulawesi (endemic ?)*

Scientific Names	Selected Local Names1	Distribution2
*Calamus diepenhorstii**	*rotan batu*	*Brunei; Indonesia: Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Philippines: Palawan; Singapore; Thailand*
*Calamus dimorphacanthus var. halconensis**	*lambutan*	*Philippines: Laguna, Mindoro*
Calamus egregius#	*duanye shengteng*	*China: Hainan Island (endemic)*
*Calamus elmerianus**	*sababai*	*Philippines: Agusan, Davao, Dinagat, Tayabas*
Calamus erinaceus	*phdao aeng*	*Borneo; Cambodia; Indonesia: Sumatra; Malaysia: Peninsular; Philippines; Singapore; Thailand*
*Calamus erioacanthus**	*wi buluh*	*Malaysia: Sarawak (endemic)*
*Calamus flabellatus**	*rotan lilin*	*Brunei; Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular, Sabah, Sarawak*
Calamus floribundus	*chota bet*	*Bangladesh; India: Northeast; Myanmar*
*Calamus gibbsianus**	*silau-silau*	*Malaysia: Sabah, Sarawak*
Calamus gracilis	*mapuri bet*	*Bangladesh; China: Yunnan; India: Northeast; Lao; Myanmar*
*Calamus hispidulus**	*rotan bulu*	*Indonesia: Kalimantan; Malaysia: Sarawak*
*Calamus hollrungii**	*uawa jawa*	*Indonesia: Papua*
*Calamus insignis**	*rotan batu*	*Indonesia: Sumatra; Malaysia: Peninsular; Singapore; Thailand*
Calamus javensis	*uwai peladas*	*Borneo; Brunei; Indonesia: Java, Sumatra; Malaysia: Peninsular; Philippines: Palawan; Thailand*

Scientific Names	**Selected Local Names1**	**Distribution2**
Calamus laevigatus var. laevigatus and var. mucronatus*	*rotan tunggal*	*Brunei; Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Singapore; Thailand*
*Calamus leiocaulis**	*rotan jermasi*	*Indonesia: Sulawesi (endemic ?)*
Calamus leptospadix	*dhangre bet*	*Bangladesh; Bhutan; India: Northeast; Myanmar; Nepal*
*Calamus leptostachys**	*ronti*	*Indonesia: Sulawesi (endemic ?)*
*Calamus longisetus**	*leme*	*Malaysia: Peninsular; Myanmar; Thailand;*
*Calamus luridus**	*huwi pantis*	*Indonesia: Sumatra; Malaysia: Peninsular; Thailand*
*Calamus manillensis**	*bayabong*	*Philippines: Agusan, Davao, Dinagat, Nueva Viscaya, Sorsogon, Surigao, Tayabas,*
*Calamus marginatus**	*rotan besi*	*Brunei; Indonesia: Kalimantan, Sumatra; Malaysia: Sabah, Sarawak; Philippines: Palawan*
*Calamus mattanensis**	*rotan maran*	*Indonesia: Kalimantan; Malaysia: Sarawak*
*Calamus microcarpus**	*kalapit*	*Philippines: Agusan, Camarines, Davao, Laguna, Lanao, Rizal, Sorsogon; Tayabas*
*Calamus microsphaerion**	*kulakling*	*Malaysia: Sabah; Philippines: Bataan, Culion, Palawan*
Calamus mindorensis#	*tumalim*	*Philippines: Luzon, Mindanao*
*Calamus muricatus**	*rotan melukut*	*Brunei; Indonesia: Kalimantan, Sumatra; Malaysia: Sabah, Sarawak;*

Scientific Names	**Selected Local Names1**	**Distribution2**
*Calamus myriacanthus**	*wi dudok*	*Brunei; Indonesia: Kalimantan; Malaysia: Sarawak;*
Calamus nambariensis	*korak bet*	*Bangladesh; Bhutan; China: Yunnan ; India: Northeast; Lao; Myanmar; Nepal; Thailand; Vietnam*
Calamus optimus#	*rotan taman*	*Brunei; Indonesia: Kalimantan; Malaysia: Sabah, Sarawak*
Calamus ornatus#	*rotan kesup*	*Brunei; Indonesia: Java, Sulawesi, Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Philippines; Singapore; Thailand*
*Calamus oxleyanus**	*manau riang*	*Brunei; Indonesia: Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Singapore; Thailand*
Calamus palustris#	*rotan buku hitam*	*China; India: Nicobar and Andaman Islands; Lao; Malaysia: Peninsular; Myanmar; Thailand; Vietnam*
*Calamus paspalanthus**	*rotan sirikis*	*Brunei; Indonesia: Kalimantan; Malaysia: Peninsular, Sabah, Sarawak*
*Calamus pedicellatus**	*samole*	*Indonesia: Sulawesi (endemic)*
*Calamus perakensis**	*rotan dudok*	*Indonesia: Sumatra; Malaysia: Peninsular*
*Calamus peregrinus**	*nguay*	*Malaysia: Peninsular; Thailand*
*Calamus pilosellus**	*rotan lintang*	*Brunei; Indonesia: Kalimantan; Malaysia: Sabah, Sarawak (endemic to Borneo)*
Calamus pogonacanthus#	*wi tut*	*Brunei; Indonesia: Kalimantan; Malaysia: Sabah, Sarawak (endemic to Borneo)*
*Calamus polystachys**	*wai lau cincin*	*Indonesia: Java, Sumatra; Malaysia: Peninsular*

Scientific Names	Selected Local Names1	Distribution2
*Calamus ramulosus**	*panlis*	*Philippines: Luzon (endemic)*
*Calamus reyesianus**	*apas*	*Philippines: Laguna, Quezon, Tayabas*
*Calamus rhomboideus**	*rotan dawuh*	*Indonesia: Java, Sumatra*
*Calamus rhytidomus**	*?*	*Indonesia: Kalimantan*
Calamus rudentum	*wai boun*	*Cambodia; Lao; Myanmar; Thailand; Vietnam*
*Calamus ruvidus**	*wee lumbak*	*Malaysia: Sarawak (endemic)*
Calamus salcifolius	*lpeak*	*Cambodia, Vietnam*
*Calamus scabridulus**	*dara panda*	*Indonesia: Sumatra; Malaysia: Peninsular*
Calamus scipionum#	*rotan semambu*	*Brunei; Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Philippines: Palawan; Singapore; Thailand*
Calamus siamensis	*wai khom*	*Cambodia; Lao; Malaysia: Peninsular; Thailand*
Calamus simplicifolius#	*danye shengteng*	*China: Hainan Island*
*Calamus siphonospathus**	*talola*	*Indonesia: Sulawesi; Philippines: Luzon, Mindanao*
Calamus solitarius	*wai thork*	*Lao; Thailand*
*Calamus spinifolius**	*kurakling*	*Philippines: Luzon*
Calamus subinermis#	*rotan batu*	*Indonesia: Sulawesi; Malaysia: Sabah; Philippines: Palawan*

Scientific Names	**Selected Local Names1**	**Distribution2**
Calamus tenuis	*bet*	*Widespread South and Southeast Asia*
Calamus tetradactylus#	*baiteng (white rattan)*	*Cambodia; China: Hainan Island , South; Lao; Thailand; Vietnam*
*Calamus tomentosus**	*rotan tukas*	*Borneo; Malaysia: Peninsular*
Calamus tumidus#	*rotan manau tikus*	*Indonesia: Sumatra; Malaysia: Peninsular*
*Calamus ulur**	*?*	*Indonesia: Sumatra; Malaysia: Peninsular*
*Calamus unifarius**	*wai sidekeni*	*India: Nicobar Islands; Indonesia: Java, Sumatra*
*Calamus usitatus**	*babuyan*	*Malaysia: Sabah; Philippines*
*Calamus viminalis**	*penjalin cacing*	*Bangladesh; Cambodia; India: Andaman Islands, Bihar, Maharastra, Orissa, Prasesh; West Bengal; Indonesia: Bali, Java, Sumatra; Lao; Malaysia: Peninsular; Myanmar; Sikkim; Thailand*
Calamus wailong#	*wailong*	*China: Yunnan; Lao*
Calamus zollingeri#	*rotan batang*	*Indonesia: Moluccas, Sulawesi*
*Daemonorops angustifolia**	*rotan getah*	*Malaysia: Peninsular; Thailand*
*Daemonorops draco**	*rotan jernang*	*Indonesia: Kalimantan, Riau Archipelago, Sumatra; Malaysia: Sarawak*
*Daemonorops elongata**	*lempinin pahetan*	*Indonesia: Kalimantan; Malaysia: Sabah (endemic to Borneo)*
Daemonorops formicaria	*uwai singkurung*	*Brunei; Malaysia: Sarawak*

Scientific Names	**Selected Local Names1**	**Distribution2**
*Daemonorops hirsuta**	*rotan sepet*	*Indonesia: Sumatra; Malaysia: Peninsular, Sarawak; Singapore*
*Daemonorops ingens**	*keplar*	*Brunei; Malaysia: Sabah, Sarawak; Indonesia: Kalimantan (endemic to Borneo)*
Daemonorops jenkinsiana	*may rut*	*Bangladesh; Bhutan; Cambodia; China; India: Northeast; Lao; Myanmar; Thailand; Vietnam*
*Daemonorops lamprolepis**	*lapa*	*Indonesia: Sulawesi (endemic ?)*
Daemonorops margaritae var. margaritae#	*huangteng*	*China: Hainan Island, South*
*Daemonorops melanochaetes**	*sekei udang*	*Indonesia: Java, Sumatra; Malaysia: Peninsular*
*Daemonorops micracantha**	*rotan jernang*	*Indonesia: Kalimantan; Malaysia: Peninsular, Sabah, Sarawak*
*Daemonorops ochrolepis**	*ditaan*	*Philippines: Leyte*
Daemonorops oxycarpa	*uwai bintango*	*Borneo; Brunei*
*Daemonorops periacantha**	*wi empunoh*	*Brunei; Indonesia: Kalimantan; Malaysia: Peninsular, Sabah, Sarawak; Singapore*
Daemonorops robusta#	*rotan susu*	*Indonesia: Moluccas, Sulawesi*
*Daemonorops ruptilis**	*widudok*	*Brunei; Malaysia: Sabah, Sarawak*
Daemonorops sabut#	*jungan*	*Brunei; Indonesia: Kalimantan; Malaysia: Peninsular, Sabah, Sarawak; Singapore; Thailand*

Scientific Names	Selected Local Names1	Distribution2
*Daemonorops scapigera**	*wi empunok ruai*	*Brunei; Indonesia: Kalimantan; Malaysia: Peninsular, Sabah, Sarawak*
*Daemonorops sparsiflora**	*wi ruah air*	*Brunei; Indonesia: Kalimantan; Malaysia: Sabah, Sarawak (endemic to Borneo)*
Korthalsia cheb#	*keb*	*Indonesia: Kalimantan; Malaysia: Sabah, Sarawak*
Korthalsia ferox	*uwai selika*	*Borneo; Brunei; Thailand*
Korthalsia flagellaris#	*rotan dahan*	*Brunei; Indonesia: Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Singapore; Thailand*
Korthalsia jala	*wi danan*	*Brunei; Malaysia: Sabah, Sarawak*
Korthalsia rigida#	*rotan dahan*	*Brunei; Indonesia: Kalimantan, Sumatra Malaysia: Peninsular, Sabah, Sarawak; Philippines: Palawan; Thailand*
Korthalsia robusta#	*rotan asas*	*Brunei; Indonesia: Kalimantan, Sumatra Malaysia: Peninsular, Sabah, Sarawak; Philippines: Palawan*
Korthalsia rostrata#	*rotan semut*	*Brunei; Indonesia: Kalimantan, Sumatra; Malaysia: Peninsular, Sabah, Sarawak; Singapore; Singapore; Thailand*

Notes: 1. Other local names are given in some of the sources cited.

2. Distribution is within the Asian region as defined;

some species also occur elsewhere.

Major commercial species, as defined by Dransfield & Manokaran, 1993.

* Minor commercial species, as defined by Dransfield & Manokaran, 1993.

Sources: Same as Table 4-5.

Discussion

A detailed discussion of rattan canes and their commercial and subsistence uses is beyond the scope of the present study. However, two objectives may be undertaken: first, to draw attention to the major sources of technical information on rattans and their products and second, to examine other selected issues related to the exploitation of wild rattans.

Technical Information on Rattans

There has been an impressive outpouring of technical studies on rattans over the past decade and a half. Rattans have easily received more attention than all other wild palm products combined, a clear indication of their economic value.

Modern rattan development was initiated in 1975 with a rattan project in Peninsular Malaysia. Four years later, the first rattan workshop was held in Singapore (IDRC, 1980) sponsored by the International Development Research Centre (IDRC) of Canada. Also the first regional rattan study, of Peninsular Malaysia, was published (Dransfield, 1979). Since then, about forty publications have appeared (Table 4-8). Workshop proceedings, regional rattan studies and studies of specific topics have generated much-needed information in three major subject areas: taxonomy, distribution and ecology of wild rattans; domestication and plantation growth of promising species; and industrial processing of canes. Two lengthy rattan bibliographies are included among the publications in Table 4-8.

Rattan research is actively being carried on in the major sources of commercial rattans in South, Southeast and East Asian countries. A library of technical information on all aspects of rattans is housed at the Rattan Information Centre, Forest Research Institute Malaysia, Kepong. The Centre published a bulletin from 1982 to 1993 (see Chapter 11).

In an effort to promote collaborative rattan research, the International Network for Bamboo and Rattan (INBAR) was established formally in 1993. The headquarters were located initially in New Delhi, but moved to Beijing four years later. INBAR is directing its activities toward five subject areas: socio-economic research; information, training and technology transfer; production research; post-harvest technology and utilization; and biodiversity and genetic conservation. INBAR publishes a quarterly newsletter (see Chapter 11) as well as a series of working papers and technical reports, focused on socioeconomics, cultivation, nursery techniques, processing and training. INBAR also supports a database of technical information on bamboo and rattan.

Table 4-8 Selected Publications on Rattan Since 1979

Abbreviated Title and Reference	**Geographic Coverage**	**Contents/Comments**
Rattans. PROSEA 6 (Dransfield & Manokaran,1993) Bibliography (Wulijarni-Soitjipto & Danimihardja, 1995).	*Australia ; Brunei, Cambodia, China, Indonesia, Lao, Malaysia, Myanmar, Papua New Guinea, Philippines, Singapore, Thailand, Vietnam,*	*Introduction to rattans of region; 30 major spp. covered in detail; brief descriptions of 105 minor spp. Excellent general information source. Bibliography provides localized references on rattans in Southeast Asia.*
Rattan Current Research (Dransfield et al., 2002)	*World* *Meeting site: Rome*	*Expert consultation on rattan development, December 2000. A special issue of Unasylva Vol. 52, 2001/2, No. 205, included some of the information from the consultation.*
Rattan Glossary (Johnson & Sunderland, 2004)	*World*	*Terminology relative to rattans in world and Africa.*
Rattan Bibliography (Kong-Ong & Manokaran, 1986)	*World*	*All aspects of rattan from 1790 to June 1986.*
Rattans of World (George & Sankara Pillae, 2003).	*World*	*Annotated bibliography of 876 citations.*
Guide Cultivation Rattan (Wan Razali et al., 1992)	*Southeast Asia but with strong focus on Peninsular Malaysia & Borneo*	*Field guide for growing rattan as commercial crop, includes discussions of econornics & processing. Primary source.*
Manual Production Rattan Furniture. (UNIDO, 1983)	*Asia*	*Manual of processing, marketing, design, manufacturing, etc.*

Abbreviated Title and Reference	**Geographic Coverage**	**Contents/Comments**
Rattan Workshop. (IDRC, 1980)	*Asia. Meeting site: Singapore*	*Proceedings 1st regional rattan meeting (1979). Mostly consists of state-of-the art review of rattan at the time*
Rattan Seminar. (Wong & Manokaran, 1985)	*Asia; country reports on China, India, Indonesia, Malaysia, Philippines & Thailand. Meeting site: Kuala Lumpur, Malaysia*	*Proceedings 2nd regional rattan meeting (1984). Technical papers (23) on following topics: propagation practices; ecology & silviculture; properties, pests & diseases; processing & utilization, extension & information dissemination. Broad coverage of key issues.*
Recent Research on Rattans. (Rao & Vongkaluang, 1989)	*Asia.* *Meeting site: Chiangmai, Thailand*	*Proceedings 3rd regional rattan meeting (1987). Technical papers (36) on following topics: research; growth & silviculture: biology; processing & utilization; properties & multipurpose uses; economics & production. Benchmark on research.*
Rattan Cultivation (Bacilieri & Appanah, 1999)	*Southeast Asia.* *Meeting site: Kuala Lumpur.*	*Proceedings of 23 papers on conservation, genetic improvement and silviculture; resource inventory, trade and marketing; international agencies in rattan development; and case studies from SE Asia.*
Rattan in Thailand (Boonsermsku et al., 2007)	*Thailand.*	*Analysis of sustainble utilization of rattans from plantations.*
Rattan Research China (Xu et al., 2000.)	*China*	*Compendium of 19 papers on broad aspects of rattans in China.*
Bamboo & Rattan in Tropical China (Zhu Zhaohua, 2001)	*China* *Meeting sites: Hainan and Yunnan.*	*Workshop proceedings; 7 of 19 papers deal with rattans*
Bamboo & Rattan in World (Zehui, 2007)	*China; World*	*Contributions from experts; about 30% of the book is devoted to rattans.*

Abbreviated Title and Reference	**Geographic Coverage**	**Contents/Comments**
Rattan Management & Utilization. (Chand Basha & Bhat, 1993)	*Primarily India; also Malaysia and Sri Lanka.* *Meeting site: Trichur, Kerala, India*	*Proceedings of Indian rattan meeting (1992). Technical papers (50) on following topics: area status reports, resource assessment & conservation; production & management; structure, properties & processing; socio-economics & trade.*
Third National Rattan Conference (ATI, 1995)	*Philippines.* *Meeting site: Manila.*	*National rattan meeting (1995). Theme: Strengthening Community Resource Management Through NTFP Enterprise Development. Papers on rattans in general*
Rattan Workshop. (PCARRD, 1990)	*Philippines.* *Meeting site: Cebu City, Philippines*	*National rattan meeting (1988). Technical papers (10) on various apects Of production, processing & marketing*
Rattans - Philippines. (PCARRD, 1985)	*Philippines*	*Summary of information & recommended practices for plantation establishment, management, cane processing & marketing.*
Sustainable Rattan Development (ERDB, 2004)	*Asia.* *Meeting site: Manila*	*Workshop Proceedings consisting of of 9 country reports and papers on sustainable management, technology needs, etc.*
Rattans - Malay Peninsula. (Dransfield, 1979)	*Malaysia & Singapore*	*Taxonomy of native rattans with good line drawings of 104 spp; natural history; utilization & cultivation; common names.*
Rattans - Sabah. Dransfield, 1984)	*Sabah, Malaysia*	*Taxonomy of 79 native rattan spp.*

Abbreviated Title and Reference	**Geographic Coverage**	**Contents/Comments**
Rattans: Asia Training Workshop (Rao & Rao, 1997)	*Asia.* *Meeting sites: Sarawak, Sabah.*	*Proceedings of Training Courses cum Workshops; 34 papers equally divided among taxonomy and ecology; and silviculture, conservation, genetic improvement and biotechnology.*
Rattans - Brunei (Dransfield, 1997). *Rettans Brunei Interactive Key (Kirkup et al., 1999)*	*Brunei*	*Taxonomy of 80 species of native rattans.*
Rattans - Sarawak. (Dransfield, 1992)	*Sarawak, Malaysia*	*Taxonomy of 105 species of native rattans.*
Rattans - Borneo (Dransfield & Patel, 2005).	*Borneo*	*Interactive key on CD Rom*
Rattans - Lao (Evans et al., 2001)	*Laos*	*Taxonomy of 51 species of native rattans.*
Rattans Cambodia (Khou 2008)	*Cambodia*	*Taxonomy of 18 species of native rattans.*
Rattnas – Nepal (Amatya, 1997).	*Nepal*	*Descriptions and distribution of 3 native rattans.*

Abbreviated Title and Reference	**Geographic Coverage**	**Contents/Comments**
Rattans – India (Basu, 1992)	*India, including Andaman & Nicobar Islands*	*Taxonomic study of 48 native rattan spp.*
Rattans - Western Ghats. (Renuka, 1992)	*Andhra Pradesh, Karnataka, Kerala Tamil Nadu states, India*	*Taxonomic study of 19 native rattan spp. of South India.*
Rattans - South India. (Lakshmana, 1993)	*India: Andhra Pradesh, Karnataka, Kerala Tamil Nadu*	*General study including taxonomy: silviculture; regeneration; pests & diseases; utilization.*
South Indian Rattans (Bhat, 1992)	*India: Andhra Pradesh, Karnataka, Kerala Tamil Nadu*	*Structure & properties of 15 native Calamus spp.*
Kerala Rattans (Renuka et al., 1987; Renuka & Bhat, 2002)	*Kerala State, India*	*Morphology, anatomy & physical properties of 10 native Calamus spp; commercial rattans.*
Rattans - Andaman & Nicobar Islands. (Renuka, 1995)	*Andaman & Nicobar Islands, India*	*Taxonomic study of 18 species of native rattans.*
Rattans - Sri Lanka. (De Zoysa & Vivekanandah, 1994)	*Sri Lanka*	*Field guide to 10 species of native rattans.*
Bamboo & Rattan - Sri Lanka. (De Zoysa & Vivekanandah, 1991)	*Sri Lanka*	*Detailed study of 8 rattan and 4 bamboo spp. native to & utilized in Sri Lanka.*

Abbreviated Title and Reference	**Geographic Coverage**	**Contents/Comments**
Rattans - Bangladesh. (Alain, 1990)	*Bangladesh*	*Taxonomic study of 11 spp. of native rattans.*
Rattans – Africa (Sunderland, 2007)	*Africa*	*Field guide to 22 native rattans.*
Rattan Workshop – Africa (Sunderland & Profizi, 2002)	*Africa*	*Workshop proceedings of 12 papers on wide range of issues.*

Other Uses of Rattan Palms

A discussion of rattan utilization would be incomplete without mention of useful products other than canes. Examples of secondary product uses are summarized in Table 4-9. It should be pointed out that Table 4-9 contains data on only the 258 rattans in Table 4-5, Table 4-6 and Table 4-7. Secondary uses are documented for other rattan species as well, but Table 4-9 captures the essence of noncane uses.

Table 4-9 Known Noncane Uses and Products of Rattans Included in Tables 4-5, 4-6 and 4-7

Product/Use	Genus and Species
fruit eaten	*Calamus acanthophyllus; C. conirostris; C. dongnaiensis; C. floribundus; C. leptospadix; C. longisetus; C. manillensis; C. merrillii; C. ornatus1; C. paspalanthus; C .rhabdocladus; C. schortechinii; C. subinermis; C. thysanolepis; C. viminalis Daemonorops formicaria; D. hirsuta; D. ingens; D. oxycarpa; D. periacantha; D. ruptilis; D. scapigera*
palm heart (shoot) eaten2	*Calamus egregius; C. gracilis; C. javensis; C. muricatus; C. myriacanthus; C. paspalanthus; C. rhabdocladus; C. salicifolius; C. siamensis; C. simplicifolius; C. subinermis; C. tenuis; C. viminalis Daemonorops fissa; D. longispatha; D. margaritae; D. melanochaetes; D. periacantha; D. scapigera; D. schmidtiana; D. sparsiflora Plectocomiopsis geminiflora*
seeds chewed	*Calamus walkeri*
fruit in traditional medicine	*Calamus castaneus; C. longispathus Daemonorops didymophylla*
root in traditional medicine	*Calamus acanthophyllus*
palm heart (shoot) in traditional medicine	*Calamus exilis; C. javensis; C. ornatus Daemonorops grandis Korthalsia rigida*
fruit as red dye source	*Daemonorops didymophylla; D. draco; D. maculata; D. micracantha; D. rubra*
leaves for thatching	*Calamus andamanicus; C. castaneus; C. dilaceratus; C. longisetus Daemonorops calicarpa; D. elongata; D. grandis; D. ingens; D. manii*

Product/Use	Genus and Species
leaflet as cigarette wrapper	*Calamus longispathus* *Daemonorops leptopus*
leaf sheath/petiole for grater	*Calamus burckianus; C. insignis*
rachis for fishing pole	*Daemonorops grandis*

Notes:

1. See Table 9-8 for nutritional composition of fruit.

2. Daemonorops jenkensiana. In Cambodia, larvae, which live in the palm heart, are collected for food and sale; the palm heart itself is not eaten.

Sources: Same as Table 4-5.

Rattan-Related Issues

Four topics are relevant to the future of rattan as a non-wood forest product and should be touched upon here. They are: 1) increased wild sources of raw cane; 2) sustainable management of wild stands; 3) conservation of threatened rattans and their habitat; and 4) socio-economic and cultural issues related to rattan collecting. Each of these topics should be reviewed as part of any forestry activity which includes rattan collecting.

Increased wild cane sources. Quantities of useable raw cane can be increased in two major ways. One is to improve harvesting techniques to minimize wastage. Rattan gatherers sometimes are unable to reach the full length of commercial cane they have cut and it goes to waste. Immature rattans are cut rather than being allowed to grow to more worthwhile cane lengths. Gatherers may leave harvested small-diameter canes in the forest to rot because they derive more income from carrying out a large-diameter cane. The foregoing problems are inherent to the gathering of non-wood forest products everywhere in the tropics and are discussed as a socio-economic issue.

A second means of increasing wild cane production is to harvest a wider range of different species. At present, only an estimated 20 percent of rattan species have commercial use (Dransfield and Manokaran, 1993). Clearly there is potential to begin to utilize some of the remaining 80 percent of the species. To introduce new commercial species to the industry requires involvement at every level of the product chain from the rattan gatherer to the rattan product consumer. Central to finding new commercial rattan species is field research on the plants themselves, studiesof their technical properties and informing collectors and end users about the new raw material. A good example of an attempt to increase wild cane production is to be found in South India where research efforts are focusing on 15 native *Calamus* spp. as sources of raw material for cane furniture and other products (Renuka, 1992; Bhat, 1992; Renuka and Bhat, 2002). Lesser known-canes can contribute to wild rattan supplies; some also are suitable for silvicultural trials (Dransfield, 1985).

Rattan management. To insure stable rattan supplies in the future, management is a reasonable compromise between continuing to rely exclusively on wild rattans and outright rattan cultivation. Rattans pose unique management difficulties because of their growth habit since they may climb from tree to tree in the forest canopy. This creates problems in the inventory of standing stock as well as in monitoring of the conditions of rattan populations and their natural regeneration.

Three basic types of management are applicable to rattans:

1) Natural regeneration within the forest. This level of management requires no specific technical inputs but does require that a sustainable harvest plan be developed and adopted. Protected areas such as national parks, nature preserves or watersheds any of which permit gathering of wild resources are highly suitable to this management approach. Siebert (1995) has shown that sustained-yield rattan harvest is achievable within two Indonesian national parks. Designating extractive reserves for rattan harvest, as suggested by Peluso (1992) for Kalimantan, Indonesia, would fit within this management approach.

2) Enhanced natural regeneration and or cultivation within natural forest. In this instance, forest cover is still largely intact (the area may have been selectively logged) and an area may be set aside for rattan and other non-wood forest products. Management inputs may include clearing of competing undergrowth vegetation in naturally-occurring forest canopy gaps to promote young rattan growth. Selective felling to create artificial canopy gaps is also an option. It is well known that canopy gaps are highly favorable for rattan growth (Chandrashekara, 1993). Priasukmana (1989) reported on planting rattan within the natural forest of East Kalimantan, Indonesia, to increase rattan stock.

3) Rattan cultivation as part of shifting cultivation or agroforestry. Incorporation of rattan into shifting cultivation is an indigenous system in Kalimantan. Weinstock (1983) describes how the Luangan Dayaks clear a forest plot to plant food crops for 1-2 years, but before leaving the land fallow they plant rattan. When the rotation is repeated in 7-15 years, the farmer first harvests the rattan then clears the plot again for food crops. Godoy (1990) suggests that traditional rattan cultivation be incorporated into new agroforestry systems to raise small landholder income. In Malaysia, trials to interplant rattans with rubber trees are being studied (Aminuddin *et al*., 1985). All of these approaches merit further attention since rattan is not a suitable monocultural crop.

Rattan conservation. Conservation is a matter of expediency for rattans because of the raw material shortages being experienced by rattan industries in Southeast Asia and because of the potential loss of essential gene pools for rattan domestication and plantation establishment.
It is somewhat encouraging that the need for rattan conservation is beginning to be recognized seriously. A CIRAD-Foret collaborative program in Malaysia focused on seed collection, establishment of conservation plots and genetic diversity (Durand, 1995). Five of the major rattan species listed in Table 4-5, Table 4-6 and Table 4-7 are under study: *Calamas manan* (threatened); *C. trachycoleus* (non-threatened) and *C. caesius*, *C. optimus* and *C. subinermus* (all of unknown status).

Rattan conservation cannot be separated from general forest conservation. The combination of decreasing forest cover and over-exploitation of wild canes threatens the very survival of a commercial rattan industry in many parts of Southeast Asia (Dransfield, 1989). As shown in

Table 4-7, the sad fact is that we do not know enough about the conservation status of wild rattans to identify which areas should be the focus of priority conservation actions.

Socio-economic and cultural issues. The impact on local rattan collectors oo the decline in wild rattan resources is often overshadowed by the more publicized concerns for the rattan product industry. Affected groups may be indigenous people living a relatively traditional life in or near the forest or small landholders eking out a living with shifting cultivation. There are a number of instances of local groups which are dependent upon gathering wild rattan and other non-wood forest products for the cash income to purchase necessary modern industrial goods.

Examples from the Philippines include the following: Antolin (1995) writes of rattan collecting as an important source of employment in the uplands of northeastern Luzon; Conelly (1985) describes how rattan and copal collecting represents a significant source of cash income for the Tagbanua of Palawan Island; and Siebert and Belsky (1985) relate how a lowland village depends upon collecting rattan and harvesting timber for a key source of livelihood. Peluso (1992) and Weinstock (1983), already referred to above with respect to Kalimantan, Indonesia, also stress the socio-economic importance of rattan. In Malaysia, Kiew (1991) and Lim and Noor (1995) emphasize how the Orang Asli communities have a stake in the future of rattan collecting.

Two interrelated socio-economic elements play a vital role in the future of rattans as non-wood forest products. One is land tenure. Rattan management, of whatever kind, will only be a success if those involved have clear title to the land, or have long and easily renewable lease rights, so that the future benefits of sustainable practices can be guaranteed. The second element involves the rattan collectors' stake in the rattan resources they exploit. Currently, a rattan collector rationally maximizes his or her income by harvesting the best and most accessible canes, because they are paid by the piece for their labors. Larger canes bring the best price and minimizing walking time is an efficiency for the collector. This same situation applies to most non-wood forest product collecting. What is needed is a means to provide the rattan collector with a stake in wild resource management and a method of payment which rewards sustainable practices over excessive or wasteful exploitation.

Recent Developments

FAO Expert Consultation of 2000. A new stage of rattan development began in late 2000 through an expert consultation meeting organized by FAO. The consultation focused on three key issues: rattan resources, socio-economics and environment and conservation. A proceedings, entitled *Rattan: Current research issues and prospects for conservation and sustainable development* (Dransfield *et al*., 2002). Results of the consultation also were featured in a theme issue on rattans in the FAO journal *Unasylva*, No. 205, 2001/2002.

Actions recommended in the consultation proceedings were presented under three headings:

1) Resources. Intensify conservation efforts among the countries involved; develop suitable resource assessment protocols, to include basic biological studies of the species; improve techniques of enrichment planting and wild stand management.

2) Products. Research on physical properties of commercial rattans and potential of lesser-known species; improve processing practices to reduce post-harvest loss and cane deterioration; introduce uniform standards for grading of canes.

3) Policies and institutional support. Raise awareness of the rattan sector to decision-makers; strengthen and coordinate institutions with regard to rattan conservation, including more NGO and private sector involvement; provide tenure security to gatherers and planters; introduce incentives for rattan cultivation and increased benefits to households and planters; deregulate markets to benefit collectors and traders; strengthen extension support at the village level and to small processors; provide training of gatherers and planters, and technical support as necessary. One direct action resulting from the FAO consultation was a rattan glossary to clarify terms and definitions associated with the rattan industry (Johnson and Sunderland, 2004). The consultation recommendations have provided useful guidelines to the rattan development activities being carried out under programs headquartered in Laos and The Philippines, described below.

WWF Sustainable Rattan Harvesting and Production Regional Program: Cambodia, Laos and Vietnam. In 2006, World Wide Fund for Nature (WWF), supported by the European Commission Union, IKEA and German and Dutch development agencies, began an ambitious set of activities aimed at sustainable production and sustainable production systems of rattan products. The projects are part of the WWF Greater Mekong Program, based in Vientiane, and focuses on the valuable rattan resources of Cambodia, Lao and Vietnam. Globally, the value of trade in rattan canes amounts to an estimated $4 billion per year. The Greater Mekong's rattan industry has the potential to gain a greater share of the world market, based upon the more than 50 species of rattans native to the three countries. WWF plans to extend the project activities to 2015.

In addition to making a contribution to the national economies of Cambodia, Lao and Vietnam, the project directly benefits village communities which rely heavily upon the rattan trade, accounting for up to 50 percent of cash income in villages located in areas of significant cane resources. The rattan industry in these villages represents a major force to alleviate poverty. Project field activities will target selected provinces in the three countries which have a high availability of wild canes; and small and medium sized rattan processing facilities near major cities. At the consumer level, the project will carry out activities in rattan consuming countries, especially in Europe, to educate retailers and consumers about "green" rattan products derived from sustainable production.

Rattans require a forest habitat for their growth and reproduction. Therefore, sustainable rattan production and the maintenance of forest cover are interconnected. An industry based on sustainable rattan production provides a financial incentive to maintain 50,000 hectares of forest in Cambodia, Lao and Vietnam brings with it a reduction of economic costs and environmental degradation in five ways: 1) reduce unsustainable harvesting practices; 2) minimizing raw material wastage through more efficient handling and processing; 3) reduce environmental pollution and improve conditions in processing facilities for better worker health, resulting from toxic chemicals used in used in cane processing and their disposal; 4) give the advantage to legitimate producers and traders by curtailment of illegal cane production and trade through appropriate national legislation and enforcement; 5) enhance cane product quality to give producers competitive products suitable for international markets.

Major project objectives until 2015 are the following: 1) by 2010: engage 100 communities within the three countries in sustainable rattan production; 2) by 2011: have 40 percent of small and medium cane processors engaged in cleaner production operations, and 15 percent of processing facilities turning out environmentally-friendly products for international markets; 3) by 2015: have 50 percent of the rattan processors in the three countries operating to minimize environmental pollution and to turning out products meeting international market standards.

For practical reasons, the WWF Program has given initial attention to rattans in Laos. The chief reason for that focus was the existence of an excellent guide to the rattans of that country (Evans *et al*., 2001), which described 51 native species. A companion guide to the rattans of Cambodia (Khou, 2008) has been published by WWF. It provides detailed information on the 18 native Cambodian rattans and sets the stage for additional studies.

Secondary noncane products also are being studied, as reflected in a technical report on rattan shoot production as a food crop in Lao. The report states that the native *Calamus tenuis* is the most important source of shoots, about 75 percent of current production originating coming from plantations (Campbell, 2009).

Along with promoting sustainable production of canes from wild sources, the program has investigated rattan cultivation as a complementary activity, to broaden the raw material base. To this end, a manual on rattan growing was published (Sengdala, 2008). The manual draws together current technical information for nursery and plantation operations from experiences in other Asian countries. It also identifies 10 suitable native species (Table 4-10).

Table 4-10 Commercial Native Rattan Species of Lao

Genus and Species	**Commercial Cane Species**	**Species with Cultivation Potential for Cane Production**	**Species with Cultivation Potential for Shoot Production**
Calamus bimaniferus	*X*		
Calamus gracilis	*X*	*X*	
Calamus palustris	*X*	*X*	
Calamus poilanei	*X*	*X*	
Calamas rudentum	*X*	*X*	
Calamus siamensis	*X*	*X*	
Calamus solitarius	*X*	*X*	
Calamus tenuis	*X*	*X*	*X*
Calamus tetradactylus	*X*		
Calamus viminalis	*X*	*X*	

Genus and Species	**Commercial Cane Species**	**Species with Cultivation Potential for Cane Production**	**Species with Cultivation Potential for Shoot Production**
Daemonorops jenkinsiana	*X*	*X*	*X*
Myrialepis paradoxa		*X*	
Korthalsia laciniosa	*X*		

Source: Campbell, 2009; Evans, 2001.

The WWF rattan program has been designed with great care and given its vertical integration all of the necessary components are in place for future success.

ITTO-Philippines-ASEAN Rattan Project. This four-year project was implemented in June 2006 and focuses on demonstration and application of production and utilization technologies for rattan sustainable development. It is comprised of five components: pilot demonstrations, research, training, database/website and networking.

Geographically, it includes the ASEAN countries and is headquartered in Laguna, Philippines. Through the end of 2008, as gleaned from the project's newsletter (RattaNews), the following accomplishments were reported.

1) Rattan pilot demonstrations were on-going in Cambodia, Indonesia, Lao, Myanmar, Philippines, Thailand and Vietnam. Demonstrations have involved nursery operation and out-planting and utilized a few key species in each country; primarily for cane production but also for rattan shoots (Thailand) and resin (Indonesia).

2) Training programs, 21 in total, have been carried out; most widely in the Philippines, but also in Cambodia, Indonesia, Lao, Thailand and Vietnam. A number of agencies collaborated in the rattan training activities which included rattan weaving.

3) The research component involves eight different projects, ranging from studies of genetic variation and sex determination of key species (Philippines), to gender role studies in forest enrichment plantings (Vietnam). Final reports of each project are in progress, which include a guide to the identification of Philippine rattans.

4) The project website/database is updated on a regular basis and will include the various final project documents when they are completed (www.aseanrattan.org).

5) Networking has involved organizations in the Philippines, as well as regional and international bodies, to share information and avoid duplication of effort. The project newsletter has served as a primary communications tool.

Figure 4-1 ***Cultivated sago palm (Metroxylon sagu) in Sarawak, East Malaysia. Photograph by Dennis Johnson.***

Figure 4-2 ***Sago palm starch (Metroxylon sagu) for sale in West Kalimantan, Indonesia. The starch is wrapped in leaves from the same palm.***

Photograph by Johanis Mogea.

Figure 4-3 Rattan canes (Calamus spp.) drying in the sun in South Sulawesi, Indonesia. Photograph by Johanis Mogea.

Figure 4-4 Rattan factory. Java, Indonesia. Photograph by Dennis Johnson.

Figure 4-5 Nipa palm (Nypa fruticans) in habitat in Sarawak, East Malaysia. Photograph by Dennis Johnson.

Figure 4-6 Salak palm fruits (Salacca zalacca) for sale. Java, Indonesia. Photograph by Dennis Johnson.

Figure 4-7 House wall panels made from buri leaves (Corypha utan). Mindanao, Philippines. Photograph by Dennis Johnson.

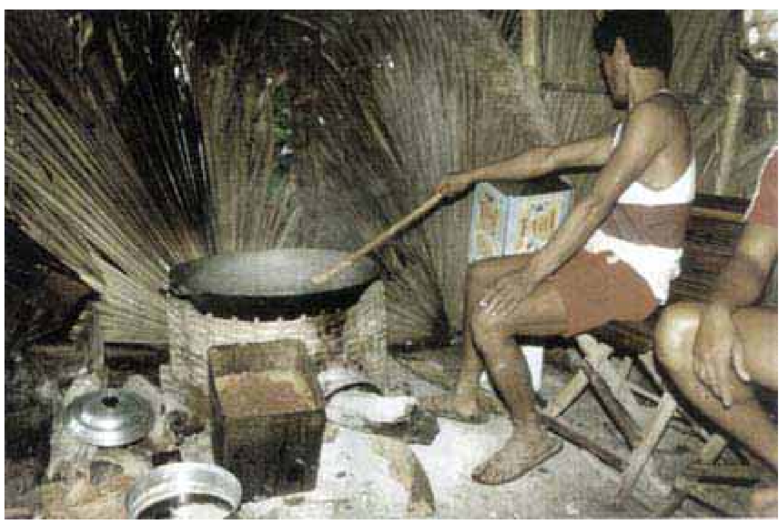

Figure 4-8 Boiling down sap of buri palm (Corypha utan) to make sugar. Mindanao, Philippines. Photograph by Domingo Madulid.

Figure 4-9 Calamus merrillii fruits (center) being sold in the Baguio Market, Philippines. Photograph by Domingo Madulid.

Figure 4-10 Wild date palm (Phoenix sylvestris) along a roadside. West Bengal, India. Photograph by Dennis Johnson.

Figure 4-11 ***Brushes made from palmyra palm (Borassus flabellifer) leaf-base fiber. Tamil Nadu, India. Photograph by Dennis Johnson.***

Figure 4-12 ***Assorted products made from palmyra palm (Borassus flabellifer) leaf fiber. Tamil Nadu, India. Photograph by Dennis Johnson.***

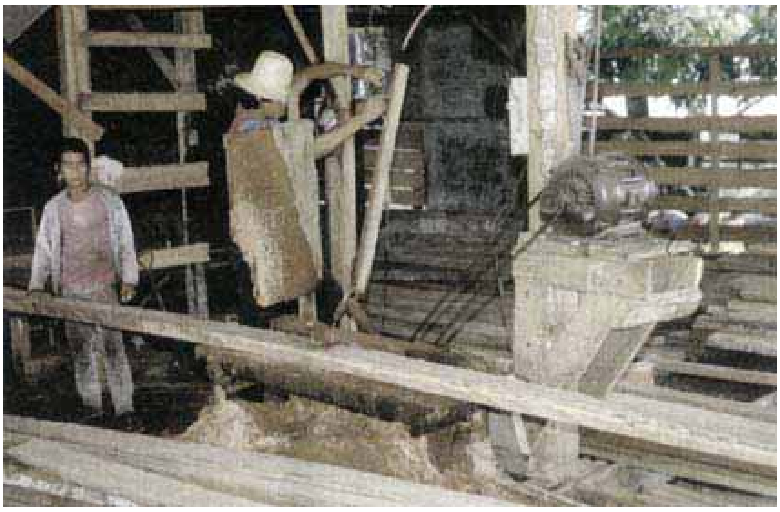

Figure 4-13 ***Sawing boards of coconut wood (Cocos nucifera) in Mindanao, Philippines. Photograph by Dennis Johnson.***

Figure 4-14 ***Tapping nipa palm (Nypa fruticans) using a bamboo container to collect the sap. Mindanao, Philippines. Photograph by Domingo Madulid.***

5 PACIFIC OCEAN REGION

This chapter considers the islands of the Pacific Ocean which are geographically divided into Micronesia, Melanesia and Polynesia. Micronesia delimits islands in the western Pacific and consists of the Mariana, Palau, Caroline, Marshall and Gilbert island groups. Melanesia lies to the northeast of Australia and includes New Caledonia, Vanuatu, Solomon Islands and Fiji. Polynesia designates the islands of the central Pacific, including Samoa (Western and American), French Polynesia (Marquesas, Society Islands, etc.) and Tonga. Papua New Guinea is also included within the scope of this chapter; politically the nation of Papua New Guinea consists of the eastern portion of the island of New Guinea and the Bismarck Archipelago as well as Bougainville.

The following geographic areas where palms occur are excluded from discussion in this chapter and this report: The Hawaiian Islands; New Zealand, including the Kermadec Islands; Australia and its island territories (e.g. Lord Howe, Norfolk, Christmas and Cocos); and the Bonin and Ryukyu Islands belonging to Japan.

The Pacific Ocean Region presents some very unusual patterns of native palm diversity. In the entire area of Micronesia there are only about ten species of native palms (Moore and Fosberg, 1956). The situation in Polynesia is comparable. In marked contrast Melanesia has much greater native palm diversity. For example, New Caledonia alone has 37 indigenous palm species, all endemic (Hodel and Pintaud, 1998; Moore and Uhl, 1984) and Vanuatu has 21 native palms (Dowe and Cabalion, 1996). Papua New Guinea and its islands hold a very rich diversity of palms, with about 270 native species in 31 genera (Baker and Dransfield, 2006; Essig, 1995; Hay, 1984). A recent study of the palms of the Fiji Islands describes the 25 native species (Watling, 2005). Dowe (2009), in a revision of the genus Livistona, provides utilization information, other than ornamental use, on a few of the 36 species recognized.

Coconut, considered as a cultivated tree, is the most widespread palm of the Pacific, found on virtually every island, inhabited or uninhabited, that is of sufficient size and high enough above sea level to support the growth of trees. A dozen or more palms from outside the region have been introduced to these islands and in some cases become naturalized, giving individual islands the appearance of a richer palm flora than they naturally possess. The betel nut palm (*Areca catechu*) and the African oil palm (*Elaeis guineensis*) as well as several strictly ornamental species serve as examples. Palms native to the region have also been introduced to islands where they are not native. Examples are the useful sago palms, *Metroxylon* spp., and two ornamental species, the Fiji fan palm, *Pritchardia pacifica* and the Marquesas palm, *Pelagodoxa henryana*.

Native palms of the Pacific Ocean Region, as defined above, were assessed for information on their utilization patterns and conservation status. The results of the assessment are evaluation presented below; however, they can be understood better if placed within a broader context. Two major factors stand out.

First of all, native palms of the region are not utilized to the magnitude that might be expected. This circumstance can be explained by the existence of excellent alternative sources of plant raw materials which are readily accessible. In the Pacific Islands, the chief alternative plants are coconuts and the screw pines (*Pandanus* spp.). The case study on the multiple utility of the coconut palm on the Truk Islands of Micronesia (Chapter 2) documents the very limited exploitation of native palms. As for the other alternative plant source, screw pines are widely distributed in the Pacific and provide edible fruits as well as leaves for thatching and weaving.

The second factor is that information is lacking that would allow assigning a threatened or non-threatened status to many native palms in the region. This applies in particular to New Guinea (the country of Papua New Guinea to the east and the province of Papua, Indonesia to the west) where a larger majority of the estimated 270 palm species carries an "unknown" conservation status. This situation is being remedied by the Palms of New Guinea Project, based at Kew Gardens. About 20 articles and a field guide to the 31 palm genera found on the island have been published (Baker and Dransfield, 2006); a full palm flora is in progress.

Threatened Pacific Ocean Region Palms

A review of the technical literature on palms revealed at least 28 species of threatened palms, representing 14 genera, currently being exploited in the region (Table 5-1). It is acknowledged that this compilation probably is incomplete as regards palm utilization because it was not possible to peruse the numerous ethnographic studies of this culturally and linguistically diverse area. Coverage for Papua New Guinea is insubstantial because both conservation status and detailed ethnographic data are lacking.

Habitat destruction or degradation caused by logging and clearing of land for agriculture and urban development are the major threats to palms in the region. Palms occurring on islands are particularly at risk because they often occupy habitats that are relatively small in area. Moreover, island palms often represent distinctive species which have evolved due to isolation. New Caledonia is a remarkable example of this circumstance for it possesses 32 native described species, all endemic to the island and in certain instances individual species occur only in small areas of the island. All 32 of New Caledonia's palms are threatened, but only one, *Alloschmidia glabrata*, is reportedly exploited, for palm hearts. In New Caledonia, as elsewhere in the region, coconuts and screw pines furnish plant materials for a wide variety of uses.

Discussion

An examination of the palm products listed in Table 5-1 indicates that in most cases the threatened palms are being exploited for subsistence-level production. Thatching and stem wood for construction purposes are most prominent with some food products as well. If the destructive impact of exploiting these palms is publicized it should be possible to promote alternative raw material sources.

Commercial-level exploitation appears to be confined to the rattan palms (*Calamus* spp.), popular sources of canes for furniture making, and palm heart exploitation.

Of the five threatened rattan species, only *Calamus hollrungii* and *C. warburgii* are of sufficient importance to be even considered "minor rattans," according to Dransfield and Manokaran (1993). *Calamus hollrungii*, according to the source just cited, is a source of excellent furniture canes and has potential for cultivation. Rattans represent a potential sustainable resource, especially in New Guinea where about 60 species of *Calamus* occur, but except for the two species mentioned above, there is as yet no published information on either conservation status or utilization.

Table 5-1 Threatened Pacific Ocean Region Palms with Reported Uses*

Scientific Names	Selected Local Names1	Distribution2	Products/Uses
Actinorhytis calapparia	*vekaveke (New Ireland); boluru (Sol)*	*PNG, Solomons*	*nuts as betel substitute, edible palm heart*
Areca guppyana	*bua lau*	*Solomons (endemic)*	*nuts as betel substitute*
1. Balaka longirostris; 2. B. pauciflora; 3. B. seemannii	*1. mbalaka, niuniu; 2. black bamboo; 3. mbalaka, niuniu*	*1, 2 & 3. Fiji (all endemic)*	*1. stems to make ceremonial spears; edible kernel; 2. stems to make spears; 3. stems for walking sticks & to make spears*
Basselinia glabrata	*?*	*New Caledonia (endemic)*	*edible palm heart*
1. Calamus hollrungii; 2. C. vanuatuensis; 3. C. vestitus; 4. C. vitiensis; 5. C. warburgii	*1. Papuan white rattan (PNG), kuanua (New Ireland); 2. loya ken; 3. ?; 4.ngganuya; 5. ?*	*1. PNG, Solomons; 2. Vanuatu (endemic); 3. PNG, Solomons; 4. Fiji, Solomons; 5. PNG, Solomons*	*1, 2,4 & 6. traditional house building & furniture making 2. minor use for furniture making, stem sap drunk & used as ointment; 3. baskets, walking sticks*
Carpoxylon macrospermum (monotypic)	*bungool*	*Vanuatu (endemic)*	*fruit eaten, brooms from leaves, carrying & storage vessels from first inflorescence bract and leaf sheath*

Scientific Names	**Selected Local Names1**	**Distribution2**	**Products/Uses**
1. Clinostigma harlandii; *2. C. onchorhynchum;* *3. C. samoense*	*1. ngami igh;* *2 & 3. niu vao*	*1. Vanuatu (endemic);* *2 & 3. Western Samoa (both endemic)*	*1. fruit mesocarp & palm heart eaten;* *2 & 3. stem wood split into rods for attaching thatch,* *leaves for thatch*
Heterospathe philipsii	*niuniu*	*Fiji (endemic)*	*immature seed & palm heart edible*
Kentiopsis spp.	*?*	*New Caledonia (endemic genus)*	*edible palm heart and stems for timber*
Licuala grandis	*tabataba*	*Vanuatu*	*leaves used for wrapping and as an umbrella,* *also in medicine*
1. Metroxylon amicarum; *2. M. salomonense;* *3. M. vitiense;* *4. M. warburgii*	*1.rypwyng;* *2. heavy nut, ivory nut (Sol), bia (Van);* *3. songo;* *4. tenebee (Sol), uluwar (Van), ota (Rot)*	*1. Carolines (endemic);* *2. Solomons, Vanuatu;* *3. Fiji (endemic);* *4. Solomons, Vanuatu Rotuma*	*1. leaves for thatching, seed is source of* *vegetable ivory;* *2. seed is source of vegetable ivory, leaves for* *thatching & other uses;* *3.leaves for thatching;* *4. leaves for thatching, stem starch*
Pelagodoxa henryana (monotypic)	*énu*	*Marquesas Islands (endemic)*	*young endosperm eaten*
Pritchardiopsis jenneneyi (monotypic)	*?*	*New Caledonia (endemic)*	*seedlings & young plants*

Scientific Names	Selected Local Names1	Distribution2	Products/Uses
1. Veitchia arecina; *2. V. filifera;* *3. V. joannis;* *4. V. vitiensis;*	*1. palmtri* *2. niuniu, thangithake;* *3. niusawa;* *4. kaivatu*	*1. Vanuatu (endemic);* *2,3,4. Fiji (all endemic)*	*1. palm heart harvested for tourist restaurants;* *2. stems previously (?) used as rafters; leaves for thatching, stem wood to make canoe ribs, ceremonial spears, immature fruit edible;* *3. leaves for thatching, stem for spars & construction; seed & palm heart edible;* *4. stems for house rafters, palm heart, seed & inflorescence all edible*

Notes:

* See also Table under Chapter 13.

1. Many other local names are given in most of the sources cited.

2. Distribution is within the region as defined; some species also occur elsewhere.

Sources: Cribb, 1992; Dowe, 1989a,b, 1996; Dowe et al., 1997; Dransfield et al., 2008; Essig, 1978, 1995; Gillett, 1971; Hay, 1984; Hodel & Pintaud, 1998; Horrocks, 1990; LeBar, 1964; Moore, 1979; Moore & Uhl, 1984; Rauwerdink, 1986; Watling, 2005; Whistler, 1992.

The native rattans of the Pacific Ocean region are in general of lower quality and have less value than the primary commercial species in Southeast Asia. As a substitute for exploiting native rattan resources, the South Pacific Forestry Development Programme introduced three commercial rattan species from Malaysia into the South Pacificwith trial plantings of *Calamus caesius, C. manau* and *C. subinermis* (Tan, 1992).

Seven palms in Table 5-1 are indicated to have edible palm hearts and *Veitchia arecina* in Vanuatu is exploited to furnish exotic salad ingredients to tou;rist restaurants. All seven of these palms are solitary species and therefore the exploitation is unsustainable and should be strongly discouraged.

The sago palms (*Metroxylon* spp.) are multipurpose species. Products currently being derived from them (Table 5-1) could all be obtained from the main cultivated species, *Metroxylon sagu*, as an alternative.

Non-threatened Pacific Ocean Region Palms

In the Region, 12 non-threatened palm species, in nine genera, have reported uses (Table 5-2). This number will certainly increase as more becomes known about the palms of New Guinea. *Arenga microcarpa, Caryota rumphiana* and *Metroxylon sagu* share the characteristics of producing suckers and are terminal flowering; palms having these growth habitats are readily managed on a sustainable basis.

Discussion

Subsistence-level uses for construction materials and food products characterize the palms in Table 5-2. Three of the palms merit further discussion. *Korthalsia zippelii* in Papua New Guinea apparently supports a cottage industry for making furniture.

Metroxylon sagu in Papua New Guinea is exploited for stem starch which is both a subsistence and commercial product. Sago is produced manually and some surplus is produced and sold in markets. Shimoda and Power (1986) and Power (1986) discuss the status of sago in Papua New Guinea. Inasmuch as *M. sagu* is native to New Guinea it represents a natural resource with substantial development potential. Over the past 20 years the sago palm has received considerable attention because it is a high producer of starch per unit area and sago starch has certain unique qualities for food and industrial uses. A new study by Schuiling (2009) provides a detailed account of starch accumulation in the sago palm trunk. Table 5-3 lists the major books on sago which have been published.

Nypa fruticans is found in pure stands in Papua New Guinea, but has been under utilized. A major drawback is the lack of local knowledge of tapping techniques to obtain nipa sap and convert it to sugar or alcohol. According to Päivöke (1983, 1984) nipa has development potential in Papua New Guinea.

Table 5-2 Non-threatened Pacific Ocean Region Palms with Reported Uses

Scientific Names	**Selected Local Names1**	**Distribution2**	**Products/Uses**
Areca macrocalyx	*Kumul, e'esu (Sol)*	*Papua New Guinea, Solomons*	*nuts as betel substitute*
Arenga microcarpa	*?*	*New Guinea*	*edible palm heart*
Caryota rumphiana	*gelep (New Ireland)*	*New Guinea, New Ireland*	*stem wood for construction planks*
Clinostigma savaiiense	*niu vao*	*Western Samoa (endemic)*	*stem wood split into rods for attaching thatch, leaves for thatch*
1.Hydriastele costata; 2. H. cylindrocarpa; 3. H. macrospadix	*1. ? ; 2. niulip; 3. niniu*	*1. New Guinea; 2. Solomons; Vanuatu (endemic to the two island groups); 3. Solomons*	*1. stem wood for floor boards & siding; 2. palm heart & fruit eaten; 3. stem wood for floor boards & siding*
Korthalsia zippelii	*? (rattan)*	*New Guinea*	*furniture making, walking sticks, etc.*

Scientific Names	**Selected Local Names1**	**Distribution2**	**Products/Uses**
1. Livistona surru *2. L. tothur*	*1. surru* *2. tot-hur*	*1&2. Papua New Guinea*	*1. roofs & umbrellas from leaves, stem portions for axe handles & house frames, leaf sheath fibers for brooms and sago strainers;* *2. roofs and umbrellas from leaves, bows from split stem, salt obtained from ash of burned petioles;*
Metroxylon sagu	*ambutrum (NG)*	*New Guinea, Solomons*	*stem starch (see Table 9-22 for nutritional composition), leaves for thatching, petioles for construction, etc.*
Nypa fruticans (monotypic)	*ak-sak (Boug); towe'el (Palau)*	*New Guinea, Bougainville; Marianas*	*leaves for thatching, tapped for sap, heart & immature endosperm eaten; leaves for thatching (Mar)*

Notes: 1. See Table 5-1.

2. See Table 5-1.

Sources: References for Table 5-1 and in addition: Dowe, 2009; Essig, 1982; McClatchey & Cox 1992; Päivöke, 1983, 1984; Ruddle et al., 1978; Whistler, 1987.

Table 5-3 Books Published on the Sago Palm (Metroxylon sagu) since 1977

Abbreviated Title and Reference	**Contents/Comments**
First Sago Symposium, Sarawak, 1976 (Tan, 1977)	*Proceedings represent a benchmark on sago & consist of 32 papers under the general headings: prehistory & ethnobotany; agronomy & economics; technology & industry.*
Palm Sago (Ruddle, et al., 1978)	*A global study of sago starch with chapters on: traditional extraction; sago as subsistence food; sago in myth and ritual; modern commercial sago production; international trade; future outlook.*
Second Sago Symposium, Malaysia, 1979 (Stanton & Flach, 1980)	*Proceedings consist of 17 papers divided between sago palm growth & starch production, & actual & potential food & industrial uses.*
Sago West Malaysia (Tan, 1983)	*A detailed study of the sago industry in Batu Pahat District, southwestern Peninsular Malaysia.*
Sago Palm (Flach, 1983)	*A development paper prepared especially for the expert consultation meeting in January 1984, see next item. A state-of-the art summary.*
Sago Palm Products (FAO, 1986)	*A collection of 25 papers for an expert consultation meeting, January 1984, covering the general topics: management of natural stands; agronomy & farming systems; sago processing & utilization; socioeconomics.*
Third Sago Symposium, Japan, 1985 (Yamada & Kainuma, 1986)	*Proceedings consist of 28 papers covering three general areas: case studies of sago production in specific areas of Southeast Asia & Papua New Guinea; sago palm growth; technical & industrial aspects of starch production.*
Fourth Sago Symposium, Sarawak, 1990 (Ng et al., 1991)	*Proceedings consist of 33 papers given in the following seven broad areas: status & prospects; ecology, distribution & germplasm; in vitro culture; growth & nutrition; environment & production; processing & quality; utilization & product development*
Fifth Sago Symposium, Thailand, 1994 (Subhadrabandhu & Sdodee, 1995)	*Proceedings comprised of 19 papers covering three general areas: technical & industrial aspects of sago starch; sago palm cultivation; economics*

Abbreviated Title and Reference	**Contents/Comments**
Sixth Sago Symposium, Sumatra, 1996 (Jose & Rasyad, 1998)	*Proceedings include 30 papers with emphasis on sago as a future source of food and feed.*
Sago Round Table Meeting, Thailand (Sriroth et al., 1999)	*Proceedings of 4 SE Asian country reports focused on small scale starch extraction.*
Sago 2000 International Seminar, Java (IPB, 2000)	*Proceedings of 35 papers on topics ranging from production to food and nonfood products from sago.*
Sago 2001, International Symposium, Japan (Kainuma et al., 2002)	*Proceedings include 29 papers on various topics including production, utilization and starch processing and regional reports.*
Eighth Sago Symposium, Indonesia, 2005 (Karafir et al., 2006)	*Theme: sago palm development and utilization; proceedings volume of 266 pp. not seen.*
Ninth Sago Symposium, 2007 (Toyoda et al., 2009)	*Theme: sago potential in food & industry.* *Proceedings published but not seen.*
Growth & development of sago palm (Schuiling, 2009)	*Published PhD dissertation examining how starch is accumulated in the stem.*

Note: Two additional other international sago meetings are known to have been held:

1. A Seventh International Sago Symposium was held in Papua New Guinea in 2001. No proceeding was published.

2. The First ASEAN Sago Symposium 2009: Current Trends and Development in Sago Research, was held in Kuching, Sarawak, Malaysia, in October 2009. A proceeding is planned.

6 LATIN AMERICAN REGION

New World palms and their products is the subject of this chapter. The region is defined as extending north-south from Mexico to Chile and Argentina, and including the islands of the Caribbean.

Palm species diversity in this region is second only to Asia. Glassman (1972) recognized over 1,100 palm species in the Americas (including the United States). However, in a field guide to New World palms, Henderson et al. (1995) consider there to be only 550 palm species native to the Americas. This significant difference in species totals is attributable to the many synonymous names included in the higher figure and the fact that Henderson *et al.* (1995) follow a broad species concept resulting in the lower number.

Over the last two decades, research in the biological and social sciences has helped to generate a reliable body of knowledge about the utilization patterns and scientific names of Latin American palms. This knowledge has come from several different approaches, and can be illustrated by the following examples grouped into five categories.

General palm studies. The survey of the major underutilized palms of tropical America (FAO/CATIE, 1984) is an excellent source of information. Papers in the palm symposium proceedings (Balick, 1988b) primarily deal with the Latin American region. Balick (1984, 1989) also has provided surveys of palm ethnobotany and diversity of use in the region. A natural resource approach was used by Kahn (1991) in a study of palms in swamp forests of the Amazon. Kahn and de Granville (1992), in their study of palm forest ecosystems of Amazonia, provide data on leaf and fruit productivity which have direct relevance to exploiting palm products. A literature survey of South American palms as sources of medicine was carried out by Plotkin and Balick (1984). Schultes (1974) examined the relationship between palms and religious beliefs among indigenous people in the northwest Amazon.

Indigenous palm use. South America has been the focus of a number of studies. The palm use of the Shipibo in Peru was studied by Bodley and Benson (1979), as previously shown in the case study in Chapter 2. Anderson (1978) investigated indigenous palm names and uses by the Yanomama in Brazil. An ethnobotanical study of the Chácobo Indians in Bolivia by Boom (1986) documented palm use. Gragson (1992) studied palm utilization by the Pume Indians and Beckerman (1977) by the Bari Indians, both in Venezuela. Palm use in coastal Ecuador among the Cayapas and Coaiqueres was investigated by Barfod and Balslev (1988). Balick (1979b) documented palm use by the Guahibo in Colombia and the Apinayé and Guajajar Indians in Brazil (1988c). Indigenous and folk communities of the southwestern Amazon in Brazil were investigated for their palm uses by Campos and Ehringhaus (2003).

Taxonomic revisions and geographic area studies. Systematic floras and national palm books often include information on usage. Such is the case with the revisions of *Aiphanes* (Borchsenius and Bernal, 1996); *Allagoptera* (Moraes, 1996); *Bactris* (Henderson, 2000); *Euterpe* and *Prestoea* (Henderson and Galeano, 1996) and *Roystonea* (Zona, 1996). The flora of Bolivia contains detailed utilization data (Moraes, 2004).

A comprehensive study of Brazilian palms (Lorenzi *et al*., 2004) includes information about the distribution of species and utilization. The book is important because Brazil has the most diverse palm flora of the Neotropics. A new revised edition is in preparation, to be published in 2010 in both Portuguese and English versions.

Examples of other national palm books include the Dominican Republic (Hoppe, 1998), Trinidad and Tobago (Comeau *et al*., 2003), Chile (Grau, 2006) and a detailed book on Ecuadorian palms (Borchsenius *et al*., 1998). The Amazon forest is richly endowed with useful palm fruits which furnish edible fruits; Miranda *et al*. (2001) is an excellent reference source on this subject.

Other studies on palms and their utilization deal with specific geographic areas, such as: the Caribbean Region (Read, 1988), Cuba (Moya López and Leiva Sánchez, 2000), French Guiana (Granville, 1999), the Dominican Republic (Horst, 1997), the island of Dominica, (James, 2009), Mexico (Quero, 1992) and Colombia (Bernal, 1992). Borchsenius *et al*. (1996) did a study of Ecuadorean palm use; and Kahn (1988), Mejía (1988, 1992) and López Parodi (1988) all researched the subject in parts of eastern Peru. Pinheiro and Balick (1987) edited and translated material on Brazilian palm use.

Oil palm studies. The American oil palms have been the subject of several investigations relative to their economic potential. Lleras and Coradin (1988) provide an overview of the oil-bearing palms of the region and Balick (1979a) examined the subject in the Amazon. Balick (1986, 1988a) also looked in detail at oil palms in the genus *Oenocarpus*). Anderson *et al*. (1991) studied in depth the potential of the babaçu palm (*Attalea speciosa*) in Brazil. Pesce (1985) and Miranda *et al*. (2001) provide information on the characteristics of Amazonian palm oils.

Management and domestication studies. Apart from American oil palms, management of other wild palm stands has been the subject of research. Anderson (1988) in the Lower Amazon in Brazil, and Urdaneta (1981) in the Orinoco Delta in Venezuela, each studied management of the açaí or manaca palm (*Euterpe oleracea*). Voeks (1988) examined management of the piassava palm (*Attalea funifera*) in Bahia, Brazil. Pinard and Putz (1992) researched palm demographics and management which included a dozen New World palms. Ecuadorian palms with agroforestry production potential were the subject of a book by Borgtoft Pedersen and Balslev (1990). Coradin and Lleras (1988) provided an overview of New World palms with domestication potential.

The only fully domesticated native palm of the region, pejibaye (*Bactris gasipaes var. gasipaes*) has been the object of a number of studies (Clement, 1988, 1998, 2008; Mora-Urpí *et al*., 1996), the results of which may be applicable to other species in the region. Another palm receiving attention for its management potential is the multipurpose moriche palm (*Mauritia flexuosa*), which occurs in nearly pure stands and in great numbers in the Amazon Basin.

Threatened Latin American Palms

The foregoing discussion provides background for an assessment of natural native palm populations which have reported uses and are also under threat in the wild. Table 6-1 lists 28 genera and their species which are known to be utilized as well as threatened by a combination of factors. Criteria for inclusion in the table on the basis of utilization were that uses are contemporary or historical with the possibility of renewal; certain examples of very minor and occasional use are omitted.

It should be noted that there are a number of threatened species which do not appear in Table 6-1 because they have no current utility. Also, information on the conservation status of some forest palms in remote areas is unknown. Within the Latin American region, the chief threats to native palms populations are deforestation or degradation related to timber harvest, forest clearing and conversion to pastures for cattle raising; as well as traditional practices of shifting cultivation. Palm species which require an understory habitat are particularly sensitive.

Discussion

The main purpose of Table 6-1 is to draw attention to those products derived from threatened palms, products which should not be promoted for commercial production if they rely upon wild palm stands. It is advisable to distinguish in general between subsistence uses and commercial uses. Subsistence-level exploitation, especially by indigenous groups of forest-dwellers, in most cases poses no significant threat to wild palm populations. But commercialization of the products of threatened palms which inevitably must lead to an increase of pressure on wild palms can bring about adverse effects. Overexploitation of leaves and fruits impairs natural regeneration of populations of standing trees. Digging of palm seedlings for ornamental use has the same effect if insufficient numbers of reproducing plants are not left in place. Felling trees themselves for products such as palm heart or fruit can result in the most serious impact of extractive activities on native palms.

The predominant uses in Table 6-1 are leaves for thatching as well as for weaving in basketry; food and feed products derived from fruits, palm heart and palm sap; and construction material from palm stems. Certain of the palms listed warrant discussion.

Table 6-1 Threatened Latin American Palms with Reported Uses*

Scientific Names	**Selected Local Names!**	**Distribution**	**Products/Uses and Selected References**
Aiphanes linearis	*chirca (Col)*	*Colombia*	*edible fruit (Borchsenius & Bernal, 1996)*
Allagoptera arenaria; *A. brevicalyx*	*1. cacando (Bra);* *2. burri da Praia (Bra)*	*1 & 2. Brazil*	*1 & 2. edible fruit*
Astrocarvum aculeatissimum; *A. malybo;* *A. triandrum*	*1. birejauva (Bra);* *2. anchamba (Col);* *3. cabecenegro (Col)*	*1. Brazil;* *2 & 3. Colombia*	*1. leaves for brooms & hats, stems for construction; liquid endosperm used as medicine;* *2. veins of young leaflets used to make mats, baskets;* *3. stems used for fencing & construction*
Attalea amygdalina; *A. crassispatha;* *A. oleifera;* *A. tessmannii*	*1. taparo (Col);* *2. carossier (Hai);* *3. catoIé (Bra);* *4. coco (Bra), conta (Per)*	*1. Colombia;* *2. Haiti;* *3. Brazil;* *4. Brazil, Peru*	*1. edible & oil -bearing seed;* *2. seeds eaten by children;* *3. leaves for thatching, oil-bearing seed;* *4. endocarp burned to smoke rubber*
Brahea aculeata; *B. dulcis*	*1. palmilla (Mex);* *2. palma de sombrero (ElS), suyate (Hon), capulin (Mex)*	*1. Mexico;* *2. Mexico to El Salvador; Nicaragua*	*1. leaves for thatching;* *2. stems for construction, leaves for thatch, leaf fibers for rope, edible fruit*
Butia eriospatha	*butiá (Bra)*	*Brazil*	*fruits used to flavor alcoholic drink*
Calyptronoma rivalis	*coquito (DR); Palma (Hai); palma manaca (PR)*	*Dominican Republic, Haiti, Puerto Rico*	*young leaves for weaving, mature leaves for thatching (Zona, 1995)*
Ceroxylon spp.	*palma de cera (Col), palma de ramo (Ecu), ramo benedito (Ven)*	*Bolivia, Colombia, Ecuador, Peru, Venezuela*	*leaves cut for Palm Sunday, stems for fences & construction, fruits fed to pigs*

Scientific Names	**Selected Local Names!**	**Distribution**	**Products/Uses and Selected References**
Chamaedorea spp. *(all except C. tepejilote)*	*canelilla, guaya, guaita, molinillo, pacaya, pacayita, palmilla, sangapilla, tepejilote, xaté*	*Mexico to Brazil; Bolivia*	*cut foliage, whole plants & seed for ornamental use. (Bridgewater et al., 2006; Endress et al., 2004, 2006; Hodel, 1992)*
Coccothrinax borhidiana; *C. crinita;* *C. ekmanii*	*1. guano (Cub);* *2. guano barbudo(Cub);* *3. gwenn (Hai)*	*1 & 2. Cuba;* *3. Haiti*	*1,2 & 3. leaves for thatching*
Colpothrinax wrightii	*palma barrigona (Cub)*	*Cuba*	*leaves for thatching, stem for canoe, water barrels, etc., fruits fed to livestock (Evans, 2001)*
Copernicia brittonorum; *C. ekmanii;* *C. gigas*	*1. jata de costa (Cub);* *2. om de pay (Hai);* *3. barrigón (Cub)*	*1 & 3. Cuba;* *2. Haiti*	*1, 2 & 3. leaves for thatching*
Cryosophila guagara; *C. williamsii*	*1. guágara (CR);* *2. mojarilla (Hon)*	*1. Costa Rica;* *2. Honduras*	*leaves for thatching;* *edible palm heart (Evans, 1996)*
Euterpe catinga; *E. edulis;* *E. luminosa*	*1. açaí da catinga (Bra), asaí de sabana (Col), manaca (Col) Ven);* *2. yayih(Arg) juçara, (Bra);* *3. guayaquil (Per)*	*1. Brazil, Colombia, Peru, Venezuela;* *2. Argentina, Brazil, Paraguay;* *3. Peru*	*stems for construction, leaves for thatching. fruits to make drink;* *edible palm heart (see Table 9-19 for nutritional composition) (EMBRAPA, 1987; Reis & Reis, 2000;* *stems for poles*
Gaussia maya	*palmasito (Bel), cambo, (Mex)*	*Belize, Mexico*	*stems used for construction*

Scientific Names	**Selected Local Names!**	**Distribution**	**Products/Uses and Selected References**
Geonoma congesta	*cortadera (Col), caña de danta (CR), suita (Hon)*	*Colombia, Costa Rica, Honduras, Nicaragua, Panama*	*leaves for thatching*
Itaya amicorum (monotypic)	*xila (Bra), marimiipa (Col)*	*Brazil, Colombia, Peru*	*leaves for thatching*
Jubaea chilensis (monotypic)	*palma de coquitos (Chi)*	*Chile*	*nuts sold as snack food, tapped for sap*
Mauritia carana	*caraná (Bra, Col, Ven), canangucha desabana (Col), aguaje (Per)*	*Brazil, Colombia, Peru, Venezuela*	*leaf sheath fibers to make brooms, leaves for thatching (Gonzalez et al., 2009)*
Oenocarpus distichus	*bacaba (Bra)*	*Bolivia, Brazil*	*fruits used to make a beverage and to extract oil*
Parajubaea sunkha; *P. torallyi*	*palma sunkha (Bol);* *janchicoco (Bol)*	*1 & 2. Bolivia*	*1 & 2. leaf sheath & petiole fiber woven into rope (Enssle et al., 2006; Moraes, 1996; Vargas, 1994)*
Phytelephas seemannii; *P. tumacana*	*tagua (Col, Pan)*	*Colombia, Panama*	*seeds for vegetable ivory, leaves for thatching (Dalling et al.,1996)*
Pseudophoenix ekmanii; *P. lediniana*	*1. cacheo (DR);* *2. pal (Hai)*	*Dominican Republic;* *Haiti*	*1. former source of palm wine by felling tree;* *2. fruits collected for livestock feed* *(Zona, 2002)*
Sabal pumos; *S. uresana*	*1. palma real (Mex);* *2. palma blanca (Mex)*	*1 & 2. Mexico*	*1. fruit mesocarp edible, leaves for thatching;* *2. leaves for thatching*

Scientific Names	Selected Local Names!	Distribution	Products/Uses and Selected References
Syagrus botryophora; *S. harleyi;* *S. pleioclada;* *S. smithii;* *S. werdermannii*	*pati (Bra);* *coco de raposa (Bra);* *coqueirinho (Bra),* *catolé (Bra);* *coco de vassoura (Bra)*	*1,2,3 & 5. Brazil;* *4. Brazil, Colombia, Peru*	*1. stems in construction, seeds for oil;* *2. waxy leaves as fuel;* *3. leaves to make brooms;* *4. leaves for thatching, seeds eaten;* *5. leaves to make brooms & strainers*
Trithrinax brasiliensis	*carandaí (Bra)*	*Brazil*	*leaflets used to weave hats*
Wettinia fascicularis; *W. hirsuta;* *W . longipetala*	*macana (Col);* *palma mazorca (Col);* *no common name*	*1. Colombia, Ecuador;* *2. Colombia*	*1,2 & 3 . stems used for construction (Bernal, 1995)*

Notes:

* See also Table under Chapter 13.

1. An index of common names appears in Henderson et al. (1995).

2. There are numerous common names for Chamaedorea palms and they vary from place to place; for more detail see Hodel (1992).

Source: Henderson et al., 1995 and others as indicated.

Table 6-1 groups species of *Ceroxylon* and *Chamaedorea*. Eleven species of *Ceroxylon* are recognized. *Ceroxylon* palms are unique because they represent, for the palm family, some of the tallest palms in the world (up to 60 m in height) and those occurring at the highest elevations (to 3,150 m). These palms grow in montane rain forests, areas under intense pressure as a result of logging and land clearing for agriculture and livestock raising. As indicated, the palm stems are a source of construction material. Formerly, palms were felled to extract the wax covering the stems of *Ceroxylon*. Remaining stands of these palms should be protected and exploitation for any of their products discouraged.

Chamaedorea palms are also grouped in a single entry, with the exception of *C. tepejilote* as noted. This represents the largest New World palm genus, with about 110 species. The habitat of *Chamaedorea* palms is the understory of tropical rain forests ranging from sea level to 2,600 m. About ten species of *Chamaedorea* are important in ornamental horticulture and for cut foliage, particularly in the United States and Europe. *Chamaedorea seifrizii* (xaté or bamboo palm) and *C. elegans* (parlor palm or neanthe bella) are the two most important commercial species. This is not the place to go into a detailed discussion of commercial species of *Chamaedorea*, a subject covered in detail by Hodel (1992). It will suffice here to point out the key issues related to wild populations.

Without question, the chief threat to chamaedoreas is the destruction of their natural forest understory habitat, for the palms cannot survive without it. Gathering of wild *Chamaedorea* seed and cutting leaves for the florist trade both have adverse effects on wild populations. Seed collection results in reduced natural regeneration and removal of more than a few leaves per stem can decrease plant vigor and diminish fruit production.

Fortunately, increasing cultivation of chamaedoreas for seed is reducing the pressure on wild palms, except in the case of certain species (e.g. *Chamadorea elegans*) which are difficult to grow without artificial pollination. The main sources of wild collected seed are Mexico and Guatemala. Cut leaf exports originate from Mexico, Guatemala and Costa Rica. In northern Guatemala, there is a project to try to manage sustainably the harvest of leaves of wild *C. elegans*, with some hopeful results (Reining and Heinzman, 1992). More recent studies in Belize and Mexico on leaf harvest have provided an economic assessment of collecting practices (Belize) and the impact of leaf harvesting on leaf production (Mexico) (Bridgewater *et al*., 2006; Endress *et al*., 2004, 2006). Most promising in the long run is to encourage local farmers to cultivate the desirable palm species to satisfy the demand for seed and cut foliage (Vovides and Garcia Bielma, 1994).

Euterpe edulis is a single-stemmed palm native to the Atlantic Forest of eastern South America. To a major degree, its inclusion in Table 6-1 is because of exploitation for commercial palm heart production in Brazil, Argentina and Paraguay. In Brazil, wild stands were reduced to near uneconomic levels, forcing many palm heart companies to shift operations to the Lower Amazon and the exploitation of *E. oleracea*. Nevertheless, naturally-occurring *E. edulis* is still being cut in southern Brazil; industries continue to operate there as well in the neighboring countries.

Nowhere is the practice sustainable. If replacement plantings were done in the forest to replace harvested trees, sustainable production of palm heart from *E. edulis* could be achieved. In Brazil, *E. edulis* has been studied in detail as an attempt to conserve and sustainably manage wild populations for palm heart production (Reis and Reis, 2000). Also, efforts are being made in Brazil to cultivate the palm on plantations and to produce a hybrid between *Euterpe edulis* and *E. oleracea* with a clustering stem that could make cultivation production price competitive with the harvest of wild *E. edulis* (EMBRAPA, 1987).

Two threatened South American palms, *Itaya amicorum* and *Jubaea chilensis*, are represented by monotypic genera; with a single species in the genus. From a conservation standpoint, monotypic species merit special attention because of the unique biodiversity they represent.

Non-threatened Latin American Palms

Table 6-2 Non-threatened Latin American Palms with Reported Uses

Scientific Names1	**Local Names2**	**Distribution**	**Products/Uses and Selected References**
Acrocomia aculeata	*mbocayá (Arg), totaí (Bra), macaúba Bra), corozo (Col, Ven), tamaco (Col), coyol (CR, EIS, Hon, Mex), carosse (Hai)*	*El Salvador, Haiti, Honduras, Mexico; Costa Rica to Argentina; Bolivia, Paraguay*	*multipurpose palm including oil-bearing seed & sap for palm wine (Balick, 1990)*
Allagoptera campestris; *A. caudescens;* *A. leucocalyx*	*1, 2 buri (Bra);* *3. tacuchicoco (Bol), coco da chapada (Bra);*	*Argentina, Brazil, Paraguay;* *Brazil;* *Argentina, Bolivia, Brazil, Paraguay*	*1.edible immature fruits;* *2. stems in construction, leaves for thatching, edible fruit;* *3. mesocarp & seeds edible*
Aphandra natalia	*piassaba (Bra, Ecu), tagua (Ecu)*	*Brazil, Ecuador, Peru*	*leaf sheath fiber for making brooms, leaves for thatching, edible immature fruit, male inflorescences fed to cattle (Borgtoft Pedersen, 1992; 1996)*
Asterogyne martiana	*cortadera (Col), pico (Ecu), capoca (Gua), pacuquilla (Hon), pata de gallo (Nic)*	*Colombia, Ecuador, Guatemala, Honduras, Nicaragua*	*leaves for thatching*

Scientific Names1	**Local Names2**	**Distribution**	**Products/Uses and Selected References**
Astrocaryum aculeatum; *A. campestre;* *A. chambira;* *A. jauari;* *A. mexicanum;* *A. murumuru;* *A. standleyanum;* *A. vulgare*	*1. chonta (Bol), tucum (Bra), awara (Guy), cemau (Sur), tucuma (Ven);* *2. jarivá (Bra);* *3. tucuma (Bra), charribira (Col, Ecu, Per), cumare (Col. Ven), coco (Col, Fen);* *4. jauri (Bra), güiridima, (Col, Ven), yavarí (Col), chambirilla, (Ecu, Per), sauarai (Guy), liba awara (Sur);* *5. lancetilla (Hon), chocho (Mex);* *6. chonta (Bol), murumuru (Bra), chuchana (Col. Ecu). huicungo (Per);* *7. guérregue (Col), accord (Ecu); tucum (Bra), swarra (Sur);* *8. tucumã (Bra), awarra (FrG, Sur)*	*1. , Bolivia, Brazil, Colombia, Guyana, Suriname, Trinidad Venezuela;* *2. Bolivia, Brazil;* *3. Brazil, Colombia, Ecuador, Venezuela;* *4. Brazil, Colombia, Guyana, Peru, Suriname, Venezuela;* *5. Belize, El Salvador, Honduras, Mexico, Nicaragua;* *6. Bolivia, Brazil, Colombia, Ecuador, Guianas, Peru, Venezuela;* *7. Colombia, Costa Rica, Ecuador, Panama;* *8. Brazil, French Guiana, Suriname*	*1. fruit mesocarp edible, oil-bearing seed (Kahn & Moussa, 1999; Moussa & Kahn, 1997);* *2. young leaf fiber to make fishing nets, fruits edible;* *3. young leaf fiber to make hammocks. fishing nets, bags (Holm Jansen & Balslev, 1995):* *4. leaf rachis used for weaving, endocarps for necklaces, fruits as fish bait, edible palm heart;* *5. young inflorescence & endosperm eaten, leaves for thatching & stems for tool handles (Ibarra-Manrriquez, 1988)* *6. mesocarp eaten, leaves for thatching, stems for construction;* *7. stems for construction, fruit fed to pigs, young leaves for weaving (Borgtoft Pendersen, 1994; Velásques Runk, 2001);* *8. fruit mesocarp to make mash, flavor ice cream & a beverage (Mousa & Kahn, 1997)*

Scientific Names1	Local Names2	Distribution	Products/Uses and Selected References
Attalea allenii; *A. butyracea;* *A. cohune;* *A. colenda;* *A. exigua;* *A. funifera;* *A. maripa;* *A. phalerata;* *A. speciosa*	*1. taparín (Col), igua (Pan);* *2. palla (Bol), jací (Bra), palma de vino (Col), palma real (CR, Pan), corozo (CR, Gua, Mex, Ven), canambo (Ecu), coquito (Gua), coyol real (Mex), shebon (Per), palma. de agua (Ven);* *3. cohune (Bel, Gua, Hon, Mex), corozo (EIS, Gua, Hon), manaca (Hon):* *4. palma real (Col, Ecu);* *5. babaçu (Bra);* *6. piaçqava (Bra);* *7. cusi (Bol), anajá (Bra), güichire (Col) inayo (Ecu), maripa (FrG, Sur), kukarit (Guy), mayuga (Per), cucurito (Ven);* *8. motaca (Bol) urucuri (Bra), shapaja (Per);* *9. cost (Bol), babaçu (Bra)*	*1. Colombia, Panama:* *2. Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Panama, Peru, Venezuela;* *3. Belize, El Salvador, Guatemala, Honduras, Mexico;* *4. Colombia, Ecuador;* *5. Brazil;* *6. Bolivia, Brazil, Ecuador, French Guiana, Guyana, Suriname, Trinidad;* *7. Colombia. Venezuela;* *8. Bolivia, Brazil. Paraguay, Peru;* *9) Bolivia, Brazil, Guyana, Suriname*	*1. leaves cut for Palm Sunday, fruit edible;* *2. leaves for thatching (Standley & Steyermark, 1958);* *3. oil from seeds, eaves for thatching (McSweeney, 1995);* *4. seeds collected for commercial oil extraction (Blicher-Mathiesen & Balslev, 1990; Feil, 1996);* *5. endosperm used to make candies & sweeten food;* *6. leaf base fiber is commercially exploited (Monteiro, 2009; Voeks, 1988, 2002);* *7. leaves for thatching;* *8. leaves for thatching, endocarps burned to smoke rubber;* *9. seeds collected for commercial oil extraction (Anderson et al., 1991, Balick, 1987)*

Scientific Names1	**Local Names2**	**Distribution**	**Products/Uses and Selected References**
1. Bactris barronis; *2. B. brongniartii;* *3. B. concinna;* *4. B. ferruginea;* *5. B. guineensis;* *6. B. major;* *7. B. maraja;* *8. B. plumeriana:*	*1. lata (Col), alar (Pan);* *2. marajá (Bra), chaearrá (Col), bango pal in (Guy), ñejilla (Per), caña negra (Ven);* *3. marajaú (Bel), marajá (Bra), chontilla (Ecu), ñejilla (Per);* *4. rnané véio (Bra);* *5. corozo (Col) biscoyol (CR), coyolito (Nic), uvita de monte (Pan), piritu (Ven);* *(Per), macanilla (Ven);* *6. hones (Bel), marayú (Bol), marajá (Bra), lata (Col), huiscoyol (Els,Gua,Hon,Nic), jahuacté (Mex), caña brava (Pan), cubarro (Ven);* *7. chontille (Bol, Col, Per), marajá Bra), Chacarrá (Col), uvita (Pan), ñeja (Per), piritu (Sur,Ven), uva de montaña (Ven);* *8. coco macaco (Cub), coco macaque (Hai), prickly pole (Jam)*	*1. Colombia, Panama;* *2. Bolivia, Brazil, Colombia, Guianas, Peru, Venezuela;* *3. Brazil, Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela;* *4. Brazil;* *5. Nicaragua;* *6. Belize, Bolivia, Colombia, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panamá, Venezuela,* *7. Bolivia, Colombia, Costa Rica, Panamá, Peru, Suriname, Venezuela;* *8. Cuba, Dominican Republic, Haití, Jamaica*	*1. split stems as flooring;* *2. fruits eaten;* *3. fruits eaten by humans & livestock;* *4. leaf fiber woven into fishing line;* *5. stems formerly once used to make walking sticks for export, fruit to make a drink;* *6, 7, 8. fruits eaten (Clement, 2008);*
Chamaedorea tepejilote	*Palmito dulce (CR), pacaya (EIS, Gua, Mex), caña verde (Pan)*	*Colombia, Costa Rica, El Salvador, Guatemala, Mexico, Panama*	*immature male inflorescence as food from cultivated & wild plants (Castillo Mont et al., 1994); see Table 9-9 for nutritional composition of this product*
Chelyocarpus chuco	*hoja redonda (Bol), caranaí (Bra)*	*Bolivia, Brazil*	*leaves for thatching & to weave hats*

Scientific Names1	**Local Names2**	**Distribution**	**Products/Uses and Selected References**
Coccothrinax argentata; *C. argentea;* *C. barbadensis;* *C. miraguama*	*1. silvertop (Bah), thatch palm (Cay), yuruguana de costa (Cub), silver thatch (Jam), knacás (Mex);* *2. guano (DR), latanye maron (Hai);* *3. latanier bala¡ (Gud, Mar), palma de abanico (PR);* *4.miraguano (Cub)*	*1. Bahamas, Cayman, Cuba, Honduras, Jamaica, Mexico;* *2. Dominican Republic, Haiti;* *3. Guadeloupe, Martinique, Puerto Rico;* *4. Cuba, Dominican Republic, Haiti*	*1. stems for construction, leaves for thatchíng;* *2 & 3. leaves for thatching;* *4. leaves for weaving & thatching*
Copernicia alba; *C. prunifera;* *C. tectorum;* *C. macroglossa, C. baileyana, C. cowellii, C.hospita, C. rigida*	*1. caranday (Arg, Bol, Par), carandá (Bra);* *2. carnaúba (Bra);* *3. sará (Col), cobija (Ven);* *4. yarey, jata, guano cano (Cub)*	*1. Argentina, Bolivia, Brazil, Paraguay;* *2. Brazil;* *3. Colombia, Venezuela;* *4. Cuba*	*1. stems for construction & utility poles, leaves for weaving (Markley, 1955; Moraes, 1991);* *2. leaves source commercial wax (see Table 9-15 for wax composition & properties) & to weave hats & mats (Johnson, 1972);* *3. leaves for weaving & thatching, stems for construction;* *4. leaves to weave hats & baskets, thatching, stems for fence posts*

Scientific Names1	**Local Names2**	**Distribution**	**Products/Uses and Selected References**
Desmoncus cirrhiferus; *D. giganteus;* *D, mitis;* *D. orthacanthos;* *D. polyacanthos*	*1. matamba (Col), boira negra (Eco);* *2. jacitara (Bra), vara casha (Per);* *3. jacitara (Bra), bejuco alcalde (Col), barahuasca (Per);* *4. basket tie (Bel), bayal (Bel, Gua, Hon, Mex), urubamba (Bol), matamba (Col, CR, Pan), jacitara (Bra), karwari (Guy), bambamaka (Sur), camuari (Ven);* *5. jacitara (Bra), bejuco alcalde (Col), vara casha (Per), voladora (Ven)*	*1. Colombia, Ecuador;* *2. Brazil, Colombia, Ecuador, Peru;* *3. Belize, Bolivia, Brazil, Colombia, Ecuador, Guatemala, Mexico, Venezuela;* *4. Bolivia, Brazil, Colombia, Costa Rica, Guyana, Honduras, Panama, Suriname, Venezuela;* *5. Bolivia, Brazil, Colombia, Peru, Venezuela*	*1. stems used to weave baskets & fish traps, fruit edible;* *2. stems used to weave various products (Henderson & Chávez, 1993);* *3. stems use for basketry & to tie beams in construction (Galeano, 1991);* *4. stems for basketry;* *5. stems for basketry & sieves (Hübschmann et al., 2007)*
Dictyocaryum fusicum; *D. lamarckianum;* *D. ptarianum*	*1. palma araque (Ven);* *2. barrigona (Col), palma real (Ecu), basanco (Per);* *3. bombona paso (Col), pona colorada (Per)*	*1. Venezuela;* *2. Bolivia, Colombia; Ecuador, Peru;* *3. Brazil, Colombia, Peru, Venezuela*	*1.wood used in cabinetry:* *2. stems used for construction;* *3. stems used in construction, leaves for thatching*
Elaeis oleifera	*caiaué (Bra), nolí (Cot)*	*Central America; Northern South America; Brazil, Colombia*	*mesocarp oil extracted for cooking & other uses (Schultes, 1990)*

Scientific Names1	**Local Names2**	**Distribution**	**Products/Uses and Selected References**
1) Euterpe oleracea; *2) E. precatoria*	*1. açaí (Bra), naidí (Col), manaca (Ven);* *2. açaí (Bra), asaí (Bol, Col), uasi (Per), manaca (Ven)*	*1.Brazil, Colombia, Ecuador, Venezuela; 2.Central America; Bolivia, Brazil, Colombia; Ecuador, Guianas, Peru, Venezuela*	*1.stem cut for commercial palm heart (see Table 9-19 for nutritional composition), fruits made into drink (Anderson, 1988; Pollak et al., 1995, Strudwick & Sobel, 1988; Tabora et al., 1993); Urdaneta, 1981);* *2. stems cut for commercial palm heart, stems used for construction, fruits made into drink*
Geonoma spp.	*(selected) ubim, assai-rana, jatata, palmiche, cortadera, ubimacu, huasipanga, daru*	*wide neotropical distribution*	*leaves of many species used for thatching, most important is G. deversa (jatata) in Bol & Per (Rioja, 1992), stems of some spp. used for construction,*
Iriartea deltoidea (monotypic)	*copa (Bol), paxiúba barriguda (Bra), barrigona (Cot), maquenque (CR), bomba (Ecu), huacrapona (Per), barriguda (Ven)*	*Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Nicaragua, Panama, Peru, Venezuela*	*stems split for construction, canoes & other wood uses (Anderson, 2004; Johnson & Mejía, 1998; Pinard, 1993)*
Leopoldinia piassaba	*piassaba (Bra), chiquichique (Col, Ven)*	*Brazil, Colombia, Venezuela*	*stem fiber gathered & traded locally, fruits used to make a drink (Putz, 1979)*
Lepidocaryum tenue	*caraná (Bra, Col), caraña (Per), morichito (Ven)*	*Brazil, Colombia, Peru, Venezuela*	*leaves for thatching, esp. in Peru (Kahn & Mejía, 1987) species used in construction*

Scientific Names1	**Local Names2**	**Distribution**	**Products/Uses and Selected References**
Manicaria saccifera	*terniche (Ven), bussú (Bra), jiquera (Col), troolie (Guy), guágara (Pan)*	*Brazil, Colombia, Ecuador, Guyana, Panama, Peru, Venezuela*	*leaves for thatching (Wilbert, 1976)*
Mauritia flexuosa	*caranday-guazú (Bol), buriti (Bra), aguaje (Per), moriche (Col, Ven)*	*Northern South America; Bolivia, Brazil, Colombia, Peru, Venezuela*	*multipurpose palm edible fruit mesocarp (see Table 9-24 for composition), oil from fruit, leaf fibers for rope, baskets, wine & starch from stem (Holm et al., 2008; Manzi & Coomes, 2009; Padoch, 1988, Ruddle & Heinen, 1974; Sampaio et al., 2008)*
1. Oenocarpus bacaba; *2. 0 bataua;* *3. 0. mapora*	*1. bacaba (Bra), manoco (Col), unguraui (Per), seje pequeño (Ven);* *2. batauá (Bra), seje (Col), chapil (Ecu), unguraui (Per), aricaguá (Ven);* *3. bacaba (Bol), bacabai (Bra), pusuy (Col), ciamba (Per), mapora (Ven)*	*I & 2. Northern South America; Brazil, Colombia, Peru, Venezuela* *3. Bolivia, Brazil, Colombia, Costa Rica, Panama, Peru, Venezuela*	*1. fruits used to make beverage;* *2. fruits contain edible oil, also used to make beverage, leaves woven into baskets, stems in construction (Balick & Gershoff, 1981);* *3. fruits used to make beverage, leaflet midveins used for basketry*
1. Phytelephas aequalorialis; *2. P. macrocarpa;* *3. P. schottii*	*1. tagua (Ecu);* *2. yarina (Col, Ecu, Per);* *3. cabecinegro (Col)*	*1. Colombia, Ecuador;* *2. Bolivia, Brazil, Peru;* *3. Colombia*	*1, 2 & 3. seeds for vegetable ivory (Barfod, 1989; Barfod et al., 1990; Calera Hidalgo, 1992; Koziol & Borgtoft Pedersen,1993; Ziffer,1992*

Scientific Names1	Local Names2	Distribution	Products/Uses and Selected References
Pseudophoenix vinifera	*cacheo (DR), katié (Hai)*	*Dominican Republic, Haiti*	*leaves for thatching, fruits fed to livestock, former source of palm wine obtained by felling tree*
Raphia taedigera	*jupatí (Bra), pángana (Col), yolillo (CR), matomba (Pan)*	*Brazil, Colombia, Costa Rica, Nicaragua, Panama*	*petioles used as poles, petiole strips used to make shrimp traps & bird cages (Carney & Hiraoka, 1997)*
Roystonea borinquena; *R. regia*	*1. palma caruta (DR), palmis (Hai), palma real (PR);* *2. yagua (Hon, Mex), palma criolla (Cub), Palma real (Cub, Hon, Mex)*	*Dominican Republic, Haiti, Puerto Rico;* *Caribbean; Cuba, Honduras, Mexico*	*1. fruits fed to livestock (Zanoni, 1991, 1996);* *2. stems cut into planks for construction, fruits fed to livestock, leaves for thatching (Zona, 1991, 1996)*

Scientific Names1	**Local Names2**	**Distribution**	**Products/Uses and Selected References**
1. Sabal causiarum; *2. S. domingensis;* *3. S. maritima;* *4. S.mauritiiformis;* *5. S. mexicana;* *6. S. palmetto;* *7. S. pumos ;* *8. S. uresana;* *9. S. yapa*	*1. palma cana (DR), palma de sombrero(PR);* *2. palma cana (DR), latanier-chapeau (Hai);* *3. guana cana (Cub), bull thatch (Jam);* *4. botán (Bel, Gua), palma amarga (Col), palma de guagara (Pan), carata (Ven);* *5. Palma de sombrero (EIS), palma de micharo (Mex);* *6. guana cana (Cub);* *7. palma real (Mex);* *8. thatch palm (Bel), botán (Bel, Gua), palma guano (Cub), cana (Mex);* *9. palma blanca (Mex)*	*1. Dominican Republic, Haiti;* *2. Cuba, Dominican Republic, Haiti;* *3. Cuba,Jamaica;* *4. Belize, Colombia, Guatemala, Mexico; Panama, Venezuela;* *5. Central America; El Salvador, Mexico;* *6. Bahamas, Cuba;* *7. Mexico;* *8. Belize, Cuba, Guatemala, Mexico;* *9. Mexico*	*leaves for thatch & weaving hats, mats, etc ; mesocarp of S. pumos edible (Joyal, 1996; Martínez-Ballesté et al., 2008; Zona, 1990)*
Socratea exorrhiza; *S. montana*	*1. pachuba (Bol), paxiúba (Bra), zancona(Col), bombón (Ecu). jira (Pan), cashapona (Per), macanilla (Ven);* *2. gualte (Ecu)*	*1. Central America; Bolivia, Brazil, Colombia, Ecuador, Panama, Peru, Venezuela;* *2. Colombia, Ecuador*	*I & 2. outer part of lower stem split to make house floors and walls*

Scientific Names1	Local Names2	Distribution	Products/Uses and Selected References
1. Syagrus cardenasii; *2. S. cornosa;* *3. S. coronata;* *4. S. flexuosa;* *5. S. inajai;* *6. S. oleracea;* *7. S. petraea;* *8. S. romanzoffiana* *9. S. sancona;* *10. S. schizophylla;* *11. S. vagans*	*1. corocito (Bol);* *2. babo (Bra);* *3. ouricuri (Bra);* *4. acum;* *5. curua rana (Bra);* *6. catoIé (Bra);* *7. cocorito (Bol), coco de vassoura, (Par);* *8. pindó (Arg, Par), jeribá (Bra);* *9. sumuqué (Bol), sarare (Col, Ven);* *10. aricuriroba (Bra);* *11. pindoba (Bra)*	*1. Bolivia;* *2. Brazil;* *3. Brazil;* *4. Brazil;* *5. Brazil, Guianas;* *6. Brazil, Paraguay;* *7. Bolivia, Brazil;* *8. Argentina, Bolivia, Brazil, Paraguay, Uruguay;* *9. Bolivia, Peru, Venezuela;* *10. Brazil;* *11. Brazil*	*1 & 2. edible fruit;* *3. edible fruit, oil from seed, edible palm heart, leaves fed to livestock, wax from leaves (Crepaldi, et al., 2004);* *4. edible fruit;* *5. leaves for thatching, edible fruit;* *6. edible fruit, edible palm heart;* *7. leaves for brooms & basketry;* *8. edible fruit, edible palm heart, stems in construction;* *9. stems for fencing and to conduct water;* *10. edible fruit;* *11. leaves & inflorescences fed to livestock, leaves fed to livestock, leaves for thatching & weaving hats*
Thrinax morrisii; *T.radiata*	*1. miraguano (Cub), palma de escoba (PR);* *2. guano de costa (Cub), guanillo (DR) latanier-la-mer (Hai) chit (Mex)*	*1. Caribbean; Cuba, Puerto Rico;* *2. Caribbean; Belize, Dominican Republic, Haiti, Honduras, Mexico;*	*1& 2. leaves for thatching, stems as poles*
1. Trithirnax campestris; *2. T. schizophylla*	*1. sago (Arg), caranday (Uru);* *2. carandillo (Arg, Bol), burití (Bra)*	*1. Argentina, Uruguay;* *2. Argentina, Brazil, Paraguay*	*1. leaves for thatching;* *2. stems in construction, leaves for thatching & making hats, baskets*

Scientific Names1	**Local Names2**	**Distribution**	**Products/Uses and Selected References**
Welfia regia	*Amargo (Col, Pan) palma conga (CR) camara (Per)*	*Northern South America; Colombia, Costa Rica, Panama, Peru*	*leaves for thatching, stems in construction*
1. Wettinia aequalis; *2. W.Kalbreyeri;* *3. W.maynesis;* *4. W.praemorsa;* *5. W.quinaria*	*1. ratonera (Col),* *2. gualte (Col, Ecu) 3. corunta(Col), gualte (Ecu), camonilla (Per);* *4. mapora (Col); prapa (Ven);* *5. memé (Col), gualte (Col, Ecu)*	*1. Colombia, Ecuador; Panama;* *2. Colombia, Ecuador;* *3. Colombia, Ecuador, Peru;* *4. Colombia, Venezuela;* *5. Colombia, Ecuador*	*1-5. stems used in construction*

Notes:

1. Scientific names follow Henderson et. al., (1995).

2. See Note 2, Table 6-1.

Sources: Henderson, el al., 1995; Quero, 1992; Read, 1988 and others as indicated.

A slightly longer list of palms is presented in Table 6-2, which includes 33 genera; 18 of which are not included in Table 6-1. The 15 genera common to both tables demonstrate that exploited palm species within the same genus may be either threatened or non-threatened in the wild, depending upon the circumstances. Palms in Table 6-2 were selected on the same basis as those in Table 6-1, that is there is documented current or past use. Uses in the latter category are included if there is a possible resumption of the exploitation. Again, a small number of palms are excluded because the level of utilization is very minor or only occurs occasionally.

Discussion

At current exploitation levels, apart from any other factors, the palms listed in Table 6-2 do not appear to be negatively impacted to any serious degree by their utilization. Major commercial products derived from palms in the region fall into four product groups: edible palm heart; vegetable oil from palm fruits; leaf and leaf base fiber; and wax from palm leaves. The following discussion is comprised of general comments about some of the respective products and palms, and is intended to highlight those utilizations which may lead to problems of sustainability in the near future.

Species of the *Acrocomia, Astrocaryum, Attalea, Elaeis* and *Oenocarpus* comprise the most important oil-bearing palms of the region. In the past, indigenous peoples depended upon these palms as a subsistence source of vegetable oil and utilization continues to this day. These palms produce high quality oil; *Oenocarpus* oil, for example, has been compared favorably to olive oil. But unfortunately the quantity of oil in these wild palm fruits is low.

Two major problems hinder large-scale industrialization of oil production from these New World palms. One, the palms are wild or semiwild and hence fruit collection is inefficient and productivity per unit area is low. Two, national and international markets are dominated by other palm oils, e.g. African oil palm and coconut, as well as oils from annual crops such as soybeans. The first problem could be overcome by domestication and breeding of superior American oil palm species; but the second problem currently is insurmountable because of high productivity per unit area of the competing vegetable oil crops. The best potential for expanded utilization may rest with the management of natural palm stands to increase population densities and promote growth along with development of village-level vegetable oil industries to serve local markets, or to develop new niche markets.

Internationally, the most significant contribution of the American oil palms thus far concerns *Elaeis oleifera*, which is being used as a source of germplasm for a breeding program to improve disease resistance in *E. guineensis*.

Leaf and leaf base fibers constitute both subsistence and commercial activities in the region. As indicated in Table 6-2, many palm leaves are used for thatching. As long as leaf harvest from individual trees is not excessive, this use is sustainable. Where the palm-like Panama hat plant (*Carludovica palmata*) occurs in Central America and northern South America, it represents an often preferred source of leaf material for weaving, reducing pressure on the palms.

In Brazil, palm leaf base fibers are collected from *Attalea funifera* (Bahia piassava, Atlantic Forest) and *Leopoldinia piassaba* (Pará piassava, Central Amazon) and primarily used to manufacture brushes and brooms. Collection of these fibers is a benign and sustainable form of exploitation providing that the trees themselves are not damaged in the process.

Over its natural range in Mexico, Central America and Colombia, the pacaya palm (*Chamaedorea tepejilote*) occurs in considerable numbers. It is also an exception within the genus. It is the tallest (to 7 m) and tolerates disturbance and more open habitats. This palm is also widely cultivated for its edible, immature male inflorescence which resembles an ear of maize. Pacaya (the palm and the food product share the common name) is a traditional food of local people and is eaten fresh as well as preserved in jars or tins (Castillo Mont *et al*., 1994). A small industry exists in Guatemala to preserve pacaya for markets in the region; a quantity is exported to supply emigrant populations in the United States and Canada. Little known outside the region or the ethnic groups in other countries, pacaya has the potential of being promoted as an exotic food item.

The carnaúba palm (*Copernicia prunifera*) represents the region's chief commercial source of hard vegetable wax. Carnaúba palms constitute almost pure stands in seasonally-flooded river valleys in northeastern Brazil. Leaves of this fan palm have a coating of hard cuticle wax which is obtained by cutting and drying the leaves and then mechanically chopping them into small pieces to dislodge the wax particles. Although in recent decades carnaúba wax has been replaced in many of its former applications by synthetics, it still retains a market for high quality floor and automobile polishes, and is used in the food, pharmaceutical and cosmetic industries because of its high melting point and because it is edible. Current levels of exploitation could be expanded with more efficient harvest techniques and new markets for the wax.

The genus *Desmoncus* represents the New World counterpart to the true rattans of the Old World. The stems of several species of this climbing palm are used in Latin America to weave baskets and other objects. In recent years, as part of a search for new wild rattan supplies, importers in the United States have investigated the possibility of exploiting *Demoncus* populations. However, the small cane diameter and general physical properties of *Desmoncus* are not well suited for making quality rattan furniture. Henderson and Chávez, 1993; and Hübschmann *et al*., 2007, describe the utilization of these liana palms. No species of *Desmoncus* is currently classified as threatened, but that could be because the conservation status of these palms is poorly known. Moreover, the genus needs systematic revision to determine valid species names. Any proposed exploitation of wild populations should be preceded by taxonomic and conservation studies.

South America is the source of most of the world's commercial palm heart. Industries based on the exploitation of natural stands of *Euterpe oleracea*, *E. precatoria* and (to a lesser degree) *E edulis* operate in Brazil, Guyana, Venezuela, Colombia, Ecuador, Argentina, Peru and Bolivia. The first two species are widely distributed in South America and occur as major tree species, the third has far more limited numbers because of the loss of so much of its natural habitat in the Atlantic Forest. All three have high quality palm heart. Exploitation is destructive because the individual tree is killed to extract the tender apical meristem.

The basic difference between *Euterpe oleracea* and together *E. edulis* and *E. precatoria* is that *oleracea* is a clustering palm, bearing ten or more stems per cluster, whereas the two others are single-stemmed species. As to the question of sustainability of this wild plant resource, the clustering species has real potential as long as annual harvest only takes the large stems and one mature stem is left per cluster to serve as a seed source for natural regeneration. Harvesting the wild single-stemmed species is unsustainable, although some level of managed regeneration may be feasible. Natural populations of *E. precatoria* will likely, in the next decade or two, follow the pattern of *E. edulis* with populations reduced to uneconomic levels. In terms of palm heart production, economic development efforts should be directed toward practical management systems for or cultivated of *E. oleracea*.

Palm heart is identified as a major wild palm product in northern South America (Broekhoven, 1996) and generally in Latin America (Shanley *et al*., 2002).

Mauritia flexuosa is Latin America's most abundant palm, occurring as dense stands in permanently swampy areas, particularly in the Amazon Basin. From an economic development standpoint the moriche palm has considerable potential because it is the source of so many different products. Management of natural stands could enhance fruit and leaf production to provide food items and fiber. Stem starch and sap production for palm wine could also be promoted as a means of diversifying economic output from a management unit. The references cited in Table 6-2 indicate there is renewed interest in this palm, which might lead to its management and ultimate domestication, following the example of the peach palm,

Vegetable ivory is the hardened endosperm of palms in the genus *Phytelephas*. Two species of this palm are included in Table 6-1 because they are threatened, whereas three species appear in Table 6-2 because at present they are not. Vegetable ivory was used in the 19th and early 20th century for making buttons, until plastics replaced it. In the 1990s, Conservation International, Washington, D.C., established the Tagua Initiative, to revive vegetable ivory products including buttons, jewelry and carvings. Promotion focused on the items being natural products and an alternative to animal ivory. Raw materials come from *P. aequatorialis* stands Ecuadorian coast, where the industries are also located. The Tagua Initiative has achieved modest success, and vegetable ivory is being harvested and processed to benefit local communities.

About one-half the genera in Table 6-2 indicate stem wood as a product. Palm stems are cut and used whole for poles and in construction. Split stems may also be used as floor and wall coverings, as well as fashioned into spears, bows and other objects. Palm wood can be sawn into parquet pieces and used on the floors and walls of public buildings and in modern homes. Palm wood from the genera *Bactris, Iriartea, Socratea* and *Wettinia* is reported to be of the highest quality. There are many abundant palms species in these four genera which could be exploited for specialized wood products. One of the unusual uses for the *Iriartea* palm stem is to make a temporary canoe (Johnson and Mejía, 1998).

As the foregoing examples clearly demonstrate, subsistence-level and commercial palm products are important in the Neotropics.

Figure 6-1 Collecting pacaya inflorescences (Chamaedorea tepejilote) in Guatemala. Photograph by Don Hodel.

Figure 6-2 Babaçu fruits (Attalea speciosa) being sun-dried in Northeast Brazil. Photograph by Dennis Johnson.

Figure 6-3 ***Tucum fruits (Astrocaryum aculeatum) for sale in Manaus, Brazil. Photograph by Dennis Johnson.***

Figure 6-4 ***The huasaí palm (Euterpe precatoria) in habitat near Iquitos, Peru. Photograph by Dennis Johnson.***

Figure 6-5 ***Spear and bow carved from buri palm wood (Allagoptera caudescens) in Bahia, Brazil. Pataxos Amerindians living near Monte Pascoal National Park make these objects to sell to tourists. Photograph by Dennis Johnson.***

Figure 6-6 ***Palm leaf products (from Euterpe oleracea and other palms) for sale in Belém, Brazil. Photograph by Dennis Johnson.***

Figure 6-7 ***Bundles of recently-harvested piassava leaf base fiber (Attalea funifera). Bahia, Brazil. Photograph by Dennis Johnson.***

Figure 6-8 ***Pejibaye palm (Bactris gasipaes var. gasipaes) cultivated in a germplasm collection near Manaus, Brazil. Photograph by Dennis Johnson.***

7 AFRICAN AND THE WESTERN INDIAN OCEAN REGION

Africa

The continent of Africa is defined geographically to include, because of close mainland ties, the equatorial Atlantic islands (Malabo, São Tomé and Príncipe) as well as Zanzibar and Pemba, part of Tanzania, in the Indian Ocean. Excluded are the northern Atlantic island groups of the Canaries and Cape Verde.

Compared to Asia or Latin America, the palm flora of Africa is relatively poor in species diversity. Only about 50 palm species are native to the continent as defined here. However, from a utilization point of view, the low species diversity is compensated for by extensive populations of several species and a range of palm products that approaches that of Asia or Latin America.

Tuley (1995), in his book on African palms, includes a major section on utilization and Sunderland (2007) provides details on rattans. Other botanical information sources are the floras of West Africa (Russell, 1968), East Africa (Dransfield, 1986), Benin (Aké Assi *et al.*, 2006) and Seychelles (Robertson, 1989).

African palms providing subsistence and commercial products have been separated into two groups on the basis of whether they are under threat or not in the wild (Table 7-1 and Table 7-2).

Threatened African Palms

The seven palms in Table 7-1 are under threat as a result of destructive exploitation by humans and animals for leaves, fruit, wood or rattan; as well as because of deforestation. The in situ conservation status of *Hyphaene* spp. over African continent is poorly known and difficult to determine because there is no modern revision of the genus and field work is hampered because of the volatile political situation in several key areas where the palms occur. Until its rediscovery in 1995 in Sudan, *Medemia argun* was feared to be extinct (Gibbons and Spanner, 1996). This palm has been brought into cultivation for ornamental purposes, but its status in the wild remains precarious. Owing to recent research on African rattans and the genera *Podococcus* and *Sclerosperma*, reflected below, knowledge of the palms of Africa is improved considerably from the first edition of this study.

*Table 7-1 Threatened African Palms with Reported Uses**

Scientific Name	Selected Local Names	Distribution	Products/Uses
Dypsis pembana	*mpapindi*	*Pemba Island, Zanzibar (endemic)*	*seed harvested for ornamental plantings*
Eremospatha dransfieldii	*balu*	*W Ghana, E. Ivory Coast, Sierra Leone*	*whole canes for furniture frames, split for coarse baskets*
Hyphaene reptans	*doum*	*Somalia*	*multiple products*
Jubaeopsis caffra (monotypic)	*inkomba, Pondoland palm*	*Cape Province, South Africa (endemic)*	*seed for ornamental plantings, edible fruit?*
Livistona carinensis	*carin*	*Djiboute, Somalia*	*leaves & stems*
Medemia argun	*argoon*	*Egypt, Sudan*	*leaves to weave mats, edible fruit, stem wood ?*
Sclerosperma mannii		*Ghana to Angola*	*leaves for thatch*

* See also Table under Chapter 13.

Sources: Ford et al., 2008; Johnson, 1991a; Shapcott et al., 2009; Sunderland, 2007; van Valkenburg et al., 2007, 2008; Täckholm & Drar 1973; Tuley, 1995; Wicht, 1969.

Non-threatened African Palms

Although the nine palm taxa in Table 7-2 generally are not known to be under threat in the wild that is not necessarily the case for all species of *Eremospatha, Hyphaene, Laccosperma* and *Raphia*. This factor is elaborated on below. *Borassus aethiopum* (presumably including *B. akeasii*), wild and semi-wild *Elaeis guineensis* and *Phoenix reclinata*, on the other hand, occur in large numbers over wide areas and are the source of many different palm products.

Africa has four genera and 22 species of rattans (Sunderland 2007). The genera *Eremospatha, Laccosperma* and *Oncocalamus* are endemic to Africa. *Calamus deerratus* is a relative of the Asian rattans with a broad distribution and a highly variable growth form. These climbing palms are sources of a large number of subsistence products for local communities as well as the support of a thriving commercial trade in rattan canes and other rattan products. In Central Africa alone, commercial rattans products annually are estimated to be worth about US$10 million (Sunderland *et al*., 2008).

Table 7-2 Non-threatened African Palms with Reported Uses

Scientific Name	**Selected Local Names**	**Distribution**	**Products/Uses**
Borassus aethiopum1	*ron, palmyra*	*African savannas*	*multiple products*
Calamus deeratus	*skote, erogbo, ki tia*	*across Africa: Senegal to Tanzania*	*canes used for weaving, furniture*
Elaeis guineensis	*African oil palm*	*humid parts of Africa*	*multiple subsistence products*
Eremospatha: cabrae, cuspidata, haullevilleana, hookeri, macrocarpa, wendlandiana	*osono* *ndera* *pongbo* *epa-emele* *penden* *eghounka*	*West Africa, Congo Basin E to Tanzania*	*whole canes for furniture frames, cane bridges; cane split to make baskets, rope; leaf sheath base as chewing stick*
Hyphaene spp.	*doum palm, lala, mokola*	*arid parts of Africa*	*multiple products*
Laccosperma: robustum, *secundiflorum*	*eka* *ohwara*	*SE Nigeria and Cameroon, S to Cabinda and W into Congo Basin*	*whole canes used for furniture & basket frames; split canes for basketry*
Oncocalamus manii	*mitou*	*S Cameroon to Gabon*	*split canes for basketry*

Scientific Name	Selected Local Names	Distribution	Products/Uses
Phoenix reclinata	*Senegal date* *wild date*	*African savannas*	*multiple products (see Table 9-27, composition of palm wine)*
Raphia spp.	*raffia*	*humid parts of Africa*	*multiple products*

Note:

1. Probably includes recently-described Borassus akeasii which has an overlapping distribution in West Africa (Bayton & Ouédraogo, 2009)

Sources: Morakinyo, 1995; Sunderland, 2004, 2007; Tuley, 1995

Since the year 2000, there has been a surge of interest in African rattans, with support from CARPE (Central African Regional Programme for the Environment) and INBAR (International Network for Bamboo and Rattan) in Beijing. A technical meeting was held in 2000 which addressed management strategies, sustainability, cultivation, processing and technology transfer from Asia to Africa. A proceeding was prepared by Sunderland and Profizi (2002).

The doum palm genus *Hyphaene* is poorly known in Africa where it chiefly occurs. Its habitat includes arid and semiarid areas and river valleys. Although as many as 26 species have been named in Africa, Dransfield *et al*. (2008) and Tuley (1995) propose the recognition of six species. The most pragmatic approach to take with respect to doum palms and their products is to promote utilization of local palm populations on a sustainable basis. Doum palms are multipurpose in nature; products include the edible mesocarp of the fruit in most species, leaves for thatch and fiber, wood and palm wine derived from tapping the trunk. This latter practice is destructive as the individual trees are killed. The data in Table 2-3 on the use of *H. petersiana* by local people in Namibia represent a good example of the potential breadth of uses.

Hyphaene products and patterns of utilization are fairly well documented. Täckholm and Drar (1973) provide information from ancient and modern Egypt; Hoebeke (1989) studied the palm and its uses in Kenya (see Table 9-21); Cunningham (1990a,b) investigated palm wine production in southern Africa; Konstant *et al*. (1995) and Sullivan *et al*. (1995) looked at *Hyphaene* utilization and the impact on palm populations in Namibia; and Cunningham and Milton (1987) did a study of basket making using mokola palm leaf fiber (*H. petersiana*) in Botswana.

Utilization of *H. compressa* leaves in a number of ways in Kenya was documented by Amwatta (2004). A study of the intensive harvesting of young leaves of *H. thebaica* in Niger revealed that the trees survived but that their development changed from a normal branching tree form into a subterranean-creeping habit which transforms palm stands into a dense canopy of leaves emerging from the underground root system. This dwarfing process also has been described as taking place with the mazari palm (*Nannorrhops ritchiana*) in Pakistan (Kahn and Luxereau, 2008). It is not know if this leaf harvesting practice is sustainable.

The genus *Raphia* is better known scientifically than *Hyphaene*, because of research by Otedoh (1982), who described 18 African species of this mostly swamp-dwelling palm. Currently, 20 species are recognized (Dransfield *et al*., 2008). Although the taxonomy of this genus has been studied, information about the *in situ* conservation status of the various species is very sparse. Like *Hyphaene,* the *Raphia* palms provide many subsistence products. *Raphia hookeri* and *R. palma-pinus* also are sources of leaf base fiber used commercially to make stiff brushes. In commerce it is known as African bass or African piassava (Tuley, 1994). *Raphia* palms also are excellent sources of leaf stalks for construction purposes, the very large leaves make good roofing material, the fruit mesocarp yields edible oil and in many of the species the inflorescence is tapped for palm wine.

The ron palm (*Borassus aethiopum* and *B. akeasi*) and the Senegal date palm (*Phoenix reclinata)* both occur in large numbers in the African savannas and represent important local sources of subsistence products. The ron palm produces a single stem whereas the Senegal date is a suckering species and forms thickets of many stems. A study by Sambou *et al*. (1992) on *Borassus* in Senegal described the uses listed in Table 7-3. Additional information may be found in a study which considered the palm over a wide area of West Africa as well as Asia (GRET, 1987).

Table 7-3 Borassus aethiopum1 Uses in Senegal

1. Uses based on structural properties
stem: timber, boards
leaves: roofs, baskets, mats, rugs, furniture
petiole: fences, fiber
2. Uses based on nutritional and medicinal properties
food: endosperm, tuber (cotyledonary haustorium), palm heart, mesocarp, sap (wine) tapped from stem
medicinal: roots, male rachillae, stamens, mesocarp, seedling (hypocotyl), sap (wine) tapped from stem

Note:

1. Probably includes recently-described Borassus akeasii which has an overlapping distribution in Senegal (Bayton & Ouédraogo, 2009)

Source: Sambou et al. (1992)

Sambou *et al*. (1992) pointed out that in countries such as Senegal, *Borassus aethiopum* is "a victim of its own high utilitarian value;" overexploitation is a serious threat and natural populations are being reduced by drought and agriculture. They argue that strict management practices should be adopted and enforced to sustain the palm populations for the benefit of local people.

Phoenix reclinata has similar but slightly more limited uses than the ron palm. The fruit is edible but smaller and inferior to the domesticated date. Both the inflorescence and stem are tapped for palm wine, and the leaves, petioles and trunk have various uses. Because of its suckering growth habit, the Senegal date palm is not threatened by exploitation for its products.

The African oil palm (*Elaeis guineensis*), as both its common name and specific epithet imply, is native to West Africa and the Congo Basin. Although it has been the object in the 20th century of one of the most successful crop improvement efforts of any cultivated palm, extensive stands of wild or semiwild African oil palms continue to exist throughout its native range. Mesocarp and endosperm oils are major subsistence products; in addition, the palm inflorescences are tapped for palm wine[6], leaves are employed in thatching and to make baskets and mats and the petioles and wood serve as construction materials. Under these conditions, the African oil palm is a classic multipurpose species, unlike the plantation counterpart which is focused only on palm oil and palm kernel oil. In recent years, interest has broadened to more efficient use of *Elaeis guineensis* as a multipurpose subsistence tree within its native area. Beye and Eychenne (1991) published an excellent study of the African oil palm which exemplifies its "tree of life" status in the Casamance of Senegal, an approach worthy of consideration elsewhere in Africa.

Palm utilization is detailed in the humid forest zone of West Africa by Falconer and Koppell (1990). Three references abstracted in the foregoing source merit mention here. Blanc-Pamard (1980) studied utilization patterns of, *Borassus aethiopum*, *Elaeis guineensis* and *Phoenix reclinata* among the Baoulé people in Ivory Coast; Coleman (1983) did a sociological study of the rattan enterprises in the Bassam area of Ivory Coast; and Shiembo (1986) researched minor forest products in Cameroon, which included *Raphia* spp. and three species of rattan.

A few introduced, naturalized or domesticated economic palms figure in the forest products of Africa. Coconuts are grown commercially from Senegal to Equatorial Guinea in West Africa, and from Somalia to Mozambique in East Africa (Kullaya, 1994). The nipa palm (*Nypa fruticans*) was introduced early in the 20th century and has become naturalized in coastal Nigeria and Cameroon. Because it is not as well known to local peoples, it represents an underutilized palm resource, compared to the numerous uses it has in its native areas in Asia.

Finally, mention needs to be made of the date palm (*Phoenix dactylifera*), which is an important oasis species and fruit crop in the countries of North Africa, and increasingly in Sub-Saharan and Southern Africa where new plantings have been established using named varieties.

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[6] See Okereke (1982) for a description of traditional palm wine practices

Figure 7-1 Raffia palm (Raphia farinifera) cultivated in a botanic garden. Photograph by Dennis Johnson.

Figure 7-2 Doum palm (Hyphaene sp.) as an ornamental tree in Burkina Faso. Photograph by Dennis Johnson

Figure 7-3 Subspontaneous African oil palm stand (Elaeis guineensis). Guinea-Bissau, West Africa. Photograph by Dennis Johnson.

Figure 7-4 African fan palms (Borassus aethiopum) in a village in Guinea-Bissau, West Africa. Photograph by Dennis Johnson.

Madagascar

This large island off the east coast of Africa has the most remarkable palm flora in the world. Madagascar currently is believed to have about 166 palm species in 14 genera (Dransfield and Beentje, 1995; Dransfield *et al*., 2006; Dransfield *et al.*, 2008; Rakotoarinivo *et al*., 2007). Only two of these species are also found in mainland Africa, giving Madagascar a palm species endemism rate of 99 percent.

In addition to its prominence as the homeland of so many endemic palm species, Madagascar has the dubious distinction of being an area of extremely high deforestation and environmental degradation. Because of their uniqueness, certain Madagascar palms also are overexploited for seed and small plants are dug from the wild for the nursery trade. As a result of the combination of these factors, nearly all of the native palms are threatened with extinction or severe reductions in wild populations.

In Madagascar, promoting the development of forest products derived from wild palm populations must be approached with great caution. On the basis of current ethnobotanical data, about 60 palm species are used in some way by local people.

Threatened Madagascar Palms

Table 7-4 gives the names of 50 utilized palms which are known to be under threat. Local palm names given in Table 7-4 and Table 7-5 must be used with care because they are often misleading. The same name may be applied to more than one described species or the same described species may have several common names over its geographic range. Making a link between a local name and a scientific name should always be verified with additional information.

Table 7-4 Threatened Madagascar Palms with Reported Uses*

Scientific Name	Selected Local Names	Distribution[1]	Products/uses
Beccariophoenix madagascariensis (monotypic)	manarano, manara, maroala, sikomba	Mantady & SW Madagascar	stem wood for house construction; edible palm heart; young leaflets to make hats
Borassus madagascariensis	dimaka, marandravina, befelatanana	Western Madagascar	edible palm heart; edible stem starch; hollowed-out stems for containers; fruits fermented for alcohol; edible shoots of germinating seedlings
Dypsis ampasindavae	lavaboka	Nosy Be and Manongarivo Mts.	edible palm heart; stems for house construction
D. andrianatonga	tsiriki andrianatonga	Manongarivo & Marojejy Massif	stem wood for house walls; leaf decoction as medicine
D. ankaizinensis	laboka, hovatra, lavaboka	Mt. Tsaratanana	edible palm heart
D. basilonga	madiovozona	Vatovavy	edible palm heart
D. canaliculata	lopaka, monimony	Manonogarivo area & Ampasimanolotra	edible palm heart
D. ceracea	lafaza	Marojejy & Betampona areas	leaves for thatching & brooms
D. confusa	tsikara, tsimikara	Masoala, Mananara & Betampona	stems to make blow-pipes
D. crinita	vonitra	NW & NE Madagascar	leaves for thatching; leaf base fiber to make palm oil filter; heartwood used in medicine
D. decaryi	laafa	S Madagascar	leaves for thatching; edible fruit; seeds exported for horticultural use
D. decipiens	betefaka, manambe, sihara leibe	Central Madagascar, between Anazobe & Fianarantsoa	edible palm heart; leaves used in erosion control

Scientific Name	**Selected Local Names**	**Distribution[1]**	**Products/uses**
D. hiarakae	sinkiara, tsirika	Manongarivo, Masoala & Mananara Avaratra	stems to make blow-pipes
D. hovomantsina	hovornantsina	Maroantsetra & Mananara	edible palm heart
D. ligulata (possibly extinct)	none recorded	NW Madagascar	edible palm heart
D. madagascariensis	hirihiry, kizohazo, farihazo, madiovozona, kindro	NW & W Madagascar	stem wood for floor boards; edible palm heart: edible fruit
D. mahia	none recorded	Manombo	stems used to make blow-pipes
D. malcomberi	rahosy,vakaka	Andohahela	stem wood for house walls; edible palm heart
D. mananjarensis	laafa, lakatra, ovodaafa	East coast between Vatomandry & Tolanaro	stem wood for house planks; edible palm heart: rachis fiber
D. nauseosa	rahoma, mangidibe, laafa	Fianarantsoa	stem wood for roofing beams & floor planks
D. nossibensis		NW Madagascar, Lokobe forest	stem wood for construction
D. oreophila	kindro, lafaza, fitsiriky	Tsaratanana, Marojejy, near Maroantsetra & Mandritsara	edible palm heart; hollowed-out stem to make blowpipe
D. perrieri	besofina, menamosona, kase	Marojejy, Masoala & Mananara Avaratra	edible palm heart; leaf sheath tomentum for mattress stuffing
D. pilulifera	ovomamy, lavaboko, hozatanana	Sambirano region, Marojejy & Mantady	edible palm heart; leaves for thatch and weaving
D. prestoniana	tavilo, babovavy, tavilo	Midongy area, SE coast	edible palm heart
D. saintelucei	none recorded	extreme SE of Madagascar	destructively used to make lobster pots
D. scandens	olokoloka	Ifanadian area in NE	stems split to make fish traps, bird cages, hats
D. schatzii	tsinkiara	E Madagascar: Betarnpona	stems formerly used to make blowpipes

Scientific Name	Selected Local Names	Distribution1	Products/uses
D. thermarum	fanikara	R Ranomafana National Park	stems split to make crayfish traps
D. thiryana	tsinkiara, sinkarambolavo maroampototra, taokonampotatra	Marojejy & Masoala to Anosibe-an- Ala	leaves for thaching?
D. tokoravina	Tokoravina	Maroantstera & Mananara	edible palm heart; leaves for weaving
D. tsaralananensis	kindro	Mt. Tsaratanana	edible palm heart
D. tsaravoasira	tsaravoasira, hovotravavy, lavaboko	Marojejy, Maroantsetra & Mananara	edible palm heart
D. utilis	vonitra, vonitrandrano	E Madagascar	edible palm heart; edible fruit
Marojejya insignis	menamoso, beondroka, maroalavehivavy, betefoka, besofina, hovotralanana, mandanzezika fohitanana	E Coast, Marojejy to Andohahela	edible palm heart; leaves for thatching
Masoala kona	kona, kogne	Ifanadiana area	leaf thought to have magical properties
M. madagascariensis	kase, hovotralanana, mandanozezikaoj	Morojejy, Masoala & Mananara	leaves for thatching; edible palm heart
Orania longisquama	sindro, anivona, ovobolafotsy, vakapasy	NW & E Madagascar	stem wood for house wall planks
O. trispatha	sindro, sindroa, anivo	E Madagascar	stem wood for house construction
Ravenea albicans	hozatsiketra	NE Madagascar	edible palm heart; leaves for weaving
R. dransfieldii	anivo, ovotsarorona, lakatra, lakabolavo	Eastern Madagascar; between Marojejy Mts. & Ifanadiana	edible palm heart; leaves for hat making
R. julietiae	sindro madiniky, saroroira, vakapasy, anive. anivona	E Madagascar, between Mananara Avaratra & Vangaindrano	stem wood for construction; hollowed out stems for irrigation pipes
R. lakatra	lakatra, tsilanitafika, manarana	E Madagascar, between Andasibe & Vargaindrano	leaf fiber for hat making; edible palm heart; stem for irrigation pipes
R. madagaseariensis	anivo, anivokely, anivona, tovovoka	Central & E Madagascar	stem wood for house wall & floor planks

Scientific Name	Selected Local Names	Distribution1	Products/uses
R. .rivularis	gora, bakaly, vakaka, malio	S Central Madagascar, Mangoky & Onilahy rivers	seed collected for export
R.. robustior	hovotravavy, manara, tanave, retanan, monimony, loharanga, anivona. laafa, anivo, lakabolavo, bobokaomby, vakabe, vakaboloka	NW, E & SE Madagascar	stem wood for construction & furniture; leaves for thatching & weaving; edible palm heart; stem pith eaten.
R. sambiranensis	anivo, anivona, mafabely, soindro, ramangaisina	NW,W&E Madagascar	stem wood for floor planks; edible palm heart edible fruit; stems for irrigation pipes; pith for rice trays
R. xerophila	ahaza, anivo, anivona	S Madagascar, between Ampanihy & Ampingaratra Mts	leaf fiber for hats & baskets
Satranala decussilvae (monotypic)	satranabe	Mananara Biosphere Reserve	leaves for thatch
Voanioala gerardii (monotypic)	voanioala	Masoala Peninsula	edible palm heart

Notes:

* See also Table under Chapter 13.

1. All are endemic to Madagascar

Sources: Byg & Balslev, 2003; Dransfield & Beentje, 1995; Dransfield et al., 2006; Walker & Dorr, 1998.

Discussion

Palm hearts and stem wood represent the most prevalent reported palm usages involving threatened palms, and the two frequently go hand-in-hand. When a palm is felled for its stem wood, the heart, if edible, is also extracted and eaten. The reported cutting of palms for stem wood or palm heart is particularly alarming since about three-fourths of the involved species are single-stemmed.

Very little empirical data exist on how individual threatened palm species could be sustainably managed. One welcome exception is a study on conservation and *in situ* management of *Dypsis decaryi*. It recommends that annual leaf harvesting be no more than about 25 percent of the leaves per tree per year and that seed collection be limited to well under 95 percent of the annual crop to assure natural regeneration (Ratsirarson *et al*., 1996).

Non-threatened Madagascar Palms

A small number of native palms currently occur in sufficient populations to consider promotion of greater use of their products. Ten such species are listed in Table 7-5. Madagascar's two non-endemic palms, *Hyphaene coriacea* and *Phoenix reclinata*, are included in the table.

Table 7-5 Non-threatened Madagascar Palms with Reported Uses

Scientific Name	Local Names	Distribution	Products/Uses
Bismarckia nobilis	satra, strabe, satrana, satranabe, satrapotsy	N & W Madagascar (endemic)	flattened trunk for construction; leaves for thatch & basketry; pith for bitter sago; ornamental tree
Dypsis baronii	farihazo, tongalo	N, Central & E Madagascar (endemic)	edible palm heart; edible fruit; ornamental tree
D. fibrosa	vonitra, vonitrambohitra, ravimbontro	MW & E Madagascar (endemic)	leaves for thatching; inflorescence as brushes/brooms; mattress stuffing; edible palm heart;
D. lastelliana	menavozona, sira, ravintsira	NW, NE & E Madagascar (endemic)	pith formerly used to make salt; inedible palm heart said to be poisonous
D. lutescens	rehazo, lafahazo, lafaza	E coast (endemic)	ornamental tree; probably other uses
D. nodifera	ovana, bedoda, sincaré, tsirika, tsingovatra	NW, E & SE Madagascar (endemic)	hollowed out stems as blowpipes

Scientific Name	Local Names	Distribution	Products/Uses
D. pinnatifrons	tsingovatra, tsingovatrovatra, ovatsiketry, ambolo, hova, tsobolo	Widespread in humid forest (endemic)	hollowed out stems as blowpipes; house beams; edible palm heart; stem or inflorescence for brooms
Hyphaene coriacea	satrana, sata	W Madagascar (non-endemic)	leaf fiber for basketry, hats, rope; edible palm heart; palm wine (see Table 9-19 for composition)
Phoenix reclinata	dara, taratra, taratsy	NW & NE Madagascar; isolated stands in SW (non-endemic)	leaflets for basketry; edible fruit
Raphia farinifera (wild and cultivated)	rafia	widespread in eastern Madagascar	leaf fiber for weaving; petioles for hut construction; edible fruits; edible palm heart

Sources: See Table 7-4.

Discussion

Although the palms in Table 7-5 have development potential for forest products, there are certain factors with respect to individual products which must be taken into account. Products requiring the felling of a palm for sago, palm heart, construction wood or other stem uses, results in destruction of the individual tree. If the involved palm species is single-stemmed, this destroys seed sources and makes regeneration difficult and uncertain; such practices are inherently unsustainable. Clustering palms, on the other hand, can be harvested for such products and possess the potential to be managed on a sustainable basis.

Three introduced species of palms in Madagascar are either under cultivation or have become naturalized. These are the coconut, *Cocos nucifera*, African oil palm, *Elaeis guineensis*; and raffia palm, *Raphia farinifera*. The raffia and coconut palms are sources of numerous food and nonfood items for local people. In sharp contrast to its wide utility on the African Mainland, the African oil palm is of limited importance in Madagascar.

Seychelles, Mascarene Islands and Comoro Islands

These three small island groups of the western Indian Ocean are comparable to Madagascar in terms of native palm populations. The palm flora of each island group is unique with exceedingly high rates of palm endemism; in the Seychelles all six of the native palms are endemic. Threats to the palm populations are as great as in Madagascar, owing to human population pressures, exotic animal introductions and agriculture which have led to significant habitat destruction. All the native palms in these islands are classified as threatened and subject to conservation measures. There should be no promotion of non-wood forest products from natural palm populations. Fortunately, coconut palms are naturalized in the islands and serve as a source of products for local people.

8 PALMS WITH DEVELOPMENT POTENTIAL

To assess the potential for development of economic palm species it is worthwhile to consider whether individual species currently have either greater domestication potential or management potential. These two categories are established for analytical purposes; they are not mutually exclusive. In fact, in some cases palm management is a useful initial step toward palm domestication.

Domestication potential implies that the products of a palm have enough promise of becoming commercialized at a scale sufficient to justify the costly and lengthy effort involved. Certainly that was and is the case of the five fully domesticated palms (arecanut, coconut, date, African oil palm and pejibaye) discussed in Chapter 2.

The chief obstacle to palm domestication is that many years are required to select and breed a superior palm for a particular product or set of products. The age of sexual maturity among the palms varies considerably from species to species, ranging from about 3-40 years. An essential part of any new palm domestication effort would include detailed studies of the reproductive biology of the candidate species, because so little is known about this aspect of wild palms. A domestication program would also need to have a clear definition of its objectives in terms of the chief commodities to be produced. If the candidate palm for domestication is a multipurpose species, there must be consideration of primary as well as secondary products. Secondary products can play an important role in providing employment and income to local people.

Coradin and Lleras (1988) reviewed research directed at domestication of New World palms with economic potential. The authors also presented a model of how to characterize native populations in order to design successful domestication or management strategies. The model is applicable to palms in Asia and Africa.

Breeding and domesticating a palm is one thing, propagating an improved palm quite another because of the time necessary to the initiation of flowering and fruiting. Any palm which can be vegetatively propagated, such as most species in the genus *Phoenix*, has a major natural advantage over palms which can only be grown from seed. However, three of the five domesticated palms mentioned in the previous paragraph are seed propagated, i.e. arecanut, coconut and African oil palm. Tissue culture is a technological alternative to seed propagation but research on palms has not yet solved all of the problems that would permit large-scale reproduction by this means at a reasonable cost.

Management potential is possessed by many more palm species because costs are significantly lower, the time required is much shorter and production continues as management practices are adopted. In addition to wild species, also included in this category are palms which are often referred to as being "semi-domesticated." This term implies that selection of wild seed or suckers for informal cultivation has taken place, but no actual breeding program undertaken. Semi-domesticated species in most cases are very promising candidates for a formal domestication effort.

Promising Palms

Reviewing the material presented within this report, a global list of palms with development potential was compiled. Table 8-1 presents information on 18 palms; the list is not exhaustive. As can be seen, most often a palm is represented by a single species, but in some instances it is represented by two species, or all or most species in a genus. This is simply a reflection of the differing circumstances from one palm to another. The palms in Table 8-1 were selected without regard for their native areas. Nevertheless, the palms included do reflect the Asian region as being foremost in economic species, with Latin America a strong second and Africa a distant third.

Discussion

The candidate palms in Table 8-1 are annotated as to whether they have more management or domestication potential. The approach taken with respect to realizing the development potential of individual palms will be determined to a significant degree by the magnitude of the economic potential of the product or products to be realized. Whether the option chosen is domestication or management, these palms should be developed within a broad context to benefit local people as well as financial investors.

Palm domestication highlights the importance of wild genetic resources in selecting genetic material for an initial breeding and improvement effort. Conservation of wild germplasm has equal value in maintaining and further improving domesticated palms. The African oil palm is a perfect example.

Comparing the palms in Table 8-1 reveals that sap and seed oil are major products common to several species. From a practical standpoint, an expensive and lengthy domestication program cannot be mounted for each palm. Instead, it will be necessary to evaluate the sap-producing palms and select one of them for possible domestication; the species not selected should be considered for management improvement. A similar approach could be used for seed oil and other major products.

The ideal mechanism for deciding which palms should be given priority for domestication or management development would be to convene a technical panel of palm specialists to make recommendations.

A key factor in palm development is that it should be done so that management and domestication efforts are not narrowly focused on individual species. There is much to be gained from a palm development program which consists of management and domestication efforts involving several palms in different countries. Major benefits would include an integrated research strategy, sharing of results from several locations on different palm species, as well as the advantage of sharing of general costs.

Table 8-1 Candidate Palms for Domestication or Management

Scientific Names Common Names	***Native Distribution and Habitat***	***Major Products.***	***Minor Products***	***Comments and Selected References***
Arenga pinnata sugar palm	*S. & SE Asia tropical rain forest into dry forest, to 1,200 m*	*sap to make sugar. wine, alcohol, vinegar, sap yield 3-6 liters/tree/day, starch from stem, yield 75 kg/tree*	*leaf sheath fiber; edible heart; etc*	*solitary, terminal flowering feather palm; traditional multipurpose palm with a history of cultivation; strong candidate for domestication; agroforestry potential: Miller 1964; Mogea et al., 1991; Sastra et al., 2006.*
Attalea funifera piassava	*S. America: Atlantic Forest, Brazil tropical rain forest, coastal areas*	*leaf base fiber*	*leaves for thatching*	*solitary feather palm; narrow range of products; over-exploitation of natural stands, experimental planting; management could stabilize fiber supplies& sustain markets; Monteiro 2009; Voeks, 1988*
Attalea speciosa babaçu	*S. America tropical rain forest, upland sites*	*edible oil, yield 40 kg/tree/yr, potential biofuel*	*edible mesocarp pulp: leaves for thatching; shells to make charcoal; press cake for livestock feed*	*solitary feather palm; multipurpose palm with many commercial & subsistence products; some management already being done, could be improved & domesticated if processing of fruits adopted; good agroforestry potential; Anderson et al., 1991*
Borassus flabellifer, B. aethiopum & B. akeasii palmyra, ron	*S. & SE. Asia; Africa tropical dry forest into savanna, to 750 m.*	*sap to make sugar, wine, alcohol, vinegar, sap yield 11-20 liters/ tree/day*	*leaf stalk fiber; leaves for thatching & basketry; edible immature fruit*	*solitary fan palms; multipurpose species of major utility to local peoples: incipient management already in practice in S. & SE. Asia: candidate for domestication, agroforestry ; Davis & Johnson,1987; GRET, 1987; Khieu, 1996*

Scientific Names Common Names	***Native Distribution and Habitat***	***Major Products.***	***Minor Products***	***Comments and Selected References***
Calamus spp. rattan	*S. & SE. Asia tropical rain forest to 1,000 m; 1 sp. In Africa*	*canes for furniture making, yield to 6 t/ha*	*edible fruit & heart in some spp.*	*climbing solitary or suckering feather palms; several under study for cultivation, cane industry-driven research & development as well as coordination by INBAR; Dransfield & Manokaran, 1993; Dransfield et al., 2002; Wan Razali et al., 1992.*
Caryota urens toddy palm	*S. & SE. Asia tropical rain forest to 1,500 m*	*sap to make sugar, wine, alcohol, vinegar, sap yield 20-27 liters/ tree/day; starch from stem, yield 100-150 kg/tree*	*leaf sheath fiber; edible heart; etc.*	*solitary, terminal flowering feather palm; numerous products; informal cultivation practiced; domestication potential in agroforestry systems; De Zoysa 1992*
Chamaedorea spp (ornamental spp.).	*Mexico, C. America, N. South America understory of tropical rain forest to 3,000 in.*	*seed for commercial growing of ornamental plants & foliage for cut flower arrangements*	*none known*	*solitary or suckering feather palms; a few major ornamental spp. under cultivation for seed in Belize, management potential of wild palms for cut foliage; Bridgewater et al., 2006. Hodel, 1992*
Chamaedorea tepejilote pacaya	*Mexico, C. America, N. South America tropical rain forest to 1,600 in.*	*edible immature male inflorescence*	*edible palm heart; leaves fed to livestock*	*solitary (sometimes suckering) feather palm already under informal cultivation, could be managed for pacaya & palm heart; agroforestry potential; Castillo Mont et al ., 1994*

Scientific Names Common Names	***Native Distribution and Habitat***	***Major Products.***	***Minor Products***	***Comments and Selected References***
Corypha umbraculifera *C. utan* *talipot buri*	*S. & SE. Asia tropical rain forest to 600 m.*	*sap to make sugar. wine alcohol, vinegar, sap yield 20 liters/tree/day for 3-4 months for C. utan; starch from stem petiole to make hats; leaf midrib used to make furniture*	*leaves for thatching & weaving various products, edible heart; etc.*	*solitary, terminal flowering fan palm multipurpose palm with good mix of commercial & subsistence products; strong candidate for management or domestication, also agroforestry potential; Madulid, 1991a*
Euterpe oleracea *E. edulis* *açaí, juçara*	*S America* *Tropical rain forest, açaí in seasonally flooded lowland sites; juçara in upland sites to 1,000 m.*	*commercial palm heart production, yield up to 1 kg/tree; juice being promoted as health drink rich in antioxidants*	*edible fruit mesocarp, leaves for weaving & thatching*	*suckering(E. oleracea) solitary (E. edulis) feather palms; açaí has excellent management potential as palm heart source, juçara of use for future breeding program for domestication; Anderson, 1988; Schauss, 2006.*
Hyphaene spp *doum*	*Africa* *Semi-deserts/deserts, to 600 m.* *Few spp. in Arabia and W. India.*	*edible fruit; sap for wine, alcohol*	*leaves for thatching & weaving*	*solitary branched fan palm; management of wild stands would provide sustainable sources of commercial & subsistence products in dry areas; Kahn & Luxereau, 2008; Tuley 1995*
Mauritia flexuosa *moriche*	*S. America tropical rain forest, seasonally flooded lowland sites*	*edible fruit mesocarp; edible oil; starch from trunk, yield to 60 kg/tree*	*leaf fiber for making rope trunk for wood; petiole for "cork"*	*solitary feather palm; extensive dense stands have management potential for multiple products; Manzi & Coomes, 2009; Padoch, 1988*

Scientific Names Common Names	***Native Distribution and Habitat***	***Major Products.***	***Minor Products***	***Comments and Selected References***
Metroxylon sagu sago	*SE. Asia tropical rain forest, fresh water swamps*	*starch from stem, yield 300 kg/tree*	*leaves for thatching*	*suckering feather palm; palm is cultivated & managed successfully; research progressing well; Ellen, 2004; Flach, 1997; Flach & Schuiling, 1989; Schuiling, 2009*
Nypa fruticans nipa	*S. & SE Asia tropical rain forest, brackish water swamps of tidal rivers*	*sap for sugar, alcohol, sugar yield 3,000kg/ha/year; leaves for thatching (atap)*	*edible fruit; powdered dried leaves studied as corrosion inhibitor of zinc*	*suckering feather palm; incipient management in practice, could benefit from improved practices & broader utilization of products, especially in Papua, New Guinea; Hamilton & Murphy, 1988; Orubite-Okorosaye & Oforka, 2004*
Oenocarpus bataua batauá	*S. America tropical rain forest, upland sites to 1,000 In.*	*edible oil, fruit*	*stem wood. leaves for thatching & weaving; possible biofuel*	*suckering feather palm: high quality seed oil gives this palm potential for domestication, also good agroforestry species; Balick, 1988*
Phoenix sylvestris wild date	*S. Asia tropical rain forest to dry forest, to 1,500 m*	*sap for sugar, wine, sugar yield 40 kg/tree/year; edible fruit*	*leaves for weaving & to make brooms; stem wood for fuel; etc.*	*solitary feather palm; already under management & informal cultivation; good multipurpose palm with domestication potential within agroforestry systems; Davis 1972; Chowdhury et al., 2008*

Scientific Names Common Names	***Native Distribution and Habitat***	***Major Products.***	***Minor Products***	***Comments and Selected References***
Raphia spp raffia.	*West Africa tropical rain forest, seasonally flooded lowland sites*	*commercial leaf base fiber (African bass fiber) for brushes & brooms; sap for wine. alcohol*	*petioles as poles, leaves for thatching & weaving; etc-*	*suckering (most spp.) terminal flowering feather palm; R. hookeri & R. palma-pinus are main brush fiber sources. also tapped for sap; one or more spp could be managed for multiple products; Tuley, 1995*
Salacca zalacca salak	*SE Asia understory of tropical rain forest, to 300 m.*	*edible fruit (fresh, canned, pickled)*	*leaves for thatching & weaving; antioxidants in fruit have potential health benefits*	*suckering feather palm fruit production from wild. semi-wild & cultivated plants; more than a dozen local variety names; strong candidate for domestication using germplasm of other promising sp. such as S. wallichiana; Aralas et al., 2009; Ashari, 2002; Yaacob & Subhadrabandhu, 1995*

Source: In addition to selected references cited, compiled from information provided elsewhere in this report.

Coordination of Activities

Informal and formal information networks exist for research and development of the five domesticated palms (African oil palm, arecanut, coconut, date and pejibaye); as well as for the sago palm and rattans. In some cases formal organizations exist such as the International Network for Bamboo and Rattan; in other instances information networking is achieved through technical conferences and journals, as with the African oil palm.

Another important source of information on specific palm products comes from looking at a particular product from an industrial point of view. An excellent example is the palm sugar workshop organized by the Asia Regional Cookstove Program and held in Indonesia in 1994 (ARECOP, 1994). Participants from six Asian countries shared experiences and discussed ways in which small scale industries could be promoted. These types of industrial activities need to be linked to enhancing production through management and domestication.

An information networking mechanism is needed for all of the economic palms not yet covered in some way. This would serve to coordinate and bolster efforts to realize their full development potential. There is considerable benefit to be derived from an exchange of ideas and examples from region to region (Johnson, 1992).

The IUCN, Species Survival Commission, Palm Specialist Group represents a means to fulfill this networking need. The Palm Specialist Group has published its Action Plan (Johnson, 1996) which is aimed at both palm conservation and utilization. The Group is headquartered at the Royal Botanic Gardens Kew, which possesses palm library and herbarium resources that can answer any question. With an outside source of funding, the Palm Specialist Group could take on the role of coordinating palm development activities in an efficient manner. In support of such an effort, there should also be formed a sub-network of institutions (other botanic gardens or research organizations) located in the Asia, Pacific, Latin America and Africa regions, to serve as local points of contact.

9 COMPOSITION AND CHARACTERISTICS OF SELECTED PALM PRODUCTS

This compilation of 28 tables has been assembled to provide technical information on the array of food and industrial products derived from palms. Included is information on domesticated and wild palms; palm products are somewhat similar so that in the absence of any data for a wild palm product some inferences can be made from closely-related domesticated species. The tables are arranged in alphabetical order by scientific name.

Table 9-1 Chemical Constituents of Arecanut, Areca catechu

Constituents[1]	**Green Nut (range)**	**Ripe Nut (range)**
Moisture content (%)	69.4-74.1	38.9-56.7
Total water extractives (%)	32.9-56.5	23.3-29.9
Polyphenols (%)	17.2-29.8	11.1-17.8
Arecoline (extraction method) (%)	0.11-0.14	0.12-0.24
Fat (%)	8.1-12.0	0.12-0.24
Crude fiber (%)	8.2-9.8	11.4-15.4
Total polysaccharides (%)	17.3-23.0	17.8-25.7
Crude protein (%)	6.7-9.4	6.2-7.5
Ash (%)	1.2-2.5	1.1-1.5

Note:

1.Constituents expressed as percentage values calculated as dry basis

(except moisture).

Source: Bavappa et al., 1982.

Table 9-2 Nutritional Composition of Pejibaye Fruit Mesocarp Pulp, Bactris gasipaes var. gasipaes (per 100 g)

Water (%)	56	Iron (mg)	2.76
Calories	194	Sodium (mg)	-
Protein (%)	3.01	Ascorbic Potassium (mg)	-
Fat (%)	6.14	Carotene (mg)	1.28
Carbohydrate (%)	33.05	Thiamine (mg)	0.030
Fiber (%)	1.02	Acid (mg)	-
Ash (%)	0.88	Niacin (mg)	0.455
Calcium (mg)	44.6	Riboflavin (mg)	0.068
Phosphorus (mg)	101.84		

Source: Pérez Vela, 1985.

Table 9-3 Nutritional Composition of Pejibaye Flour1, Bactris gasipaes var. gasipaes (fresh basis per 100 g)

Calories	413.5	Vitamin B_2 (mg)	0.3
Humidity (g)	12.0	Vitamin C (mg)	62.2
Protein (g)	3.8	Niacin (mg)	2.5
Fat (g)	8.9	Iron (mg)	6.1
Ash (g)	1.3	Calcium (mg)	10.9
Crude fiber (g)	2.1	Sodium (mg)	2.7
Carbohydrates (g)[2]	72.1	Potassium (mg)	162.8
Vitamin A (*u*g eq)	1.2	Magnesium (mg)	11.7
Vitamin B_1 (g)	0.1	Zinc (mg)	2.1

Notes:

1. Values calculated from fresh pejibaye fruit mesocarp.

2. Carbohydrates by difference.

Source: Blanco Metzler et al., 1992.

Table 9-4 Composition of Fibers of Bactris setosa and Borassus flabellifer (vascular bundle with sheath of sclerenchymatous fiber). Results expressed as % of oven-dried material.

Palm/Common name	Cellulose	Lignin	Total furfur-aldehyde	Cell furfur-aldehyde	Xylan in cellulose	Furfuraldehyde from polyuron-ides
Bactris setosa Tucum branco	81.54	7.42	5.13	3.10	4.8	2.0
Borassus flabellifer Palmyra	63.50*	25.01	13.80	10.16	15.7	3.6

* This figure is less reliable than other cellulose determination.

Source: Norman, 1937.

Table 9-5 Nutritional Composition of Palmyra Sweet Sap, Borassus flabellifer

Specific gravity	1.07	Calcium	Trace
pH	6.7-6.9	Phosphorus (g/100 cc)	0.14
Nitrogen (g/100 cc)	0.056	Iron (g/100 cc)	0.4
Protein (g/100 cc)	0.35	Vitamin C (mg/100 cc)	13.25
Total sugar (g/100 cc)	10.93	Vitamin B_1 (IU)	3.9
Reduced sugar (g/100 cc)	0.96	Vitamin B complex	Negli-gible
Minerals as ash (g/100cc)	0.54		

Source: Davis & Johnson, 1987.

Table 9-6 Nutritional Composition of Palmyra Sugar (Jaggery), Borassus flabellifer

Moisture	Nil	Phosphorus (%)	0.064
Protein (%)	0.24	Iron (mg/100 g)	30.0
Fat (%, ether extract)	0.37	Nicotinic acid (*u*mg/100 g)	4.02
Mineral matter (%)	0.50	Vitamin B_1 (*u*mg/100 g)	Nil
Carbohydrate (% by difference)	98.89	Riboflavin (*u*mg/100 g)	229
Carbohydrate (%, direct polarimetry)	98.4	Caloric value (/100 g)	398
Calcium (%)	0.08		

Source: Davis & Johnson, 1987

Table 9-7 Quantitative Anatomical Features of Calamus spp. (mean values; maximum values in parenthesis)

Calamus Species	Hypo-dermis no. of layers	Cortex width, no. of layers	V.B., diam. μm	V.B., no/mm²	Meta-xylem vessel diam.	Fiber dimensions				Silica body diam. μm	Diam. Secretary Cavity μm
						Length mm	Width μm	Lumen Diam. μm	2X wall thickness μm		
Large-diameter canes											
C. dransfieldii	1-2	25-28	780 (1000)	3.4 (6)	90 (320)	1.800 (2.200)	20 (28)	12 (18)	8 (10)	13 (16)	(100)
C. nagbettai	1-2	30-40	798 (1000)	3 (7)	383 (465)	1.980 (2.900)	21 (32)	10 (22)	11 (22)	11 (14)	58 (59)
C. thwaitesii	1-2	35-40	760 (1000)	3.3 (9)	352 (448)	1.700 (2.900)	19 (34)	8 (20)	11 (14)	12 (15)	(100)
Medium-diameter canes											
C. gamblei	1-2	14	800 (1010)	5.5 (8)	294 (340)	1.680 (2.166)	20 (34)	10 (18)	10 (16)	(10)	(92)
C. hookerianus	1-2	25	520 (630)	10.9	245 (290)	1.560 (2.052)	22 (28)	14 (17)	8 (11)	(16)	
C. karnatakensis	1	12	668 (800)	5	293 (350)	1.900 (2.920)	21 (32)	10 (18)	11 (22)	10 (12)	53 (63)
C. lacciferus	1	25	670 (800)	4.6	299 (360)	2.123 (3.028)	20 (24)	11 (19)	9 (12)	10 (12)	93 (102)
C. pseudotenuis	1	8	410 (650)	14.6	200 (240)	1.811 (2.318)	(26)	(16)	9 (10)	(10)	(60)
C. stoloniferus	1-2	9	493 (680)	5.0	172 (200)	1.778 (2.640)	17 (24)	9 (16)	8 (14)	8 (9)	68 (70)
C. vattayila	1	30	700 (920)	6.0	240 (260)	1.900 (3.620)	21 (32)	15 (24)	6 (8)		
Small-diameter canes											
C. brandisii	1-2	6-7	380 (418)	12.0	202 (222)	1.656 (2.420)	16 (28)	9 (16)	7 (16)	7.5 (8)	44 (50)
C. lakshamanae	1-2	8	415 (540)	14.9	204 (250)	1.523 (2.260)	15 (20)	7 (16)	8 (12)	m (8)	55 (60)
C. metzianus	1	12	516 (610)	11.1	280 (320)	1.670 (2.090)	(30)	(24)	3.6 (6)	(8)	(80)
C. rotang	1	8	365	14.4	220 (230)	1.921 (2.622)	16 (24)	9 (14)	7 (10)	(6)	(88)
C. travancoricus	1	8	310 (460)	19.5 (23)	130 (260)	1.4 (2.800)	17 (28)	7 (20)	10	7 (10)	(50)

Source: Modified after Bhat, 1992.

Table 9-8 Nutritional Composition of Limuran Fruit, Calamus ornatus var. ornatus (per 100 g)

Water (%)	0	Iron (mg)	8.1
Calories	376	Sodium (mg)	-
Protein (%)	2.9	Ascorbic Potassium (mg)	-
Fat (%)	5.7	Carotene (*u*g)	-
Carbohydrate (%)	88.6	Thiamine (mg)	0.29
Fiber (%)	2.4	Acid (mg)	23.8
Ash (%)	2.9	Niacin (mg)	4.29
Calcium (mg)	90.5	Riboflavin (mg)	0.05
Phosphorus (mg)	47.6		

Source: Atchley, 1984.

Table 9-9 Nutritional Composition of Palm Inflorescence, Pacaya, Chamaedorea tepejilote (10 g edible portion)

Energy value (cal)	45	Phosphorus (mg)	106.0
Water (%)	85	Iron (mg)	1.4
Protein (g)	4.0	Vitamin A (mcg)	5.0
Carbohydrates (g)	8.3	Thiamine (mg)	0.08
Fiber (g)	1.2	Riboflavin (mg)	0.10
Ash (g)	2.0	Niacin (mg)	0.9
Calcium (mg)	3.69	Ascorbic acid (mg)	14.0

Source: Castillo Mont et al., 1994.

Table 9-10 Components of Whole Coconut, Cocos nucifera (wet basis

Husk	35%	Meat (endosperm)	28%
Shell	12%	Water	25%

Source: Phil. Coco. Auth., 1979.

Table 9-11 Characteristics of Coconut Oil from Copra, Cocos nucifera (usual range)

Fat, % of part, dry basis	65-72
Characteristics of fat	
Acid value	1-10
Saponification value	251-264
Iodine value	7-10
Thiocyanogen value	6.1-7.0
R-M value	6-8
Polenske value	12-18
Unsaponifiable (%)	0.15-0.6
Refr. index, *n*D, 40° C	1.448-1.450
Sp. gr., 40°/25°	0.908-0.913
Melting point (° C)	23-26
Titer (° C)	20-24
Composition of fatty acids, wt. % of total fatty acids	
Saturated acids Capric	0-0.8
Caprylic	5.5-9.5
Capric	4.5-9.5
Lauric	44-52
Myristic	13-19
Palmitic	7.5-10.5
Stearic	1-3
Arachidic	0-0.4
Unsaturated acids Hexadecenoic	0-1.3

Oleic	5-8
Linoleic	1.5-2.5

Source: Eckey, 1954.

Table 9-12 Composition of Coconut Shell, Cocos nucifera (dry basis)

Lignin	36%	Ash	0.6%
Cellulose	53%		

Source: Ohler, 1984.

Table 9-13 Nutritional Composition of Coconut Water, Cocos nucifera

Water (%)	95.5	Carbohydrates (%)	4.0
Protein (%)	0.1	Calcium (%)	0.02
Fat (%)	0.1	Phosphorous (%)	0.001
Mineral matter (%)	0.4	Iron (mg/100 g)	0.5

Source: Thampan, 1975.

Table 9-14 Mechanical Properties of Coconut Wood, Cocos nucifera

Basic density kg/m³	Av.MC %	MoE Mpa	MoR MPa	Stress at limit of proportionality MPa	Impact Bending mN	Compression parallel grain MPa	Compresion perpendicular grain /1 Mpa	Shear radial[2] MPa	Cleavage maximum[3] N/mm²
600 +	57	10857	86	52	20	49	8	10	12
	12	11414	104	62	20	57	9	13	11
400-599	107	6880	53	30	18	31	3	6	9
	12	7116	63	38	10	38	3	8	8
250-399	240	3100	26	13	8	15	1	4	4
	12	3633	33	15	9	19	2	n.a.	4

Notes:

1. Compressive stress at limit of proportionality.

2. Radial and tangential values differ insignificantly.

3. Combined maximum values of radial and tangential cleavage.

Source: Killmann, 1988.

Table 9-15 Composition and Properties of Carnaúba Wax, Copernicia prunifera

	Types[1] 1,2,2A	**Types 3,4**	**Type 5**
Melting point - minimum (°C)	83	82.5	82.5
Flash point - minimum (°C)	310	299	299
Volatile matter (including moisture) maximum %	2	1.5	6
Insoluble impurities - maximum %	1	2	1.5

Note:

1. Carnaúba wax is graded in terms of quality on a scale from 1-5; Type 1 is the highest quality.

Source: Johnson, 1970.

Table 9-16 Nutritional Composition of Buri Palm Fruit, Corypha utan (per 100 g)

Water (%)	0	Iron (mg)	1.1
Calories	326	Sodium (mg)	-
Protein (%)	3.7	Ascorbic Potassium (mg)	-
Fat (%)	0.5	Carotene (*u*g)	-
Carbohydrate (%)	93.7	Thiamine (mg)	0.05
Fiber (%)	6.8	Acid (mg)	57.9
Ash (%)	2.1	Niacin (mg)	3.16
Calcium (mg)	73.7	Riboflavin (mg)	0.11
Phosphorus (mg)	89.5		

Source: Atchley, 1984.

Table 9-17 Nutritional Composition of African Oil Palm Fruit, Elaeis guineensis (per 100 g)

Water (%)	0	Iron (mg)	5.6
Calories	746	Sodium (mg)	-
Protein (%)	2.2	Ascorbic Potassium (mg)	-
Fat (%)	81.9	Carotene (*u*g)	50,680.6
Carbohydrate (%)	14.6	Thiamine (mg)	0.35
Fiber (%)	3.8	Acid (mg)	12.5
Ash (%)	1.3	Niacin (mg)	1.81
Calcium (mg)	136.1	Riboflavin (mg)	0.17
Phosphorus (mg)	61.1		

Source: Atchley, 1984.

Table 9-18 Nutritional Composition of African Oil Palm Oil1 Elaeis guineensis (per 100 g)

Water (%)	0	Iron (mg)	5.5
Calories	882	Sodium (mg)	-
Protein (%)	0.0	Ascorbic Potassium (mg)	-
Fat (%)	99.6	Carotene (*u*g)	27,417.1
Carbohydrate (%)	0.4	Thiamine (mg)	0.00
Fiber (%)	0.0	Acid (mg)	-
Ash (%)	0.0	Niacin (mg)	0.00
Calcium (mg)	7.0	Riboflavin (mg)	0.03
Phosphorus (mg)	8.0		

Note:

1. Source does not indicate whether mesocarp oil or kernel oil.

Source: Atchley, 1984.

Table 9-19 Nutritional Composition of Palm Heart, Euterpe spp.

Component	***Euterpe edulis***	***Euterpe oleracea***
Protein (%)	2.42	1.72
Ash (%)	1.43	0.83
Crude fiber (%)	0.89	0.27
Fat (%)	0.33	0.08
Total sugars (%)	0.86	0.70
Reducing sugars (%)	0.49	0.30
Tannins (%)	0.06	0.06
Vitamin C (mg/100 g)	1.8	1.4

Source: Quast & Bernhardt, 1978.

Table 9-20 Nutritional Composition of Açaí Fruit Pulp and Skin, Euterpe oleracea

Constituents[1]	*Percent by dry weight based on two analyses*
Lipids	*33.1; 49.4*
Proteins	*9.3; 13.8*
Ash	*2.2; 5.2*
Total dietary fiber	*18.0; 27.3*
Freeze Dried Fruit and Skin[2]	
Total content of anthocyanins	*3.1919 mg/g dry weight*
Concentration of total roanthocyanidins	*12.89 mg/g dry weight*
Total polyunsaturated fatty acids	*11.1 % of total fatty acid*
Total monounsaturated fatty acid	*60.2 % of total fatty acid*
Total saturated fatty acid	*28.7 % of total fatty acid*
Total amino acid content	*7.59 % of total weight*
Total sterols	*0.048 % of total weight*

Sources:

1. Neida & Elba, 2007.
2. Schauss et al., 2006.

Table 9-21 Nutritional Composition of African Doum Palm Fruit Mesocarp, Hyphaene compressa

Moisture (%)	4	Calcium (mg)	34
Energy (Kcal)	390	Phosphorus (mg)	110
Protein (g)	3.8	Thiamin (mg)	0.05
Fat (g)	0.8	Riboflavin (mg)	0.10
Carbohydrate (g)	84.1	Niacin (mg)	3.4
Ash (g)	7.3		

Source: Hoebeke, 1989.

Table 9-22 Nutritional Composition of Palm Wine from Sap of Hyphaene coriacea (per 100 g)

Moisture (%)	98.8	Potassium (mg)	152
Ash (g)	0.4	Copper (mg)	0.04
Protein (g)	0.1	Zinc (mg)	0.01
Fat (g)	-	Manganese (mg)	trace
Fiber (g)	-	Phosphorus (mg)	1.37
Carbohydrate (g)	0.7	Thiamin (mg)	0.01
Energy value	13 + 109	Riboflavin (mg)	0.01
Calcium (mg)	0.13	Niacin (mg)	0.22
Magnesium (mg)	4.18	Vitamin C (mg)	6.8
Iron (mg)	0.07	Alcohol (% v/v)	3.6
Sodium (mg)	9.88		

Source: Cunningham & Wehmeyer, 1988.

Table 9-23 Nutritional Composition of Indian Doum Palm Mesocarp, Hyphaene dichotoma (young fruit)

Energy Cal/100 g	406	Fiber (%)	50.07
Water (%)	0	Ash (%)	7.69
Protein (%)	9.26	Calcium (mg/100g)	268
Fat (%)	7.21	Phosphorus (mg/100g)	224
Carbohydrate (%)	75.81	Iron (mg/100g)	38.24[1]

Note:

1. High iron value probably due to soil type.

Source: Bonde et al., 1990

Table 9-24 Nutritional Composition of Moriche Palm Fruit1, Mauritia flexuosa. (per 100 g)

Water (%)	0	Iron (mg)	12.9
Calories	526	Sodium (mg)	-
Protein (%)	11.0	Ascorbic Potassium (mg)	-
Fat (%)	38.6	Carotene (*u*g)	90,992.6
Carbohydrate (%)	46.0	Thiamine (mg)	0.11
Fiber (%)	41.9	Acid (mg)	95.6
Ash (%)	4.4	Niacin (mg)	2.57
Calcium (mg)	415.4	Riboflavin (mg)	0.85
Phosphorus (mg)	69.9		

Note:

1. Source does not indicate, but assumed to be mesocarp pulp.

Source: Atchley, 1984.

Table 9-25 Nutritional Composition of Sago Starch, Metroxylon sagu (per 100 g of raw sago)

Calories	285.0	Calcium (mg)	30.0
Water (g)	27.0	Carbohydrate (g)	71.0
Protein (g)	0.2	Iron (mg)	0.7
Fat, carotene, thiamine, ascorbic acid	negligible	Fiber (g)	0.3

Source: Ruddle et al., 1978.

Table 9-26 Nutritional Composition of Date1 Fruit, Phoenix dactylifera (100 g, edible portion)

Water (%)	22.5	Iron (mg)	3.0
Food energy (cal)	274	Sodium (mg)	1
Protein (g)	2.2	Potassium (mg)	648
Fat (g)	0.5	Vitamin A (IU)	50
Carbohydrate (g, total)	72.9	Thiamine (mg)	0.9
Carbohydrate (g, fiber)	2.3	Riboflavin (mg)	0.10
Ash (g)	1.9	Niacin (mg)	2.2
Calcium (mg)	59	Ascorbic acid (mg)	0
Phosphorus (mg)	63		

Note:

1. Natural, domestic date; not stated but very likely the Deglet Noor variety.

Source: Watt & Merrill, 1963.

Table 9-27 Nutritional Composition of Palm Wine from Sap of Phoenix reclinata (per 100 g)

Moisture (%)	98.3	Potassium (mg)	157
Ash (g)	0.4	Copper (mg)	0.05
Protein (g)	0.2	Zinc (mg)	0.02
Fat (g)	-	Manganese (mg)	trace
Fiber (g)	-	Phosphorus (mg)	1.74
Carbohydrate (g)	1.1	Thiamin (mg)	0.01
Energy value	22 + 109	Riboflavin (mg)	0.01
Calcium (mg)	0.45	Niacin (mg)	0.5
Magnesium (mg)	5.12	Vitamin C (mg)	6.5
Iron (mg)	0.07	Alcohol (% v/v)	3.6
Sodium (mg)	5.85		

Source: Cunningham & Wehmeyer, 1988.

Table 9-28 Nutritional Composition of Salak Palm Fruit, Salacca zalacca (per 100 g)

Water (%)	0	Iron (mg)	19.1
Calories	345	Sodium (mg)	-
Protein (%)	1.8	Ascorbic Potassium (mg)	-
Fat (%)	0.0	Carotene (*u*g)	0.00
Carbohydrate (%)	95.0	Thiamine (mg)	0.18
Fiber (%)	-	Acid (mg)	9.1
Ash (%)	3.2	Niacin (mg)	-
Calcium (mg)	127.3	Riboflavin (mg)	-
Phosphorus (mg)	81.8		

Source: Atchley, 1984.

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11 ADDITIONAL INFORMATION SOURCES

Industry Reports

Industrialized palm products, excluding edible products, are the subject of a series of reports being produced by ICON Group International of San Diego CA. USA, and periodically updated. Information contained in these reports may be relevant to certain development projects involving coconut, African oil palm, babassu palm and rattans. Individual reports treat these commodities by focusing on the following subjects: world outlook, global trade perspective, world trade, regional trade, benchmark and gap analysis; other reports focus on specific regions and specific countries. Selected current titles are as follows:

Coconut

The 2009-2114 World Outlook for Once-Refined Coconut Oil after Alkali or Caustic Wash but before Deodorizing of Use in End Products. 199 pp.
ISBN: 0497841959.

The 2009-2114 World Outlook for Once-Refined Coconut Oil That Has Been Only Purchased and Deodorized. 191 pp. ISBN: 0497842114.

The 2009-2014 World Outlook for Sweetened, Creamed, and Toasted Coconut. 187 pp. ISBN: 0497849534.

The World Market for Unspun Coconut Fibers Including Tow, Noils, and Waste: A 2009 Global Trade Perspective. 72 pp. ISBN: 054635159X

Palm Oil (including babassu oil)

The 2009-2114 World Outlook for Once-Refined Palm Oil and Alkali or Caustic Wash but before Deodorizing. 191 pp. ISBN: 0497841975.

The 2009-2114 World Outlook for Once-Refined Palm Oil That Has Been Only Purchased and Deodorized. 191 pp. ISBN: 0497842106.

The World Market for Crude Palm Kernel or Babassu Oil: A 2009 Global Trade Perspective. 72 pp. ISBN: 0546352790.

Rattan

The 2009-2114 World Outlook for Non-Upholstered Household Furniture Made of Rattan, Reed, Wicker, and Willow. 197 pp. ISBN: 0497913984.

The World Market for Rattans: A 2009 Global Trade Perspective. 53 pp. ISBN: 0497944685.

Note: ICON publications are available as E-books. More information can be found at the company website: http://www.icongrouponline.com

Palm Journal and Newsletters

Boletin Pejibaye. Irregular. 1989-1996. Universidad de Costa Rica, Ciudad Universitaria, San José, Costa Rica. Ceased publication. (peach palm)

BuroTrop Bulletin. Two per year. 1991-2003. French and English editions. BuroTrop, Montpelier, France. Ceased publication. (African oil palm and coconut)

Cocoinfo International. Two per year. 1994- Asian and Pacific Coconut Community, Jakarta, Indonesia. http://www.apccsec.org

Cocominity Newsletter. Monthly. 1971- Asian and Pacific Coconut Community, Jakarta, Indonesia. . http://www.apccsec.org

Cocos. Journal of the Coconut Research Institute of Sri Lanka. One per year, but sporadic. 1983- Lunuwila, Sri Lanka. http://cri.lk

Cord. Coconut Research and Development. Two per year. 1985-
Asian and Pacific Coconut Community, Jakarta, Indonesia. http://www.apccsec.org

Date Palm Journal. Two per year. 1981-1987. FAO Regional Project for Palm and Dates Research Centre, Baghdad, Iraq. Ceased publication.

INBAR Newsletter. Irregular. 1993- (electronic 2004-) International Centre for Bamboo and Rattan, Beijing, China. http://www.inbar.int

Journal of Bamboo and Rattan. Four per year. 2001- http://www.springer.com

Journal of Oil Palm Research. (formerly *Elaeis*) Two per year. 1989- Palm Oil Research Institute of Malaysia, Kuala Lumpur.
http://jopr.mpob.gov.my

Mooreana, Journal of the Palmetum. Three per year. 1991-1996. Townsville City Council, Australia. Ceased publication.

Nigerian Journal of Palms and Oil Seeds. Irregular. 1953- Nigerian Institute of Oil Palm Research, Benin City. (African oil palm and coconut) http://www.nifor.org

Palm Enthusiast. Three per year. 1984- South African Palm Society. http://www.sapalm.co.za

Palm Journal. Irregular. 1993- Palm Society of Southern California. http://www.palmssc.org

Palms. (formerly *Principes*). Four per year. 1956- International Palm Society. http://www.palms.org

Palms & Cycads. Four per year. 1984- Palm & Cycad Society of Australia. http://www.pacsoa.org.au

Philippine Journal of Coconut Studies. Two per year. 1976- Philippine Coconut Research and Development Foundation. http://www.pcrdf.org

Revista Palmas. Four per year. 1980- Federación Nacional de Cultivadores de Palma Africana, Bogotá, Colombia. (African oil palm) http://www.fedepalma.org

RIC Bulletin. Four per year. 1982-1993. Rattan Information Centre, Malaysia. Ceased publication.

Sago Palm. Irregular. 1993- In Japanese and English. Tsukuba Sago Fund, Japan. http://www.bio.mie-u.ac.jp

Palm CD Roms and Videos

General

Useful Palms of the Tropics and Their Potential. F.W. Martin & B. Brunner. Echo, Inc., N. Ft. Myers FL. CD Rom. 1995. http://www.echonet.org

Virtual Palm Encyclopedia. J. Haynes. Palm & Cycad Societies of Florida. CD Rom 2000. http://www.plantapalm.com

Coconut Palm

A series of six coconut video documentaries (VHS-PAL format), each of 20-25 minutes duration, are available with the following titles:

Wealth under the Tree of Life. Promotes advantages of mixed farming systems including coconuts.

Cash in Shell. Overview of coconut shell products.

Coir the Versatile Fibre. Coir fiber and its products.

Nectar from the Tree of Life. Tapping coconuts for sap to produce toddy, arrack, jaggery and coconut sugar.

On Coconut Culture. Features scientific and profitable ways of growing coconuts.

Coconut Pests. Various types of coconut pests and control measures.

Asian & Pacific Coconut Community, Jakarta, Indonesia. http://www.apccsec.org

Date Palm

Feast of Dates. Date palm in United Arab Emirates. Ministry of Information and Culture, Abu Dhabi. 26 minutes in either Arabic or English. CD Rom 2005. http://www.uaeinteract.com

Rattans

Rattan: The Hidden Resource. 18 minutes, either VHS-PAL or NTSC formats. 1989. IDRC, Canada. Rattan use, processing and research in Asia.
http://www.idrc.ca

Rattans of Borneo An Interactive Key. J. Dransfield & M. Patel.
Kew Publishing. CD Rom 2005. Covers the 150 species of rattans of Borneo. http://www.kewbooks.com

12 PALM SPECIALIST DIRECTORY[8]

Name	Postal Address	Email Address	Special Interests
Asmussen-Lange, Conny B.	Institute of Agriculture & Ecology University of Copenhagen Rolighedsjez 21 DK-1958 Frederiksberg C., Denmark	con@life.ku.dk	Central and South America; Molecular Systematics, Evolution, Conservation
Bacon, Christine D.	Colorado State University Campus Delivery 1878 Ft. Collins CO 80523 USA	cbacon@rams.colostate.edu	Tropical America, Pacific, Hawaii, Systematics, Evolution, *Chamaedorea, Trachycarpus, Pritchardia,* Conservation
Baker, William J. (Chairman IUCN/SSC Palm Specialist Group)	Royal Botanic Gardens Kew, Richmond, Surrey TW9 3AE UK	w.baker@kew.org	SE Asia, Pacific, Madagascar, Systematics, Evolution, Distributions, Conservation
Balick, Michael J.	New York Botanical Garden Bronx NY 10458 USA	mbalick@nybg.org	Palm Ethnobotany, Conservation, Neotropics, Oceania
Balslev, Henrik	Institute of Biological Sciences University of Aarhus, Bldg. 1540 Ny Munkegade, DK-8000 Aarhus Denmark	henrik.balslev@biology.au.dk	Neotropics, Ethnobotany, Western Amazon, Community Ecology
Barfod, Anders	Institute of Biological Sciences University of Aarhus, Bldg. 1540 Ny Munkegade, DK-8000 Aarhus Denmark	anders.barfod@biology.au.dk	SE Asia, Pacific, Systematics, Morphology, Economic Botany, Macroecology, Conservation
Bernal, Rodrigo	Instituto de Ciencias Naturales Univ. Nacional de Colombia Apartado 7495, Bogotá, Colombia	rgbernalg@gmail.com	Neotropics, Systematics, Ecology, Use, Management, Conservation
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[8] Based on the membership list of the 2009 IUCN/SSC Palm Specialist Group.

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13 THE MOST THREATENED PALMS OF THE WORLD: UTILIZED AND NOT UTILIZED

Genus/Species (Names in Bold are reported to be utilized as documented in this report)	Geographical Distribution	IUCN Red List Category[1]/ Year Assessed	Notes
Acanthophoenix rubra	Indian Ocean: Mascarenes	CR 1998	monotypic, island endemic
Aiphanes grandis	South America: Ecuador	EN 2003	population decreasing
Aiphanes leiostachys	South America: Colombia	EN 1998	
Aiphanes verrucosa	South America: Ecuador	En 2003	population decreasing
Alsmithia longipes	Pacific Ocean: Fiji	EN 1998	monotypic; island endemic
Areca concinna	South Asia: Sri Lanka	EN 1998	island endemic
Arenga micrantha	East Asia: China	EN 2004	
Asterogyne yaracuyense	South America: Venezuela	CR 1998	
Astrocaryum minus	South America: French Guiana, Brazil	CR 1998	
Astrocaryum triandrum	South America: Colombia	EN 1998	
Attalea crassispatha	Caribbean: Haiti	CR 1998	island endemic
Bactris nancibaensis	South America: French Guiana	CR 1998	
Bactris setiflora	South America: Ecuador	EN 2003	population decreasing
Balaka macrocarpa	Pacific Ocean: Fiji	CR 1998	island endemic
Balaka microcarpa	Pacific Ocean: Fiji	EN 1998	island endemic
Beccariophoenix madagascariensis	Indian Ocean: Madagascar	CR 1998	monotypic, island endemic
Bentinckia nicobarica	Indian Ocean: (India) Nicobar Islands	EN 1998	island endemic
Borassus sambiranensis	Indian Ocean: Madagascar	EN 1998	island endemic
Brahea edulis	North America: (Mexico) Guadalupe Is.	EN 1998	island endemic
Calamus compsostachys	East Asia: China	CR 2004	
Calamus obovoideus	East Asia: China	CR 2004	
Calamus wailong	East/Southeast Asia: China, Laos, Thailand	CR 2004	
Carpoxylon macrospermum	Pacific Ocean: Vanuatu	CR 1998	monotypic, island endemic
Ceroxylon alpinum	South America: Venezuela to Ecuador	EN 1998	
Ceroxylon amazonicum	South America: Ecuador	EN 2003	population decreasing
Ceroxylon sasaimae	South America: Colombia	CR 1998	
Chuniophoenix hainanensis	East Asia: China, including Hainan Is.	EN 2004	
Clinostigma samoense	Pacific Ocean: Samoa	EN 1998	island endemic
Coccothrinax borhidiana	Caribbean: Cuba	CR 1998	island endemic
Coccothrinax crinita	Caribbean: Cuba	EN 1998	two subspp., island endemic
Copernicia ekmanii	Caribbean: Hispaniola	EN 1998	island endemic

Genus/Species (Names in Bold are reported to be utilized as documented in this report)	Geographical Distribution	IUCN Red List Category[1]/ Year Assessed	Notes
Cryosophila bartlettii	North America: Panama	EN 1998	
Cryosophila cookii	North America: Costa Rica	CR 1998	
Cryosophila grayumii	North America: Costa Rica	CR 1998	
Cyphophoenix nucele	Pacific Ocean: New Caledonia	CR 1998	island endemic
Cyphosperma tanga	Pacific Ocean: Fiji	CR 1998	island endemic
Cyphosperma voutmelense	Pacific Ocean: Vanuatu	EN 1998	
Deckenia nobilis	Indian Ocean: Seychelles	EN 1998	monotypic, island endemic
Drymophloeus (=Solfia) samoensis	Pacific Ocean: Samoa	CR 1998	monotypic, island endemic
Dypsis ambanjae	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis ambositrae	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis ampasindavae	Indian Ocean: Madagascar	EN 1998	island endemic
Dypsis antanambensis	Indian Ocean: Madagascar	EN 1998	island endemic
Dypsis arenarum	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis basilonga	Indian Ocean: Madagascar	EN 1998	island endemic
Dypsis bejofo	Indian Ocean: Madagascar	EN 1998	island endemic
Dypsis boiviniana	Indian Ocean: Madagascar	EN 1998	island endemic
Dypsis canaliculata	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis canescens	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis ceracea	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis commersoniana	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis decipiens	Indian Ocean: Madagascar	EN 1998	island endemic
Dypsis dransfieldii	Indian Ocean: Madagascar	EN 1998	island endemic
Dypsis faneva	Indian Ocean: Madagascar	EN 1998	island endemic
Dypsis hovomantsina	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis ifanadianae	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis intermedia	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis interrupta	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis ligulata	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis mangorensis	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis nauseosa	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis nossibensis	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis oropedionis	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis ovobontsira	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis psammophila	Indian Ocean: Madagascar	CR 1998	island endemic

Genus/Species (Names in Bold are reported to be utilized as documented in this report)	Geographical Distribution	IUCN Red List Category[1]/ Year Assessed	Notes
Dypsis rivulsaris	Indian Ocean: Madagascar	EN 1998	island endemic
Dypsis sahanofensis	Indian Ocean: Madagascar	EN 1998	island endemic
Dypsis saintelucei	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis singularis	Indian Ocean: Madagascar	CR 1998	island endemic
Dypsis tsaravoasira	Indian Ocean: Madagascar	EN 1998	island endemic
Gaussia spirituana	Caribbean: Cuba	EN 1998	island endemic
Geonoma irena	South America: Ecuador	EN 2003	population decreasing
Hyophorbe amaricaulis	Indian Ocean: Mauritius	CR 2000	island endemic, population decreasing
Hyophorbe indica	Indian Ocean: Réunion	EN 1998	island endemic
Hyophorbe lagenicaulis	Indian Ocean: Mauritius	CR 1998	island endemic
Hyphorbe vaughanii	Indian Ocean: Mauritius	CR 2000	island endemic, population decreasing
Hyphorbe verschaffeltii	Indian Ocean: Rodrigues	CR 1998	island endemic
Kentiopsis oliviformis	Pacific Ocean: New Caledonia	EN 1998	island endemic
Latania loddigesii	Indian Ocean: Mauritius	EN 1998	island endemic
Latania lontaroides	Indian Ocean: Réunion	EN 1998	island endemic
Latania verschaffeltii	Indian Ocean: Rodrigues	EN 1998	island endemic
Lavoixia macrocarpa	Pacific Ocean: New Caledonia	CR 1998	monotypic, island endemic
Lemurophoenix halleuxii	Indian Ocean: Madagascar	EN 1998	monotypic, island endemic
Livistona drudei	Australia	EN 1998	
Loxococcus rupicola	South Asia: Sri Lanka	CR 1998	monotypic, island endemic
Marojejya darianii	Indian Ocean: Madagascar	CR 1998	island endemic
Masola kona	Indian Ocean: Madagascar	EN 1998	island endemic
Medemia argun	Africa: Egypt, Sudan	CR 1998	monotypic
Neoveitchia storckii	Pacific Ocean: Fiji	EN 1998	island endemic
Orania trispatha	Indian Ocean: Madagascar	CR 1998	island endemic
Parajubaea sunkha	South America: Bolivia	EN 2006	population unknown
Parajubaea torallyi	South America: Bolivia	EN 1998	
Pelagodoxa henryana	Pacific Ocean: Marquesas	CR 1998	island endemic
Phytelephas tumacana	South America: Colombia	EN 1998	
Pinanga tashiroi	East Asia: Taiwan	CR 2004	island endemic
Plectocomia microstachya	South Asia: Myanmar	EN 2004	
Pritchardia affinis	Pacific Ocean: Hawaiian Islands	CR 1998	island endemic
Pritchardia aylmer-robinsonii	Pacific Ocean: Hawaiian Islands	CR 1998	island endemic
Pritchardia forbesiana	Pacific Ocean: Hawaiian Islands	EN 1998	island endemic

Genus/Species (Names in Bold are reported to be utilized as documented in this report)	Geographical Distribution	IUCN Red List Category[1]/ Year Assessed	Notes
Pritchardia glabrata	Pacific Ocean: Hawaiian Islands	EN 1998	island endemic
Pritchardia hardyi	Pacific Ocean: Hawaiian Islands	CR 1998	island endemic
Pritchardia kaalae	Pacific Ocean: Hawaiian Islands	CR 1998	island endemic
Pritchardia lanaiensis	Pacific Ocean: Hawaiian Islands	EN 1998	island endemic
Pritchardia lanigera	Pacific Ocean: Hawaiian Islands	EN 1998	island endemic
Pritchardia limahuliensis	Pacific Ocean: Hawaiian Islands	CR 1998	island endemic
Pritchardia munroi	Pacific Ocean: Hawaiian Islands	CR 1998	island endemic
Pritchardia napaliensis	Pacific Ocean: Hawaiian Islands	CR 1998	island endemic
Pritchardia perlmanii	Pacific Ocean: Hawaiian Islands	EN 1998	island endemic
Pritchardia remota	Pacific Ocean: Hawaiian Islands	EN 1998	island endemic
Pritchardia schattaueri	Pacific Ocean: Hawaiian Islands	CR 1998	island endemic
Pritchardia viscosa	Pacific Ocean: Hawaiian Islands	CR 1998	island endemic
Pritchardiopsis jeanneneyi	Pacific Ocean: New Caledonia	CR 1998	monotypic, island endemic
Pseudophoenix lediniana	Caribbean: Haiti	CR 1998	island endemic
Ptychosperma gracile	Pacific Ocean: Bismarck Arch.	EN 1998	island endemic
Ptychosperma (=*Drymophloeus*) *hentyi*	Pacific Ocean: Bismarck Arch.	EN 1998	island endemic
Ravenea albicans	Indian Ocean: Madagascar	EN 1998	island endemic
Ravenea hildebrandtii	Indian Ocean: Madagascar	EN 1998	island endemic
Ravenea julietiae	Indian Ocean: Madagascar	EN 1998	island endemic
Ravenea lakatra	Indian Ocean: Madagascar	EN 1998	island endemic
Ravenea latisecta	Indian Ocean: Madagascar	EN 1998	island endemic
Ravenea louvelii	Indian Ocean: Madagascar	EN 1998	island endemic
Ravenea moorei	Indian Ocean: Madagascar	CR 1998	island endemic
Ravenea nana	Indian Ocean: Madagascar	EN 1998	island endemic
Ravenea xerophila	Indian Ocean: Madagascar	EN 1998	island endemic
Roystonea dunlapiana	North America: Mexico to Central America Cuba	EN 1998	
Roystonea regia	North America: USA (Florida)	CR 1998	
Roystonea stellata	Caribbean: Cuba	EN 1998	island endemic
Sabal bermudana	Atlantic Ocean: Bermuda	EN 1998	island endemic
Satranala decussilvae	Indian Ocean: Madagascar	EN 1998	monotypic, island endemic
Syagrus macrocarpa	South America: Brazil	EN 1998	
Tectiphiala ferox	Indian Ocean: Mauritius	CR 1998	monotypic, island endemic
Thrinax ekmaniana	Caribbean: Cuba	CR 1998	island endemic
Trachycarpus nanus	East Asia: China	EN 2004	

Genus/Species (Names in Bold are reported to be utilized as documented in this report)	Geographical Distribution	IUCN Red List Category[1]/ Year Assessed	Notes
Veitchia montgomeryana (=arecina)	Pacific Ocean: Vanuatu	EN 1998	island endemic
Voanioala gerardii	Indian Ocean: Madagascar	CR 1998	monotypic, island endemic
Wettinia hirsuta	South America: Colombia	EN 1998	
Wettinia minima	South America: Ecuador	EN 2003	population unknown

1 CR = Critically Endangered. The species is considered to be facing an extremely high risk of extinction in the wild.

EN = The species is considered to be facing a very high risk of extinction in the wild.

Note: Palms known to be extinct in the wild are: Corypha taliera, South Asia; and Cryosophila williamsii, Central America.

Source: Based upon The IUCN Red List of Threatened Species (2008), with updated nomenclature and some additional notes.

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Palms, belonging to the Arecaceae family, are among the most common plants in tropical countries and provide a vast assortment of products ranging from food to construction materials, fibre and fuel. *Tropical palms*, originally published in 1998, has been updated in 2010 to include the most recent information and developments regarding the conservation status and use of various tropical palm species. It describes the many uses of the products derived from palms and provides updated references and sources of additional information. Palm products are considered both at the subsistence and commercial levels. Using this publication, readers will be able to assess the role of palms and their products within forest management, reforestation, agriculture and nature conservation activities.

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