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REGIONAL OFFICE FOR ASIA AND THE PACIFIC (RAPA)
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
BANGKOK 1994

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FOREWORD

Non-wood forest products (NWFPs) have been vitally important to forest-dwellers and rural communities for centuries. Local people collect, process and market bamboo, rattan, beedi (*Diospyros melanoxylon*) leaves, resins, gums, lac, oil seeds, essential oils, medicinal herbs, and tanning materials. Rural communities also draw upon forests for food such as honey, mushrooms, fruits, nuts, tubers, leaves, bush meat, and numerous other forest foods.

Although foresters never completely ignored NWFPs, for decades their management received only secondary or tertiary attention relative to timber management. Increased concern over the degradation and loss of forests in recent years, however, has brought new attention to NWFPs. NWFPs are increasingly being seen as offering new alternatives to timber extraction, forest conversion, and more destructive forms of forest exploitation.

Recognizing that successful conservation of forests will depend on developing alternatives or complements to timber harvesting in many areas, conservation-minded foresters and scientists are "rediscovering" the non-timber products of the forest. Renewed emphasis is being placed on managing forests for a multitude of products to directly benefit those people whose actions might otherwise destroy the forest. Multi-purpose forest management is being complemented with improvements in the processing, marketing, and commercialization of NWFPs. New forest policies and strategies are likewise being promulgated to enhance the development of NWFPs.

FAO has recently stepped up its support for the development of NWFPs by improving data collection, compiling case studies on the successful management of NWFPs, facilitating information dissemination, organizing workshops and consultations, and formulating new projects related to NWFP development. This publication is a product of FAO's enhanced attention to this long-neglected area of forestry. It contains reports describing the status, management, and importance of NWFPs in eleven Asian countries. These reports should be useful in supporting the efforts of foresters, conservationists, and rural development workers in helping local communities increase their benefits from nearby forests.

A.Z.M. Obaidullah Khan
Assistant Director-General and
Regional Representative of FAO

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BANGLADESH

Shafique A. Khan
Deputy Conservator of Forests
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INTRODUCTION

In a developing country like Bangladesh, non-wood forest products (NWFPs) play a vital role in the economic and socio-political arenas of the country. Though branded as "minor forest products" in old forestry literature and departmental records, they are certainly not "minor" products in the context of the feeble Bangladeshi economy. They deserve to be given due attention in their own right.

MAJOR NWFPs

Bamboo (*Melocanna baccifera, Bambusa tulda*, etc.) is often called the "poor man's timber" in Bangladesh and in other Southeast Asian countries. Although officially grouped as a minor forest product, it plays a crucial role in the rural economy of Bangladesh. It earns a handsome revenue for the Forest Directorate at home and abroad, but also is an essential material for construction of temporary housing for the rural people, especially the hill tribe people.

The qualities of bamboo can not be over-emphasized. Bamboo is the fastest growing plant in the world, and grows well on a variety of sites. Over 20 species of bamboo grow in Bangladesh's natural forests and village homesteads. Bamboo is used for hundreds of purposes. It can honestly be said that bamboo is required from the cradle to the coffin in parts of Bangladesh and other developing countries.

Table 1. Production of bamboo in Bangladesh

Year	Quantity (1,000 culms)
1975-76	47,268
1976-77	62,579
1977-78	73,586
1978-79	60,135
1979-80	78,115
1980-81	74,028
1981-82	77,865
1982-83	92,335
1983-84	92,061
1984-85	76,989
1985-86	75,786
1986-87	92,616

Source: Statistical Year Book of Bangladesh 1989

Sungrass (*Imperata* spp.) is the most common roofing and thatching material for temporary low-cost housing in the villages and forests of Bangladesh.

Sungrass grows naturally, especially in the forests of low-lying areas, or around the denuded and barren hills unfit for growing high-quality timber trees. Table 2 summarizes the production of sungrass in Bangladesh during the years 1975-76 to 1986-87.

Stone is one of the most important NWFPs, available only in some areas of

Table 2. Production of sungrass in Bangladesh

Year	Quantity (1,000 bundles)
1975-76	1,772
1976-77	6,831
1977-78	1,784
1978-79	1,534
1979-80	3,795
1980-81	6,706
1981-82	2,432
1982-83	1,390
1983-84	1,279
1984-85	1,295
1985-86	859
1986-87	1,710

Source: Statistical Year Book of Bangladesh 1989.

Bangladesh, such as Sylhet, Hill Tracts, and Dinajpur. Stone is required for construction of highways, buildings and other infrastructural needs.

In Dinajpur alone, there is said to be a deposit of 115 million cubic feet of hardstone. The Government of Bangladesh earns substantial revenue from the sale of stone.

Sand is also an essential material for all major construction, found in large quantities in forest areas.

Medicinal plants: The leaves, bark, and fruit of many plants are commonly used as medicines in Bangladesh. Among the most common are: kurus pata (*Holarrhene antidysonberica*), horitaka (*Terminalia chebula*), amlaki (*Phyllauthus emblica*) and bohera (*Terminalia belerica*).

Cane (*Calamus viminalis, C. guruba*) is a climbing plant, mostly grown in homesteads and the low-lying areas of reserved forests. Canes are used for domestic purposes by the rural population, and for sophisticated furniture and luxury souvenirs suitable for export. Recently, attempts have been made to grow these species from seed imported from Malaysia. In some areas of Sylhet, Chittagong Hill Tracts and Chittagong, domestic varieties of canes are grown.

Pati pata or Murta (*Clinogynae dichotoma*) grows naturally in the low-lying areas of Sylhet and also in rural areas of Tagail and Dhaka districts. It can be grown artificially in other areas of the country using suitable planting material. Pati-pata is an excellent material for floor mats, and is extensively used by rich and poor alike. Finished products are commonly exported.

Honey occupies an important position as a foreign exchange earner. It is internationally known and is used as food, drink, and medicine in many parts of the world. Honey is produced naturally in the beehives of the Sundarbans forest where it is collected in large quantities every year (Table 3).

Honey is also grown in the forest regions of Chittagong, Sylhet, Cox's Bazar, and Mymensingh.

Recently, apiculture (artificial bee-keeping) has been introduced in some areas of North Bengal and Mymensingh district with considerable success. Honey is probably the most promising NWFP in Bangladesh in terms of export potential, provided its production can be better organized.

Table 3. Honey production in Bangladesh	
Year	Quantity (1,000 tons)
1975-76	156.02
1976-77	239.78
1877-78	228.47
1978-79	176.33
1979-80	213.36
1980-81	310.93
1981-82	225.26
1982-83	232.65
1983-84	260.35
1984-85	255.80
1985-86	224.52
1986-87	229.11

Table 4. Production of Gol-patta in Bangladesh	
Year	Quantity (1,000 tons)
1975-76	75.29
1976-77	70.59
1977-78	67.49
1978-79	83.72
1979-80	69.87
1980-81	67.97
1981-82	68.61
1982-83	64.05
1983-84	63.38
1984-85	61.44
1985-86	61.96
1986-87	70.77

Shells, Conch Shells, Oysters, etc. are collected in large numbers in the coastal forest belts of Cox's Bazar, Teknaf, Moheskhali, Barisal, Patuakhali, and Sundarbans. This activity provides income to local inhabitants who sell them to tourists as souvenirs. Some are also exported. Although the Forest Department has no effective control on processing and export of these products, it is indirectly supporting the growth and expansion of this cottage industry. If the Government promotes it with proper incentives, this industry has considerable export potential. No statistics are available for these products.

Gol-patta (*Nipa fruticans*) is one of the most abundant NWFPs in Bangladesh, growing naturally throughout the Sundarbans forest and in other coastal areas. Made from the leaves of nipa, gol-patta thatching and roofing is very common in Khulna, Bagerhat, and Sarkhira districts. It provides considerable revenue for the Forest Department. Production figures are shown in Table 4.

Fish resources: In rivers within forest areas (Sundarbans, Chittagong Hill Tracts, and Sylhet), as well as in the coastal belts and off-shore islands under the jurisdiction of the Forest Department, a large quantity of fish (both fresh-water and saline fish), are collected by local fishermen, for which the Forest Department earns a good deal of revenue.

Recently, shrimp cultivation has been initiated in the coastal belts and off-shore islands of Bangladesh. Although offering attractive export potential, such shrimp production causes severe damage to the mangrove and coastal forest plantations, which have been felled to accommodate ponds.

Wildlife resources: Bangladesh has tremendous potential for breeding and export of a number of wildlife species and wildlife products.

About 20 years ago, large number of Rhesus monkeys were exported from Bangladesh in to the United States for

medical research. Similarly, lizard skins were exported to different countries until recently. However, because of poaching of valuable wildlife species, all exports of wildlife are now banned. If regulations were changed, however, good prospects exist for exports of captive-bred deer, crocodile, snakes, lizards, and other animals.

Famous for Royal Bengal tigers, the Sundarbans forest offers high potential for tourism and organized *safaris* for incoming visitors, provided the wildlife can be significantly increased through scientific management.

COLLECTION AND PROCESSING OF NWFPs

Collection and processing are the weakest links in the NWFPs sector in Bangladesh, needing special attention from the concerned authorities. The collection and processing arrangements are primarily carried out by two sectors—the Government, through the Forest Department, and small-scale entrepreneurs.

The Forest Department has no specialized division for processing or collecting NWFPs. It is done as an additional responsibility.

Some major departmental initiatives for collecting and processing of NWFPs include:

- Collection of honey from the Sundarbans by the Sundarban Forest Division.
- Collection of gol patta/thatching material by local cutters (bawalis) under the issuance of Forest Department permits and supervision of the Sundarbans Forest Division staff.
- Collection, extraction and transportation of bamboo from large bamboo brakes (mohals), especially in the Sylhet Forest Division and, to a lesser extent, in Chittagong Hill Tract, Cox's Bazar and Chittagong Forest Division.
- Collection of cane and pati pata (murta) by local people on payment of royalties, mainly to the Forest Department.

A look into the nature of departmental and governmental efforts for the collection of NWFPs indicates that:

i) There is no specialized or professional body for this purpose.

ii) Governmental action aims primarily at the collection of revenue and policing the resource. Planned efforts development have yet to be carried out.

iii) Management and monitoring of NWFP are carried out in addition to routine departmental functions.

iv) NWFP management lacks professionalism and high technical standards.

v) The country lacks a detailed inventory of NWFP resources.

Some steps are being taken by the private sector on a very small scale and on purely commercial basis. For example, there are a number of cane and bamboo processing units in Sylhet and Chittagong which are engaged in manufacturing furniture and souvenirs to be offered in the local market. Though this has the potential to become a booming industry, it remains suppressed because of the lack of professionalism and technically sound project planning. Similarly, the collection and processing of shells in the coastal belts of Cox's Bazar and Chittagong has become a cottage industry that has attracted many private entrepreneurs. So far, however, hardly any scientifically trained professional body has emerged to deal with the collection, processing and export of NWFPs.

ECONOMIC AND SOCIAL BENEFITS FROM NWFPs

Though described as "minor" forest products, NWFPs have made major contributions to the Bangladesh agrarian economy. A critical review of the contributions of NWFPs would reveal numerous economic and socio-psychological benefits.

Macro-Economic Benefits

The Government of Bangladesh collects significant earnings from the royalties, taxes, and other charges on NWFPs. Modest export earnings are derived from the sale of bamboo and shells.

Sophisticated finished articles and souvenirs made from NWFPs are major exportable items of the country which often carry with them the aesthetic cultural dignity of the nation.

Micro-Level Economic Benefits

The collection, processing, and marketing of NWFPs provides employment to thousands of rural Bangladeshis.

NWFP homestead or mini industries use local labor and raw materials, which are crucial importance to the otherwise rather stagnant rural economy of Bangladesh.

Socio-Psychological Benefits

With the employment generators and security of regular earning (through NWFPs), there is a recognizable growth in the quality of socio-psychological life of the involved population. Though there is virtually no study on this social aspect, this becomes evident from the behavior patterns of the people. The Chakmas (bamboo collectors of the Chittagong Hill Tracts regions), honey collectors of the Sundarbans, stone merchants and murta workers of Sylhet forests are a few of these groups who are in close contact with the foresters. It has been observed that a distinct change has emerged in their sense of values and views of the world. They have grown more conscious of their rights, more abiding of state laws pertaining to forest resources, and more cooperative with officials of the Forestry Department, the police and local civil administrations. This phenomenon needs to be addressed more thoroughly by social scientists.

PROMOTING NWFPs

Recent Strategies for Promotion:

On the face of the utter degradation of state forests, renewed emphasis has been attached to NWFPs. Some significant steps have been taken by the Forest Directorate to conserve, regenerate and propagate some of the major NWFPs. These steps include:

- Artificial planting of bamboo using improved planting materials (offset, branch-cutting and tissue culture) at selected sites by the Forest Department and the Bangladesh Forest Research Institute (BFRI).
- Regeneration of cane through improved high-quality imported seeds in the state forests, and in homestead agroforestry areas.
- Promotion and improvement of pati pata/murta in Sylhet by restricting indiscriminate cutting and by enforcing rules for regeneration.

Bottlenecks:

In spite of all limitations, cottage industries making products of bamboo, cane, shells, oysters honey, bees wax, lemon grass etc. have made notable progress in recent years.

The status of NWFPs in Bangladesh is far from satisfactory. However, the following are the primary bottlenecks:

- Trained personnel and efficient management have not yet been developed for dealing with NW FP collection, processing and export.
- Good marketing facilities have not been developed mainly due to lack of awareness at the level of the entrepreneurs as well as the buyers.
- Incentives and inputs from the Government private and entrepreneurs for promoting NWFP development are lacking.
- Infrastructure, institutional support and logistics for collection, processing and transport of NWFPs are lacking.
- Technical know-low is lacking at every level.

Looking Ahead:

NWFP development in Bangladesh should be dealt with on two broad levels.

Policy Issues:

- A clear-cut national policy on NWFP promotion and development has to be established now. The policy should contribute to the harmonious functioning of all public and private sectors concerned.
- A broad-range inventory has to be made regarding the availability of NWFPs and their potential used.

- To raise the technical standards of the public and private workers (related to collection and processing of NWFP) a condensed technical or vocational training package should be devised. There are a number of forestry and agricultural research institutions in the country which are capable of developing such a programme.

- With the inception of a new democratic regime in the country, a strong political commitment at the macro level for the promotion and harvesting of NWFPs is optimistically expected.

- Private entrepreneurs should be encouraged by sufficient incentives and policy protection to take up NWFPs development, as the Government is overburdened with its other major obligations. Moreover, if there is a liberal policy on NWFP development, it might attract the attention of foreign investors.

- Government could also link the trade and processing of NWFPs with the flourishing Export Processing Zone now established in the country.

Functional Issues:

- The potential of NWFPs can not be fully realized because of the lack of a sound marketing policy. The government should initially organize markets for NWFPs until such time as the private investors are fully established and the markets have matured.

- Coordination among the different public and private agencies involved in the collection and processing of NWFPs is badly needed.

- An incentive welfare scheme should be launched for the forest staff working in remote areas (associated with NWFPs), until a separate professional body for handling the matters relating to NWFPs is introduced.

- A Government sponsored programme should immediately be taken up for the development of modern apicultural techniques to improve honey production in the country, especially in the Sundarbans and Chittagong areas, where the potential for producing high-quality Sundarbans honey is greatest.

- NWFP development should be linked up with the country's Participatory Forestry projects which have achieved notable success in motivating and mobilizing local inhabitants and resources.

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Mushrooms are prized forest foods with increasing commercial value.

CHINA

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INTRODUCTION

The forest is a plant community composed of trees and other vegetation which contains not only a great quantity of timber reserves, but also abundant non-wood plant and animal resources. According to incomplete statistics, there are over 1,900 species of woody plants in the forested areas of China. There are over 340 species of aromatic plants; more than 120 species of edible plants; about 400 species of medicinal plants; over 100 species of economic plants and 80 species of nectariferous plant. In addition, there are over 500 species of wildlife.

In China, the so-called "non-wood plant resources" in forest areas include leaves, bark, fruit, seed and flowers, as well as other non-woody plants. By rational exploitation and integrated utilization of these resources a great quantity of food, clothing and daily necessities are provided for the people and remarkable economic values can be generated.

Over the last 10 years, the development of NWFP resources has been given high priority in China. The area devoted to NWFP production now totals 14 million hectares and will increase at an annual planting rate of more than 600,000 hectares. In 1990, the output of main non-wood forest products such as chestnut, red jujube, walnut, tea oil, almond, hawthorn and ginkgo, topped all previous records. According to the preliminary estimate, the output value of NWFPs exceeded 4 billion yuan, accounting for one-fourth of the total output value of forestry in the country. Foreign exchange earnings from the sale of NWFPs reached US$340 million. NWFPs constitute a large proportion of total exports of forest products in China, and they have become essential means of livelihood for the people.

PRODUCTION AND UTILIZATION OF NON-WOOD FOREST PRODUCTS

In China, non-wood forest products are roughly classified according to their uses, as described below:

Woody Food and Oil

Food trees and oil trees have common characteristics: strong resistance to natural disaster, stable yields and less manpower input compared with agricultural crops. These kinds of trees can be used to green the mountains and landscape, to beautify the environment, to conserve water and soil, and to produce a variety of forest by-products such as timber, forage and medicinal materials. Therefore, broad prospects exist in the development and integrated utilization of food and oil trees.

Chestnut (*Castanea spp*) is a nutritious, fragrant and tasty forest-derived food, and an important export product. It grows in 23 provinces south of Liaoning Province, covering a total area of 300,000 hectares. The annual production of chestnuts averages about 33,000 tons, accounting for one-tenth of the world total. There are 51 counties that produce at least 250 tons. The output of Qianxi, Xinglong and Zunhua counties in Hebei Province tops 500 tons per year in each county. China exports 25,000 tons of chestnuts annually (most of which go to Japan), earning foreign exchange totaling about US$50 million each year.

Walnut (*Juglans L.*) is a traditional commodity of China which is exported in large quantities. The total area of walnut in the country is over 1 million hectares, and annual output averages about 100,000 tons. Chinese walnuts are delicious and of good quality. The calorific value of walnut nucleolus is six times that of beef. It contains protein and fat which are easy absorbed by the human body. Nucleolus is also a good solvent which can be used in extraction of rose oil, violet, essential oil of fish, and pelargonium. It is also valuable to the perfumery industry. The annual export quantity of walnuts from China is about 47,000 tons, with an annual export value of US$30-50 million. Walnuts are exported mainly to Europe, Canada and other countries in Asia.

Jujube (*Zizyphus spp*) is also a major forest-based food in China with a total area of about 240,000 hectares. The annual output of fresh jujube is 400,000 tons. The output in five provinces— Hebei, Shandong, Henan, Shanxi and Shaanxi— makes up 90 percent of the total in the country. China exports about 4,700 tons of dry jujube, earning US$5 million in foreign exchange each year.

Gingko (*Ginkgo*) is a rare species peculiar to China. It contains rich starch, fat, protein and a variety of vitamins and can be used as food and medicine. Progesterone can be extracted from the fruits of gingko, used to treat cerebrovascular disease, cerebrum functional failure, coronary heart disease, and angina pectoris. Oral and injection liquids have also been extracted from the leaves of gingko in recent years. Gingko is distributed over more than 20 provinces in China with an annual output of 5,000 tons, most of which is exported. The foreign exchange earnings top US$7 million each year.

Tea-oil (*Camellia oleigera*) is a special product in China, growing in 15 provinces over an area of more than 4 million hectares. The annual output of tea oil is 500 tons, accounting for 8.6 percent of the edible plant oil produced in the country.

In Hunan and Jiangxi provinces, which are the central production areas of tea oil in China, over half of the edible oil consumed in the rural areas is tea oil. The unsaturated fatty acid contained in tea oil is as high as 98 percent and is easily absorbed by the human body. Integrated utilization of tea oil and its residues produces good effects. For example, China has extracted saponin from tea dregs, which can be used to manufacture cleansers, detergents, foaming agents and insecticides. It also acts as medicine to decrease cholesterol and prevent heart disease.

Yellowhorn (*Xanthoceras sorbifolia*) is an important oil tree species in Northeast China, North China and Northwest China. It has been introduced and cultivated in 14 provinces over a total area of about 50,000 hectares. The annual output is about 3,750 tons. Yellowhorn is very high in linoleic acid, thus good for health. Yellowhorn also yields an important material used in the manufacturing of liquid crystals used in color televisions and calculators.

Woody Fat, Lacquer and Wax

This category includes traditional forest by-products and special products such as tung oil, tallow tree oil, white wax and raw lacquer as well as other woody oils.

Tallow Tree (*Sapium sebiferum*) is an important woody oil plant in China, found in 15 provinces. It covers more than 200,000 hectares with annual output of about 85,000 tons. The oil is extracted from the seed of tallow tree. Its fat and pulp are important chemical materials which are widely used in soap, wax candles, paint, printing ink, wax paper, skin-protecting lotions, metal-painting agents and others. The leaf contains much tannin which can be used in the manufacture of black pigment and pesticides. The leaf and root can be used as medicinal materials and for detumescence, toxification, diuresis and pain relief. The bark is a material for tanning extracts and the flower is a nectar source. China has made certain achievements in the utilization of tallow tree fat and the exploitation of new woody oil plants in recent years. There is a small quantity exported, mainly to Europe and America.

Tung Oil Tree (*Aleurites fordii*) is one of the major industrial oil tree species in China, occurring in the 16 southern provinces, with a total area of about 1.8 million hectares planted and an annual output of 105,000 tons (1989).

Tung oil has been exported by China for many years. The annual export volume is about 12,000 tons and the foreign exchange earned is about US$ 15 million. In recent years, Japan has been the biggest importer of tung oil, accounting for about 75 percent of the total exported.

Raw Lacquer is made from the leaf liquid of the lacquer tree (*Toxicodendron vernicifluum*) and has strong absorptive and anti-corrosive qualities. In addition to coating materials used widely for building construction it can also be widely used in defence, machinery, petroleum, and the chemical industries, mining, brewing, ship building, arts and crafts, and printing and dyeing.

The lacquer tree is distributed over the five provinces of Shaanxi, Guizhou, Hubei, Yunnan and Hunan, covering an area of about 500,000 hectares. The annual output of raw lacquer is 2,750 tons. Raw lacquer is a traditional export of China.

Between 1980 and 1986, the annual exports of raw lacquer averaged 300 tons. Japan, Hong Kong, Macao and the United Kingdom are the main importing countries. Foreign exchange earned is about US$4 million per year.

Rosin and Turpentine are important earners of foreign exchange for China.

The annual output of rosin and turpentine are 400,000 tons and 46,000 tons, respectively. The annual export of rosin is about 200,000 tons, which represents 40 to 50 percent of the total trade of rosin throughout the world. The foreign exchange earned for China from rosin is about US$100 million a year. Over 550,000 tons of resin are produced in South China each year, which has created 300,000 jobs and increased personal income by 2,000 yuan per person per year on average.

Secondary processing of rosin produces added value and benefits. The Central-South Forestry College, in cooperation with Shaoyang Forest Chemical Factory, for example, earns 10,000 yuan profit per ton for ketone produced from rosin. The Dequing Forest Chemical Factory, Guangdong Province, produces a full line of secondary products made from rosin including high-quality rosin, turpentine, and synthetic camphor. Exports earn US$3.6 million in foreign exchange each year.

Forest Perfume Products

An important aspect in the exploitation and utilization of non-wood forest products in China is the use of residues from the final cutting and thinning of fragrant plants to produce oils or extracts.

Mountain Spicy Tree (***Litsea cubeba***) is an important aromatic oil plant widely distributed in almost all provinces. Most parts of the plant, including the root, stem, leaf, bark and fruit, contain aromatic oil. Especially useful is the fruit, from which aromatic oil (cubeba oil) can be obtained after simple distillation. Its oil contains lemon aldehyde, aromadendrol and terpene. It can be used directly as fragrant materials in soda drinks and beer, and indirectly for perfume, medicine, plastics, synthetic rubber, printing and food. It has been proved that cubeba oil can remove the carcinogenic substances from grain.

A considerable benefit has been obtained from the secondary processing of cubeba. For example, the Yiyang Chemical Factory, Hunan Provinces has produced a variety of products from nucleotus oil with an annual output value of 8.5 million yuan. As the content of nucleolus oil is similar to that of coconut oil, it has been used in Hunan to replace the latter. This has saved a large amount of foreign exchange.

Eucalypts were introduced into China more than a hundred years ago. Now they are cultivatedon over 670,000 hectares distributed over 16 provinces. The output of eucalypt oil, which can be extracted from the leaves is about 3,000 tons for an average year, of which one-third is exported, mainly to France and Germany. Eucalypt oil is mainly used in medicine, perfumery and industrial production. At present, good economic benefits have been achieved in many eucalypt oil-producing factories in China. For example, the annual output of essential oil in the Kunming Perfume Factory, Yunnan Province, is about 500 tons, including the "Yilan" Brand which contains 80 percent eucalypt oil and enjoys high prestige in the international markets. ***Eucalyptus citriodora*** oil produced in the Baihua Perfume Factory, Guangzhou, as well as pure citronellal, citronellol and rhodinol extracted from crude oil in the Fuzhou

Perfume Factory, and the Zhangzhou Perfume Factory have been put on the market, resulting in high economic benefits.

Forest Drinks

Forest drinks are natural drinks which are produced or extracted from tree juice, wild berry, fruit, leaves and flowers of plants, as well as the pollen of nectariferous plants. This kind of drink is enjoyed by consumers because of its nutritional and medicinal values. There are abundant materials for making forest drinks from birch, seabuckthorn (*Hippophae rhamnoides*), yangtao (*Actinidia chinensis*), bureja gooseberry (*Ribes burejense*), raspberry (*Rubus*), amur grape (*Vitis amurensis*), wild rose, cowberry (*Vaccinium vitis-idaea*), black currant (*Ribes nigrun*), Siberia nitaria (*Nitraria sibirica*) and pine needle powder. Some of these are discussed below.

Birch Juice is a popular soft drink in China. China has abundant birch resources, with 34 species covering a total area of 10 million hectares. These resources are mainly distributed in North, Northeast, Northwest and Southwest China, including Heilogjiang Province (1.5 million hectares), Inner Mongolia Autonomous Region (3.96 million hectares) and Jilin Province (290,000 hectares). The drink made from birch juice is widely enjoyed by consumers. Good quality birch juice soft drink produced by the Chifeng Forest Research Institute, Inner Mongolia, in cooperation with Ningcheng County Tin Factory, has been displayed and sold in many national exhibitions. A series of products such as birch syrup, birch cola, birch honey peach, and others produced by the Forest Drink Factory of Dailing Forestry Bureau, Heilongjiang Province, represents an annual value of 2.94 million yuan. More than a hundred people have been employed since production began in 1986. The Forest Research Institute of Korea Autonomous Prefecture and Wangqing Forestry Bureau, Jilin Province, in collaboration with research organizations, have trial-produced "Senhua Champagne," "Senhuabao" and "Birch Haw Drink." These birch products are also exported to South Korea and Hong Kong.

Seabuckthorn (*Hippophae rhomnoides*) is a wild shrub growing in 20 provinces in North China, Northeast China and Northwest China, covering an area of over 1 million hectares. In the past, seabuckthorn was mainly used to establish soil and water conservation forests and fuelwood forests. The exploitation and utilization of this rare resource dates from only the mid-1980s, but has developed rapidly, producing remarkable economic and social benefits. Seabuckthorn contains rich nutritional and medicinal qualities. Seabuckthorn juice is a healthy drink, and seabuckthorn wine is anti-pyretic and good for the mind. The oil reduces radiation, fatigue, and blood fat, and strengthens vitality.

In 1990, there were over 150 seabuckthorn processing factories in China, with an annual production capacity of about 150,000 tons. The variety of products made from seabuckthorn has evolved from the original crude juice and soft drinks, to over 200 finished products in 8 different categories, including soft drinks, food,

wine, daily-use chemicals, medicine, health protection, forage and additives. Over 50 products have won high awards at national and provincial levels. The products of seabuckthorn produced by Hualin Seabuckthorn Factory, Shanxi Province, are of particularly high quality. This factory is the most advanced and biggest of its kind in China and has production lines with advanced technology using a high degree of automation.

Great benefits will result from the exploitation of seabuckthorn. Fifteen tons of juice can be obtained from 1 hectare of wild seabuckthorn forest, yielding a net profit of 10,000 yuan. The Seabuckthorn Beverage Factory of Youyu County, Shanxi Province, has an annual production capacity of 4,000 tons, with output of 1,640 tons of condensed seabuckthorn juice, powder and light sparkling wine, valued at 5 million yuan. The total value of seabuckthorn products in the 7 provinces in middle and upper reaches of the Changjiang River exceeded 100 million yuan in 1988. In recent years, joint ventures have been set up between China and the United States, Japan and Switzerland to develop seabuckthorn products.

Yangtao Actinidia (*Actinidia chinesis*) is an important wild fruit, growing in 24 provinces, with an annual output of about 300,000 tons. Xixia County, Henan Province, has abundant yangtao actinidia with an average annual output of 2,500 tons. The biggest plantations of yangtao actinidia in China are situated in the province, with a total area of 672 hectares. A research institute has been set up specifically to support yangtao actinidia development. Yangtao actinidia products such as soft drinks, wine and jam produced in Xixia County are sold both in domestic and international markets. The yangtao actinidia wine produced by Guanxian County Yangtao Actinidia Wine Factory, Sichuan Province, has won awards and wide recognition.

Black Currant (*Ribes nigrum*) is a perennial berry shrub whose fruits are rich in nutrients and a variety of vitamins, organic acids, trace elements sugar, and others. Black currant can be processed into wine, fructose, fruit juice and jam. As one of the major non-wood forest products in Heilongjiang Province, the cultivation area of black currant covers 14,000 hectares supplying more than 70 processing factories.

"Huanle" Brand high-grade beverage, jointly produced by Acheng Black Currant Products Factory, Heilongjiang Province, and a factory in Chengde, Hebei Province, was assigned to produce for state banquets by the State Council in 1985, and has won broad acceptance in international markets.

Edible Fungus

Several hundred species of edible fungi are found in forest areas in China. In Yunnan Province there are more than 300, and in the Changbaishan forest area in Northeast China there are 140 species. The most valuable fungi are: ***Dictyophora duplicata, Hericium erinaceus, Pleurotus citrinopileatus, Boletus spp., Morchella esculenta, Auricularia auricula, Ganoderma lucidum, Grifola umbellata***, and ***Cordyceps sinensis***. Many of the fungi

have substantial medicinal value. In the last 10 years, edible fungus has become a staple forest by-product along with the development of a diversified economy and the emergence of modernized production of edible fungus factories. According to incomplete statistics, the total output of edible fungus in the country is 540,000 tons (including agricultural areas), with an annual value of 1.6 billion yuan, and export quantities (including processed products) over 180,000 tons. The annual foreign exchange earned is US$200 million.

The forestry departments in China have their own personnel and special bases to produce edible fungus. They have paid attention to quality control and management, with remarkable results. The Hebei Forestry Bureau, Heilongjiang Province, for example has set up 6 production bases and produced 95 tons of edible fungi in 1989.

Mountain-Grown Edible Wild Herbs

There are abundant mountain-grown edible wild herb resources in China. In Heilongjiang Province, for example, the reserves of brakes (***Pleridium aquilinum***) amount to over 100,000 tons, with the annual output of 2,000 tons. Mountain-grown edible wild herbs are rich in nutrition and contain a variety of amino acids which are essential to the human body. High economic benefit has been achieved by exploiting mountain-grown edible wild herbs in the forestry departments of China. The Tin Food Factory of Dongfanghong Forestry Bureau, Heilongjiang Province, for example, has introduced an advanced domestic automatic production line to produce quick meals, with the abundant local edible herbs as raw materials. Annual sales account for 1 million yuan. The Soft-Packed Edible Herb Tin Food Factory, Langxiang Forestry Bureau, Heilongjiang Province, produces 1 ton of tinned products each day, with annual value of 25 million yuan.

Chinese Medicinal Materials in Forest Areas

Forest areas are the important bases in China for production of Chinese medicinal materials. These include: ginseng, American ginseng, pilose antler, fruit of common macrocarpium (***Macrocarpium officinalis***), tall gastrodia (***Gastrodia elata***), bezoar, fulling (**Poris cocos**), eucommia (***Eucommia ulmoides***), root of common baphicacanthus (***Baphicacanthus cusia***), liquorice (***Glycyrrhiza uralensis***), lily magnolia (***Magnolia liliflora***), Chinese thorowax (***Bupleurum chinense***), officinal magnolia (***Magnolia officinalis***), Chinese wolfberry (***Lycium chinense***), cinchona (***Cinchona***), Chinese magnoliavine (***Schisandra chinensis***), manyprickle acanthopanax (***Acanthopanax senticosus***), common stone crop (***Hylotelephium erythrostictum***), amur corktree (***phellodendron amurense***), and glossy ganoderma (***Ganoderma lucidum***). Some of these are briefly described below.

Ginseng (***Panax ginseng***) is one of the key medicinal products from North China. Jilin Province, a major ginseng-producing area, produces about 80 percent of the ginseng of the country, making up 40 percent of the world total. Output values for the Baishishan Forestry Bureau, Jilin Province, reached

Forestry Bureau, of this province, developed an area of 20 Hectares of ginseng with an output of 175 tons and a value of 5 million yuan during the period of The Seventh Five-Year Plan. The forestry departments in the province are engaged in research and extension work on techniques of cultivation, processing and storage, establishment of a scientific quality-control system, and the exploitation of a series of products.

American ginseng (***Panax quinquefollius***) was introduced to China in 1975 and is being planted in more than 10 provinces with an annual output of over 50 tons. Muling Forestry Bureau, Heilongjiang Province, the biggest production base in China, has an area of 47,000 square meters of American ginseng. The total annual sales exceed 3.5 million yuan. The bureau has experienced good economic results from the management of ginseng and American ginseng, employing more than 8,000 in its operations.

Common Macrocarpium (***Macrocarpium officinalis***) occurs in many provinces, including Zhejiang, Anhui, Henan, Shandong, Shanxi, Shaanxi and Sichuan. Its fruit contains glucoside, organic acids, vitamin A, sugar and minerals. It is good for the liver and kidneys, good for the stomach and eyes, diuresis, and the blood and for reducing blood pressure. The country's annual output fluctuates between 600 and 900 tons. Under normal management, the output of fresh fruit is 30 to 50 kilograms per hectare, valued at 230 to 300 yuan. As of 1987, the total area planted reached 1,333 hectares, with an annual output of 160 tons, producing an income of 82 million yuan.

Pilose Deer Antler production goes back a long time in China. The price of pilose antler per kilogram is 1,300 to 1,400 yuan, with the price for first class pilose antler produced in Jilin Province reaching 2,260 yuan per kilogram. Being a high-grade tonic medicine, the pilose antler is of high medicinal value. Pilose antler processed using the microwave technique in the state-run Dunhua Deer Farm, Yanbian Korean Autonomous Prefecture, Jilin Province is of exceptional quality. Over 30 tons of pilose antler were produced in Jilin Province in 1987, yet the supply falls short of the demand.

Forest-based Forage

Forest-based forage includes tree leaves, shoots, bark, and various non-tree forage plants.

Pine needle powder is a supplementary forage for fowl and livestock developed by the Research Institute of Chemical Processing and Utilization of Forest Products, Chinese Academy of Forestry. It has been shown that with 5 percent pine needle in the daily forage of hens, production of eggs is increased more than 13 percent. If 2.5 to 4.5 percent pine needle powder is added to pig forage, the growth rates increase by 15 to 30 percent and the percentage of lean meat is increased. If 10 percent pine needle powder is added to the forage of milk cows, the output of milk can be increased by 7.4 percent. The cost of processing pine needle powder is about 2 yuan per kilogram. As of 1987, 19 provinces produced and used needle powder forage. Sixty pine needle powder factories have been established, with an annual output of 15,000 tons.

Pine needle ointment has also been developed by the Research Institute of Chemical Processing and Utilization of Forest Products. It has been found that .02 to .04 percent pine needle ointment added to fowl forage increases egg output by 10 percent and increases the weight of young ducks by 13.7 percent. If used to feed rabbits, the length of hair can increase by 165 percent; the rabbit enjoys good health and a luminous coat. Pine needle ointment has also been shown to cure diseases of the mouth and chilblains. A factory has been set up in Xugou Forestry Bureau, Lianyungang, Jiangsu Province to produce pine needle ointment.

PROSPECTS FOR NWFP DEVELOPMENT IN CHINA

Under China's reforms and opening-up policy, the production and utilization of non-wood forest products has developed rapidly over the last 10 years. China must now focus on improving products quality and developing new products to improve environmental, economic and social benefits. China plans to develop 45 crop tree species and establish, by the year 2000, a production base for special NWFPs of 530,000 hectares in 459 counties throughout the country. Advanced seed selection, cultivation, management, collection, processing, storage and transportation will be applied.

It will be necessary to develop programs for non-wood forest products that adhere to the principle of "three dimensional forestry" linking exploitation, integrated utilization and all-round development. Such exploitation and utilization must be combined with protection of the forest. Effective development plans for forest areas must be drawn up and management capacity must be strengthened. Meanwhile, China must also strengthen technical training; train more technical personnel and workers, carry out international technical cooperation and exchanges, and draw additional foreign capital. The overall objective must be to contribute to the economies of forest areas and improve the living standards of the people in rural areas.

Resins are important NWFPs nearly everywhere pines are grown.

Beedi (*Diospyros melanoxylon*) leaf collection in India.

Manufacturing cigarettes from tobacco and beedi leaves provides employment for more than 3 million people in rural India.

INDIA

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INTRODUCTION

India is a country of vast diversity lying at the juncture of the bio-geographic provinces of Afro-Eurasia and the Orient. Because of the country's diversified climatic and physiographic factors, India is blessed with all types of vegetation: tropical, sub-tropical, temperate, and alpine. Due to its wide-ranging environmental regimes and diverse biological communities, the country is one of the world's top 12 "megadiversity" nations.

Of the nearly 425 families of flowering plants in the world, 328 families with 21,000 species occur in India. From this varied emporium, non-wood forest products (NWFPs) are derived from over 3,000 species. For convenience, these products are classified as: (i) leaves; (ii) bamboos; (iii) gums, resins and oleoresins; (iv) oil seeds; (v) essential oils, including oil-yielding grasses; (vi) fibers and flosses; (vii) grasses other than oil-yielding grasses; (viii) tans and dyes; (ix) drugs and spices; (x) animal products; and (xi) edible products.

The royalties realized through the sale of NWFPs exceeded Rs1,000 million in 1985-86 and have gone up since. The value of NWFPs is seriously under estimated in official records. It is estimated that 60 percent of all NWFPs are consumed locally and are not accounted for in the calculation of revenues. There also are many products which are not extracted fully or which go to waste because of insufficient knowledge of their use or because they occur in inaccessible locations.

The basic objectives of the National Forest Policy of 1988 include conserving the national flora and fauna, meeting the needs of rural and tribal populations, and encouraging efficient utilization of all forest produce. The policy states that NWFPs which provide sustenance to local communities should be protected and improved. It provides for research into the conservation and management of forest resources and for increasing productivity through the application of modern scientific and technological methods. The survey of forest resources is to be given high priority.

STATUS OF VARIOUS CATEGORIES OF NON-WOOD FOREST PRODUCTS

Leaves

Diospyros melanoxylon

Local names: Commonly known as "tendu," but also called "abnus" in Andhra Pradesh, "kendu" in Orissa and West Bengal, "tembru" in Gujarat, "kari" in Kerala, "tembhurni" in Maharahstra, and "bali tupra" in Tamil Nadu.

Uses: Leaves are used as wrappers of tobacco to produce *bidi*. Off-cuts of leaves

are burned and the ash is used in tooth powder.

Distribution: The species is abundant in Madhya Pradesh, Orissa, Maharashtra, Andhra Pradesh, Bihar, Rajasthan, Uttar Pradesh, Gujarat, Tamil Nadu, and West Bengal. It generally grows in dry mixed deciduous forests, occurring alongside *Shorea robusta* and *Tectona grandis*.

Regeneration: Under natural conditions, seed germinates in the rainy season and seedling production is plentiful. Seedlings tolerate considerable shade, but for optional development more light is required. Seedlings resist frost and drought, but are vulnerable to excessive dampness. The profusion and tenacity of root suckers ensure the survival and spread of the species without planting.

There is wide variation in the quality of leaves from different locations. Superior-quality leaves of large size, papery texture, and inconspicuous veins fetch up to 5 times the price of inferior-quality leaves. There is, however, vast opportunity for propagating better strains artificially. About 40 percent of fresh seed germinates. Germination starts after 36 days and is complete in 80 days. It is best to raise seedlings in long narrow baskets and transplant the seedlings with the second rains. Seed can also be directly sown in lines.

For coppicing, the ideal girth of plants is 15 centimeters. Coppicing yields the best quality leaves and also facilitates easy collection. A light burning just before sprouting stimulates the dominant leaf buds and favors a better flush of numerous tender leaves. The best coppicing results are attained when stems are cut 15 centimeters above the ground, but cutting at such a height is difficult. Therefore, the common practie is to cut flush with the ground. Cutting occurs between January and March. There is a bumper production of leaves once in four years.

Collection of leaves: Leaves are plucked just after they have turned from crimson to bright green and have a leathery texture. Generally, collection starts from the second fortnight of April and continues until the onset of the monsoon. Bundles of 50, 70, or 100 leaves (depending on drying conditions) are assembled and tied with strings or fibers from bark. These bundles are brought by laborers to collection centers where they are sold.

Drying and curing of leaves: Proper drying of leaves is important. Too much moisture makes the leaves black and mouldy with a foul odor. Too much drying makes the leaves brittle, resulting in loss during handling. To dry, leaf bundles are spread on the ground, keeping the dorsal sides up for three to four days. The bundles are then turned upside down. Drying is complete in about 8 to 10 days. In solar leaf driers, the drying is complete in about 18 hours and the greenish color of the leaves is retained. These leaves fetch a higher price and damage from termites is avoided. Solar drying, however, can only be done where electricity is available for the air blower.

Packing and storage: Dried leaves are packed in gunny sacks for storage in godowns until sold or used for making *bidis*. The number of leaves in one standard bag varies from state to state. Before filling the bags, water is sprinkled on bundles to soften the leaves for easier packing.

Annual production and value: Around 300,000 tons of *bidi* leaves are produced annually in India, of which over 85 percent is collected from Madhya Pradesh, Orissa, Maharashtra and Andhra Pradesh (Table 1).

Table 1. Annual production of tendu leaves

State	Production (1000 tons)	Value (Million Rs)
Madhya Pradesh	123.0	1,845.0
Orissa	50.0	750.0
Maharahstra	46.0	690.0
Andhra Pradesh	39.0	585.0
Bihar	24.0	360.0
Rajastan	6.5	97.5
Uttar Pradesh	5.0	75.0
Gujarat	5.0	75.0
Tamil Nadu	2.0	30.0
West Bengal	0.5	7.5
Total	301.0	4,515.0

The value of these leaves is based on an average price of Rs15,000 per ton, but rates vary from state to state, according to demand, availability of leaves, and location of bidi-making industries.

Bauhinia vahlii

Local names: "mahul" in Uttar Pradesh and Madhya Pradesh, "siali" in West Bengal and Orissa.

Uses: Leaves are used for making cups and plates and for wrapping food.

Distribution: *Bauhinia vahlii* is a giant climber and one of the most abundant Indian *Bauhinia* species. The species is distributed in the Sub-Himalayan region up to 3,000 meters above sea level and in Assam, Central India, Bihar, Eastern and Western Ghats. Commercial collection of leaves is done in Madhya Pradesh, Orissa, and Andhra Pradesh.

Regeneration: The species grows naturally in the forests. No efforts to regenerate it artificially are made. It is usually considered a weed because of the damage it does to healthy trees by climbing and spreading over them.

Collection of leaves: Leaves vary in size from 20 to 40 centimeters in diameter, and are bilobed at the apex. Collection takes place two to three months after the rains. Leaves are collected by tribals and other forest dwellers and packed and tied with fibers obtained from the same species. No standard practice exists as to the number of leaves in each pack. Average collection per person per day is 5 to 6 kilograms. Green leaf packets are sold in the market without additional processing.

Annual production and value: Country-wide data on the collection and value of leaves are not available. In Madhya Pradesh, about 780 tons of leaves are collected, valued at approximately Rs 2 million. In Orissa, over 160 tons of dried leaves and 86 million leaf plates are marketed annually. Collectors receive only about Rs1.50 per kilogram and earn only Rs8.00 to 10.00 per day. Therefore, collection of *Bauhinia* leaves is done only as a last resort during the low-income season.

Bamboos

General: Over 100 species of bamboo occur naturally in India. ***Bambusa arundinacea, B. tulda, B. polymorpha, Dendrocalamus strictus, D. hamil-tonii, Melocanna baccifera*** and ***Ochlandra travancorica*** are the most important species because of their wide availability.

Dendrocalamus strictus and ***Bambusa arundinacea*** are the two principal economic species.

Uses: Because of its fast growth, easy propagation, soil-binding properties, and early maturity, bamboo is an ideal species for afforestation, soil conservation, and social forestry programs.

Bamboo is strong, straight, and light. It is hard and hollow, and easy to work. It comes in many sizes and has long fibers. Such characteristics make bamboo highly versatile. Table 2 indicates the consumption pattern of bamboos for various uses (Purshotham, 1962).

Table 2. Consumption of bamboo in India

Uses	Percentage of total Consumption
Pulp	35.00
Housing	20.00
Non-residential construction	5.00
Rural uses	20.00
Fuel	8.50
Packing, including baskets	5.00
Transport	1.50
Furniture	1.00
Other wood-working industries	1.00
Others, including ladders, staff mats etc.	3.00
Total	100.00

New uses of bamboo include parquet (block) flooring, laminated bamboos, strips for aircraft, bamboo reinforced concrete, and artificially shaped bamboo for decorative items. Among bamboo's medicinal properties is banslochan, a secretion found in the culms, used as a cooling tonic, aphrodisiac, and as a treatment for asthma, and coughing (Raizada and Chatterjee, 1956).

Distribution: Bamboo is found almost everywhere. Its distribution is governed largely by rainfall, temperature, altitude, and soil conditions. Most bamboo requires a temperature of 8° to 36°C, a minimum of 1,000 millimeters of rainfall annually, and high humidity for good growth. Bamboo is an important constituent of many deciduous and evergreen forests and extends from tropical to mild temperate regions. It grows on flat alluvial plains up to altitudes of 3,050 meters above mean sea level.

Regeneration: Between seeding periods, reproduction of bamboo is by asexual means. In bamboo clumps, rhizomes grow under-ground and produce new culms as annual shoots. This process continues until the plant produces flowers and seeds, then dies.

The most common method of vegetative reproduction is by rhizomes, or offset planting. Layering, propagation through nodal cuttings, marcotting, and culm cutting are also practiced in some species.

Bamboo flowers gregariously after long periods, although sporadic flowering occurs almost every year. During the years of gregarious flowering, the forest floor is carpeted with seedlings and the areas are naturally regenerated.

Management: New culms are produced every year and one-year-old culms are already able to support the growth of new culms. Culms mature after three years and are commonly harvested at that time. After five years, culms begin to die. On a three-year cycle, a good plantation may yield 3 to 4 tons of bamboo per hectare at the first cut, 5 to 6 tons at the second cut, and 8 tons from the third cut on. The total expected

Table 3. Area of bamboo and potential annual cut

State	Bamboo area (hectares)	Potential annual cut (1000 culms)
Andhra Pradesh	1,979,000	255
Arunachal Pradesh	777,900	200
Assam	1,000,000	1,210
Bihar	529,400	200
Gujarat	193,600	46
Himachal Pradesh	10,400	3
Karnataka	600,000	475
Kerala	63,100	108
Madhya Pradesh	1,486,400	800
Maharashtra	850,000	300
Manipur	250,000	200
Orissa	1,050,000	489
Punjab	NA	9
Tamil Nadu	538,800	NA
Tripura	284,900	215
Uttar Pradesh	400,000	41
West Bengal	16,400	8
Total	10,029,900	4,559

yield per hectare is estimated at 70 to 74 tons over the entire life of a plantation (Rao, 1980).

Annual production and value: The area of bamboo in each state and the potential annual cut are shown in Table 3 (Tewari, 1981).

Although no precise data are available, observations suggest that bamboo areas are declining because of gregarious flowering and consequent dying of clumps. A large quantity of seeds fall on the ground, producing innumerable young germinants, but effective protection of seedlings from fire and other biotic damage is not ensured in many areas.

The price of bamboo varies with its end use. Most of the annual cut is used in making paper or rayon, for which producers receive about Rs300 per ton. The value of the potential annual cut is Rs1,367 million.

Gums and resins

General: Gums are translucent, amorphous substances which are degradation products of the cell wall of woody species. They exude spontaneously from trees and are soluble in water. Resins also are exudates but are soluble in alcohol, not water. Closely related to true gums are gum resins, which are also produced by plants. Since these are a combination of gum and resin, they do not dissolve in water completely. Resins often occur mixed with a high percentage of essential oils known as oleoresins. When oleoresins include some gum, as in the case of exudation from *Boswellia serrata*, they are called gum

Table 4: Classification of Indian resins and gums		
Category	Typical product in world trade	Source of typical Indian products
True gums	Gum arabic Gum tragacanth	*Acacia nilotica* spp. *indica* *A. catechu* *A. modesta* *A. senegal* *Anogeissus latifolia* *Bauhinia retusa* *Cochlospermum religiosum* *Lannea coromandelica* *Pterocarpus marsupium* *Sterculia urens* and *S. villosa* *Several minor species*
Hard resins	Copal Dammar Amber Lacquer Shellac Sandarac Mastic	*Canarium strictum* *Hopea odorata* *Shorea robusta* *Vateria indica*
Oleo-resins	Turpentines Balsams of Peru of Tolu of Styrax or Storax other oleo-resins Copaiba Elemi	*Pinus roxburghii* and three other *Pinus* species *Boswellia serrata* *Dipterocarpus turbinatus* *Kingiodendron pinnatum*
Gum resins	Gamboge Assafoetida Galbanum Myrrh Olibanum or Frankincense	*Garcinia morella* *Commiphora mukul*

oleoresins. Table 4 gives the classification of these important products in world trade (Anon, 1972).

Uses: Commercial gums enter the market in the form of dried exudates. The varieties having the least color and highest adhesive power and viscosity are the most valuable. The finer grades are used in clarifying liquors, "finishing" silk, and in the preparation of quality water colors. Intermediate grades are used in confectionery, pharmaceuticals, and printing inks, in sizing and finishing textile fabrics, in dyeing, and in the paint industry. In the cosmetic and pharmaceutical industry, gums serve to emulsify or bind mixtures in creams, lotions and ointments. Many gums add body and bulk to foodstuffs (e.g. commercial ice cream).

Resins are used in the manufacture of lacquers and varnishes. Resinous substances can be used for waterproof coatings. Resins dissolve readily in alkali to form soaps. They are used in medicines, for sizing paper, for incense, and in the preparation of sealing wax and other products.

Important oleoresins are turpentines, balsams, copaiba, and elemi. These are used in perfumery and medicines, for making varnishes, and lacquers, as fixatives, and in scenting soaps.

Gum resins have varied uses. Gamboge is used to color golden lacquers, as water-color pigments, and in medicines. Assafoetida is used for flavoring curries and other food products, and also as a drug. Galbanum is used in medicine. Myrrh is used in incense, perfume, and embalming. Frankincense is used primarily as incense.

Collection and marketing: Although spontaneous exudation of gums occurs from unhealthy trees, artificial incisions are made in healthy trees to increase the yield of gums. Harvesting is done by hand picking. Larger lumps are broken with a wooden mallet and foreign bodies removed. Grading, based on color, size, and transparency of the tears is done manually.

Resins ooze out through the bark, hardening on exposure. These are collected mostly from artificial wounds or fossil material. The importance of natural resins has declined in recent years because synthetic resins have become cheaper.

In India, ***Pinus roxburghii*** trees yield the highest amounts of oleoresin. Blazes on the tree trunk are cut to facilitate the flow of oleoresin from resin canals. Traditionally, oleoresin is collected by the cup-and-lip method from March to early November. The rill method for tapping, though more scientific, has not found favor in the field. Treatment of blazes with acid or 2-4D solution reportedly increases and prolongs the flow of resin. The yield is highest in June, when the sun is hottest. The oleoresin collected in cups is transferred to tins every time the cups are filled. The tins are transported to depots, then to factories for processing.

Salai gum (a gum oleoresin) is an exudate obtained by tapping ***Boswellia serrata*** trees. The fresh exudation from the punctured resin ducts comes in 5- to 8- centimeter long tears. It hardens in about four days. Tapping extends from November to June.

Among the above products, gum from ***Acacia nilotica*** (called "gum arabic") and from other ***Acacia*** species such as ***A.***

catechu, A. modesta, and *A. senegal* are collectively categorized as Acacia gums. Gum karaya, or katira, from *Sterculia urens,* and oleoresin from *Pinus roxburghii,* are tapped in significant quantities to be of commercial importance.

Annual production and value: Madhya Pradesh has the potential to produce as much gum karaya as the rest of India combined. However, tapping of *Sterculia urens* in the state was banned in 1982 for a period of 10 years. Approximately 1,400 tons of gum karaya are collected annually from other states, valued at about Rs60 million. After 1991, when tapping is resumed in Madhya Pradesh, production should be doubled. Production of other gums is about 1,900 tons, fetching Rs12 million annually. About 46,000 tons of oleoresin are obtained from *Pinus roxburghii* each year, valued at approximately Rs2.8 million.

Oil seeds

General: India has about 86 different oil seed tree species. A substantial amount of oil seed is collected from *Shorea robusta, Madhuca indica, Mangifera indica, Garcinia indica, Azadirachta indica, Pongamia glabra, Schleichera trijuga, Salvadora oleoides, S. persica,* and *Actinidaphne hookeri.*

Uses: Sal (*Shorea robusta*) seed cotyledons yield the well known sal butter used for cooking and lighting. It is a useful confectionery fat and can be used in soap making.

Mahua (*Madhuca indica*) seed: Almost the entire production of oil from this seed is used in the production of washing soaps (Awasthi, 1971). Refined mahua oil can be utilized for cooking, confectionery and in chocolate making (Anon,1962). Refined oil is used in the jute industry and in the manufacture of lubricating greases, candles, bathing oil, fatty alcohols, and stearic acid. Mahua oil has emollient properties and is used in treating skin disease, rheumatism and headaches. It is a good laxative and is used in treating habitual constipation, piles, and hemorrhoids (Nagarajan, et al., 1988).

Karanj oil (*Pongamia glabra*): Both the seed and oil are poisonous but they possess remarkable medicinal properties. The seed is carminative, purifies and enriches the blood, and is used for inflammation, earache, lumbago, and chest ailments. The oil is styptic, anti-helminthic, and good for rheumatism and cutaneous infections, and as a remedy for scabies and herpes. Undistilled oils can be used in high-quality laundry soaps, while the distilled oils can be used in the manufacture of toilet soap (Lakshmikanthan, 1988). The oil cake is a good fertilizer.

Kusum (*Schleichera trijuga*): A major part of the kusum oil produced is utilized by the soap industry. The oil compares favorably with other oils in softness and lathering. It is also used in hair dressing, and in medicines used in treating skin diseases, rheumatism, and headaches.

Neem (*Azadirachta indica*): Seed oil is used in soap and local medicines. Seed oil cake is used as fertilizer (Gupta, 1944; Agarwal, 1955).

Mango (*Mangifera indica*): Seed oil is used as a cocoa butter substitute.

Khakan (*Salvadora oleoides*) and pisa (*Actinodaphne hookeri*): These oils are used in making soap. The fruit of khakan is edible, and is fed to cattle to increase milk yield.

Distribution: Sal forests occur in the central Indian belt (accounting for 90 percent of the sal forests) and at the foot of the Himalayas. Mahua trees grow in almost of all parts of India. There are two species, *Madhuca latifolia* grows in the north and *M. longifolia* thrives in south India. However, no distinction is made in the trade of their seeds or fats. Mango trees grow throughout India except in the high Himalayas. Kusum trees occur mainly in forests in sub-Himalayan tracts in north and central India, and parts of eastern India. Karanj is found in dry deciduous forests and prefers saline soil. Neem grows wild in dry forests and is cultivated throughout India. Salvadora is a shrub or a small tree growing wild in arid and sandy areas. Pisa trees occur in sub-tropical hilly forests of the Western Ghats, some parts of Assam, Orissa, and Sikkim.

Seed collection: The times and methods of seed collection for various species are:

Sal: Mid-May to end of June. Seeds are collected from the forest floor.

Mahua: May to July. Mature fruit is collected from the ground.

Mango: April to September. Pits are collected from villages and city waste dumps.

Kusum: June to July. Seeds are obtained by picking bunches of fruit. They are depulped by soaking and rubbing them in water.

Neem: June to July. Bunches of fruit are picked from trees or from the ground.

Karanj: Throughout the year. Trees are climbed and the branches are beaten to shake loose the seeds. Seeds are then collected from the ground.

Salvadora: May. The fruits are picked or felled by shaking the branches.

Pisa: May to June. Fruit-bearing twigs are plucked and berries are collected.

Processing, storage, and marketing: Only the sal seed trade is organized. After collection, the fruit is piled and lightly burned. Through a rubbing process called "decortication," the seeds are separated from the wings and pericarps. The seeds are brought to depots of forest departments or corporations for sale. The purchasing agency stores the seeds in bags for disposal, normally by auction.

The pulp surrounding neem seeds is removed by rubbing the fruit against rough surfaces. The remaining adhering pulp is then removed by washing in water. Mango stones are sold to purchasers who arrange for manual decortication and sun drying of kernels. Dried karanj pods are usually split with a hammer or stick and the shells are removed by winnowing. Kusum seed coats are brittle and break under slight pressure, exposing the kernels. Pisa fruit is rubbed to separate the kernel from the outer shell, both of which yield oils of different properties. All of these seeds and fruits are purchased by agents and taken for crushing.

Annual production and value: Sal seed is collected and marketed on a commercial scale. The potential production is estimated

at 5.5 million tons but current collection is only 100,000 tons, valued at Rs200 million. Mahua has a potential kernel production of 1.1 million tons but the annual collection is around 25,000 tons, valued at about Rs17 million. Production of other species has not been systematically monitored. Estimates of the production and value of some seeds presented in Table 5.

Table 5. Annual seed production of selected tree species in India

Species	Potential production (1000 tons)	Current production (1000 tons)	Value of current produce (Million Rs.)
Kusum	200	30	112
Pilu	50	10	NA
Pisa	1	NA	NA
Karanj	110	26	78
Neem	400	100	150

Essential oils

General: Essential oils, also called volatile oils, are liquids which possess a pleasant taste and strong aromatic odor. They occur in about 60 plant families and are frequent or abundant in the Labiatae, Rutaceae, Geraniaceae, Umbellifereae, Asteraceae, Lauraceae, Graminae, and Fabaceae families. Any part of the plant may be the source of essential oil. They are used in making perfumes, soap, and other toiletries. Many are used as flavoring agents or as essence for tooth paste and tobacco. Many have therapeutic and antiseptic properties. Several others are used as solvents in the paint and varnish industries, as insecticides and deodorants, and in the manufacture of synthetic scents and flavors.

The important essential oils produced in India are oils of sandalwood, lemon grass, palmarosa, eucalyptus, khus, and linaloe. These oils are distinguished from fatty oils because they evaporate or volatilize when they come in contact with air.

Classification of Indian essential oils: An economic classification of plants yielding essential oils based on their end use is exceedingly difficult as the uses often overlap. For example, sandalwood oil is used for perfumery, medicine, and many other uses. In numerous cases, the same oil is used for flavoring and in medicine. For convenience, the essential oils are classified according to source:

(a) Grass oils: These are mostly obtained from tropical grasses rich in aromatic essential oil, belonging mostly to the ***Andropogon*** and ***Cymbopogon*** genera. Indian grass oils include (i) lemon grass oil, (ii) palmarosa oil, (iii) ginger grass oil, (iv) citronella oil, and (v) vetiver oil.

(b) Wood oils: (i) sandalwood oil, (ii) agar oil, (iii) deodar oil, and (iv) pine oil.

(c) Leaf oils: (i) Eucalyptus oil from ***E. globulus*** and ***E. citriodora***, (ii) camphor and camphor oil, (iii) cinnamon leaf and bark oils, (iv) pine needle oil, (v) mint oil, and (vi) wintergreen oil.

(d) Root oils: (i) Costus oil from *Saussuria lappa* (Kuth), and (ii) Indian valerian oil from *Valeriana wallichii*.

(e) Flower oils

(f) Essential oils of lesser importance.

Industrial uses of essential oils: Essential oils are used in the following industries:

(i) Soap and cosmetics;
(ii) Pharmaceuticals;
(iii) Confectionery and aerated water; and
(iv) Attars, scented tobacco, agarbattis, incense, etc.

Collection of raw material and recovery of essential oil: Plant parts containing oil are collected from the field, and essential oils are extracted in different ways depending on the quantity and stability of the compound involved. The following methods are commonly practiced:

(i) Distillation: applicable to materials in which the aroma is not spoiled by hot water or steam;

(ii) Expression by hand or machinery: applicable especially to fruit rinds;

(iii) Extraction by volatile solvents, hot oils, fats (maceration), or cold neutral fats (enfleurage).

Production of essential oils: Estimated production of some of the important essential oils produced in India is presented in Table 6.

Table 6. Estimated production of essential oils

Essential oil	Production (tons)
Lemon grass oil	1,200
Sandalwood oil	1,300
Palmarosa oil	90
Vetiver oil	50
Eucalyptus oil	50
Cinnamon oil	33
Deodar wood oil	2
Linoloe oil	3
Cinnamon oil	2
Total	2,830

Fibers and flosses

Fibers

General: Fibers fall into three categories: soft, hard, and surface. Soft fibers are obtained from the bast or stem of plants; hard fibers from the leaf; and surface fibers are those which are borne on the surfaces of stems, leaves, seeds, etc. Based on their general use, they are classified as textile fibers, brush fibers, plaiting and weaving fibers, filling fibers, natural fabrics and paper making fibers. The most important fibers coming from the forests of India are from the families of ***Bombacaceae, Sterculiaceae, Tiliaceae, Fabaceae, Asclepiadaceae, Myrtaceae, Moraceae, Urticaceae, Palmaceae, Musaceae***, and ***Gramineae***.

The following species are commonly used by cottage industries: ***Agave sisalana, Abroma augusta, Abutilon*** spp., ***Ananas cosmosus, Antiaris toxicaria, Boehmeria nivea, Borassus flabillifer, Canabis sativa, Cordia dichotoma, C. rothii, Giradinia heterophylla, Grewia glabra, G. elastica, G.optiva, Hibiscus*** spp., ***Malachra capitata, Marsdenia tenacissima, M. volubilis, Phormium tenax, Sensivieria roxburghiana, Sesbania bispinosa, Sida rhombifolia, Sterculia foetida, S. urens, S. villosa, Themeda arundinacea, Trema orientalis, Typha elephantina, Urena lobata, Oreocnide integrifolia***.

Of the above species, only ***Agave sisalana*** and ***Sterculia villosa*** have commercial importance. Agave fibers are used in making ropes and mats. The fiber is also useful for cordage, twines, and nets.

Agave plants usually grow in semi-arid tropical regions. They are propagated from

rhizomes or bulbils, planted at a spacing of 2.4 to 2.7 meters. It takes 2 to 6 years for the plant to grow to harvestable size. Leaves are harvested from the plant until it dies after flowering. Yields range from 1.0 to 2.8 tons of fiber per hectare. Fiber stripping is done within 48 hours of harvest.

Sterculia villosa is mainly found in Uttar Pradesh, Tamil Nadu, and Kerala, although it is scattered throughout most of India. The species yields coarse, strong fiber which strips off the tree in long broad flakes. The flakes have a characteristic net-like appearance. The fiber is used for making ropes. In West Bengal and Tamil Nadu, it is used for making elephant harnesses and drag ropes and for securing rafts. Fiber yields from ***Sterculia villosa*** vary from 4.5 to 5.5 tons per hectare.

Annual production and value: It is estimated that around 2,500 tons per annum of agave fibers are produced in the country, with a present value of Rs45 million. Overall production data for ***Sterculia villosa*** are not available.

Flosses

General: Flosses are obtained from certain wild fruits. Important species are ***Bombax ceiba*** and ***Ceiba pentandra.***

Distribution: ***Bombax ceiba*** grows throughout the Indian plains and Deccan plateau. ***Ceiba pentandra*** trees are found in Western and Southern states and the Andaman Islands.

Uses: The floss from ***Bombax ceiba*** is obtained from capsules and is known as "Indian kapok." The floss is soft and strong and used in life-saving devices for boats, stuffing for cushions, pillows and mattresses, thermal insulation, and sound-proof covers and walls. It is a preferred filling material for padded surgical dressings.

Flosses obtained from the fruit of ***Ceiba pentandra*** (kapok or silk cotton) are elastic and are used in the manufacture of life belts and buoys.

Collection and processing: The capsules are collected green from the tree as the floss loses much of its resilience after the capsules are open. The capsules are then dried in the sun and split open with mallets. The floss, mixed with seeds, is again dried in the sun and the seeds are separated by beating with sticks. The collection and processing is crude and needs improvement to avoid waste and to improve quality.

Annual production and value: About 300 tons of kapok are produced annually in India, with a value of Rs30 million.

Grasses

General: Grasses are used for paper making, cattle fodder, matting, ropes, thatching, and in manufacturing furniture, baskets, and screens. These uses are discussed below:

(i) **Grasses for paper making**: ***Eulaliopsis binata*** (sabai grass) is the chief species, distributed in Uttar Pradesh, Bihar, Orissa, Madhya Pradesh, Haryana, Punjab, and Himachal Pradesh.

(ii) **Fodder grasses**: ***Andropogon*** grows in dry regions of India and is a principal constituent of wild forage.

Cenchrus ciliaris, Bothriochloa ischaemum, B. intermedia, B. pertusa, and *Bromus* spp. are important fodder grasses growing in the wild.

(iii) **Grasses for matting**: The culms of *Phragmites* spp. and *Arundo* spp. are split and used for matting. *Saccharum munja, Typha elephantina* and *Cyperus corymbosus* are also preferred.

(iv) **Grasses for ropes**: *Eulaliopsis binata, Desmostachya bipinnata, Saccharum munja, S. spontaneum*, and *Themeda arundinacea* are the main species.

(v) **Thatching grasses**: *Imperata cylindrica* is the main species; *Saccharum munja, S. spontaneum*, and *Heteropogon contortus* are also used.

(vi) **Grasses for miscellaneous uses**: Furniture is made out of *Saccharum munja* stems. Screens of *Vetiveria zizanioides* roots are used in houses and offices as room coolers during summer. These are kept wet for a fragrant cooling effect. *Thysanolaena maxima* grass is valued for brooms and fodder.

Regeneration: *Eulaliopsis binata, Saccharum munja, Cenchrus ciliaris, Vetiveria zizanioides, Thysanolaena maxima* and some other fodder grasses are planted using cuttings, slips or seeds.

Collection and processing: Fodder grasses are commonly grazed directly by cattle in the forests. Others are collected and stall-fed to animals or sold in bundles. Some grasses are cut, collected, and baled for transportation to depots. These are grasses usually utilized by paper mills or for cattle fodder during times of scarcity.

Annual production and value: Some 0.3 to 0.4 million tons of grass could be harvested annually in India (Sharma, 1977), but the figures for actual production are not available. Some 60,000 to 80,000 tons of sabai grass are purchased each year by paper mills. The price of sabai grass is around Rs300 per ton.

Tannins and dyes

Tannins

General: Tannins are polyphenolic compounds widely distributed among India's flora. They occur in varying concentrations in all plant material, but only certain plants contain concentrations permitting commerical exploitation. Tannins are classified as condensed or hydrolizsable. The former, called catechol-type tannins, are based on polymeric flavan -3.01. The latter, also called pyrogallol tannins are based on esters of Gallic acid and/or hexahydroxy diphenic acid and its analogous acids, with a variety of polyols and alicyclic acids. Different parts of plants may contain different types of tannins.

Classification: Tannins produced in India can be classified as fruit tannins, bark tannins, or leaf tannins. Fruit tannins are generally obtained from myrobalans, though pods of *Acacia nilotica* and drupes of *Emblica officinalis* and *Zizyphus xylocarpa* are also used locally. The main tree species yielding bark tannins are *Acacia nilotica, A. mollisima, Cassia auriculata*, and *Shorea*

robusta. The leaves of *Anogeissus latifolia* and *Carissa spinarum* are also harvested for tannin production.

Uses: 90 percent of the total vegetable tannins in the world are used by the leather industry. India has the largest livestock population (about 415 million head) in the world (Anon., 1982). Prospects for the leather industry are therefore bright.

Important tannin yielding plants:

Terminalia chebula

General: The fruit of *Terminalia schebula*, commercially known as chebulic myrobalan, yields important tannin material. Chebulic myrobalan trees are found throughout the mixed deciduous forests and dry forests. Myrobalans are the most important tanning materials of the pyrogallol type. These tannins produce a brownish colored deposit on leather called "bloom." Catchol type tannins do not produce a bloom. Myrobalan tannins are not very astringent, and penetrate the hide very slowly. When used alone, they producess a soft, mellow and rather spongy leather which lacks good wearing properties. Myrobalans in India are largely used in combination with *Acacia nilotica* and *Cassia auriculata* tannins.

Time of collection: January to March is the best period for fruit collection, with January harvests yielding optimum tannin content. The tannin content varies from 12 to 49 percent, although average tannin content is around 32 percent.

Grading: Grading generally consists of separating inferior fruit which constitute a second grade, the remainder being the first grade. The following grades are recognized, based on their origin (Anon,1972).

- Bimlies (Bs) exported from Bimlipatam (Andhra Pradesh);
- Jabalpur (Js) exported from Jabalpur (Madhya Pradesh);
- Rajpores (Rs) exported from Kolhapur (Maharashtra);
- Vingloras (Vs) exported from Maharashtra; and
- Coast Madras, or Madras, exported from Tamil Nadu forests.

The myrobalans from Salem district (Tamil Nadu) are regarded as the best in the country for color and tannin content.

Processing: Collected fruit is sun dried. It is important to store the fruit properly as it easily rots. Crushed myrobalans and solid extract of myrobalans regularly enter the commercial trade. The extract is prepared in factories and is exported in solid blocks containing 50 to 60 percent tannin. Most tanners prefer to make their own liquors with 30-35 percent tannin content.

Annual production and value: Around 78,000 to 100,000 tons of myrobalan nuts are estimated to be produced annually, valued at Rs15 to 20 million.

Acacia mollissima (wattle)

General: Tannin is obtained from the bark of this tree. It gives astringent liquor with good penetrating properties. It blends well with acid-producing tanning materials, such as myrobalans, giving a pleasing biscuit color to leather. If used alone, it gives pink

color, which darkens on exposure to light. Wattle is planted in Kodaikanal and in the Ooty hills of Tamil Nadu, covering about 20,000 hectares.

Collection and processing: Wattle is managed under the coppice system. Coppice shoots are regularly cut and the bark is stripped and dried. Drying involves standing the pieces on end against each other or against a rough trestle, with the outer bark exposed. This must be done in fine weather or under cover, as rain water leaches away tannin. The dried bark contains 18 to 35 percent tannin, depending upon the age and the part of the tree from where bark has been collected. Tannin liquors are extracted from the bark by applying steam in specially prepared wooden vats. These can be purified and mixed with other extracts to give the desired color or quality to leather.

Annual production and value: Over 23,000 tons of wattle bark are harvested every year, valued at Rs38 million.

Acacia nilotica (babul)

General: In northern India, the bark of *A. nilotica* forms the most important tannin-yielding raw material. It is a common tree found in forest, wastelands, and cultivated fields throughout India. Babul bark is very good for tanning heavier leathers. In combination with myrobalans, it gives an excellent finished leather.

Collection and processing: Bark is available to the tanning industry as a by-product when trees are felled for timber or fuel. Bark is dried and despatched in bundles to the tanning factories. The most important consumption center for this bark is Kanpur. The tannin content of babul bark varies considerably, with the average being 12 percent. The bark from older trees is richer in tannin and deeper in color.

Production and value: An average 15-year-old plantation yields about 12.5 tons of bark. About 22,000 tons of babul bark are produced annually, valued at Rs55 million.

Cassia auriculata (avaram)

General: Avaram is a small bush which grows wild in south India. It thrives on dry stony hills and on black soils, along road sides, in degraded forests, and on waste-lands.

Collection and processing: Bark is collected by cutting coppice shoots off at the base. Shoots can be harvested annually. The bark is stripped and dried. The bark contains an average of 18 percent of tannin. The leather tanned by unstripped twigs is as good as that from stripped bark. The tannin from the bark penetrates hide quickly and produces a special form of lightly tanned, pale colored leather with an elastic grain and good tensile stength.

Annual production and value: Annual production of avaram bark is estimated at 23,000 tons, valued at about Rs35 million.

Dyes

General: Over 2,000 plant pigments are known, of which only a few are of a commercial importance. Vegetable dyes have not been able to successfully compete with artificial dyes in recent years.

Classification:

(i) *Wood dyes*: Kutch dye from *Acacia catechu* and other dyes from *Artocarpus heterophyllus*, *A. lakoocha*, *Pterocarpus santalinus*, and *Caesalpinia sappan*.

(ii) **Bark dyes**: Obtained from *Terminalia tomentosa*, *Acacia concinna*, *A. farnesiana*, *A. ieucophloea*, *Alnus* spp. *Casuarina equisetifolia*, *Manilkara littoralis*, *Myrica esculenta*, and *Ventilago madraspatana*.

(iii) **Flower and fruit dyes**: This is the most important group of natural dyes. Flower and fruit dyes are commonly obtained from *Mallouts philippensis*, *Woodfordia floribunda*, *Bixa orellana*, *Butea monosperma*, *Toona ciliata*, *Nyctanthes arbortristis*, *Mammea longifolia*, *Wrightiatinctoria*, and *Carocus stativus*.

(iv) **Root dyes**: Root dyes are obtained from *Berberis aristata*, *Datioca cannabina*, *Morinda tinctoria*, *Punica granatum*, and *Rubia cordifolia*.

(v) **Leaf dyes**: *Indigofera tinctoria* and *Lanssonia inermis* are important species.

The above plant parts do not provide significant livelihood to forest dwellers because the procurement price in the markets is extremely low. There is no organized trade for collection, processing and marketing of vegetable dye stuffs.

Drugs and Spices

General: India's medicinal plant wealth is comprised of about 1,500 species. Knowledge of the medicinal properties of these plants has been recorded in "Materia-Medica" a description of indigenous systems of medicine which have become extensive and heterogenous over the centuries. Every region of India has contributed to its development.

Systematic studies and research have been carried out on only a few of the countless drugs used in indigenous systems of medicine. Drugs have been classified depending upon the plant organ from which they are derived: roots and other underground parts, bark, wood, leaves, flowers, and fruit and seed.

Cultivation of important species: Due to continuous use, many medicinal plant species have become scarce in the forests and efforts are being made to cultivate them.

Dioscorea deltoidea and *D. trazeri* grow in northwest Himalayas and northeastern India, respectively. Both species yield diosgenin but grow very slowly and their production cannot meet the demand. *D. floribunda*, a Central American species, has been introduced for commercial cultivation in Assam, Goa, Bangalore, and Koorg districts of Karnataka. The crop is raised from seeds, single-node leaf cuttings or tuber pieces. On average, a two-year-old plant yields 2.5 to 3 kilograms of tubers, or 50 to 60 tons per hectare. The content of diosgenin is 3 percent on dry weight basis (Bammi and Rao, 1982).

D. composita, also a native of Central America, is now being cultivated in Jammu.

Tubers begin to increase in size from the third year on. This species yields about 2 to 3 percent diosgenin. The highest diosgenin content is obtained in July when the plants are about to flower, but it varies considerably from one locality to another. Propagation from rhizome cuttings gives better results than from seeds or seedlings. With a planting density of 40,000 per hectare, yields of up to 54.8 tons per hectare after 16 or 17 months (the ideal age for harvesting are possible. An income of Rs 4,500 to 5,000 per hectare accrues to the cultivator (Sobti *et al.*, 1982).

Solanum khasianum occurs in northeast, northwest, southern and central India. It is cultivated through seeds or nursery-raised seedlings. The crop takes about 6 months to mature. Two improved varieties have been developed at the Regional Research Laboratory, Jammu, yielding 7.5 and 8.3 tons fresh berries, respectively. Solasodine content ranges from 1.55 to 1.89 percent from the fruit. (Kaul and Zutshi, 1982).

Costus speciosus is widely distributed in India. In the plains, the plant occurs as a weed in orchards, boundaries of cultivated fields, and in wastelands. In Meghalaya, Arunachal Pradesh, Nagaland, and in tropical rain forests in Tamil Nadu, it grows on the forest floor.

Datura stramonium, D. innoxia and *D. metel* are important medicinal species. The first is rich in hyoscyamin, while the latter two are rich in scopolamine. *D. innoxia* is a coarse bushy annual which grows in the western Himalayas, the hilly region of peninsular India, and a few other places in the country. *D. metel* is a spreading herb growing throughout India. All can be raised by seeds. In the case of *D. innoxia*, fully grown, but green, fruits yield 1.2 to 1.7 tons of dry seeds per hectare, with alkaloid content varying from 0.2 to 0.35 percent. For *D. metel*, maximum alkaloid yield is obtained by harvesting tender branches and leaves in June and July. The plant regenerates and it is possible to harvest twice more in late August and October. In addition to foliage, a large number of fruits are also harvested when ripe. Two improved varieties of *D. metal* developed by the Regional Research Laboratory, Jammu, yield 21 to 29 tons of green herb and 1.5 to 2.4 tons of seeds per hectare. The alkaloid content varies from 0.24 to 0.36 percent in leaves and from 0.098 to 0.19 percent in seeds (Sobti and Kaul, 1982).

Atropa acuminata (belladonna) occurs in the western Himalayas, particularly in Kashmir and Himachal Pradesh. Its leaves and roots are used in the pharmaceutical industry. About 70 tons of dry leaves are needed annually to meet the country's demand. In recent years, the natural stocks of the species have dwindled because of over-exploitation. The Kashmir Forest Department has therefore been promoting its cultivation. It is raised from seeds. Leaves are harvested at the time of flowering, when the content of active ingredients is at its peak. Maximum yields are obtained by cutting the entire plant 7.5 centimeters above the ground. After cutting, the plants sprout again. Two to four quintals of leaves are obtained from each hectare (Gulati et al., 1982).

Rauwolfia serpentina is one of the most important medicinal plants in India, occurring throughout the country. The plant which can be propagated from seeds, stem cuttings, or root cuttings, is a perennial shrub growing up to 50 centimeters in

height. The root should be harvested 15 and 36 months after planting to obtain the optimum yield of alkaloid.

The major trade centers for *Rauwolfia* roots are Calcutta, Bombay and Patna, which in turn are supplied by a number of primary trade centers throughout the country. The market value per ton of roots varies from Rs2,000 to Rs4,000 depending upon the quality.

Cassia angustifolia (senna): is found in Tamil Nadu, and on a smaller scale in Karnataka and Maharashtra. Sennosides are extracted from leaves and pods, and made into tablets. The plant can be raised from seeds, and is ready to harvest after 2 months. Sennoside content is maximum (11.92 percent) in 3 to 5 days old pods, while in leaves it is maximum (6.93 percent) in immature leaves (Gupta et al., 1977).

About 7 quintals of leaves and a quintal of pods are obtained from one hectare under rainfed conditions, and 14 quintals of leaves and 1.5 quintal of pods are obtained under irrigated conditions. Senna leaves, pods or their powder retain their biological activity even after 5 years of storage. About 5,500 hectares of land are under senna cultivation in India, yielding around 7,150 tons of leaves and pods annually, valued at Rs57 million.

Spices:

Spices are aromatic vegetable products characterized by pungency, strong flavors and sweet or bitter taste. They occur naturally in some forests and are also cultivated in some regions. The important spice-yielding plants are *Alpinia glanga* (greater galangal), *Cinnamomum zeylanicum* (cinnamon or dalchini), *Curcuma* spp. (haldi), *Elettaria cardamomum* (cardamom), and *Piper longum* and *P. nigrum* (pepper).

Animal products

Lac, honey and wax, silk, horns, ivory, bat guano, edible birds' nests, and bees' dammar are some products that are obtained from forests. Of these, the former three are most important.

Lac

General: Commonly known as "shellac" in its refined flake form, lac is a resinous secretion from the insect *Laccifer lacca,* which feeds on the plant sap.

Uses: Lac is presently used for various purposes in plastics, electricals, adhesives, leather, wood finishing, printing, polish and varnish, ink and other industries. It is also the principal ingredient of sealing wax.

Lac crops: Two main strains of lac insect are recognized: "rangeeni" and "kusumi". The rangeeni crop is raised on several host plants, the important being *Butea monosperma* and *Zizyphus mauritiana.* The kusumi strain is raised on *Schleichera oleosa.* There are two crops of lac produced by both strains each year. In addition, there are many other plants species which are of local or specific importance. Only species with near neutral or slightly acidic sap are good hosts for lac insects.

Cultivation of lac: To get good results, the insects must be provided with succulent shoots. Lac sticks, which have mature female insects (called "brood lac") ready to give rise to next generation, are cut and tied

on the branches of the new host plants. To get the maximum benefit, lac cultivation is done on a rotational basis so that the host plants, whose vitality is drained off by lac insects, are given sufficient periods to recover.

Collection and storage of stick lac: Lac is collected in two forms, "ari" and "phunki." The former is cut from the host plant and the latter is collected from the brood lac, after being used for inoculation. The lac is then sold "as is," or freed from the sticks and then sold. The lac removed from the sticks is commercially known as "sticklac."

Sticklac is spread in shade about 15 centimeters thick and turned over once or twice a week until it dries. After drying, sticklac is winnowed to free it from foreign matter. The granular substance, obtained from sticklac after washing away the insect bodies and the dye is called "seed lac," which after bleaching is used in the manufacture of interior floor polishes. Shellac is manufactured from seed lac by either a heat process or a solvent process. The yield of shellac is roughly 55 percent by weight of the sticklac.

Annual production and value: About 14,500 to 20,000 tons of stick lac is produced annually in India. Its price varies from Rs4,500 to 16,000 per ton depending upon quality; most of the produce sells around Rs14,000 per ton. Thus, the total value of the annual production in India is Rs203 million to Rs280 million.

Honey and wax

General: Honey forms a natural nutritious food for the rural people. It is also used widely for medicinal purposes. Two species of bees, *Apis dorsata* (rock bee) and *Apis indica* (Indian bee) produce honey. The former is wild in montane and sub-montane regions throughout India. It is a good honey gatherer and a single comb may yield up to 35 kilograms of honey and one kilogram of wax. The latter is amenable to domestication, but it is not a good honey gatherer. The yield per hive ranges from 3 to 13 kilograms of honey in the hills and 3 to 8 kilograms in the plains.

Annual production and value: About 250 tons of rock bee honey and 98 tons of Indian bee honey are produced annually. At a price of Rs40 per kilogram, the total value of honey produced is Rs139 million.

Bee's wax is used in the manufacture of furniture and floor polishes, dressing and water proofing of leather goods. It is also an ingredient of shoe polish, cosmetics, lip-stick, and face cream. About 28 tons of wax are produced annually, valued at approximately Rs1.6 million.

Silk

India produces four kinds of silk: mulberry, tassar, muga, and eri. Silk is obtained from cocoons of silk worms. Its production has four components; i) cultivation of host plants for silk worms, ii) rearing silk worms up to cocoon stage, iii) reeling of cocoons into continuous filaments called raw silk and, iv) silk throwing and weaving by which filaments are twisted and woven into fabrics (Anon, 1976).

The silk worm ***Bombyx mori*** is fed on mulberry leaves cultivated in plantations. There are other silk worms which are found wild on forest trees, the best known of these is ***Antheraea paphia***, which produces the

famous "tassar" silk of India. It feeds on several trees such as ***Anogeissus latifolia, Terminalia tomentosa, T. arjuna, Lagerstroemia parviflora***, and ***Madhuca indica***. Two or three crops of cocoons are usually obtained each year and about 12 grams of silk are obtained from 15-20 cocoons. Other wild silk worms are ***Antheraea assamensis***, producing "muga" silk, and ***Philosamia synthia ricini***, producing "eri" silk. In some areas silk worms are introduced on host plants to enhance the production of silk. Estimated annual production of tassar silk is 130 tons. Production of other types of silk exceed 10,000 tons.

Edible plant products

General: Natural forests supplement the food supply for human beings. Several forest fruits and seeds, flowers, rhizomes, tubers, roots, barks, etc. are consumed by people during periods of food scarcity and in normal times. A number of tree species provide such edible products. Important fruits are from ***Buchanania lanzan*** (chironji), ***Anacardium occidentale*** (kaju), ***Pinus gerardiana*** (chilgoza), ***Emblica officinalis*** (aonla), ***Tamarindus indica*** (tamarind), ***Aegle marmelos*** (bel), ***Feronia elephantum*** (kaitha), ***Artocarpus lakoocha*** (barhal), ***Syzygium cuminii*** (jamun), ***Annona squamosa*** (custard apple), ***Carissa opaca*** (karaunda), ***Juglans regia*** (akhrot), ***Moringa oleifera*** (drum stick), and ***Zizyphus jujuba*** (ber). Edible flowers came from ***Madhuca indica*** (mahua), and ***M. longifolia*** (mahua). Roots and tubers of ***Amorphophalus campanulatum, Dioscorca belophylla, D. oppositifolia***, and ***Ipomoea aquatica*** are also important.

The following forest species are particularly important in producing delicacies consumed by rural people:

Buchanamia lanzan is commonly known as chironji, achaar or char. It is frequently found in dry mixed deciduous forests of Uttar Pradesh, Bihar, Madhya Pradesh, Orissa, Maharashtra, West Bengal and Andhra Pradesh.

It is a medium-sized tree, attaining a height of over 15 meters and a girth of 120 centimeters. Natural regeneration is poor and artificial cultivation is difficult. People hack the branches to collect the fruits, a practice that weakens the tree.

The species flowers from January to March and the fruit ripens from April to June. The fruit is eaten by the local people and kernels are extracted and dried for sale in the market. Kernels have a mixed flavor of pistachio and almond, and are eaten raw or roasted. They are commonly used in preparing desserts. The market price is about Rs120 per kilogram.

Anacardium occidentale is a small tree, known as cashew nut or kaju. It was introduced to India from Mexico, Central and South America, and eastern Brazil. In India, it is grown in Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Goa and western Maharashtra.

Cashew is an erect, spreading evergreen tree, growing to a height of 10 meters. The tree begins to flower in December. Mature fruit is collected from February to May.

The tree is usually propagated from seedlings raised in baskets, although it can be propagated by grafting and layering. The

tree starts bearing fruits from the third or fourth year, but the best production starts from the tenth year and continues for another 20 years. The average yield of kernels per tree ranges from 9 to 18 kilograms. The kernels vary in size, ranging from 100 to 425 per kilogram (Verma, 1988).

The nuts are separated from cashew apples immediately after harvest. They are then dried in the sen and shelled. The dried nuts are roasted either in open pans over furnaces or in rotary cylinders with oilbaths. India, with an annual production of about 60,000 tons of raw nuts, is the largest producer of cashew nuts in the world (Murthy and Subrahmanuam, 1989). The price of raw kernel is Rs30 per kilogram and that of processed nut is from Rs80 to 120 per kilogram.

Pinus gerardiana is an evergreen pine known as "chilgoza" or "neoza," attaining a height of 17 to 27 meters and girth of 2 to 4 meters. The species is endemic to a part of Himachal Pradesh in the Himalayan dry temperate forests. The tree flowers in May-June and female cones ripen during September-October of the following year. Good seed years alternate with poor ones. A tree on an average yields about 7.4 kilograms of seeds. Collection is best done in September-October when the cones are still green. On heating, the cone scales open and the seeds are shaken out. Seeds are also separated by drying the green cones in the sun.

Natural regeneration is limited because local inhabitants aggressively collect the cones to extract the chilgoza nuts. Attempts to raise chilgoza plantations by sowing have not succeeded because the seeds are readily eaten by various animals. Some success has been achieved, however, in planting seedlings and by heteroplastic grafting. Collection rights are given to local villagers, who supply nuts to the markets in the plains. About 140 tons of nuts are produced every year. They are priced at approximately Rs100 per kilogram (Gupta and Sharma, 1975).

EXPORT OF NON-WOOD FOREST PRODUCTS

The economic contribution of NWFPs exceeds 70 percent of the total value of forest-based exports from India. NWFPs are primarily exported as raw materials. If proper facilities for processing were available, earnings could be much higher.

Export figures for the period 1984 to 1988 are shown in Table 7.

ORGANIZATION FOR COLLECTION AND PROCESSING

In 1980, the Central Board of Forestry suggested the following plan of action for procurement and processing of NWFPs to enhance the economic situation of tribal people.

(i) Adopt ways and means to ensure smooth, adequate and sustained supply of NWFPs for domestic use and also for trade and processing.

(ii) Develop and utilize NWFP resources for the benefit of tribals and also for the contribution to the national economy.

Table 7. Export of important non-wood forest products

Product	1984-85		1985-86		1986-87		1987-88	
	Quantity (tons)	Value (million Rs)	Quantity (tons)	Value (million Rs.)	Quantity (tons)	Value (million Rs.)	Quantity (tons)	Value (million Rs.)
Tendu leaves	2503	30.3	4487	54.1	5103	66.5	5942	83.5
Bamboo	132.3	0.8	1.4	0.007	4.7	0.03	0.7	0.004
Acacia gum	149.4	4.7	46.7	1.6	16.8	0.5	NA	NA
African gum	4.1	0.02	NA	NA	10.0	0.2	NA	NA
Arabic gum	0.9	0.04	58.2	0.9	11.9	0.2	6.3	0.38
Karaya gum	3044	82.9	2505	71.0	2124	57.4	2801	64.20
Asafoetida	111	4.6	140	5.3	102	5.3	140	8.3
Myrrh	3.0	0.06	16.9	0.3	7.0	0.3	NA	NA
Other gum resin	11.9	0.30	70.6	1.9	42.1	1.1	102.4	2.7
Sal oil	3822.7	82.1	8751.0	231.0	192.6	5.4	532.0	12.4
Myrobalan	60.2	0.20	5.8	0.02	378.9	1.2	304.7	2.6
Belladona leaves and roots	0.4	0.008	3.0	0.036	3.1	0.9	NA	NA
Kuth roots	20.0	0.24	42.7	1.1	3.6	0.3	0.5	0.02
Psyllum husk	11019	365.2	1095	336.4	8865	233.8	12641	479.6
Psyllum seed	2071.2	28.6	2499.5	23.3	2994.1	25.6	2265.2	34.4
Serpentina roots	3.9	0.04	8.0	0.06	55.9	0.4	NA	NA
Senna leaves and pods	3313.4	29.2	5705.9	52.40	5672.2	48.2	5270.4	34.9
Henna leaves and wood	5250.2	29.9	8067.0	48.10	5157.9	40.0	4783.1	42.1
Chiraita	8.1	0.05	6.8	0.03	38.2	0.09	58.5	1.7
Cassia pods	1007.6	7.5	723.7	3.2	901.4	6.3	NA	NA
Soap nut	27.9	0.17	271.2	0.9	69.3	0.6	35.6	0.2
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Product	1984-85		1985-86		1986-87		1987-88	
	Quantity (tons)	Value (million Rs.)	Quantity (tons)	Value (million Rs.)	Quantity (tons)	Value (million Rs.)	Quantity (tons)	Value (million Rs)
Green pepper	98.7	4.2	76.3	5.4	179.0	15.6	114.8	15.7
Black pepper, garbled	18622	410.6	38580	1754.4	35771	1947.3	41332	2463.0
Black pepper, ungarbled	41.1	1.2	724.8	32.9	404.8	19.8	433.8	24.3
Pepper, long	4.4	0.16	NA	NA	11.5	0.2	NA	NA
Cinnamon bark	5.4	0.09	2.2	0.04	1.3	0.02	NA	NA
Cardamom, large	245.2	9.3	387.8	19.3	271.6	12.1	256.1	14.0
Cardamom, small	948.8	281.8	1657.9	264.6	1014.3	136.2	227.2	29.0
Tamarind, fresh	956.4	4.5	1046.2	7.2	1287.0	6.9	1160.0	3.1
Tamarind, dried	3110.4	20.1	724.8	32.9	2792.0	25.9	NA	NA
Shellac, hand-made	763.4	34.1	580.1	38.6	543.4	20.0	637.6	28.0
Shellac, machine-made	1712.7	78.7	4175.9	299.0	3944.5	156.0	3655.2	121.5
Seed lac	310.9	10.3	272.6	12.5	146.0	4.3	NA	NA
Button and garnet lac	28.5	2.2	3.1	0.2	1.7	0.09	NA	NA
Other lacs	1939.5	66.7	1121.3	70.7	2629.9	101.3	NA	NA
Cashew kernel, broken	2453.1	113.0	7182.4	377.9	3222.9	234.7	2804.7	214.8
Cashew kernel, whole	3002.6	137.7	29913.8	1863.1	39780.5	3040.7	3142.0	2894.7

(iii) To ensure fair wages, the collection and initial processing of NWFP should be done either by direct recruitment of labor or through Large-Size Multipurpose Cooperative Societies (LAMPS). Intermediaries should be abolished.

In view of the above, the Tribal Development Federation (TRIFED) has been formed as an apex body at the national level to help the state-level federations and forest development corporations with marketing of NWFPs procured from tribals. TRIFED purchases all such produce from the state- level federations or corporations, with the condition that the state bodies pay tribals a fixed minimum price for their produce.

The institutional framework created for collection and marketing of NWFPs differs from state to state:

Andhra Pradesh tribals have the right to collect, consume and sell NWFP items. The Girijan Co-operative Corporation (GCC) has monopoly rights over procurement and marketing of NWFPs. GCC engages primary cooperatives at the grass root-level for collecting and processing the produce. The corporation pays royalties to the forest department.

In ***Bihar***, tendu leaves and oil seeds (***Shorea, Pongamia, Madhuca,*** and ***Schleichera***) are nationalized items. Collection of ***Diospyros melanoxylon*** leaves is undertaken by the forest department itself. The Forest Development Corporation has monopoly over oil seeds and their procurement is done through LAMPS and other agencies. Though lac is an important NWFP item, it is not nationalized. Some lac is procured through LAMPS and marketed by the Bihar State Cooperative Lac Marketing Federation. Other NWFPs are purchased directly by agents.

Gujarat has established the Gujarat Forest Development Corporation, which procures NWFPs like ***Diospyros*** leaves, ***Madhuca*** flowers, and other seeds and gums on a monopoly basis. The corporation trains tribals in improved methods of collection and processing and has increased collection and sale from Rs5.1 million in 1976-77 to over Rs30 million in 1987-88. Employment (primarily of children, women and elderly tribals) from the collection of NWFPs has increased from 889,000 person-days in 1976-77 to 3,795,000 person-days in 1984-85. Gujarat is the only state where most of the forest coupes are being worked by Forest Labour Cooperatives (FLCs). There are about 141 FLCs in the state, of which 132 are in tribal areas. The membership of FLCs totals 63,000 of which 59,000 are tribals.

In ***Kerala***, the right to collect all NWFPs has been given to tribals (Girijans). A cooperative society has been established in each forest area, with membership reserved only for Girijans. State forest departments purchase all the collected NWFPs at procurement prices fixed for each collection season by a committee constituted by the State Government.

In ***Madhya Pradesh, Diospyros*** leaves, ***Shorea*** seeds, ***Terminalia chebula*** nuts, gums (five types), ***Acacia catechu*** wood, and bamboos are nationalized items specified for monopoly state trading. Gums, catechu wood, and bamboos are collected through the departmental agency. ***Shorea*** seeds and ***Terminalia*** nuts were largely handled through purchaser-agent

systems until recently, but the Madhya Pradesh Government has now switched over to a direct tender system.

The state of Madhya Pradesh is the largest producer of tendu (*Diospyros melanoxylon* leaves. The average annual production of tendu leaves in the state is 123,000 tons, which accounts for over 60 percent of the total production in the country. Tendu leaf trade has been fully controlled by the state government since 1964. Tendu leaf growing areas of the state have been divided into units, from where Minor Forest Product Cooperatives collect the leaves. After necessary curing and treatment, leaves are packed in bags and stored in godowns. They are later sold by the forest department through sealed tenders from registered bidi manufacturers and tendu patta traders. After expenses are deducted, the profits are distributed among the members of the Minor Forest Produce Cooperatives.

The trade of sal seeds, myrobalans, and mahua flowers in Madhya Pradesh is nationalized and the task of collection and disposal is entrusted to the State Forest Produce Trading and Development Co-operative Federation, which is a subsidiary organization of the forest department. The Federation has a large number of Tribal Cooperatives and Primary Agricultural Cooperatives as its members. About 30 LAMPS are also engaged in procurement of myrobalans on a commission basis.

For other NWFPs, local inhabitants obtain rights to collect from the forest department by paying a nominal royalty. After collection they sell the produce to traders.

Since the *Maharashtra* Tribal Economic Condition Improvement Act, 1976, trading of NWFPs in tribal areas has been entrusted to the Maharashtra State Cooperative Tribal Development Corporation on a monopoly basis. This corporation presently is trading in gums, *Madhuca indica* flowers and fruits, *Terminalia chebula*, and *Buchanania lanzan* seeds, after procuring them from tribals. Where the Tribal Development Corporation is not functioning, collection of NWFPs is contracted to Forest Labour Cooperative Societies or auctioned to contracters. Tendu leaf trade has been nationalized in the state since 1969, leaves being collected under the purchaser-agents system.

In *Orissa*, collection of NWFPs follows a multi-dimensional pattern. *Diospyros* leaves and sal seeds are nationalized and the state has monopoly over their trading. The idea behind the government taking over the trade is to remove the middleman and ensure better wages to primary collectors. Tendu leaves are collected by the forest department through tribals, and after processing and packing they are handed over to the Orissa Forest Corporation for marketing. Other NWFPs are collected by local inhabitants and sold to traders who pay royalties to the forest department and process and market the produce.

In the tribal areas of *Rajasthan*, the NWFP collection monopoly has been given to the Tribal Area Development Cooperative Federation (TADCF). LAMPS and Cooperative Societies are involved in collection of grasses, gums, fruits, medicinal plants, etc.

In *Uttar Pradesh*, tendu leaf trade has been nationalized. The Tarai Anusuchit Janjati Vikas Nigam has started involving

tribal people in the collection of tendu leaves. Other items are auctioned to contractors.

In ***West Bengal***, the collection and trade of NWFPs is managed by the West Bengal Tribal Development Cooperative Corporation (WBTDCC). The corporation involves tribals through LAMPS in collecting the produce. LAMPS are provided with working capital in the form of cash credit since these are the primary societies of WBTDCC. The corporation is responsible for marketing the produce through open auction or tender. Tribals have been given the right to collect all NWFPs for their own consumption or sale. LAMPS procure ***Diospyros*** leaves, oil seeds (***Shorea, Madhuca, Pongamia, Schlichera, Azadirachta***, etc.) ***Madhuca*** flowers, sabai grass, and ***Terminalia belerica*** fruits from tribal collectors.

EMPLOYMENT GENERATION AND SOCIAL BENEFITS

In India, unemployment has always been a concern for planners and policy makers. The forestry sector, with 23 percent of the country's geographical area, provides 2.3 million person-years of employment. Of this total, 1.6 million person-years is related to NWFPs. Employment generated by various NWFPs is presented in Table 8.

It is estimated that NWFPs are capable of generating 4 million person-years of employment annually, if their full potential were exploited. The government is committed to increasing employment opportunities, so NWFPs should be one of the first items to be considered. A special national drive has been launched to intensify collection, procurement, processing, and marketing of NWFPs.

Most NWFPs currently provide employment during only part of the year because processing of NWFPs is still poorly developed. Improved labor-intensive technologies for processing NWFPs would increase the employment opportunties for longer periods of the year and ensure higher prices for the produce.

The Constitution of India enjoins the state to promote the educational and economic interests of the scheduled castes and scheduled tribes, and to protect them from social injustice and exploitation. It also requires the protection of the forests and wildlife of the country. The National Forest Policy, 1988, also stresses the conservation of the country's natural heritage and the efficient utilisation of all forest produce. The policy suggests that NWFPs which provide employment to the population residing in and around forests should be protected, improved, and managed for increased production. It emphasizes the need for research in the conservation and management of forest resources and the application of advanced scientific and technological measures.

Today, all the states of the country have forest corporations dealing with collection, processing and marketing of forest produce. Poor forest laborers, who were previously unorganized, have been brought under the umbrella of various organizations like the Forest Labour Cooperative Societies, the Large - Area Multipurpose Societies (LAMPS), the Tribal Development Corporations (TDC), the Minor Forest Produce Federations (MFPF), and other organizations.

Table 8. Production and employment generation from non-wood forest products in India

Product	Collection period	Production (thousand tons)		Employment (thousand person-years)	
		Current	Potential	Current	Potential
Fibers	March-May	2.5	45	4.4	79
Kapok flosses	May-June	3	4.5	10	15
Grasses	Oct-March	350	535	1,200	1,800
Bamboo	Continuous	1,932	4,309	48.3	110
Canes	Continuous	14	21	0.7	1.05
Lemon grass oil	May-June	1.3	1.95	21.7	32.55
Palmaros oil	Oct-November	0.09	0.135	1.5	2.25
Eucalyptus oil	Continuous	0.14	0.21	2.32	3.48
Cinnamon oil	Continuous	0.003	0.004	0.05	0.07
Sandal wood oil	Continuous	0.15	0.225	1.5	2.25
Deodar oil	Continuous	0.015	0.023	0.15	0.23
Pine oil	Continuous	NA	100	NA	100
Mahua seed	April-June (Northern) Oct-Nov (Southern)	85	490	28.6	163
Neem seed	May-June	6	418	1	70
Karanj seed	June-Oct	56	111	19	37
Kusum seed	June-July	30	90	6.7	30
Sal seed	April-June	240	5,504	53	1,123
Kokum seed	May-June	0.5	2	0.167	0.7
Khakan seed	May-June	NA	46.3	0.570	15.3
Nahor seed	May-June	1.7	5.7	NA	1.9
Undi seed	April-June & Sept-November	NA	3.8	NA	NA
Babul bark	Continuous	27.4	50	4.57	8.3
Avaram bark	Continuous	30	45	5	7.5
Wattle bark	Continuous	30	45	5	7.5
Myrobalans	Jan-March	100	150	6.6	9.9
Karaya gum	April-June	15	22.5	50	75
Ghatti & babul gums	April-June	2	3	7	10.5
Resins	March-June	74.2	150	30	60.2
Lac & lac products	Oct-Jan & April-July	22	33	7.3	10.95
Tassar silk	Aug-Dec	0.3	1.9	1.5	9.5
Tendu leaves	April-June	210	300	74.9	107
Sarpagandha	Variable	0.6	1	16	42.67
Kuth	October	0.6	1	16	26.67
Cinchona	Variable	1.42	2	23,635	33,335
Edible products	Variable	NA	NA	NA	NA
	Total	3,235.8	12,492.2	1,647.2	3,995.8

Source: Gupta and Guleria (1982). Non-Wood Forest Products in India. Oxford and IBII Pub. New Delhi

The Tribal Federation (TRIFED), a government agency, is protecting the interests of the tribals by providing marketing support to state-level corporations, federations, and cooperatives involved with tribal collection of NWFPs. The State Forest Departments are permitting NWFPs to be collected, consumed, or marketed directly by the tribals, unless they are nationalized.

FUTURE DIRECTIONS TO PROMOTE NWFPs

The present status and potential of many NWFPs is not fully understood or appreciated. Since these products occupy an important place in the international markets, ample opportunities exist for enhancing export earnings by developing appropriate facilities for processing, drying, storage, packaging, and marketing.

Survey and documentation of the NWFP-yielding plants is urgently needed. It is essential to know phenology of different species, their growth behavior, and utilization patterns by local inhabitants. Although these facts are well appreciated, systematic studies have not been carried out.

It is essential to first inventory selected forest areas in different eco-climatic zones. Based on the results of surveys, the state forest departments should preserve selected areas for *in-situ* conservation. Seeds and progagules of important species, especially those threatened with extinction, should be collected, and nurseries and herbal gardens should be established. This should be followed by source and provenance trials, genetic improvement, and further cultivation of improved varieties.

Plantations of desired species should be raised for meeting the needs of industries and the rural population. Training tribals and the rural poor on improved cultivation practices, scientific collection, processing and marketing of NWFPs should be an important component of the future program.

The majority of NWFPs are obtained from government forests. Many plants have been over-exploited and are gradually disappearing. Crude collection methods, such as burning the forest floor, hacking of branches, uprooting herbs or shrubs, and digging of roots and tubers, have seriously degraded the resources. Therefore, cultivation of NWFP-yielding species on private and communal lands is important.

Most of the NWFPs are collected in a particular season although they are utilized all year round. Therefore, proper storage methods must be developed. Currently, as much as 50 percent of NWFPs spoil during storage. Scientific studies to develop suitable processing and storage techniques for these products should be undertaken and well-designed warehouses should be built in the interior areas to facilitate proper storage.

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INDONESIA

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INTRODUCTION

The Indonesian archipelago consists of more than 13,000 islands covering an area of 200 million hectares and over 500 million hectares of sea. The country has 25,000 flowering plants, 4,000 species of land fauna, and numerous aquatic species.

These figures reflect Indonesia's fantastic tropical biodiversity. Some 10,000 of the flowering plants are categorized as trees, although only a few hundred of them are presently being commercially exploited for timber. In addition to timber, however, Indonesia's forests are endowed with a tremendous number of non-wood forest products (NWFPs). This paper mentions only a few of the economically important ones. Many of the NWFPs, although playing a significant role in the lives of rural dwellers, are left out of the statistics.

NWFPs PRODUCTION AND STATUS

History indicates that a large number of NWFPs such as drug plants, gum, and honey were harvested from forests long before timber was considered a major forest product. For many years, such NWFP-producing plants have been harvested on an unsustainable basis. During the last decade, the role of Indonesia's NWFPs diminished relative to timber, due to a rise in revenue from timber exports (Table 1).

Some 90 NWFPs have entered the domestic and overseas market. The revenue obtained from these resources may be small in economic terms, but as renewable resources the NWFPs are now indispensable.

The value of Indonesian NWFPs is well-known both in monetary terms and with respect to genetic diversity. Present harvesting practices, however, are often unsustainable and have in some cases led to the extinction of species.

At present, the NWFPs of Indonesia are classified as follows:

1. **Non-woody plants** such as rattan, bamboo, illipe nuts, roots, fruits and drug plants.

2. **Resinous material and gums** which are widely used in industry for paints, adhesives and various extractives.

3. **Essential oils and fats** which are obtained from leaves, roots, bark, fruit and flowers by water or chemical extraction.

Table 1. National revenues from the exports of wood and non-wood forest products from Indonesia, 1985-89

Year	Wood Exports (1,000 US$)	NWFPs Exports		
		Flora (1,000 US$)	Fauna (1,000 US$)	NWFPs Share of Total Exports (percent)
1985	1,213,059	176,202	10,701	15.4
1986	1,505,904	206,515	9,028	14.3
1987	2,428,652	274,800	11,112	11.8
1988	3,037,760	268,563	1,748	8.9
1989	3,659,568	310,223	36,401	9.5

4. **Unclassified NWFPs,** which belong to any of the above categories.

5. **Fauna and derived products,** including reptiles, mammals, and birds (live or preserved.)

Non-woody plants

The most prominent non-woody NWFP exports are rattan, bamboo, patchouli leaves, iles-iles (***Amorphophalus variabili***), temu lawak (***Zingiberaceae***), sage (***Metroxylon*** spp.), and several medicinal plants. In 1988, non-woody forest product exports, such as rattan, netted US$192.5 million in earnings for Indonesia. The number of people engaged in rattan cultivation, trade and handicraft production was 117,000 in 1985.

In recent years, the rattan industry has evolved from its earlier state when it was dominated by small and medium producers. Over 380 rattan industries, with small-to-large production capacities, are now operating, employing more than 150,000 people (Peluso, 1989).

Bamboo is another valuable NWFP. Thirty-five bamboo species are found on almost every island of Indonesia. Although there are 50,000 hectares of bamboo plantations in East Java and South Sulawesi, the bulk of bamboo comes from the rural areas. In 1989, the value of bamboo exports, reached $1.2 million. The major portion of bamboo and derived products, however, is consumed by the domestic market. In 1985, consumption of bamboo totalled 146 million stalks (Silitonga, Prahasto, and Priasukmana, 1990).

Dominant bamboo species in Indonesia include ***Dendrocalamus asper***, ***Phyllostachys aurea***, ***Schizostachyum blumei***, ***Gigantochloa apus,*** and 30 other species which have been cultivated. To low-and middle-income Indonesians, bamboo is regarded as both art and necessity.

Medicinal plants are also classified as non-woody forest products. The

gathering of such plants is done by collectors or by herbalists in rural areas. In many cases the collectors grow them in small plots in their gardens. Information on commercial harvesting of these plants is scarce. Perhaps the best information on the distribution and characteristics of medicinal plants in Indonesia is still the work of Heyne, presented in his 4-volume publication completed more than four decades ago (Heyne, 1947).

Resins and Gums

A 1990 report of the Central Bureau of Statistics indicated that in 1989 over 20 different resins and gums were exported. Resin of pine, jelutung, francincense and Arabic gums were at the top of the list. Exports of resinous and gum products in 1989, totalled 40,688 tons, valued at US$22 million.

Most resins and gums are extracted from pine (for pine resin), ***Vatica*** and ***Dryobalanops*** (for Arabic gum), and ***Dyera*** (for jelutung).

The potential of resin from pine in Indonesia is constantly growing. Among the uses of NWFPs, the cultivation and tapping of pines and resins is the best organized. In 1983, natural and planted pine forests, covered 747,000 hectares in Indonesia. Some 600,000 hectares are grown in Java alone. Since 1983, the pine forests have been expanded at a rate of 15,000 hectares per year. By the end of the century, pine forests could cover over 1 million hectares in Indonesia. The tapping of pine for resin on Java is very important. Usually the tapping starts with 11-year old, or older, pine stands. More than .70,000 hectares of pine forests in Java were being tapped in 1988, producing 3,827 tons of resin and 5,240 tons of turpentine. Resin collection is usually done by a team of three who are assigned to 3 hectares of forest. The pine stands in Java provide work for at least 70,000 people.

Patchouli oil is a natural resource of western Indonesia. Yearly exports exceed 650,000 tons, valued at more than US$ 11.5 million.

Illipe nuts, produced by ***Shorea*** spp., are used locally and in the perfume industry. In 1989, exports of illipe nuts totalled 2,319 tons, valued at US$3.7 million.

Perhaps the most peculiar NWFPs from Indonesia are resins of francincense from ***Styrax benzoin*** and the resin of gaharu or garro from ***Aquilaria*** spp. and ***Gonystilus*** spp. The resin of francincense is found only in Indonesia. The best quality of gaharu is also produced in Indonesia. The price for gaharu reaches as high as US$500 per kilogram, depending on the extractive content and the stage of maturity. These two prominent products are widely traded for cultural uses.

Essential Oils and Fats

Numerous essential oils can be obtained by extraction or distillation of roots, leaves, stems, bark, exudates, and flowers of various species. Most of the essential oils have similar basic components such as terpene and oxidized hydrocarbons.

Conversely, fats are generally formed in mixtures of ester, glycerol, and fatty acid. Fats may be rendered by solution, extraction, or by hot and cold pressing. Essential oils from NWFPs are used as essence, flavoring agents in perfumes and cosmetics, and in food manufacturing. Fats have a variety of uses as household items. Essential oils and fats already sold in export markets include patchouli, turpentine, sandalwood, eucalyptus, and cananga. Exported fats include tengkawang oil, refined ricinus of castor, tung oil (kemiri), garro wood, and others.

Refined ricinus of castor, is an important hydraulic oil, lubricant and medicine. Tung oil is used for water proofing and as a drying oil. Tengkawang oil (illipe nut oil) has been exported for production of pharmaceuticals, cosmetics (lipstick in particular), high quality soaps, margarine, and chocolate bars. Castor oil is produced by extracting fat from the ***Picinus communis*** plant seeds.

Exports of essential oils and fats in 1989 totalled 45,792 tons and earned US$50 million in foreign exchange.

Unclassified NWFPs

NWFPs not included in the above categories are grouped as "unclassified NWFPs." Notable products in this group are sandalwood from ***Santalum album***, Macadamia nut (***Aleurites mollucana***), ***Cassia vera***, gambir (***Uncaria gambir***), and charcoal. Total exports of the unclassified NWFPs for 1989 were 87,112 tons, which earned US$ 69.1 million.

Wildlife and Wildlife Derived Products

Wildlife and wildlife-product exports from Indonesia are increasing rapidly. During the last decade, the total sales increased from US$2.4 million in 1981 to US$36.4 million in 1989.

These unique commodities could produce income both directly and indirectly. Direct income may be obtained from trade of the wildlife and derived products. Macaque and other monkey species used for research purposes, for example, have been exported in considerable numbers.

At this time, wildlife species fall into the following categories:

- Protected by public law
- Soon to be protected
- Rare species (those included in IUCN's Red Data Book)
- Limited protection
- Unprotected

Average earnings from unprotected wildlife sales from Indonesia amounted to $11 million per year. Many breeding centers for monkeys, snakes, crocodiles, turtles, snails, and other species now are found in Indonesia. Ten years ago, this trade did not exist.

Indonesia has 37 wildlife exporting companies. Most of the trade does not adhere to the Convention of International Trade of Endangered Species (CITES).

Significant indirect income is derived from wildlife in the form of nature-based tourism. In 1985, 4.4 million tourists entered wildlife sanctuaries, paying the

government 17.7 million rupiah in entrance fees. These numbers are expected to increase dramatically in coming years.

TRENDS IN NWFP USE

Shifting cultivators and forest dwellers are the principal collectors of a wide variety of NWFPs for commercial and for subsistence purposes. In most cases, they switch from one product to another, or from collecting and selling products to participating in other economic activities, influenced by changes in price and availability of the NWFPs. Certain products are known to be cultivated either in home gardens and *ladangs*, or planted in the forest. In many regions, planting forest land is a means of claiming the forest land.

Rattan has been planted by Indonesian forest dwellers for over 100 years. Although most rattan comes from natural forests, much of the smaller diameter rattan is harvested from plantations. Large diameter rattan needs 15 to 20 years before it is harvestable. These slow-yielding plants are usually less desirable. This situation calls for serious attention if shortages are to be overcome.

The irregular demand for NWFPs has partly resulted in a strategy by the collectors that allows them maximum flexibility. This strategy requires not only a broad-based knowledge of the forest, but also the exploitation of different products as the need or demand arises.

Dependence on other forest products results from locally generated needs. Peluso (1989) noted that certain villages in Apo Kayam, Kalimantan, are known for their traditional healers who have extensive knowledge of forest plants for traditional medicine. From this area comes a ginseng-type of medicine, locally known as "Pasak bumi" which is famous in other parts of the country as an aphrodisiac.

The total value of NWFPs consumed domestically, although very high, is difficult to trace. No reliable data are available on the value of NWFPs used domestically.

CONCLUSIONS

The statistics on non-wood forest products presently available in Indonesia cover only a few of the economically most important products. Many NWFPs may be considered minor in terms of economic value, but they make a significant contribution to the sustainability of the forest ecosystem. These are frequently left out of the statistics and are difficult to identify.

For many decades, Indonesia has been producing and exporting many important NWFPs. Rattan, ***Styrax metroxylon***, gaharu gums, and patchouli, are among the most important. Many of Indonesia's NWFPs are unique to the country.

In recent years, NWFPs have attracted more attention because the very existence of the tropical forest and its biodiversity are threatened.

Seasonality in NWFP collection fits the rhythm of yearly activities of forest dwellers. Although forest product collection may provide only a part of a household's income, it may be crucial for the family. NWFPs may make the difference between a household's position above or below the poverty line. Losses, or lack of opportunity to collect forest products, will leave gaps that need to be filled by other activities.

Rice container made from finely woven split rattan.

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MALAYSIA

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INTRODUCTION

In Malaysia, minor forest products are defined as all forest products other than logs because of their relatively small contribution to revenue generation. The term "minor forest product" has recently been replaced by a more appropriate term, "non-wood forest product," recognizing that these products are important for their market and non-market values. Non-wood forest products include rattan, bamboo, firewood, charcoal, damar, palm, wood-oil, gums, resins, medicinal plants and others. This paper will discuss only rattan and bamboo (two of the most important and valuable non-wood forest products) and medicinal plants.

Royalties collected from non-wood forest products contribute substantially to the revenue of each state. On average (1981 to 1990), rattan contributed about 13.8 percent of the total royalties collected from non-wood forest products, while bamboo accounted for about 71 percent.

In addition, these two products are foreign exchange earners: earnings from rattan increased from US$3 million (M$8 million) in 1981 to US$26.5 million (M$71.5 million) in 1990. Foreign exchange earnings from bamboo increased from US$81,150 (M$219,106) in 1988 to US$176,474 (M$476,480) in 1990.

Besides generating revenue and being important foreign exchange earners, these two forest industries employ 24,370 individuals, mostly rural people, in 1,685 factories.

These factories primarily focus on handicraft production with little interest in venturing into manufacturing furniture or higher value bamboo products marketed locally or to neighboring countries. Nonetheless, these small industries play a significant role in raising the living standards of the rural people.

Other social benefits contributed by non-wood forest products include various kinds of environmental protection. The dense interlocking root system of bamboo, for example, prevents soil erosion and minimizes damage from floods.

RATTAN

Resources

Of the approximately 600 species of rattan in the world, 104 species, belonging to 8 genera, are found in the forests of Malaysia (Appendix 1). Only 21 of these species, however, are currently utilized and marketed (Dransfield, 1979). The most important rattans and their main uses are shown in Table 1.

In Peninsular Malaysia, rattan is sometimes found together with bamboo. In Sarawak, rattan is found both in swamp and hill forests.

Table 1. Major commercial rattan species in Malaysia		
Species	Local name	Uses
Calamus manan	Rotan manau	Furniture
C. caesius	Rotan sega	Binding and weaving basket ware
C. scipionum	Rotan semambu	Walking sticks, umbrella handles
C. ornatus	Rotan dok	Cheap furniture
Korthalsia spp.	Rotan dahan	Cheap furniture, broom handles

Source: Department of Forestry, Peninsular Malaysia, Sarawak and Sabah

Table 2. Rattan resources in virgin and logged-over forests of Malaysia, millions of clumps (3 meters per clump average)						
Forest types	*C. manan*	*C. caesium*	*C. scipionum*	*C. ornatus*	*Korthalsia* spp.	Total
Peninsular Malaysia						
Virgin forest	129.3	18.0	38.4	74.6	69.9	330.0
Logged-over forest	124.4	48.8	59.4	41.2	93.7	367.5
Sub total	254.6	66.8	97.8	115.7	163.5	697.5
Sarawak						
Virgin forest	270.8	37.6	80.4	156.2	146.4	691.4
Logged-over forests	138.1	54.2	66.0	45.7	104.0	408.0
Sub total	408.9	91.8	146.4	201.9	250.4	1,099.4
Sabah						
Virgin forest	69.1	9.6	20.5	39.9	37.3	176.4
Logged-over forest	116.3	45.6	55.6	35.5	87.6	343.6
Sub total	185.4	55.2	76.1	78.4	124.9	520.0
Malaysia - Total						
Virgin forest	468.1	65.2	139.3	270.6	253.6	1,197.8
Logged-over forest	378.8	148.6	181.0	125.4	285.3	1,119.1
Total	847.9	213.8	320.3	396.0	538.8	2,316.9

Source: Department of Forestry, Peninsular Malaysia, Sarawak and Sabah.

Table 3. Estimated rattan clumps (3m/clump) per hectare in virgin and logged-over forest in Malaysia					
Forest types	*C. manan*	*C. caesius*	*C. scipionum*	*C. orantus*	*Korthalisia* spp.
Virgin Forest	55.7	7.7	16.5	32.1	30.1
Logged-over Forests	40.4	15.8	19.3	13.4	30.4

Source: Department of Forestry, Peninsular Malaysia, Sarawak and Sabah

The Second National Forest Inventory of Malaysia (1981 to 1982) describes rattan resources. The total estimated stock of rattan is 2.3 billion clumps, (3m/clump), consisting of 847.9 million clumps (36.6 percent) of ***Calamus manan***, 213.8 million clumps (9.2 percent) of *C. caesius*, 320.3 million clumps (13.8 percent) of *C. scipionum*, 396.0 million clumps (17.1 percent) of *C. ornatus* and 538.8 million clumps (23.3 percent) of *Korthalsia* spp. (Table 2).

C. manan and *C. ornatus* are mainly found in the virgin forests, while *C. caesius, C. scipionum* and *Korthalsia* spp. grow in logged-over forests (Table 3).

Most of Malaysia's rattan is found in Sarawak (47.5 percent), followed by Peninsular Malaysia (30.1 percent) and Sabah (22.4 percent). About 51.7 percent of the rattan clumps are in virgin forests.

The total value of rattan growing stock, based on the prevailing market price for each species is US$1.4 billion (M$3.7 billion). *C. manan* accounts for US$942.2 million (M$2.5 billion); *C. casesius* for US$ 35.6 million (M$96.2 million); *C. scipionum* for US$89.0 million (M$240.2 million); *C. ornatus* for US$190.7 million (M$514.8 million); and *Korthalsai* spp. for US$99.8 million (M$269.7 million) (Table 4).

The total estimated value of the rattan growing stock in Peninsular Malaysia is US$ 400.1 million (M$1.1 billion). Sarawak's growing stock is valued at US$653.9 (M$ 1.8 billion) and Sabah's at US$297.2 million (M$0.8 billion).

Rattan Plantations

In Malaysia, large-scale rattan plantations were started some 10 years ago, mainly in logged-over forests. Lately, they also have been planted in rubber smallholdings to supplement the incomes of the planters.

Between 1980 and 1990, 15,615.1 hectares of rattan plantations were established, with 5,031 hectares (32.2 percent) in Peninsular Malaysia, 224 hectares (1.4 percent) in Sarawak and 10,360 hectares (66.4 percent) in Sabah. Of this total, 14,031 hectares (89.9 percent) were planted in logged-over forests and the balance, 1,584 hectares (10.1 percent), in rubber smallholdings.

About 69.6 percent of the logged-over forests planted with rattan is in Sabah, followed by Peninsular Malaysia with 28.8 percent and Sarawak with 1.6 percent. Peninsular Malaysia has 62.1 percent of the rattan planted in rubber smallholdings, with the rest in Sabah. No rattan has been planted in rubber smallholdings in Sarawak (Table 5).

Under the Sixth Malaysia Plan (1991 to 1995), 26,100 hectares of rattan plantation are expected to be established in Peninsular Malaysia. Of this total, 15,500 hectares are to be planted by the Forest Department, 4,600 hectares by the Rubber Industry Smallholders Development Authority (RISDA), 2,000 hectares each by the Federal Land Development Authority (FELDA), the Federal Land Consolidation and Rehabilitation Authority (FELCRA), and the private sector. About 22,100 hectares of the total area will be planted with *C. manan* and the balance with *C. caesius*.

Table 4. Value of rattan resources in Malaysia, 1989 (thousand M$)

Region	*Calamus manan*	*Calamus caesius*	*Calamus scipionum*	*Calamus ornatus*	*Korthalsia* spp.	Total
P. Malaysia	760,947	30,047	73,363	150,459	81,768	1,096,584
Sarawak	1,226,706	41,321	109,792	262,495	125,185	1,765,499
Sabah	556,194	24,857	57,071	101,860	62,464	802,446
Malaysia	2,543,847	96,225	240,226	514,814	269,417	3,664,529

Source: Department Of Forestry, Peninsular Malaysia, Sarawak and Sabah.
Note: 1 US$ = M$ 2.70 in 1990

Table 5. Areas planted with rattan in Malaysia, 1980-1990 (hectares)

Region	Logged-over forests	Rubber small holdings	Total
P. Malaysia	4,046.4	984.4	5,030.8
Sarwak	224.0	0	224.0
Sabah	9,760.3	600.0	10,360.3
Total	14,030.7	1,584.4	15,615.1

Source: Ministry of Primary Industries

In Sabah, the Sabah Forestry Development Authority (SAFODA) plans to plant 15,000 hectares of rattan in addition to the 7,000 hectares of ***C. insignis*** already planted in natural forests. Rattan planting trials have been initiated in Sarawak and commercial planting of rattan will commence over an area of 2,800 hectares during the Sixth Malaysia Plan period.

Harvesting

In Peninsular Malaysia, a license is required to harvest rattan from the forest. A monthly fee of M$5 per person is charged by the Forest Department. In Sarawak, a monthly fee of M$1 is charged for collection of rattan. No permit is required if rattan is collected for domestic use. A permit and license is required in Sabah for the extraction of rattan. The monthly fee is M$5 per person.

Harvesting rattan in the forest consists of dragging the rattan out of the canopy, removing dead leaf sheaths and debris, discarding the upper 2 to 3 meters, and cutting the cane into lengths suitable for bundling and transporting to the processors. Removal of leaf sheaths and debris is usually carried out by coiling the rattan stem around a small tree trunk and pulling it. Big stem rattan is usually cut into 3-meter lengths, while small stem rattan is usually cut into 9- meter lengths, bent into two and bound into bundles. The cutting is done as the rattan is pulled.

Cutting of rattan is done mostly by forest dwellers. Normally a group of 10 people stays for a week or two in the forest to gather rattan. About 2,000 rattan sticks are usually extracted during the dry season by each cutter.

Production and Revenues

Direct production data are not available because of variations in the units of measurement used in Peninsular Malaysia. However, production levels can be indirectly ascertained by reviewing the royalties collected by the Forestry Department, Peninsular Malaysia.

Fees vary according to state and species. On average, however, the rate for ***C. manan*** and ***C. caesius*** is M$0.20 per meter

and M$0.10 per meter respectively.

Royalties collected from rattan in Peninsular Malaysia averaged US$ 57,131 (M$154,254) per year between 1981 and 1990 (Table 6). Rattan contributed between 9.2 and 23.2 percent of the total of all non-wood forest products royalties from 1981 to 1990.

Table 6. Royalties collected for rattan, Peninsular Malaysia, 1981-1990

Year	Rattan (M$)	Total Non-Wood Forest Products (M$)	Contribution of rattan to total Non-Wood Forest Products (percent)
1981	179,374	1,687,714	10.6
1982	131,562	841,713	15.6
1983	119,430	874,225	13.7
1984	117,604	1,041,395	11.3
1985	97,706	934,986	10.5
1986	94,333	893,307	10.6
1987	236,486	1,128,186	21.0
1988	162,051	1,339,604	12.1
1989	286,975	1,238,404	23.2
1990	117,013	1,279,306	9.2

Source: Department of Forestry, Peninsular Malaysia
Note: Total non-wood forest products column includes royalties from firewood, charcoal, rattan, bamboo, damar, palm and wood-oil

Although rattan is heavily exploited in Sarawak, there are no records of production levels. The reason is that royalties are not collected by the state for this forest product. In Sabah, royalties collected from rattan are lumped under miscellaneous forest revenue. The present rate is M$400 per ton, irrespective of species.

Production of rattan can also be ascertained from the estimated monthly production figures for the country. Monthly production of ***C. manan*** is about 2 million sticks (3-meter length per stick); for *C. caesius*, monthly production is 60 tons. Details of other rattan species are shown in Table 7.

Industry

Table 7. Estimated monthly production of rattan, Malaysia, 1987

Species	Quantity
C. manan	2 million sticks
C. scipionum	1 million sticks
C. ornatus	2 million sticks
Korthalsia spp.	1.8-2 million sticks
C. caesius	60 tons
C. insignis	800 tons

Source: Rattan Manufacturers Association of Malaysia

At present, there are 653 rattan mills throughout the country manufacturing rattan furniture and rattan products such as walking sticks, rattan balls, baskets, toys and mats. Of this total, 46 percent are classified as cottage enterprises, 34 percent as small-scale enterprises, and the remainder as medium and large-scale enterprises (Razak, Hamdan and Latif, 1989).

About 15.5 percent (101 mills) are involved in rattan processing, 12.6 percent (82 mills) operate in both processing and manufacturing, and the remaining 71.9 percent (470 mills) are involved only in manufacturing. The industry employs 16,120 people. Cottage enterprises employ 4 to 5 workers each, small-scale factories employ 10 to 20 workers each, and medium-scale or large-scale firms employ 50 to 100 workers each, (Razak, Hamdan and Latif, 1989).

Trade

Malaysia exports rattan in two forms, whole rattan and split rattan. As such, the country has lost substantially in terms of potentially higher export earnings from value-added products.

In 1981, rattan exports accounted for 0.2 percent of the total export value of forest products. The level of contribution rose until

it peaked in 1988 at 1.14 percent. This sharp increase in the export value of rattan in 1987 and 1988 is attributed to the high price of whole rattan and split rattan. The FOB price of whole rattan increased from M$1,915 per ton in 1987 to M$2,754 in 1988, while the FOB prices of split rattan rose from M$1,468 per ton to M$2,878 per ton. One reason for the increase in price was Indonesia's 1986 ban on the export of rattan not processed beyond fine polishing or converted into furniture parts.

Malaysia's export of whole rattan, split rattan and rattan furniture increased from US$3 million (M$8 million) in 1981 to US$26.5 million (M$71.5 million) in 1990. There was a surge in rattan exports in 1987, when the exports rose to US$18.9 million (M$51.1 million). This rise was caused by a 547 percent increase in the export of whole canes in 1987 as compared with 1986 and a 57.6 percent increase in the exports of rattan furniture during the same period. Since 1987, exports of whole and split rattan are decreasing, while exports of rattan furniture are rising.

In volume, Malaysia's exports of whole rattan and split rattan increased from 9,413 tons in 1981 to 26,185 tons in 1989, then decreased to 7,785 tons in 1990. The sudden drop was the result of the fall in the exports of whole rattan (Table 8).

To encourage the domestic processing of rattan, an export duty of M$1,350 per ton was imposed in October 1981. This was increased to M$2,700 per ton in August 1987. The export of raw rattan was banned in December 1989. The ban is meant to ensure a consistent supply of raw material at reasonable prices to meet the Industrial Master Plan export target of M$400 million worth of rattan furniture by 1995.

Whole canes are exported mainly to Singapore and Taiwan. Split rattan is exported mainly to Singapore, with lesser volumes exported to Taiwan, the Philippines, and the Netherlands. Major importers of rattan furniture are the United Kingdom, the United States, Denmark, Germany, Japan, Australia, Belgium, Sweden and Singapore.

BAMBOO

Resources

Seven genera, with 44 species, of bamboo are known in Malaysia (Appendix 2), but only 12 are commercially utilized. Table 9 lists the most common species.

In Malaysia, bamboo is common from sea level up to 1,000 meters. Bamboo occurs in significant quantities in disturbed areas such as logged-over forests, wasteland or in marginal localities fringing the forest, river banks and hill slopes. It grows in pure stands or with other tree species in the forest. It does not favor water-logged conditions and is seldom found in swampy areas. Bamboo is commonly cultivated in the rural areas for daily use by local communities and in urban areas as ornamental plants.

As with rattan, information on distribution in natural forests is lacking. Distribution can be estimated from data in the Second National Forest Inventory (1981 to 1982). The estimated number of bamboo sticks per

Table 8. Volume of rattan exports from Malaysia, 1981 - 1990

Year	Whole cane (tons)	Percent of total	Split cane (tons)	Percent of total	Total (tons)
1981	8,980.00	95.4	432.86	4.6	9,412.72
1982	5,992.39	92.7	474.00	7.3	6,466.39
1983	4,140.28	84.7	749.77	15.3	4,890.05
1984	2,663.53	75.8	852.64	24.2	3,516.17
1985	2,996.69	79.8	757.59	20.2	3,754.28
1986	4,496.98	85.5	760.65	14.5	5,257.63
1987	20,472.91	97.4	548.52	2.6	21,021.43
1988	16,310.36	77.6	300.47	1.4	16,610.83
1989	25,516.19	97.4	668.51	2.6	26,184.70
1990	6,695.53	86.0	1,089.78	14.0	7,785.31

Source: Department of Statistics

Table 9. Commercially utilized bamboos in Malaysia

Species	Local names	Uses
Bambusa blumeana	Buluh duri	toothpicks, furniture, musical instruments, shoots as food
B. heterostachya	Buluh galah	toothpicks, chopsticks, blinds
B. vulgaris	Buluh minyak	paper, furniture
Dendrocalamus asper	Buluh belong	fences, bridges, baskets, shoots as food
Gigantochloa scortechinii	Buluh semantan	satay sticks, toothpicks, blinds
Schizostachyum brachycladum	Buluh nipis	chopsticks, handicrafts

Table 10. Estimated number of bamboo sticks (6m/stick) per hectare by forest types in Malaysia

Forest types	*D. asper*	Other species over 3 cm in diameter	Other species less than 3cm in diameter
Virgin forest	42.9	53.55	80.5
Logged-over forest	61.4	2.40	45.0

Source: Department of Forestry, Peninsular Malaysia, Sarawak and Sabah

hectare according to forest types and species is shown in Table 10.

The estimated number of bamboo poles (at least 6 meters in length) in Malaysia is 2.7 billion sticks. This is comprised of 839.1 million sticks of *Dendrocalamus asper*, 843.1 million sticks of other species with diameters more than 3 centimeters, and 980.2 million sticks of other species with diameters less than 3 centimeters. *D. asper* and other species with diameters more than 3 centimeters are found in abundance in logged-over forests. Other species with diameters less than 3 centimeters are more commonly found in virgin forests.

About 31 percent of Malaysia's bamboo sticks are found in Peninsular Malaysia, 45 percent in Sarawak and 24 percent in Sabah.

In terms of weight, the estimated bamboo in Peninsular Malaysia, Sarawak and Sabah is 10.3 million tons, 14.9 million tons and 8.1 million tons, respectively, for a total of 33.3 million tons (Table 11). The estimated market value is US$862.8 million (M$2.3 million). The virgin forests of Malaysia produce 16.3 million tons of bamboo, while the balance of 17.0 million tons is from logged-over forests.

Table 11. Estimated wet weight and value of bamboo resources in Malaysia, 1989

	Wet weight (1000 tons)	Value (1000 m$)
P. Malaysia	10,297	720,790
Sarawak	14,893	1,042,510
Sabah	8,091	566,370
Malaysia-Total	33,281	2,329,670

Source: Department of Forestry, Peninsular Malaysia, Sarawak and Sabah
Note: 1 ton = 80 sticks of wet bamboo with lengths of 6 meters. The ex-mill price of wet bamboo in 1989 was M$70 per ton.

Bamboo Plantations

Planting of bamboo on a large-scale has been done only by Forest Departments and the Forest Research Institute of Malaysia. Although there are no plantations in Malaysia, bamboo is cultivated by rural folk along their rice fields and around their homes. As bamboo does not require much land, logged-over forests can be allocated.

Harvesting

Permits are required for the extraction of bamboo from the forest. The monthly fee is M$5 per person. Other sources of bamboo are land under FELDA, FELCRA rural development schemes, river banks, hill sides and ridge tops. Harvesting of bamboo is usually done during the dry season when the starch content is lower and borer attacks are fewer. Bamboo must be processed within three days after harvesting as it is prone to discoloration.

Production

Production figures for bamboo are not available and can only be estimated by examining the royalties collected for Peninsular Malaysia (Table 12). Rates vary according to condition and length. The average rate ranges from 2 to 6 cents per pole.

Royalties averaged US$29,002 (M$78,306) between 1981 and 1990. Royalties collected for bamboo contributed 5.3 to 11.6 percent of the total collected from non-wood forest products. Based on the average royalty rate of 4 cents per pole, the estimated annual production of bamboo is 2 million sticks or 25,000 tons. Thus the annual production value is US$64,815 (M$175,000).

Table 12. Royalties collected for bamboo, Peninsular Malaysia, 1981-1990

Year	Bamboo (M$)	Total non-wood forest products (M$)	Contribution of bamboo to total non-wood forest products (percent)
1981	101.232	1,687,714	6.0
1982	97,402	841,713	11.0
1983	75,909	874,225	8.7
1984	76,112	1,041,395	7.3
1985	68,128	934,986	7.3
1986	59,067	893,307	6.6
1987	65,591	1,128,186	5.8
1988	70,902	1,339,604	5.3
1989	89,358	1,238,404	7.2
1990	79,359	1,279,306	6.2

Source: Department of Forestry, Peninsular Malaysia.
Note: total non-wood forest products column includes royalties from firewood, charcoal, rattan, bamboo, damar, palm and wood-oil

Industry

There are about 1,032 bamboo processing factories in Malaysia. At present, the industry mainly manufactures finished products such as satay sticks, toothpicks, chopsticks, bamboo splits, basketry, handicrafts, and furniture meant for the domestic market. Most of these mills are small and found in the west coast states of Peninsular Malaysia which offers bigger market potential, more developed infrastructure, communication services and other supporting services.

Of the 1,032 mills, 694 (67.3 percent) are engaged in handicraft making, 336 mills (32.5 percent) make disposable utensils such as skewers, chopsticks and toothpicks, and 2 mills (0.2 percent) make furniture.

The work force in the bamboo factories is comprised primarily of rural housewives and children who work during free time to supplement their family income. The labor force in the bamboo industry is 8,250 persons.

Trade

Exports of bamboo from Malaysia increased from 483.7 tons, valued at M$219,106 (US$81,150) in 1988 to 585.6 tons valued at M$476,480 (US$176,474) in 1990 (Table 13).

Table 13. Volume and value of bamboo exports from Malaysia, 1988-1990

Year	Volume (tons)	Value (M$)
1988	483.70	219,106
1989	453.27	296,553
1990	585.56	476,480

Source: Department of Statistics

In 1988, the main importers of bamboo were Singapore (importing 47.1 percent of the total export volume) and South Korea (with 25.9 percent). The main markets for Malaysia's bamboo in 1990 were Singapore (30.2 percent), United Arab Emirates (27.6 percent) and Taiwan (25.7 percent).

MEDICINAL PLANTS

Resources

Malaysia is blessed with an abundant and diverse flora, much of which is believed to possess medicinal value. Most of these potentially useful plant resources grow wild in the lowland and hill dipterocarp forests, which are under serious threat of being replaced by mono-specific tree crops (rubber and oil palm), intensive logging or conversion to non-forestry land uses such as hydroelectric dams and rural settlements.

Plant species from the families Euphorbiaceae, Leguminosae, Graminae, Verbenaceae, Solanaceae, Simaroubiaceae, Vitaceae, Malavaceae, Palmae and Rubiaceae are commonly used to treat various ailments and diseases. These include diarrhoea, skin problems, headache, fever, cough, wounds, hypertension, diabetes, and rheumatism. Certain products derived from medicinal plants are of economic value and have been traded for a long time. Some of these products and their uses are shown in Table 14.

Harvesting

Forest medicinal plants (roots, barks, stems, leaves, fruit and flowers) are usually collected by the aboriginal communities and sold to the traditional practitioners in fresh or dried form. The fresh or dried parts of the forest medicinal plants are boiled or pounded to extract their juices and mixed with other forest plants. The "processed" forest plants are either applied externally or taken orally.

Production

No production figures are available because no royalty is collected, but a license is required for extraction. Forest medicinal plants are primarily used by aboriginal communities, especially those who live deep in the jungle where medical help is not available.

Widespread use of forest medicinal plants may increase their economic value, but uncontrolled collection of these products can damage the ecosystem.

PROMOTION OF NON-WOOD FOREST PRODUCTS

Following are ways to promote non-wood forest products in Malaysia:

1. **Financial assistance** in the form of interest-free loans of US$800 to 20,000 or loans with interest below market rates by government-supported institutions such as the Agricultural Bank (BP), the Trustee Council for Indigenous People (MARA) and the Development Bank of Malaysia Limited (BPMB) to assist people in growing, harvesting, processing and trading NWFPs.

2. **Technical assistance** extended by providing machinery, help in production and basic design, and training through seminars, workshops, and training courses in management and production.

3. **Research and development** to establish the characteristics of processing, find new uses for non-wood forest products, and identify under-utilized species.

4. **Investment incentives** for the establishment of plantations and down-stream processing, especially for rattan and bamboo. Some possible investment incentives include granting investment tax allowances, double deductions on freight charges, and exemption from import duties and surtaxes for raw materials and components used in manufacturing.

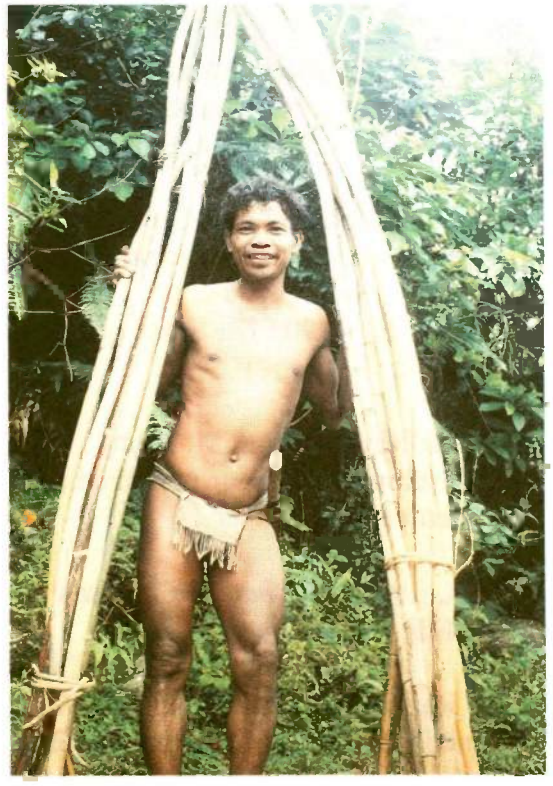
Table 14. Selected medicinal plants in Malaysia		
Species	Local name	Uses
Eurycoma longifolia	Tongkat ali	aphrodisiac, fever
Areca catechu	Pinang	tapeworms, round worms
Oldenlandia diffusa	Siku-siku	dysentery urethritis, snake bites, abdominal pain
Myristica fragrans	Buah pala	diarrhoea, vomiting, indigestion, abdominal pain
Piper nigrum	Black pepper/White pepper	Malaria, scorpion bites
Melastoma decemfidum	Sesenduduk putih	Intestinal measles, poison

5. **Intercropping non-wood forest products** in rubber estates to complement the extraction of raw materials.

6. **Dissemination of information** on export markets for Malaysian non-wood forest products, organization of trade fairs and exhibitions and creation of market opportunities for entrepreneurs.

7. **Education** on how to produce rattan and bamboo handicrafts incorporated into the curricula in industrial arts courses in high schools.

8. **Banning exports,** or increasing export duties encourage downstream processing and save foreign exchange.



Rattan collection is a common source of income and employment for indigenous people of Indonesia, Malaysia, and the Philippines.

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APPENDIX 1

RATTAN FOUND IN MALAYSIA

	Botanical Names	Local Names
I.	**Korthalsia**	
	1. *K. rigida*	Rotan dahan
	2. *K. grandis*	Rotan dahan
	3. *K. flagellaris*	Rotan dahan
	4. *K. tenuissima*	Rotan dahan tikus
	5. *K. lanceolata*	-
	6. *K. scaphigera*	Rotan semut/udang
	7. *K. echinometra*	Rotan dahan/semut
	8. *K. scortechinii*	Rotan semut
	9. *K. hispida*	Rotan semut
II.	**Plectocomia**	
	10. *P. griggithii*	Rotan mantang
	11. *P. muelleri*	Rotan mantang paya
	12. *P. sp.*	Rotan mantang ilang
III.	**Plectocomiopsis**	
	13. *P. geminiflorus*	Rotan gilang
	14. *P. wrayi*	Rotan pepe
	15. *P. Corneri*	Rotan rilang gajah
IV.	**Myrialepis**	
	16. *M. scortechinii*	Rotan kertong
V.	**Calospatha**	
	17. *C. scortechinii*	Rotan demuk
VI.	**Daemonorops**	
	18. *D. angustifolia*	Rotan getah*
	19. *D. grandis*	Rotan sendang
	20. *D. melanochaetes*	Rotan getah*
	21. *D. sepal*	Rotan getah gunung
	22. *D. calicarpa*	Lumpit
	23. *D. lewisiana*	Lumpit kecil
	24. *D. monticola*	Rotan getah lumpit
	25. *D. ursina*	Rotan jernang
	26. *D. didymophylla*	Rotan jernang
	27. *D. propinqua*	-

28.	*D. brachystachys*	Rotan jernang
29.	*D. micracantha*	Rotan jernang
30.	*D. leptopus*	Rotan bacap
31.	*D. hystrix*	Rotan tai landak*
32.	*D. kunstleri*	Rotan bulu landak
33.	*D. geniculata*	Rotan jahaca
34.	*D. Sabut*	Rotan cincin*
35.	*D. macrophylla*	Rotan cincin*
36.	*D. oligophylla*	-
37.	*D. verticillaris*	Rotan sabong
38.	*D. lasiospatha*	-
39.	*D. periacantha*	-
40.	*D. longipes*	-
	Calamus	
41.	*C. castaneus*	Cucor
42.	*C. erinaceus*	Rotan bakau*
43.	*C. polystachys*	Rotan sabong
44.	*C. caesius*	Rotan sega*
45.	*C. axillaris*	Rotan sega air*
46.	*C. laevigatus*	Rotan tunggal*
47.	*C. simplex*	-
48.	*C. palustris*	-
49.	*C. manan*	Rotan manau*
50.	*C. tumidus*	Rotan manau tikus*
51.	*C. oxleyanus*	Rotan minyak
52.	*C. viridispinus*	Rotan kerai gunung*
53.	*C. ulur*	-
54.	*C. endauensis*	-
55.	*C. longisetus*	-
56.	*C. arborescens*	-
57.	*C. multirameus*	-
58.	*C. paspalanthus*	Rotan sirikis
59.	*C. sedens*	Rotan duduk
60.	*C. perakensis*	Rotan duduk
61.	*C. laxissimus*	-
62.	*C. whitmorei*	-
63.	*C. minutus*	-
64.	*C. cockburnii*	-
65.	*C. exilis*	Rotan paku
66.	*C. padangensis*	-
67.	*C. spectatissimus*	Rotan semut
68.	*C. longispathus*	Rotan kunyung
69.	*C. peregrinus*	-
70.	*C. conirostris*	Rotan kerai

71.	*C. pycnocarpus*	Rotan kong
72.	*C. lobbianus*	Cucor kelabu
73.	*C. tomentosus*	Rotan tukas
74.	*C. blumei*	Rotan tukas
75.	*C. flabellatus*	-
76.	*C. flabelloides*	-
77.	*C. javensis*	Rotan lilin*
78.	*C. pandanosmus*	Rotan pandan wangi*
79.	*C. ornatus*	Rotan dok *
80.	*C. scipionum*	Rotan semambu*
81.	*C. speciosissimus*	Rotan sega badak
82.	*C. filipendulus*	Rotan batu
83.	*C. insignis*	Rotan batu*
84.	*C. penicillatus*	Rotan batu
85.	*C. senalingenis*	-
86.	*C. rugosus*	Rotan perut ayam
87.	*C. corneri*	Rotan perut ayam
88.	*C. tankadatei*	Rotan tekok
89.	*C. holttumii*	Rotan perut ayam
90.	*C. scabridulus*	Rotan kerai
91.	*C. radulosus*	-
92.	*C. concinnus*	-
93.	*C. siamensis*	-
94.	*C. viminalis*	-
95.	*C. moorhousei*	-
96.	*C. balingenis*	Rotan tanah
97.	*C. satulosus*	Rotan kerai
98.	*C. luridus*	Rotan kerai*
99.	*C. burkillianus*	Rotan kerai laut*
100.	*C. densiflorus*	Rotan kerai*
101.	*C. ridleyamus*	Rotan kerai*
102.	*C. diepenhorstii*	Rotan kerai
VIII	**Ceratolobus**	
103.	*C. subangulatus*	Rotan tapait
104.	*C. kingianus*	Rotan jere landak

Note : * commercially utilized species

APPENDIX 2

BAMBOOS FOUND IN MALAYSIA

	Botanical Names	Local Names
I.	**Bambusa**	
	1. *B. blumeana*	Buluh duri
	2. *B. arundinacea*	-
	3. *B. burmanica*	Buluh aloh bukit
	4. *B. vulgaris*	Buluh minyak
	5. *B. heterostachya*	Buluh galah
	6. *B. glaucescens*	Buluh pagar
	7. *B. ventricosa*	-
	8. *B. ridleyi*	Buluh akar
	9. *B. wrayi*	Buluh sumpitan
	10. *B. magica*	Buluh perindu
	11. *B. montana*	-
	12. *B. pauciflora*	Buluh padi
	13. *B. klossii*	-
	14. *B. texilis*	-
II.	**Dendrocalamus**	
	15. *D. pendulus*	Buluh akar
	16. *D. hirtellus*	Buluh kapur
	17. *D. elegans*	-
	18. *D. dumosus*	-
	19. *D. sinuatus*	Buluh akar
	20. *D. strictus*	-
	21. *D. asper*	Buluh betong/beting
	22. *D. giganteus*	Buluh beton
III.	**Dinochica**	
	23. *D. scandens*	Buluh akar

IV.	**Gigantochloa**	
	24. *G. apus*	-
	25. *G. maxima*	-
	26. *G. rostrata*	-
	27. *G. holttumiana*	-
	28. *G. hasskarliana*	-
	29. *G. levis*	Buluh bisa/beting
	30. *G. scortechninii*	Buluh semantan/rayah
	31. *G. wrayi*	Buluh beti/raga
	32. *G. ridleyi*	-
	33. *G. ligulata*	Buluh tumpat/tikus
	34. *G. latifolia*	Buluh pahit
V.	**Racemobambos**	
	35. *R. setifera*	-
VI.	**Schizostachyum**	
	36. *S. grande*	Buluh semeliang/semeyeh
	37. *S. gracile*	Buluh repen/akar
	38. *S. aciculare*	Buluh padi/akar
	39. *S. jaculans*	Buluh sumpitan/tikus
	40. *S. zollingeri*	Buluh nipis/aur
	41. *S. brachyladum*	Buluh lemang/nipis/padi
	42. *S. latifolium*	-
	43. *S. terminale*	-
VII.	**Thyrsostachys**	
	44. *T. Siamensis*	-

Note: * denotes commercially utilized species

Sabai grass (*Eulaliopsis binata*) used for rope making, thatching, and paper making in South Asia.

NEPAL

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INTRODUCTION

Nepal, situated between India and China, has an area of about 14.7 million hectares and lies at 80^0 04' to 88^0 12' E and 26^0 22' to 30^0 27'N. The country is rectangular in shape, extending from east to west. Within a north-south horizontal distance of about 150 kilometers, there is a climatic range from the sub-tropics of the Terai in the south to the upper tree limit and perennial snow of the Himalayan mountains in the north. Rugged hills and mountains cover more than 80 percent of the land. In the south, there is a belt of almost level land, 20 to 45 kilometers wide, known as the Terai, which is an extension of the Gangetic plain of India.

Nepal can be divided into five parallel physiographic zones running east to west: the Terai, Siwaliks, Middle mountains, High mountains, and High Himal. They occupy respectively 14, 13, 30, 20 and 23 percent of the total land area. Administratively, the country is divided into five development regions and 75 districts.

With its great range of altitudes, temperatures, and rainfall, and its position at the confluence of different floristic regions, Nepal has a rich flora. The number of eco-systems per unit area is probably greater than in any other country in the world. The distribution of vegetation generally follows the attitudinal zones.

The country's land use is categorized as follows:

- cultivated lands (21 percent)
- non-cultivated inclusions (7 percent)
- grasslands (12 percent)
- forested lands/plantations (37 percent)
- shrub lands/degraded forest (5 percent)
- other lands (18 percent)

In mid-1986, Nepal's population was estimated at 17.1 million. The medium-variant projection of the Central Bureau of Statistics puts the population at 23.6 million by the year 2001, which means an average annual growth rate of 2.2 percent.

A livestock survey conducted by the Department of Food and Agricultural Marketing Services puts the 1985 livestock population of the country at 6.4 million head of cattle, 2.8 million buffaloes, 8 million sheep and 4.9 million goats or an equivalent of 7.8 million livestock units (LU). The livestock population is expected to reach 11.6 million LU by 2001.

Development of the country is severely limited by its extreme range of topography and climate, especially in the geologically unstable and environmentally fragile mountain zones. More than 90 percent of the people rely on agriculture for their livelihood.

Industries, which contribute about 10 percent to the gross national product, provide employment to about 6 percent of the population. The current per capita annual income is estimated at US$160.

Biomass, including fuelwood, agricultural residues and animal dung, is the major energy source in Nepal, providing 94 percent of the total energy consumption.

Heavy pressure is being exerted on the forests of Nepal by the increasing population of both humans and livestock. As a result of this pressure, the forests have been reduced in area and are becoming increasingly degraded. As a consequence, the environmental quality of Nepal is deteriorating, and it has become increasingly difficult for people to find essential forest products. A vicious cycle is operating, where intensified pressure on forests creates environmental deterioration, which in turn leads to scarcity of forest products and further pressure on existing forests.

In early 1986, His Majesty's Government, put into operation the Master Plan for the Forestry Sector Project (MPFSP) to rationalize the forestry sector. MPFSP was co-financed by the Asian Development Bank and the Finnish International Development Agency. MPSFSP was charged with the formulation of a 25-year master plan for developing the forestry sector of Nepal.

The information and data for this country status paper on non-wood forest products in Nepal has been extracted from various MPFSP documents and reports.

IMPORTANT NON-WOOD FOREST PRODUCTS: PRODUCTION AND VALUE

Non-wood forest products, also called "minor" forest products by classical definition, are all forest products other than timber and fuelwood. In Nepal, fodder is not regarded as a minor forest product, being one of the main products of the forests. Subsistence farmers make up more than 90 percent of the population of Nepal and rely on livestock for their agriculture-based livelihood. Fodder for livestock is as important to a subsistence farmer as any other forest commodity. Fodder is thus a "major" forest product in Nepal and therefore not included in descriptions and analyses of non-wood forest products in Nepal.

The significant NWFPs in Nepal are medicinal and aromatic plants, loktapaper, pine resin, Sal seed, katha, sabai grass, bamboo and cane.

Medicinal and aromatic plants

There are about 700 species of medicinal and aromatic plants in Nepal, about 12 percent of the country's vascular flora. They are distributed in all ecological zones of the country, but a greater concentration occurs in the tropical and sub-tropical zones.

Collecting of medicinal and aromatic plants has been going on in Nepal since time immemorial. A small portion of the plants collected is used locally in the treatment of diseases, but about 90 percent are sold as crude herbs, mainly for export. The trade in crude herbs goes through four tiers: collectors, local dealers, big dealers and international trading houses.

The poor people of the hills and mountains of Nepal depend upon medicinal plants for their health care in accordance with their cultural heritage and traditional practices. Domestically, primarily in auyervedic preparations, the value of herbs was estimated at Rs600,000 in 1986.

Lokta for hand-made paper

Daphne spp., locally known as "lokta," has been used as raw material for hand-made paper for a long time. It is the basis for an expanding cottage industry with an annual turnover of around Rs10 million. The industry provides direct employment for about 1,500 families, some of them the poorest of the poor, living in remote, backward areas.

The growing stock of lokta was estimated at about 100,000 tons in 1984. Not all of the growing stock is harvestable, as the bulk of it grows in remote and difficult to access areas.

Resin and turpentine

Resin has been tapped from pine trees for several decades in Nepal, and has great economic significance. It provides raw materials for domestic use and for the rosin and turpentine industries recently established in the country. Oleoresin gums are obtained from the native chir pine (***Pinus roxburghii***) and blue pine (***Pinus wallichina***). Only chir pine can be tapped economically, yielding about 3 to 5 kilograms annually per tree. Blue pine, which occurs at higher altitudes yields only about 1 kilogram annually per tree and is therefore usually not profitable to tap.

The estimated potential production of pine resin in Nepal is 21,700 tons per year on a sustained-yield basis. Too little is known about the real production capacity of Nepalese pine forests. A revised and well-studied assessment of the resource is needed, to be followed by a sound management plan.

Rosin and its derivatives are used in paper making, sizing, boot polish, adhesives, paints, printing inks, surface coatings, varnishes, textiles, rubber making, soap making, the tire industry, the sporting goods industry, and many others. Local production has provided much needed income to collectors in rural areas, and reduced the need to import rosin and turpentine. The primary producers on average receive Rs2 per kilogram, which is only about 10 percent of the total product value.

Sal seed oil

Aside from being a major source of building timber, sal (***Shorea robusta***) is a prolific producer of seeds. Sal seed has a high oil content and the oil extracted from it has many industrial and household uses.

The actual authorized and unauthorized collection is only about 41,000 tons per year, only 6 percent of the potential, based on the Indian yields. Sal seed is collected in Nepal by four oil industries which receive quotas for monopoly collection in specific areas. Most industries collect through a network of small contractors who bring the pods in tins. Each tin usually contains about 10 to 12 kilograms of pods and the collectors are paid Rs3 to 3.50 per tin (about Rs0.40 to 0.50 per kilogram). Each tin of pods yields about 7 kilogram of seeds (about 62 percent of actual pod weight).

A comprehensive study related to collection, processing, and marketing is needed.

Katha and Cutch

Katha is an extract derived from the hardwood of khair (***Acacia catechu***) by boiling. It is a clay-colored crystalline substance used in the preparation of "pan," a chewing material popular in Asia and East Africa.

Cutch, a by-product of katha production is a black reddish gum resin which is used in tanning, dyeing and as a lubricant in oil-well drilling. It is also traditionally used for making medicines.

The future of the country's six katha plants will depend on the availability of khair, a rapidly vanishing riverine tree. The sustainable annual yield of khair from Terai forests has declined from 26,000m^3 in 1979 to about 8,400m^3 in 1988, while the total annual quota of the six plants is almost 38,000m^3.

The market for most of Nepal's katha is Kanpur, India where the price of katha varies from Rs80 to Rs250 per kilogram and the price of cutch varies from Rs6 to Rs13 per kilogram. The price of adulterated katha in Delhi can be as low as Rs26 per kilogram.

Sabai Grass

Sabai grass (***Eulaliopsis binata***) is traditionally used in rope making and thatching. For paper making, sabai is reputed to be superior to most other available grasses. In India it has been used for paper making since 1870.

Although industrial paper making in Nepal is new, small paper mills have been operating since 1986. These paper mills have been designed to take sabai grass and straw as raw material. These mills have a combined capacity of about 70 tons per day.

A country-wide data base on annual production of sabai grass does not exist. Based on studies carried out in a few districts, the quantity which may be available for commercial purposes in the Terai and Siwaliks could be about 300,000 tons of air dried material per annum.

The Forest Survey and Research Office has estimated the cost of sabai grass for the Nepal Paper Industries Ltd. at Rs1.71 per kilogram. This was made up of Rs1.00 to collectors, Rs0.36 for transport to depot and Rs35 for transport from depot to factory.

Rope-making machines have been widely introduced in some villages bordering India and it is estimated that nearly 75 percent of the sabai grass being harvested for this purpose. There are ready buyers from India who will pay Rs31.00 for 5 kilograms of rope.

Bamboo and cane

Bamboo and cane are used extensively by Nepalese for fodder, to make traditional baskets, mats and furniture, and for building in rural areas. The habitat of commercially exploitable bamboo and cane has been reduced to the brink of disappearance.

There are still few scientific data on the identification, distribution, uses, and development prospects of bamboo, although this multiple-use plant is an integral part of Nepalese life.

EXPORTS OF NWFPs

Data on Nepal's NWFP trade vary considerably from one source to the next. According to Trade Promotion Center figures, Nepal annually exports more than 90 percent of its crude drug harvest, which was worth Rs16.5 million in 1986-87. A 1986 FAO estimate shows that the annual export of medicinal and aromatic plants totals more than 1,000 ton worth approximately Rs 31 million, but the data sources are not known. Data obtained from the Foreign Trade Statistics of the Department of Customs, Ministry of Finance, show that 6,263 tons of medicinal plants were exported in 1985-86, worth Rs78 million. Ministry of Finance data show a significant decline in exports in 1986-87, however, to only 361 tons, valued Rs17 million. This decline is due to the imposition of a ban on the export of crude drugs in 1986. It is suspected, however, that a large volume of crude drugs are still be exported unofficially, especially to India.

Exporting large quantities of medicinal plants and crude drugs are not possible because regeneration cannot occur fast enough. The export of medicinal and aromatic plants has diminished during the last decade and product quality has declined. The uneven and often poor quality of the products is another reason.

Hand-made paper from lokta is used for a variety of purposes, from legal documentation to record-keeping papers, religious scriptures, file folders, envelopes, greeting cards, and calendars. The total domestic consumption as office paper comes to about 7.4 million sheets annually, or about 185 tons. Other end-users consume the remaining 115 tons. Handmade paper is only exported in small quantities. From 1981 to 1985, UNICEF purchased about 1.6 million sheets for greeting cards. The value of exports of hand-made paper has varied between Rs0.2 million and Rs1.2 million between 1982 and 1986.

There is no significant export of rosin and its derivatives from Nepal. Whatever is tapped is used domestically. If the paper industry grows according to the projected demand for printing and writing papers up to 21,700 tons per year, 945 tons of rosin derivatives would be required. If the other resin-consuming industries grow at an annual rate of 5 percent, they will consume 2,900 tons of resin derivatives. Thus the Nepalese consumption of rosin and its derivatives could increase to about 4,000 tons by the year 2010. This means that if the rosin industries expanded to the full capacity that could be sustained by the resource base, there should still be about 1,900 tons of rosin and over 2,550 tons of turpentine available for export. The markets for these volumes must be found in nearby countries. In the world market, resin products are readily available from big pulp mills which produce them as by products without raw material collecting costs.

Four of the seven oil extraction plants in the country have agreements with the Department of Forests to procure 26,000 tons of sal seed annually. Industry sources claim that 2 million person-days are employed in the harvest season and that Rs15 million are paid to the collectors. Sal fat is used as a partial substitute for cocoa butter in Japan, West Germany, Switzerland and Italy. Large quantities of sal fat, either crude, neutralized or dry fractioned, have been exported to the United Kingdom, Japan and some other countries since 1970. Studies documenting export quantities and their values have not been carried out.

According to the Trade Promotion Center and Department of Customs, the production of katha and cutch has fluctuated between 1,100 and 1,700 tons per year between 1980 and 1985. In 1983-84 Nepal exported 1,591 tons of katha and cutch, mainly to India, worth Rs60.6 million. Total export value may still remain about the same because rising prices have compensated for decreasing quantities.

Although the Indian paper industries have been using Nepal's sabai grass for a long time, after the establishment of paper industries in Nepal the Indian industries have been discouraged from purchasing Nepalese sabai. Thus there is now no significant export of sabai.

Bamboo and cane are used traditionally in Nepal. At present there is no significant export of bamboo from Nepal. A long-term development program under the Ministry of Industries has been proposed to provide raw materials for cottage industries and to contribute to the basic needs policy of HMGN.

COLLECTION AND PROCESSING OF NWFPs

In general, non-wood forest products are an unorganized part of the economy in which the primary producers are at the mercy of the traders. The price paid to the primary producers has no relation to the wholesale price at the terminal market. The share of the primary producer may be as little as 25 percent of the terminal wholesale price, although in most cases only transport costs are involved, and there is no additional processing. Only a few products, including sal seed, resin, sabai grass, and khair are linked to processing industries in Nepal. There is no monitoring system nor government intervention agency which could ensure a more equitable price to the primary producer.

There is no development plan for non-wood forest products in Nepal as a whole, and there is no special agency dealing with them. Medicinal and aromatic herbs are a notable exception, but even in this area little has been done to organize or regulate the collection of plant materials from the forests.

The entire sub-sector of non-wood forest products, has not received the benefit of an integrated development approach. The economic plight of the primary producers, conservation of the ecosystems that constitute the resource base, management plans for regulated extraction, and improvements in trading and processing all need to be considered as parts of the whole system.

Lokta is the only NWFP for which an effort has been made to provide a better price to the primary producers, to regulate harvesting for sustained yield, to introduce better technology for procurement and to add further downstream value by secondary industries. Most of these activities have come as a result of UNICEF initiatives.

With the exception of medicinal and aromatic plants and lokta, there has been no assessment of the resource base, even for important NWFPs. No studies have been made on the collection and trading.

EMPLOYMENT AND SOCIAL BENEFITS FROM NWFPs

For most minor forest products, private-sector trade and the law of supply-and-demand controls the price and market

network. The system is a traditional one, based on traders financing the collectors during lean periods. The traders buy everything the collectors bring, as they know the terminal markets and the current prices. The collectors want both to earn cash and to purchase essential commodities. The traders commonly supply collectors these goods in advance, on credit, and thereby gain a hold over them.

Various agencies of the government seem to be unaware of the predicament of the primary producers or collectors. Collectors get Rs0.60 per kilogram for sal seeds, for example, while their counter-parts in India, some 300 kilometers away, receive three times as much. Resin tappers get Rs1.50 to Rs2.00 per kilogram, which again is about one third of the rate paid in India. Sabai grass collectors get Rs0.40 per kilogram when they sell for delivery to the Bhrikuti Paper Mills in Nepal. The factory rate price at the Bhrikuti Paper Mills, however, is supposed to be Rs1.25 per kilogram.

FUTURE DIRECTIONS TO PROMOTE NWFP

The Master Plan for Forestry Sector Project (MPFSP) has formulated basic objectives for the development of the minor forest products sub-sector. These are:

- to increase the supply of essential commodities like drugs derived from medicinal and aromatic plants;
- to provide opportunities for the rural people to earn income;
- to gradually shift from dispersed collection to plantations and to systematic resource management; and
- to add value to the products through processing so that a part of the benefit flows back to the primary producer, and so that the entire country may benefit in economic terms.

It is recognized that at the operational level, there must be a correct inventory and evaluation of resources, and there must be a management plan to harvest these resources on a sustained-yield basis. It is also recognized that it is necessary to build up organizational structures (intervention and operational agencies) which can assist the private sector in developing production and processing systems, and guarantee that a fair share of the benefit goes to primary producers.

Criteria have been established to identify priority NWFPs for development. Criteria have also been set for the selection of new commodities that have importance to the national economy and will provide income to the collectors.

A phased development program for the sub-sector has been proposed. The program is based on a common plan for developing production, processing, and marketing systems for medicinal and aromatic plants and other minor forest products and strengthening institutional support including policy reform, resource assessment, research and development, and extension.

Resin extraction from chir pine (*Pinus roxburghii*).

PAKISTAN

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INTRODUCTION

Pakistan has limited, but diverse, forest resources spread over an area of 4.37 million hectares, or about 5 percent of the country's total area. Areas under different forest types in the country are shown in Table 1.

Table 1. Distribution of forest types in Pakistan

Forest type	Area (1,000 ha)	Percent of total
Coniferous forests	1,870	43
Scrub forests (dry sub-tropical broad leaved and tropical thorn forests)	1,683	39
Irrigated plantations	200	4
Riverine forests	290	7
Coastal mangroves	283	6
Others (linear plantations mazri, etc.)	40	1
Total	4,366	100

Source: FAO/RAPA, 1987

In addition to the natural and man-made forests mentioned above, considerable tree growth exists on farmlands. According to a recent survey, the farmlands in the North West Frontier Province (NWFP) alone carry a total growing stock of 80 million trees (14 million cubic meters), i.e., 46 trees or 8 cubic meters per hectare (Amjad, 1990). Results of the survey in other provinces have not yet been compiled.

The forests in Pakistan, besides providing timber, firewood, water, wildlife and recreation, also supply products known as "minor forest produce" in the official terminology of the Forest Department. These include the following:

A. Food products

- Morels
- Honey
- Wild fruits and nuts
- Vegetables
- Condiments

B. Medicinal plants

C. Industrial products

- Resin
- Babul bark
- Bhabar grass

D. Fibers (e.g. mazri leaves)

E. Silk cocoons

F. Miscellaneous products

Soap-nut
Walnut bark
Palosa gum
Neem leaves

The importance of these products cannot be over-emphasized as they provide job opportunities to a large number of rural people (Iqbal, 1991). They also augment the meager income of rural poor (Sheikh and Hafeez, 1977). Some of them, such as morels, are an important source of valuable foreign exchange. The term "minor forest produce" is therefore misleading because the products are not minor at all in their economic significance.

The initials of the term "non-wood forest products" are the same as those of the, North West Frontier Province. Therefore, the term non-timber forest produce (NTFP) has been adopted for this paper. It implies all the tangible products produced by forests, other than timber and firewood, which are used by people. In the stricter sense, the term should include wildlife and bush meat, but these have not been covered in this paper.

FOOD PRODUCTS

Morels

A variety of black mushrooms or morels (*Morchella esculenta, M.conica, M. anqusticipt,* etc.), grow naturally in the temperate forests of Pakistan between 1,800 and 3,000 meters above sea level. About 50 tons of dried morels are collected each year by about 150,000 forest dwellers, mainly children and women.

The morels are purchased by local grocers or roving purchasers who sell them to dealers in nearby towns. The dealers sell the morels to wholesalers in Mingora, Rawalpindi and Peshawar. From the wholesalers the mushrooms go to big cities such as Karachi, Lahore and Islamabad. Some of the wholesalers in Minogora are exporters as well.

The entire quantity of morels is exported, generating Rs130 to 150 million (1US$ = Rs.25)in foreign exchange (Shah, 1991). Except for drying, de-stalking, grading and fumigating, no further processing is involved. To increase the supply base, technology for their cultivation needs to be developed and standardized for the benefit of the forest dwellers (Iqbal, 1991).

Honey

Honey collected from wild beehives is an important source of nutrition, as well as income for forest dwellers in the country. Between 55 to 65 tons of honey are collected each year in the country from wild beehives by about 15,000 persons (Ahmad and Muzaffar, 1987; Iqbal, 1991).

Traditional beekeeping by rearing colonies of Oriental bees (*Apis cerana*) in earthen pots and log hollows fixed in the walls of the houses is popular among women living in remote forest areas in the north and northwest parts of the country. The number of these beehives is 35,000 to 40,000, producing about 50 tons of honey. The honey is sold to local grocers at Rs60 to 80 per kilogram. An average colony yields 4 to 5 kilograms of honey, but 35 to 45 percent of the colonies are sub-standard and produce little or no honey (Ahmad and Muzaffar, 1987).

A recent survey (Iqbal, 1991), observed that Oriental bees do not colonize the hives as frequently as they did 10 to 12 years ago, possibly because the local bees are unable to compete with the 20,000 colonies of European bees (*A. mellifera*) brought by the Afghan refugees into the tracts. Consequently, natural populations of the local bees have dwindled. To overcome the problem and to augment income of the rural women, it is recommended that modern beekeeping with European bees should be introduced among the traditional beekeepers (Iqbal, 1991).

The entire production of honey is used within the country as food and in a number of medicinal formulations. Although modern beekeeping is gaining popularity in the country, the demand for honey cannot be met and honey worth Rs3 to 4 million is imported each year.

Wild fruits and nuts

A variety of wild fruits and nuts is collected by forest dwellers, both for domestic consumption and for sale. Some of the important ones are discussed below:

Pine nut: Roased seeds of *Pinus gerardiana*, locally known as chalghoza pine, are a popular dried fruit. Natural forests of pine occur in the dry temperate zone in Waziristan, near the Pakistan-Afghanistan border and in some parts of Baluchistan and the NWFP. A tree yields 20 to 40 kilograms of nuts. Total production in the country is estimated 21,000 tons of which 95 percent comes from Baluchistan.

Seeds are collected from the still-green cones by climbing the trees and wrenching off the cones with hooks attached to long poles. The cones are then buried for about a fortnight until they open. The seeds are then extracted by striking the cones against a hard surface.

The pine nuts are roasted by mixing them in a special kind of soil in iron containers placed over fire. The roasted nuts are sold at Rs1,500 per 40 kilograms. Total value of produce is about Rs37.5 million per year.

In addition to domestic consumption, the pine nuts are exported to the Middle East. Information on the export of pine nuts during the last five years is given in Table 2, which indicates that about 271 tons of pine nuts are exported each year, fetching Rs6.3 million.

Table 2. Export of roasted pine nuts from Pakistan

Year	Quantity (tons)	Value (1,000 Rs)	Unit value (Rs/kg)
1986	768	11,131	14.49
1987	234	6,996	29.78
1988	105	2,800	26.59
1989	122	4,063	33.28
1990	125	6,719	53.72
Average	271	6,342	31.57

Source: Monthly statistical bulletin, Federal Bureau of Statistics, Statistics Division, Govt. of Pakistan

Walnuts: Walnut (***Juglans regia***) kernels are a favourite dry fruit in the country. Walnut trees grow naturally between 1,500 and 3,000 meters in the northern and northwestern mountains. In cultivated form, they grow at about 1,000 meters. Production is about 20,000 tons per year. The bulk is produced in NWFP and Azad Kashmir. The average wholesale price is Rs 10 per kilogram. The total annual value of the produce is about Rs200 million. The average number of walnut trees per household is 5 and average production per

tree is 115 kilograms (Iqbal, 1991). About 35,000 families are involved in walnut production. The entire production is consumed within the country.

Wild persimmon: The wild persimmon tree (***Diaspyros lotus***) grows naturally between 600 and 1,800 meters in the north and northwestern mountains. The fruit is purple, globoid or ovoid, and 12 to 20 millimeters in diameter, is sweet, and can be eaten fresh or dried. Semi-dried fruits are collected from the trees in November and December. An average tree yields 120 kilograms of dry fruit. Total production is estimated at about 800 tons (Iqbal, 1991), most of which comes from NWFP. Actual production is more, but not all of it is collected. Most of the fruit goes to waste. The number of households involved in collecting persimmon is about 2,000 (Iqbal, 1991).

The current wholesale price is Rs3.50 to 3.75 per kilogram and the total value of the produce has been estimated to be Rs2.8 to 3.0 million.

Wild persimmon is considered an inferior fruit. It is perishable and deteriorates in storage. All of it is consumed domestically.

Other wild fruit: Small quantities of wild fruit such as gurgura (***Reptonia buxifolia***); deela (*Capparis aphlla*), pelu (*Salvadora oleoides*), jujube (*Zizyphus spp.*), sumal (*Berberis lycium*), guch (*Viburnum nervosum*), wild fig (*Ficus glometra*) and mulberry (*Morus alba*) are collected by men, women and children for domestic use, often eaten on the spot. The wild fruit is collected by graziers in the forests. Occasionally small quantities appear in local towns for sale (RAPA, 1987).

Vegetables

Kachnal: Unopened flower buds of the tree, ***Bauhinia variegata***, are collected as a favorite vegetable. The tree is cultivated in plains and sub-mountainous tracts. Flower buds which appear from March to April are collected by climbing the trees 2 to 3 times a season. Collection of individual buds from a tree is a tedious process.

An average tree yields 20 to 25 kilograms. Total production in Pakistan is estimated to be 30 tons, of which 20 tons are produced in NWFP. Wholesale price is Rs5 to 10 per kilogram. The vegetable is cooked fresh as well as in dried form. All of it is consumed within the country.

Suhanjna: The drumstick, or horseradish, tree (*Moringa oleifera*), locally known as "suhanjna," is cultivated on a limited scale in irrigated plains of the country primarily for its partially opened inflorescences. These are eaten as a vegetable. There is a small supply of about 10 tons, which is used domestically. Prices average Rs 7 to 8 per kilogram.

Kunjai: (*Dryopteris felix-mas*) is a male fern which grows in moist temperate forests in the country at 1,500 to 3,000 meters. Women, while going to forests for grazing livestock or collecting firewood, collect the fern. It is available from mid-April to mid-May. Total production is 15 to 20 tons (Iqbal, 1991), all of which is used locally. Average retail price is Rs7 to 8 per kilogram.

Condiments

Wild pomegranate seeds: Dried seeds of wild pomegranate (***Punica granatum***), locally known as "anar dana," are widely

used in cooking to develop a sour taste in dishes. They also have medicinal properties. The tree grows naturally in sub-mountainous tracts of the country from 900 to 1,800 meters. Flowers appear in April and May and the fruit is ready for harvesting in September and October. An average tree yields 15 to 25 kilograms of fresh fruit.

Total production of the fruit is about 250 tons, of which two-thirds comes from NWFP and one-third from the Punjab. The fruit yields 90 to 95 tons of dried seed and about 100 tons of skin. The skin is used by tanneries in Punjab.

Production of fresh pomegranate fruit is estimated at 35 kilograms per household (Iqbal, 1991). About 6,000 to 7,000 families collect wild pomegranate fruits. The seeds are extracted by about 150 to 200 old women who work in the warehouses of dealers. The women generally do not like the work because it stains their hands.

The entire production of Pakistan is consumed within the country. It is not enough to meet local demand and some quantities are imported from Iran. The Iranian anar dana is, however, of inferior quality because of its sweetish taste and is mostly used in pharmaceutical preparations by local Greco-Arab pharmacies.

Caraway: (*Carum carvi*), known locally as "zeera siah," is widely used to flavor bread, biscuits, cakes and cheese. It is also an ingredient of pickling spice. It is a mild stomachic and carminative, occasionally used for flatulent colic and as an adjuvant or corrective for medicines (CSIR, 1950).

The plant is a perennial herb with thick tuberous roots. It grows wild in dry temperate regions of the country. The fruit is collected before ripening. The plants are dried and fruits are thrashed out, cleaned, and stored in bags.

Total production is about 300 tons (Khan, 1985), all which is consumed locally. Wholesale prices range from Rs160 to 180 per kilogram.

MEDICINAL PLANTS

Because of its varied environment, Pakistan is rich in medicinal herbs. The country's list of plants is quite long (Zaman and Khan, 1970), but all of the plants are not exploited commercially. A survey conducted by the Pakistan Forest Institute records 320 medicinal plants, growing in different ecological zones (RAPA, 1987). A list of commercially important medicinal plants is provided in Table 3.

All these plants grow wild and no effort has been made to cultivate them. Pakistan Forest Institute has standardized the methodology of cultivation of a number of important medicinal herbs (Khan and Zaidi, 1989)

Methods of collection

The collection of medicinal plants is controlled by the Forest Department. Three methods of collection are practised (Iqbal, 1991; RAPA, 1987; and Khan, 1985):

- Leasing the area for collection of medicinal herbs. This method is used in the Hazara forests in NWFP.

- Collection by the traders from local people who pay nominal royalties to the Forest Department. This method is common in the Malakand forests in NWFP.

Table 3. Commercially important medicinal plants collected from forests in Pakistan

Name	Botanical name	Part used	Estimated quantities extracted annually (tons)	Price (Rs/kg)	Export potential; comments
Mushk-e-Bala	*Valeriana wallichii*	Roots	300-400	40-50	About 150 tons exported to Hong Kong and Germany @Rs. 40-50 per kg.
Persoshan (maiden hair fern)	*Adiantum capillus*	Whole plant	100-125	6-8	About 15-20 tons exported to Germany each year. Extraction can be increased up to 1,000 tons per year.
Anjabar	*Polygonum amplexicule*	Roots	40	10	-
Unab	*Zizyphus vulgaris*	Fruits	30-40	10-12	-
Hub-al-as (Munru)	*Myrtus communis*	Fruits and leaves	40-45	40	-
Banafsha	*Viola serpens*	Flowers Leaves	30 40	100-240 15	Upto 200 tons can be collected easily
Suranjan-e-Telkh	*Colchicum luteum*	Corms Seeds	12 2	60 125-150	Entire quantity is exported to Germany, South Africa, France and Bulgaria
Ban Kakri	*Podophyllum emodi*	Rhizomes and roots	30-60	40-45	Exported to Belgium
Kamila	*Mallotus philippensis*	Fruits	4-5	40-50	-
Mamekh	*Paeonia emodi*	Rhizomes	18	22	-
Afsantine	*Artemisia maritima*	Leaves/ shoots	100-150	15	-
Ajwain	*Carum copticum*	Seeds	200	15	-
Chiraita	*Swertia chirata*	Twigs	30	28	-
Wirch	*Acorus calamus*	Roots	10	24	-
Darhald or Meda Chob	*Berberis lycium*	Wood Roots	600 120	10 14	- -
Khurasani	*Hyocyamus niger*	Seeds	2	20	-
Ajwain Khaksir	*Sisymbrium irio*	Seeds	50	10	-
Ajwain	*Carum copticum*	Seeds	200	15	-

Zeera Siah	*Carum carvi*	Seeds	10	160-180	-
Bermi Booti	*Centella asiatica*	Whole plant	12	32	-
Meetha Teela or sufaid Mori	*Aconitum chasmanthum*	Roots	4	25	-
Atis	*Aconitum hetero phyllum*	Roots	2	250	-
Kaniz (Yam)	*Dioscorea deltodea*	Rhizome	230	16	Kurram Chemical purchases it @Rs 4-5 per kg. Also reported to be exported to Japan
Angoor shefa (Belladona)	*Atropa acuminata*	Whole plant	10	12	-
Barg-u; Azra (Foxglove)	*Digitalis purpurea*	Whole plant	10	10	-
Bhaikar	*Adhatoda vasica*	Leaves	20	5	-
Bhang	*Cannabis sativa*	Whole plant	20	10	-
Panir Dodi	*Withania coagulans*	Fruit	125	5	Khyber Agency, Waziristan
Asgand	*Withania sominfera*	Roots	32	35	Naziampur, Peshawar Exported to India
Amaltas	*Cassia fistula*	Pods	150	15	Haripur and Gadoon
Baid Mushk	*Salix alba*	Bark	10	18	Mardan, Peshaw Swabi, Rustam
Jangli piaz Scilla	*Urginea indica*	Bulbs	6	30	Rustam, Kot, Buner
Indrayan (Colocynth)	*Citrulus colocynthus*	Fruits	12	9	Risalpur, Nizampur, Peshawar
Asmania	*Ephedra nebrodemsis*	Twigs	780	43	Baluchistan

Source: Iqbal, 1991 and Khan, 1985

- In Azad Kashmir, the Forest Department auctions off fixed quantities.

The method adopted in Malakand forests has given encouraging results. It is flexible and competitive because of the absence of unnecessary controls of the Forest Department. As a result, Mingora has emerged as one of the biggest trading centres of medicinal herbs in the country. Some of the traders in Mingora also export medicinal herbs.

Role of forest dwellers

Collection is done by the forest dwellers living in remote valleys, people who go to forests to graze their livestock, cut grass, collect firewood and mushrooms. Akram and Sabir (1990) describe the process of collecting:

"It is an unusual observation, while having tea in a way-side hotel in the mountain range of Himalaya in Pakistan that workmen descending from a hill top with a load of firewood, hand over a small collection of mushrooms or a bundle of Swertia herb to the shopkeeper. The tea shopowner, when asked about the fate of the herb, took us inside a spacious mud room, used as a store, where jute bags full of dried Swertia were kept for an expected buyer."

A survey by Iqbal (1991) in NWFP, found 21,000 men, women and children involved in collection of medicinal herbs. No such information is available for other parts of the country.

Marketing

The herbs are sold either dried or fresh to the local grocers who sell them to wholesalers. The wholesalers sell them to the pharmaceutical concerns or to exporters.

Processing plants

There is only one state-owned processing plant, Kurram Chemicals Ltd., in Rawalpindi. It uses ***Artemisia martitima***, yam roots (***Dioscorea deltoidea***) and ***Ephdedra nebrodensis*** as raw materials to extract alkaloids. The factory, which used to process 100 tons a year, stopped using ***Artemisia maritima*** two years ago because of the availability of synthetic substitutes. The factory has capacity to process 560 tons of yam root to extract diosgenin, but it was only able to procure 240 tons last year. The yam roots are purchased at the factory gate for Rs5 per kilogram.

The factory is also capable of processing 1200 tons of ***Ephedra nebrodensis*** into ephedrin each year. All of its supplies come from Baluchistan, where the plant contains 0.7 to 1 per cent ephedrin. Extraction is done between September and October each year, when the Forest Department gives out contracts. Contractors supply the material to the factory at Rawalpindi. The extraction charges established by the contractor and the department are paid by the factory management to the contractors. Moreover, an amount of Rs5 per kilogram is also paid by the factory management to the forestry department in royalties. During 1990, the factory paid Rs0.95 per kilogram to the contractors in additon to paying Rs5 to the department as royalty. Thus, total cost of raw material was Rs1.08 per kilogram. During 1990, total supply of the plant to the factory was 780 tons, 65 percent of its

installed capacity.

Recommendations

All medicinal herbs in the country are obtained from the wild. There is no cultivation and no efforts are made to replenish sources. As a result, production of plants such as ***Valerina wallichii*** and ***Dioscores deltoidea*** has declined. To ensure a sustainable supply of medicinal herbs, cultivation of important medicinal herbs in forest areas should be encouraged, particularly those with export potential. For this purpose, long-term leases should be given to interested parties.

The Pakistan Forest Institute has developed technology to cultivate some of the commercially important medicinal herbs (Khan and Zaidi, 1989). These results need to be disseminated among the forest dwellers along with other extension services. The supply base needs to be widened to increase job and income opportunities for forest dwellers. This can be achieved by including cultivation of medicinal herbs in social forestry programs.

In light of the success of the experience in the Malakand Forest, that model should be replicated in other places in the coutnry to encourage collection and to develop the trade to the advantage of forest dwellers.

INDUSTRIAL PRODUCTS

Resin

Resin is obtained by tapping the chir pine (***Pinus roxburghii***) trees. Chir pine forests occur primarily in the Punjab (60,000 hectares), Azad Kashmir (60,000 hectares), and the NWFP (80,000 hectares).

Method of extraction: The French method of resin tapping, introduced in 1888, is still in use. Trees under 30 centimeters in diameter are not tapped. Trees between 30 and 57 centimeters are given 1 blaze and those above 57 centimeters are given 2 blazes.

When a tree is tapped for the first time, a 20-centimeter broad cut is made about 15 centimeters above ground level. A thin sheet of iron, 15 centimeters long and 5 centimeters wide, is hammered into this cut to form a lip. Above the lip a 15 x 12 centimeter gash is made in the wood. This is called a "channel," or "blaze." An earthern pot is hung below the lip to collect the resin. The blaze is freshened every week. At each freshening, the length of blaze is increased by about 0.8 centimeters. The process continues for about 5 years, after which a new blaze is started about 15 centimeters to the left of the old one. At each freshening of the blaze, the resin from the clay pot goes into an empty kerosene tin. The tins are transported to roadside depots and from there to the resin processing factories. This method yields 1.5 to 2 kilograms of resin per tree each season (Sheikh and Hafeez, 1977).

The operation of resin tapping is carried out manually with small hand tools. It is seasonal and lasts for 7 to 8 months from March/April to October/November. The work is labor intensive and affords job opportunities to some 2,000 workers (Khattak and Amjad, 1981.)

One problem is that extraction contractors are not careful in making blazes and as a result many trees are damaged. The situation is exacerbated when the resin blazes catch fire and valuable butt logs are scarred and damaged (Iqbal, 1980). For these reasons,

the Forestry Department in Punjab has stopped resin extraction and its rosin factory at Jallo has been closed.

Resin extraction and processing are controlled by the Government through its Forestry Departments.

The average production of crude resin during the last 10 years is 4,132 tons (Table 4).

Table 4. Production of crude resin in Pakistan (tons)

Year	Azad Kashmir	NWFP	Punjab	Total
1981	2,697	1,350	1,200	5,247
1982	2,369	1,163	1,105	4,637
1983	2,371	1,714	937	4,022
1984	1,870	1,021	991	3,882
1985	1,448	780	1,320	3,548
1986	2,151	1,092	1,318	4,562
1987	2,098	887	1,659	4,644
1988	2,180	653	604	3,437
1989	2,318	887	-	3,205
Average	2,167	950	1,142	4,132

Source: Amjad and Khan, 1990; Records of Rosin and Turpentine Factory, Haripur (NWFP)

Processing facilities: Crude resin is processed to produce rosin and turpentine. The yield of rosin from crude resin is about 65 to 75 percent and of turpentine 15 to 20 percent. At present, only one state-owned factory, at Haripur in NWFP is producing rosin and turpentine. The capacity of the factory at Haripur is 3,600 tons, but it is running at one-third capacity because of a shortage of resin.

The importation of synthetic rosin, which is cheaper than domestic rosin, has further set back the processing plants and the closure of the Haripur factory is being considered.

Extraction costs Rs3 to 4 per kilogram and for Rs6.70 per kilogram in NWFP and Rs11.55 per kilogram in Azad Kashmir. The wholesale price of rosin and turpentine is Rs28.82 per kilogram and Rs27.08 per liter, respectively, at the factory gate.

Vegetable tanning

Bark or "babul" (*Acacia nilotica*) is the principal agent used in vegetable tanning of hides in Pakistan. The bark is obtained as a by-product when the trees are felled. It is separated from logs by beating them with wooden mallets and the strips are dried in the open and sent to tanneries. The proportion of bark to wood is 1:5 by weight and a plantation of 25 trees per acre, when 15 years old, may yield about 5 tons of bark (CSIR 1950).

Tannin content of bark varies from 7 to 20 percent. The bark from old trees and main stems, though richer in tannin, is inferior to the bark from branches and young trees because the latter has a low proportion of non-tanning coloring substances.

The leather produced by babul bark possesses firmness and durability, but it exhibits harshness and is dark colored. Babul bark is bulky and its tanin content is comparatively low (Trotter, 1940).

Recently, farmers in some parts of Punjab (Sargodha, Jhang and Faisalabad) have started raising babul plantations around their crops. They harvest the plants after 2 years and extract the bark. The bark is sold to the crushing plants at Rs1.00 to 1.25 per kilogram. The crushing plants sell the crushed bark to the tanneries at Rs1.75 per kilogram. Thus the status of bark has shifted from being a by-product to being a main product.

About 210 kilograms of crushed bark are needed to produce 100 kilograms of leather (5 hides). Total annual production of vegetable-tanned leather in the country is estimated at 40,000 tons. The tanneries are concentrated in Punjab (Wazirabad, Qusur, Gujranwala, Sialkot, Daska and Pasrur). Annual consumption of babul bark is estimated at 84,000 tons. Potential production of the bark is more than that, but not all of it is currently extracted.

The vegetable tanning process has also been set back because of availability of the synthetic tannin. A number of tanneries have been closed or have shifted to synthetic tanin. There is, therefore, not much hope for expansion of this cottage industry. Furthermore, the bark is not exported because of its bulk and the availability of synthetic tanin. Nearly all leather produced by vegetable tanning is used domestically.

Bhabar grass

Bhabar or Sabai (***Euliopsis binata***) is a tufted perennial grass. It grows on dry and bare sub-mountainous tracts in Torai Shinai (Kohat), Nizampur and Parang Ghar (Mohamand Agency) in NWFP. The grass is hardy, surviving both frost and drought and is light demanding. Sabai grass is harvested annually in November and December. Yields vary from 20 to 75 maunds (1 maund = 82.3 pounds) per acre, depending upon locality, rainfall and intensity of management (CSIR, 1950).

Sabai grass, when carefully collected and free from weeds and foreign material, yields medium-quality writing paper. It is singularly homogenous in quality throughout the whole plant. Even the nodes are digestable and consequently it is reduced to a clean and regular pulp by simple digestion. The yield of good quality bleached pulp ranges from 33 to 35 percent (of the weight of raw material). The fibre length is about 2 millimeters (CSIR, 1950).

There is only one paper mill in the country, at Nowshera (NWFP), which uses Sabai grass in addition to ***Saccharum*** grass. The mill purchases 1,000 to 1,500 tons of the grass annually at Rs750 per ton. The supplies come exclusively from the Parang Ghar area.

Harvesting the grass is tedious, low-paying work. Poor people with no alternatives resort to this work. A person can earn Rs25 to 30 per day from this work. After harvesting, the grass is bundled and despatched to the mill in trucks. About 250 to 300 people are involved in supplying the grass to the mill.

Another 500 to 600 tons of grass are sold each year in local markets at Rs1.00 per kilogram, for use as carpeting in mosques.

FIBERS

Mazri leaves

Mazri is the local name for dwarf palm (***Nonnorrhops ritchieana***). It is a gregarious, tufted, low-growing and shrubby palm, growing naturally in NWFP, Baluchistan and the adjacent tribal belt along both sides of the Suleiman Range, from 600 to 1100 meters in elevation. Farmers in some parts of NWFP (Paniala, D.I. Khan) have also started cultivating it in their agricultural fields between other crops.

Mazri leaves are used in a variety of every-day products, including mats, baskets, brooms, trays, hand fans, grain bins and

cordage. Average annual production of raw mazri leaves in the country is 37,315 tons (Table 5).

Table 5. Mazri production in Pakistan

Province	Estimated average annual production (tons)
Baluchistan	27,265
NWFP	2,851
Federally Administered Tribal Areas (FATA)	7,199
Total	37,315

Source: Amjad and Khan, 1990; Iqbal, 1991

It has been estimated that an average worker can process more than 0.5 tons of raw mazri leaves per year (Iqbal, 1991). About 65,000 people are involved in processing mazri leaves, 78 percent of them women.

The retail price of raw mazri leaves is about Rs3.40 per kilogram with a total value of collected leaves reaching Rs126 million annually. Although prices of the finished mazri products vary considerably, the estimated value of mazri leaves almost doubles after processing. Thus processing nets about Rs126 million to the manufacturers each year (Iqbal, 1991).

Because of indiscriminate damage, mazri forests are disappearing in many places. The supply base is gradually shrinking and the incomes of families are threatened. Re-habilitation of mazri forests is, therefore, essential in order to maintain the supply base. Also, the farmers who have taken up mazri cultivation need extension support to obtain the maximum possible returns.

In some areas, such as Hangu (Kohat), unnecessary legal restrictions on harvesting, transportation and marketing of mazri leaves and its products have put the manufacturers of mazri products at a disadvantage. The law requires that raw mazri leaves and products should be marketed in places designated by the Government. In the mazri producing areas, the products are to be sold only to the purchasers of the mazri leaves. This restriction seriously weakens the bargaining position of the manufactuers of mazri products and consequently they do not get adequate return for their products. The relaxation of legal restrictions may encourage a free market and improve the situation for the manufacturers (Iqbal, 1991).

SILK COCOONS

Silkworm rearing on mulberry leaves obtained from high-trunk trees grown in government plantations and farmlands is an old cottage industry in many rural areas. Only one crop of silkworms is reared during the spring season. About 40,000 packets (one packet contains 20,000 eggs) of silkseed imported from Korea and Japan are distributed each year among silkworm rearers, by both public and private agencies. About 13,000 families are involved in silkworm rearing. Total production of dry cocoons in the country is about 245 tons (RAPA, 1987).

Up to 600 kilograms of mulberry leaves are required to rear silkworms obtained from one packet of silkseed. Thus, 22,000 to 24,000 tons of mulberry leaves are consumed each year. Iqbal (1991) has reported that the value of the leaves required to rear one packet of silk seed is Rs200 to 300. The total value, therefore, is about Rs10 million, based on an average price of

Rs250. Net return to the rearers is estimated at Rs1,140 per packet (Iqbal, 1991), generating a total net income of Rs45.6 million to the silkworm rearers in the country.

Silkworm rearing techniques are generally primitive. Consequently the yield is low. Moreover, a recent survey by Iqbal (1991) observed that silkworm rearing is mainly done by women but the extension staff of the sericulture sections of the Forest Departments are all men, who are unable to communicate directly with the women silkworm rearers. Therefore, there is an obvious opportunity to improve extension services by employing women extension workers.

The entire production of cocoons is processed locally on primitive hand-reeling machines. The raw silk is used as weft in the local weaving industry. The warp is imported.

MISCELLANEOUS PRODUCTS

Soap-nut

Soap-nut, known as "retha," is a fruit of a tree (*Sapindus mukrossi*). Its pericarp contains saponin, which makes lather with water and is used as a substitute for soap. It is preferable to regular soap for certain articles such as flannel and silk clothes. Women use it as shampoo.

The soap-nut tree is cultivated in sub-Himalayan tracts up to 1,200 meters. People in Haripur (Hazara) grow the tree in their court yards and agricultural fields.

The tree starts bearing when 6 to 8 years old. It flowers between May and June and all the fruit ripens at once in November and December. The fruit is picked from the tree and dropped to the ground where it is gathered by other workers. Two people can collect the fruit of one tree in a single day. The wholesale price has risen from Rs5 per kilogram in 1988 to Rs10 per kilogram in 1990. The produce is often sold while still on the tree at Rs400 to 500 per tree. The purchaser is then responsible for collecting the fruits.

A recent survey in the village of Najafpur (Haripur) indicated that yields per tree are 50 to 100 kilogram (average 60.8 kilograms) and the number of bearing trees is between one and three per family (Iqbal, 1991). Total production in the country is estimated to be 250 tons. The number of families involved in collection is about 4,100 with a total value estimated to be Rs2.5 million, based on an average wholesale price of Rs10 per kilogram.

To expand opportunities in soap-nut production, the Forest Department should encourage cultivation through its watershed and social forestry programmes.

Walnut bark

Root bark of walnut (*Juglans regia,*) and sometimes even the stem bark is frequently used in the country as a tooth cleanser, particularly by women, as it imparts a pinkish colour to the lips. Removal of the bark, however, injures the trees. In extreme cases, it even kills them. Moreover, it is suspected that the bark is used in preparing fake tea, which is harmful to the health. For this reason, extraction of walnut bark has been banned by the government. It is still extracted by forest dwellers, however, for domestic use and for sale to visitors. Prior to the ban, the bark was exported to the Middle East.

The quantity of bark extracted each year is difficult to estimate due to the ban on its extraction and marketing.

Palosa gum

Gum collected from trees of *Acacia modesta* is locally known as "palosa." Palosa gum is eaten by women as a sweet. It is believed to restore vitality, particularly after child birth.

The tree grows in sub-mountainous tracts up to 1,200 meters. It starts producing gum after 4 or 5 years, when it yields about 0.06 kilograms of gum. Production increases with age until about 20 years, when it stabilizes at about 0.25 kilograms per tree per year. The gum oozes spontaneously from the stems and main branches in October and November and is then collected by hand.

A recent survey in the village of Sherawala (Haripur) found the number of *Acacia modesta* trees ranged between 2 and 200 per family (average 69). The quantity of gum obtained from these trees ranged from 1 to 20 kilograms per household (average 11.2 kilograms), of which 15 percent is estimated to be consumed within the household (Iqbal, 1991). The rest is sold for about Rs60 per kilogram, generating an average revenue of Rs571 per family. Production figures for the entire country are not available.

Basketry

Branches of *Tamarix dioica*, locally known as "lei," by the nomads living along the banks of river Indus are used for making baskets. The branches are cut during July and August and stored for the rest of the year. An average household, consisting of 5 working members makes 2,000 baskets each year. An average worker makes two baskets in a day. The baskets are made without tools. The number of households involved has been estimated to be 300. Therefore about 1,500 persons are involved in the process. Total annual production is estimated to be 600,000 baskets, consuming 2,000 to 2,500 tons of raw material each year.

The baskets are transported to the nearby towns where they are sold to the shop-keepers at an average price of Rs5 each. This produces a revenue of Rs3 million each year.

Neem leaves and seeds

Leaves of the neem tree (*Azadirachta indica*) are used by rural women as insect repellant. Layers of leaves are placed between woolen clothes to keep the moths away while storing them. The leaves also protect grain from grain pests during storage. At present there is no market for the product.

Neem seeds contain 40 percent of deep yellow fatty oil known as "margosa oil." It is effective in the treatment of leprosy and skin diseases and is used in pharmaceutical preparations, face cream, hair lotion, medicated soap, tooth paste, disinfectant and as an emulsifying agent in insecticides. The unrefined margosa oil is used as lamp oil. The seed cake is a good fertilizer and is said to keep white ants away from plants. All parts of the neem tree, including "neem toddy," the juice that exudes from the trunk spontaneously or through wounds, have numerous therapeutic uses in traditional medicine.

Unfortunately, the potential of this wonderful multi-purpose tree has only begun to be exploited, although it grows abundantly in the plains of Punjab, Sind, and the southern parts of NWFP. There is a

need to re-introduce neem as a multi-purpose tree through social forestry programs of the Forest Department and to harness its potential for supplying raw material for industry.

CONCLUSIONS AND FUTURE DIRECTIONS

Use of the term "minor forest produce" has relegated NTFPs to an insignificant position among the priorities of the Forest Departments. Many products are not even included in the official statistics, with the result that little information is available regarding their production, uses, prices, and markets. Products which are not extracted by the Forest Departments, or on which no taxes are levied, have particularly been ignored. For example, official statistics say nothing about morels, despite the fact that the livelihood of millions of forest dwellers depend on them, and valuable foreign exchange (Rs130 to 150 million), is earned each year.

Consequently, the potential of NTFPs has never been fully exploited, either for the development of the forests or for the betterment of the people. Hardly any efforts have been made to develop these products and very little research support is available.

The positive side of NTFPs is that the products are a key component of the social fabric of forest dwellers and a significant source of revenue for poor people. Iqbal (1991) estimated that NTFPs contribute about 34 percent to the income of those involved in collecting and processing them.

NTFPs have real potential in watershed and social forestry programs in the Forest Departments of the country. The departments should be reorientated to include NTFPs as an alterative source of income for forest dwellers to wean them away from the destructive habit of using trees as a primary source of income.

This can be achieved only by adequate research leading to a better understanding of NTFPs. Extensive surveys of existing levels of NTFP production, marketing chains and end-uses are a good starting point.

Neem (*Azadirachta indica*) provides a multitude of useful wood and non-wood products.

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PHILIPPINES

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INTRODUCTION

In the Philippines, non-wood forest products (NWFPs) are classified and referred to as "minor forest products." The Revised Forestry License Regulations of 1970 define minor forest products as "all other forest products except timber, pulpwood and chipwood." Based on this definition, minor forest products, or NWFPs, include firewood, charcoal, rattan, bamboo, daluru, bark, resin, gum, wood oil, beeswax, nipa, buri, fibre, dyewood, vine, flowering plants, ferns, orchids and other forest growth.

NWFPs are used as the raw material of furniture and in cottage industries manufacturing pulp, paper, plastic, paint and varnish, soap and shampoo, and for landscaping and interior decor. They are also important sources of materials for low-cost housing, food and beverages, clothing materials, medicine and other products, especially in the rural areas. The gathering and utilization of these products provide marginal farmers and people living in the uplands with additional income.

Lately, NWFPs have been given more attention as sources of foreign exchange and employment opportunities following recent developments depressing the country's wood-based industry sector. The banning of logging operations in certain areas of the country has displaced workers of several logging companies.

The total ban on log exports, which started in 1987 and was followed by the restriction of lumber exports in 1989, has resulted in the declining importance of the forestry sector to the country's economy. While the forestry sector's share of the Gross National Product in 1973, when wood products were a major export commodity, was 3.93 percent, this gradually dropped to 1.1 percent in 1990. A further drop in the forestry sector's contribution is expected if a proposal bill banning commercial logging comes into effect.

This report covers only some of the more important NWFPs that are being gathered, traded and utilized in the Philippines.

NWFPs AND THEIR USES

Among the more economically important NWFPs are:

Palms

The palm family is well represented in the Philippines. There are 123 indigenous species plus other introduced palms classified as either "climbing" (rattan) or "erect."

Climbing palms

Rattan is the most important forest product in the country after timber. Rattan in the Philippines is represented by 62 species, of which 12 are of commercial

value. They are: palasan (*Calamus merrillii*); limuran (*C. ornatus var. philippinensis*); tumalim (*C.mindorensis*); sika (*C. caesius*); panlis (*C.ramulosus*); malacca cane (*C.scipionum*); lambutan (*C. halconensis*); apas or lukuan (*C. revesianus*); kurakling (*C.microsphaerion*); tagiktik (*C. filispadix*); ditaan (*Daemonorops millis*); and *D. pedicellaris*.

The nationwide forest resources inventory conducted by the Forest Management Bureau with the assistance of the German government disclosed that in 1988 the country's rattan resources totalled 4.57 billion linear meters. Palasan (*C. merrillii*), which is the species preferred by most furniture manufacturers, accounts for 1.38 billion linear meters or 30 percent of the total available rattan poles. Limuran, which is also a preferred species, accounts for 1.14 billion linear meters or 25 percent of the total, followed by tumalim with 583 million (13 percent); apas, 518 million (11 percent); tandulan gubat, 410 million (9 percent); ditaan, 232 million (5 percent); sika (*C. caesius*), 76 million (2 percent) sumulid (*D. orchrolepis*) 75 million (2 percent) and other species, 160 million (3 percent) (Table 1).

Rattan poles are in great demand for furniture manufacturing. They also provide the raw material for handicrafts and for the manufacture of baskets, picture frames, hampers, handbags, hats, and novelty items for domestic consumption and export. Rattan poles and splits are also used to make fish traps and as tying materials. The shoots of rattan are eaten as a vegetable and the fruit is edible.

Erect palms

There are several species of erect palms in Philippine forests. The more important economic species are buri (*Corypha elata*), nipa (*Nipa fruticans)* anahaw (*Livistonia roundifolia*) and kaong or sugar palm (*Arenga pinnata*).

Nipa (*Nipa fruiticana*) - In economic value, nipa is one of the most important erect palms in the country, second only to coconut. The species thrives well along tidal flats and brackish swamps.

Its pinnate leaves, about 7 meters in length, are used to make shingles for roofing and walls of low-cost houses. Other uses are for making hats, mats, bags and baskets. The mid-ribs are made into brooms and the petioles are used as fuel.

The sap of nipa is used in making alcohol and vinegar. The fermented juice is a popular local drink.

Buri (*Corypha elata*) - This is the largest palm species in the country, with trunks attaining a diameter of 1 meter and a height of 20 meters. The trunk yields large quantities of food material in the form of starch. Wine, alcohol, vinegar, syrup and sugar can be produced from the sap. The kernel of young fruit is made into sweets, while the buds are used for salad or as a vegetable.

The large petioles of buri yield a fibre locally known as "buntal," which is used in the manufacture of the famous "buntal" hat. The mature leaves are used for thatching houses, while the immature, unopened ones are used in making ropes, mats, bags and other fancy articles. The

mid-ribs of the immature leaves are also the source of fiber used in making the so-called "Calasiao" hat named after the, hat place where it is produced. The mid-ribs of mature leaves are used in the manufacture of light furniture (tables, chains, dividers), baskets, hampers and wall decorations. Buri palms are widely distributed in the Philippines, mostly at low elevations. The nationwide forest inventory disclosed that only 198,000 buri palms remain in the country's dipterocarp forests (Table 2), but substantial numbers grow in rural backyards and fields.

Anahaw (*Livistonia roundifolia*)—Anahaw grows naturally in the forest and is widely distributed throughout the archipelago. An estimated 39 million anahaw palms remain (Table 2).

Anahaw, like buri and other erect palms, has may uses. Its trunk, which grows to a height of 20 meters and a diameter of 20 centimeters, is used widely for fishpens. The wood of the trunk is used as pillars and floors for houses in the rural areas, and is an excellent material for making bows, spear shafts and canes.

The leaves of anahaw palms are used for thatching houses and making hats and fans. The buds are eaten as a vegetable. Anahaw is also cultivated as an ornamental plant.

Kaong (*Arenga pinnata* or sugar palm)—This species is widely distributed throughout the country. It thrives along stream banks at low to middle altitudes. The country's dipterocarp forests are estimated to contain some 4.67 million sugar palms (Table 2).

Sugar palm grows to 15 meters, with a diameter of 40 centimeters. Its pinnate leaves reach 8.5 centimeters in length with linear leaflets of up to 1.5 meters long. It bears numerous crowded, green nuts which turn yellow when mature. The fruits are about 5 centimeters in diameter and contain two or three seeds.

The leaves of the sugar palm provide low-cost materials for roofs and walls of houses. The mid-ribs of the leaflets are used in making brooms and baskets.

The seeds of immature nuts are made into sweets and the buds are cooked as vegetables.

Sugar palm is also the source of a stiff, tough black fibre locally known as "cabonegro" (gomuti). The fibre, which is produced at the base of the petioles, is used to make rope and thatching for houses. Rope made from this fibre is durable and is ideal for marine use. The stiff fibers are also used for making various types of brushes.

Starch can be extracted from sugar palm trunks. Each tree can yield 50 to 75 kilograms of starch.

Sap, extracted from the cut in florescent stalk, is used in the production of sugar, wine, vinegar and alcohol. Production ranges from 10 to 12 liters of sap per tree per day for 2 1/2 months.

Bamboo

There are around 32 species of bamboo in the Philippines, of which 19 species are erect.

Table 1. Rattan Resources in Philippine Dipterocarp Forests

Species	<2cm diam (1000 linear m)	Percent	>2cm diam (1000 linear m)	Percent	Total	Percent
Apas (*Calamus reyesianus*)	460,166	16.06	57,780	3.39	517,946	11.33
Ditaan (*Daemonorops mollis*)	199,062	6.95	32,935	1.93	231,997	5.07
Limuran (*Calamus ornatus*)	550,179	19.20	591,389	34.65	1,141,568	24.97
Palasan (*Calamus merrillii*)	645,220	22.52	730,641	42.81	1,375,861	30.09
Sika (*Calamus caesius*)	68,590	2.39	7,903	0.46	76,493	1.67
Sumulid (*Daemonorops orchrolepis*)	58,249	2.03	16,493	0.97	74,742	1.63
Tanduland-Gubat (*Calamus dimorphacanthus*)	340,749	11.89	69,676	4.08	410,425	8.98
Tumalim (*Calamus mindorensis*)	451,150	15,74	131,724	7.72	582,874	12.75
Others	92,286	3.22	68,271	4.00	160,557	3.51
Total	2,865,651	100.00	1,706,812	100.00	4,572,463	100.00

Source: National Forest Resources Inventory Project

The commercially important bamboo species in the country are:

- Kauayan tinik, or spiny bamboo (***Bambusa blumeana)***
- Kauayan kiling (***Bambusa vulgaris)***
- Bayog (***Dendrocalamus merrillianus)***
- Bolo (*Gigantochloa levis*)
- Buho (*Schizostachyum lumampao)*

Among the five species, spiny bamboo and kauayan kiling are the preferred species for building, furniture making and boat outriggers. Bayog is used for tying and making ropes.

Bamboo is found growing in settled areas where it is planted or grown in plantations and in the forest where it grows from low altitudes to as high as 2,600 meters in the mountain provinces of northern Luzon. So far, there is no information on bamboo in settled areas. The recently concluded national forest inventory placed the country's bamboo in forested land at 10.73 billion stems, although most of these are non-commercial species (Table 3).

Pandans

There are more than 40 species of pandan in the Philippines. They are widely distributed throughout the archipelago with some species growing along sandy beaches and others in virgin forests. They vary in size depending on the species, from less than 1 meter to 15 meters in height.

Among the more important pandan species in the country are bariu (***Pandanus copelandii***), taboan (***P. dubius***), alasas (***P. luzonensis***), oyango (***P. radicans***), sabutan (***P. sabotan)*** karagomoi (***P. simplex.***) common or beach pandan (***P. tectorius***), and pandan layugan (***P. exaltatus***).

The economic value of pandans is in the leaves, which are used for making coarse and fine baskets, bags, hats, mats, picture frames and other fancy articles. Recently, the Philippine Forest Products Research and Development Institute (FPRDI) has developed cocoon frames for silkworm production out of pandan leaves. The wood of some pandan species is also being manufactured into splints used in making baskets.

It is estimated that there are 58.88 billion stems of pandans in the country's forests (Table 4).

Resin

Resins commonly collected for commercial and industrial purposes in the Philippines are produced from almaciga (***Agathis philippinensis***) Benguet pine (***Pinus kesiya***), piling liitan (***Canarium luzonicum)*** and apitong (***Dipterocarpus grandiflorus***).

Almaciga (*Agathis philippinensis*) is the source of a resin which is popularly known as "Manila copal." Manila copal is used as incense, for caulking boats, as a smudge for mosquitoes, for torches, in varnish manufacturing, sizing paper and other industrial uses. At present, almost all almaciga resin produced in the country is being exported.

Almaciga is one of the protected tree species in the Philippines and felling it is prohibited.

Table 2. Erect Palm Resources in Philippine Dipterocarp Forests

Species	<2cm diam. (1,000 stems)	Percent	>2cm diam. (1,000 stems)	Percent	Total (1,000 stems)	Percent
Anahaw (*Livistonia rotundifolia*)	6,008	1.67	33,351	6.16	39,359	4.37
Buri (*Corypha elata*)	47	0.01	151	0.03	198	0.02
Kaong/Sugar Palm (*Arenga pinnata*)	518	0.14	4,153	0.77	4,671	0.52
Others	353,146	98.17	503,467	93.04	856,613	95.09
Total	359,719	100.00	541,122	100.00	900,841	100.00

Source: National Forest Resources Inventory Project

Table 3. Bamboo Resources in Philippine Dipterocarp Forests

Species	<2 cm diam. (1,000 stems)	Percent	>2 cm diam. (1,000 stems)	Percent	Total (1,000 stems)	Percent
Anos	132,197	2.05	85,337	1.99	217,534	2.03
Bayog	2,406	0.04	3,10	0.07	5,513	0.05
Bikal	3,799,632	58.99	2,257,805	52.64	6,057,437	56.45
Bikal Baboi	1,754,248	27.24	504,475	11.76	2,258,723	21.05
Bocaue	1,903	0.03	0		1,903	0.02
Bolo	7,014	0.11	0		7,014	0.07
Buho	721,535	11.2	1,341,872	31.28	2,063,407	19.23
Kawayan Kiling	11,952	0.19	70,387	1.64	82,339	0.77
Others	9,922	0.15	26,261	0.61	36,183	0.34
	6,440,809	100.00	4,289,244	100.00	10,730,053	100.00

Source: National Forest Resources Inventory Project

Table 4. Pandan Resources in Philippines Dipterocarp Forests

Species	<2cm diam. (1,000 stems)	Percent	>2cm diam. (1,000 stems)	Percent	Total	Percent
Pandan (*Pandanus* sp.)	12,278	80.49	36,513	83.71	48,791	82.87
Pandan-Layugan (*Pandanus exaltus*)	1,359	8.91	2,160	4.95	3,519	5.98
Mottled Pandan (*Pannus veitchil*)	1,617	10.60	4,948	11.34	6,565	11.15
Total	15,254	100.00	43,621	100.00	58,875	100.00

Source: National Forest Resources Inventory Project

It is well distributed throughout the archipelago. The national forest resources inventory estimated the stock of almaciga, as of 1988, at 2.5 million cubic meters.

Benguet pine, (*Pinus kesiya*) which is the source of oleo resin used in the production of turpentine, grows naturally only in the Cordillera mountains in northern Luzon at altitudes from 500 to 2,500 meters. The species, has been successfully grown in plantations in various parts of the country, however. Extensive plantations of Benguet pine are found in the province of Bukidnon in central Mindanao. As of 1990, the country's pine forest is estimated at 236,400 hectares of which 128,300 hectares are closed canopy forest and 108,100 hectares are considered to be open canopy-forest.

Manila elemi is produced from piling liitan (*Canarium luzonicum)* and pili (*C. ovatum*) of the family Burseraceae. The resin extracted from these tree species is used to manufacture varnish, medicinal ointments, transparent paper, caulking compound and as torch fuel. Piling liitan grows in the wild, while pili is being cultivated in plantations or backyards more for its nuts than resin.

Balau resin is obtained from the trunk of apitong (*Dipterocarpus grandiflorus*) and other species of the genus Dipterocarpus. Like the other resins, balau is used to make varnish, caulking compound, and fuel for torches. Oil has also been extracted by Filipino scientists through water distillation from balau resin and found to be a good substitute for diesel fuel. Oil yield is around 38 to 40 percent.

Oil

Lumbang (*Aleurites moluccana)* and bagilumbang (*A. trisperma*) are two important seed oil-producing tree species in the Philippines. Both species grow naturally in forest areas in various parts of the country. These species have also been grown in plantations although the extent of these plantations is not known. One forest concessionaire in Mindanao, the Nasipit Lumber Company, has extensive plantations of lumbang.

Oil produced from the nuts of these tree species is a good substitute for tung oil. Bagilumbang oil resembles tung oil more closely than does lumbang oil. Although lumbang oil is slightly inferior to tung oil, both are superior to linseed oil.

Lumbang and bagilumbang oils are used for the preparation of paints, varnishes and linoleum, soap manufacture, wood preservation, and lighting.

Vines

Diliman (**Stenochlaena palustris**) nito (*Lygodium* **spp.**), lukmoy (*Pothos* **spp.**), and baling-uai (*Flagellaria indica*) are some of the more important climbers in the Philippines. These climbers thrive well in both virgin and logged-over forest, and in bush and open areas. They are widely distributed throughout the archipelago.

Diliman is a species of fern with stems from 2 to 4 meters in length. It is used chiefly as tying material in the preparation of fish traps because of its durability in salt water. It is also used for making ropes and baskets.

Nito is the name used for different species of ***Lygodium***, although the most common and widely used species in the country is ***Lygodium circinnatum***. It is used in the manufacture of baskets, hats, bags and other fancy articles.

Pothos are climbers which produce numerous, long tough, aerial roots of uniform diameter. The central cylinders of these roots are used in baskets.

Baling-uai is a vine with a slender stem. It is for tying, in sewing nipa shingles and in making baskets.

Medicinal plants

Medicinal plants are important elements of tropical forests. These plants can be herbs, vines, shrubs or trees from which medicine can be extracted from the roots, wood, bark, leaves, seeds, flowers or fruit to heal specific illnesses and diseases. These medicinal plants are very popular in the rural areas because of the high cost of modern drugs. Most of these plants are available in rural areas and knowledge of their healing powers is passed on from one generation to another. Some of these medicinal plants are:

Cinchona (*Cinchona ledgeriana*) is not native to the Philippines. The first cinchona plantation was established by the Bureau of Forestry (now Forest Management Bureau) in 1926 in Bukidnon Province. At present there are some 248 hectares of cinchona plantations consisting of 5 species and 2 varieties.

Cinchona is a medium-sized tree that grows to a diameter of 60 centimeters and a height of 25 meters. It is a source of quinine used for malaria and quindine for treating fibrillation and certain disorders of heart rhythm. Quinine, which is sensitive to light, is also used in the manufacture of photographic film.

Banaba (*Lagerstroemia speciosa*) is a medium-size tree, usually found in secondary forests at low to middle altitudes in the Philippines. A decoction of its bark and leaves is used to cure fever, diabetes, diarrhea, and as a diuretic and a purgative. It is also grown as a shade and ornamental tree in town plazas, school grounds and along roads and highways.

Dita (*Alstonia scholaris*) is a medium-sized tree belonging to the Apocynaceae family. It is found in primary and secondary forests at low to middle altitudes. A decoction of the bark is a febrifuge (remedy for fever), anticholeric if used for chronic diarrhea and dysentery, an anthelmintic (expels intestinal worms), for diabetes and for coughs. The latex and powdered leaves are used as a poultice on boils, ulcers and rheumatic pains. A decoction of young leaves is also used to cure beri-beri.

Kalingag (*Cinnamomum mercadoi*) is a small tree endemic to the Philippines. It is widely distributed throughout the country and grows at low to middle altitudes. Plantations of the species have been established by the DENR in a few areas. The bark is used for flatulence, as an expectorant, and for curing headaches, stomach disorders, rheumatism and tuberculosis.

Pandakaki (*Ervatamiap pandacaqui*) is a shrub belonging to the Apocynaceae family and is commonly found in thickets at low altitudes. The leaves are used as an

antiseptic and an anodyne on wounds. A decoction of the root and bark is used to cure certain afflictions of the stomach and intestines.

Nitong puti (*Lygodium flexuosum*) is a vine species of the family Schizaeaceae. Its roots and leaves are used to cure skin ailments such as ringworm. Infusion of the plant is used in the treatment of blennorrhagia.

Alagasi (*Leucosyke capitellata*) is a small tree of the family Urticaceae. Alagasi is widely distributed in the Philippines, often found growing in low to middle altitudes. A decoction of its roots is used as a cure for pulmonary tuberculosis, cough, headaches and gastralgia (pain in the stomach).

Bast Fibers

Several shrubs and tree species in the Philippines are sources of bast fibers. The most important of these species is **salago** (*Wikstroemia* spp.).

Salago is a shrub that grows up to 3m high. It is found in thickets, in marginal lands as well as in primary and secondary forests at low to middle elevations. The species has been successfully grown in some of the DENR reforestation projects. There is no information on the extent of plantings of salago in the country.

Long and silky fibres can be extracted from the bark of salago which are excellent for the manufacture of high grade paper used in bank notes, paper money, checks, paper for legal documents and other specialty papers requiring strength and durability. The fibers are also used in ropemaking, fishing lines and nets, sacks, textiles, cords, bags, hats and novelty items.

CONTRIBUTION OF NWFPs TO THE NATIONAL ECONOMY

As Raw Materials for Local Industries

Non-wood forest products are important sources of raw material for local industries. Prior to the 1960s, most of the non-wood forest products gathered from the country's forests were exported in their raw form. With the creation of the National Cottage Industries Development Authority (NACIDA) in 1962, the development of cottage industries has been encouraged. NACIDA-registered businesses are given various incentives such as subsidized loans, training and marketing assistance. Many of these firms utilize non-wood forest products as their raw material and cater mostly to domestic markets. A number of them are in the rural areas and produce rattan and bamboo furniture, baskets, handicrafts, and other items.

In addition to being used for construction, furniture and handicrafts, bamboo is used as props for the banana industry. With some 24,000 hectares of banana plantations, mostly in Davao Province, millions of props are needed annually.

The country's upland fishing industry uses the trunks of anahaw and bamboo poles in the construction of fish pens, fish cages and other structures such as pathways and guardhouses. Demand for bamboo poles for boat outriggers is substantial.

A Philippine paper plant used bamboo as its raw material but recently was forced to switch to other raw material because of a shortage of bamboo.

A naval stores factory previously processed oleoresin from Benguet pine, but a lack of raw material forced the plant to close. In the late 1970s, the government stopped issuing permits to tap Benguet pine trees for oleoresin because of ips beetle (*Ips callighrapus*) infestations.

Source of Government Revenue

Non-wood forest products have provided the government with additional sources of revenue through forest charges. Currently, the forest charge on NWFPs is 10 percent of the market value. From 1981 to 1990, the average annual forest charges collected from NWFPs were 1,596,895 Philippine pesos (Table 5), or approximately US$ 63,000 at 1990 exchange rates. Although the amount is small compared with timber, NWFP revenues provide badly needed money to finance government development projects.

Table 5. Forest Charges on Non-Wood Forest Products: 1981-1990

Year	Amount (Philippine Pesos)
1990	1,162,327
1989	1,917,917
1988	2,782,175
1987	1,819,764
1986	1,299,326
1985	1,182,058
1984	2,607,865
1983	1,135,742
1982	1,883,767
1981	178,014
Total	15,968,955
Average	1,596,895

Source: 1990 Philippine Forestry Statistics

Employment Generation

Non-wood forest products have provided people living in or near forest lands, especially subsistence upland farmers and the unemployed or underemployed in the lowlands, with sources of income. Although there are no figures on how many people are involved in gathering NWFPs, the National Statistics Office disclose that for 57,341 families, or 0.58 percent of the country's 9,847,357 families, forestry and hunting was their main source of income in 1985. In 1988, however, this went down to 40,121 or 0.38 percent. With an average of 6 people per family, the number of people dependent on forestry and hunting was 344,046 in 1985 and 240,726 in 1988. Forestry activities, as defined in the survey, included tree planting, firewood gathering, small-scale logging, charcoal making and gathering of non-wood forest products, cogon, nipa, rattan, bamboo, resin and gum.

There is also a dearth of information on the number of people employed in the processing sector, possibly because many of the smaller processors and manufacturers are not registered with government agencies and do not submit reports. In the furniture industry alone, it is estimated that these are over 15,000 backyard manufacturers. Assuming that each manufacturer employs an average of 10 workers, the total workforce in these backyard-type operations is about 150,000.

There are some 250 medium-to-large rattan furniture factories in the country. Each of these factories employs 200 to 1,500 workers with a total estimated work force of about 100,000.

Source of Foreign Exchange

Non-wood forest products are exported either in raw form or as finished or semi-finished products. Resins (Manila copal and Manila elemi) have been the country's main raw NWFP exports. Almost all resins that are produced are exported because there are virtually no factories to process them into finished products. In 1981, 720,600 kilograms of resin with an FOB value of US$440,000 were exported. In 1990, resin exports rose to 899,234 kilograms valued at FOB US$1,275,644. Exports of salago bark have also earned an average of US$600,000 annually during the last 10 years. Other NWFPs exported in raw form include buri braids and raffia, bamboo, and rattan poles and splits. Exports of these products are small. Rattan poles and splits in limited quantities are being allowed to the United States in compliance with an agreement to provide replacement parts.

Exports of manufactured NWFPs have likewise been increasing during the last few years. Foremost of these are rattan furniture, bags and baskets of bamboo and rattan, and wicker work. Rattan furniture and chair exports rose from US$45.92 million in 1981 to US$121.31 million in 1990, with an average annual growth rate of 13.4 percent. Exports of bamboo furniture and chairs during the same period increased from US$960,000 to US$1.67 million, an annual growth rate of 9.8 percent. Exports of bags and baskets increased from US$18.57 million in 1981 to US$65.13 million in 1990. For basket-work and wicker-work, the value of exports rose from US$27.31 million 1981 to US$52.61 million in 1990. Other manufactured NWFP exports include buri and pandan placemats, handbags, wallets, purses and similar articles of palm and bamboo, buntal and buri hats. These manufactured articles contributed additional foreign exchange earnings of US$5,636,454 in 1990.

COLLECTION AND PROCESSING

Government Policies and Regulations

The extraction and gathering of non-wood forest products in forest lands is legally regulated by the government through the issuance of licenses or permits, but an undetermined quantity of NWFPs are extracted illegally.

Licensing Regulations

The Revised Forestry Licensing Regulations of September 1970 specify guidelines for the issuance of forestry licenses, leases or permits for the extraction of NWFPs. They also outline the responsibilities of forest products licensees, lessees or permittees. In granting licenses or permits, the sustained yield capacity of the forest area is of paramount importance. Thus, before granting a license or permit, a forest resource inventory is undertaken to determine the amount to be extracted.

Licenses are issued by the heads of regional offices of the Department of Environment and Natural Resources. This is in line with government's policy to decentralize so field offices can respond easily to the needs of the people, especially in the rural areas. Permits, except for rattan, are good for one year.

Rattan Regulation

With rattan, different regulations apply to rationalize the development of the industry.

The sharp increase in the demand for rattan poles for furniture manufacturing in the 1980s caused prices to rise to prohibitive levels because of the influx of middlemen.

These middlemen became the outlets of illegally cut rattan. In 1988, the Bureau of Forest Development (now Forest Management Bureau) issued an order to individual tribal people and cooperatives which have supply agreements with licensed processing plants. The order requires licensees to plant at least 10 rattan seedlings for every 100 linear meters harvested.

A DENR order, dated January 10, 1989, provides for the competitive bidding of areas identified as available for harvesting. To remove unfair advantage of the big operators over small-timers in bidding, separate areas are allocated for large and small entrepreneurs. Generally, the allocation of rattan production areas for public bidding is as follows:

- Fifty-five percent of the rattan production area of any region is to be allocated to small entrepreneurs with a paid up capitalization of 250,000 pesos.

- Forty-five percent to big entrepreneurs with paid up capital of more than 250,000 pesos.

In the case of rattan production areas within lands reserved for, or occupied by, tribal groups, priority is given to the tribal groups.

The eligible individual or group offering the highest bid wins the concession. The successful bid must be at least P0.46 per linear meter of rattan, which is on top of the normal forest charge of P0.75 per linear meter for large diameter rattan (>2cm) and P0.03 per linear meter for small diameter rattan (<2 cm). In addition, the winning bidder has to post a deposit which will accrue to the rattan development fund. The fund is used to plant rattan seedlings to replenish and ensure sustainability of rattan.

The maximum area granted under a rattan cutting license to an individual is 5,000 hectares. For corporations, partnerships, associations, and cooperatives, the maximum area is 30,000 hectares.

The number of rattan cutting permits issued, and the allowable cut granted, has increased dramatically during the last 10 years. Sixty-nine permits, with an aggregate allowable cut of 14.74 million linear meters, were issued in 1981, rising to 279 permits, with a total allowable cut of 138.95 million linear meters, in 1990.

Tapping of gums and resins

For gums and resins, tapping guidelines have been prescribed. Almaciga resin tapping is allowed only in trees at least 60 centimeters in diameter. Tapping on the trunks of trees should not exceed three-fourths of the thickness of the bark, should in no case be more than 40 centimeters in length, and should always be at least 60 centimeters apart horizontally.

In tapping balau resin from dipterocarp species, incisions in the trunks of trees should not exceed in width one-fifth the circumference of the tree, nor more than one-fifth of the diameter. Incisions should be made at least 50 centimeters above the ground, and not past the first branch. Tapping is authorized only in trees at least 40 centimeters in diameter.

With Benguet pine, tapping of oleoresin is allowed only on trees that will be cut within five years and on trees at least 30 centimeters in diameter. The rules stipulate that for trees with a diameter below 40 centimeters, only one face of the tree should be chipped. For trees 40 centimeters and over in diameter at breast height, chipping may be done on two faces, but only one at a time, with a space of about 10 centimeters to be left between the faces. The width of each face should not exceed the diameter of the tree and the depth of the cut should not exceed 1.5 centimeters.

Regulations also prohibit the felling or unnecessary damaging of trees in the collection of resins, gums, gutta percha, wood oils and similar forest products. Violation of this rule could lead to the cancellation of the license and payment of a fine equal to four times the regular rate for timber.

Tanbark or dyebark collection

For tanbark or dyebark collection, the requirement is to leave an undamaged strip of bark at least one-third of the circumference of the tree, extending from the roots to the branches.

Forest charges

Holders of NWFPs licenses or permits are required to pay the forest charges prior to transport, disposition or processing. Forest officers assess the charges on the products' market value.

Transport of NWFPs

To monitor the movement of NWFPs from the forests to markets or processing plants, licensees are required to secure Certificates of Minor Forest Products Origin (CMFPO) from the local Community Environment and Natural Resources Office. The CMFPO contains the name of the licensee or permittee, the place where the forest products were cut or gathered, the consignee and destination, the quantity to be transported, the means of transport and date of transportation.

Forest products being transported but not covered by the required documents are considered illegally cut and can be confiscated. Also subject to confiscation are the conveyances used in this transport.

Production

Production figures presented in Table 6 include only the quantity of NWFPs legally cut, extracted or gathered from the forest under license. Therefore, they do not provide a true picture of the amount of NWFPs extracted. An undetermined quantity, which may be even greater than the reported production, is unaccounted for each year. In the case of rattan, the average production during the last 10 years was only 26.7 million meters while manufacturers of rattan furniture for exports alone utilized from 120 to 150 million linear meters of rattan poles per year. In 1990, the total allowable cut granted to 279 rattan licenses was 138.95 million linear meters, but the reported production for that year was only 19.3 million linear meters.

From 1981 to 1990, no production of Manila elemi was reported, yet some 3 million kilograms were exported. During

Table 6. Non-Wood Forest Products Legally Harvested in the Philippines: 1981-1990
(in thousands of units)

Year	Almaciga Resin (kg)	Anahaw leaves (pc)	Bamboo & Boho (pc)	Buri Midribs (kg)	Diliman Nito, Hingin & other vines (kg)	Honey (litre)	Nipa Shingles (pc)	Oleoresin (kg)	Split rattan (kg)	Unsplit rattan (lm)	Salago bark (kg)	Tanbark (kg)	Elemi (kg)	Lumbang nut (kg)	Nipa sap (litre)
1981	476	40	885	308	2	0.7	2,978	-	1,177	33,511	673	859	6	14	2
1982	1,407	22	647	97	3	94.3	4,126	-	195	15,594	258	83	4	-	6
1983	462	96	410	57	10	1.1	3,166	-	73	24,244	83	52	5	-	0.3
1984	191	6	309	155	27	-	1,757	-	2,770	25,370	144	98	6	19	0.5
1985	380	31	644	48	50	1.4	2,675	-	72	19,437	47	53		75	-
1986	386	-	428	33	4	0.7	3,989	-	249	28,588	156	1,020	-	-	25
1987	485	2	402	5	27	0.3	3,579	16	98	33,902	2	33	-	-	4
1988	700	10	133	41	13	-	2,504	-	54	34,215	8	-	-	-	-
1989	472	16	204	88	157	0.6	5,298	-	30	33,254	2	-	-	-	-
1990	943	2	984	58	89	-	8,023	-	10	19,266	6	30	-		

same period, some 852,000 kilograms of Almaciga resin were exported annually while the average yearly reported production was only 587,000 kilograms.

The large volume of unrecorded NWFPs is due to DENR's inability to monitor and supervise the operations of NWFPs licensees because of a shortage of personnel. Thus, even some of the NWFPs cut or gathered under license or permit are not reported, resulting in loss of forest revenue.

Under existing regulations, licensees are required to gather or extract the products themselves or to employ their own gatherers. As such, they are obligated to submit the names, addresses and residence certificates of their agents and employees to the Community Environment and Natural Resources Officer (CENRO) who has jurisdiction over the area..

Licensees are likewise required to inform the CENRO when their operations commence. This enables the CENRO to assign forest officers to monitor and supervise their operations.

In many instances, the gathering of NWFPs is done by members of cultural communities and other upland dwellers without the benefit of a license or permit issued by the DENR. Although members of cultural communities are given priority in the gathering of forest products in their locality or areas they claim to be part of their ancestral lands, many of them do not bother to apply for a license or permit. The forest products are then sold either to holders of forest products permits or middlemen. In turn, these permittees, or middlemen, either sell the products to local processors or manufacturers, or export them in raw form. In some instances, initial processing is done to increase the value of the product.

Middlemen play an important role. They have the necessary capital to finance handling, storage, and transport. Many NWFPs gatherers, with or without permits, do not have the means to sell their produce directly to processors or manufacturers, whose plants are mostly in the cities or far from the forest. On the other hand, some processors or manufacturers, especially the small ones, can not afford to put up buying stations in the hinterlands because of their limited capital. Therefore, the role of middlemen in bringing the raw materials from the producers to manufacturers has become indispensable to NWFP utilization in the Philippines.

Processing

While some NWFPs are being exported in raw forms, others are consumed by the gatherers themselves or sold to local processors or manufacturers. Most of the processors or manufacturers are cottage type or backyard level industries employing not more than 20 workers each. There are, however, around 250 medium to large firms which are primarily involved in the manufacture of rattan and bamboo furniture for export. Some of these firms have been granted forest concessions which provide them with an adequate and continuous supply of raw material. Others procure their raw materials from NWFP permittees or from middlemen. A few of them have already resorted to the importation of raw materials to sustain the operations of their manufacturing plants.

Problems confronting NWFP-based Industries

The development of NWFP-based industries is being hindered by several problems:

- **Lack of raw material supply**. This is a result of destructive extraction of forest products, slash and burn agriculture and conversion of forest to other uses. Illegal extraction or gathering has led to over-exploitation and fast depletion of NWFP resources. The government's inability to stop illegal extraction and trade of NWFPs has compounded the problem.

- **Inefficient extraction and processing technology**. Inefficient technologies have resulted in considerable waste in the extraction and processing of NWFPs. For example, the cutting of immature rattan plants results in the production of low quality poles. Poor handling and storage techniques also result in fungal attack and the lowering of pole quality. In the case of resin and gums, excessive removal of bark in the process of tapping weakens the tree or causes it to die. These sorts of activities have contributed to the rapid depletion of NWFP resources.

- **Lack of market information**. The lack of market information has resulted in the very limited utilization of certain species of NWFPs. Thus, a situation arises wherein certain species of NWFPs are underutilized, while other species are being over-exploited. Of the country's bamboo resource, for example, around 77.5 percent is composed of climbing species (bikal and bikal-baboi), which are presently considered as non-commercial species. These species are, however, potential raw material for pulp and paper manufacture. In the case of rattan, the large diameter poles are currently in demand for furniture manufacture. So, there is the tendency to overcut the large diameter species while those of smaller diameter are under-utilized.

- **Lack of capital to finance NWFP plantation development**. Although the government has provided several incentives to encourage NWFP plantation development, the lack of capital has been a major deterrent for private sector participation. This is aggravated by the long-term gestation and the high risk involved in forest plantation development.

FUTURE DIRECTIONS AND PROSPECTS

The Philippine Master Plan for Forest Development (MPFD), prepared by the DENR with the assistance of the Government of Finland and the Asian Development Bank, provides for a national program on non-wood forest products. The program aims "to develop and bring under sustainable management these various resources for economic and ecological benefits of the greatest number of Filipino people." Specifically, the program seeks to achieve the following objectives:

- To provide adequate supply of raw materials to various end-users and the industries while at the same time

conserving the resources;

- To promote equitable access to opportunities in the utilization of the resources;
- To promote economic development in the rural areas; and
- To institutionalize the development of the resources.

The program, however, covers only rattan, bamboo, resins, gums and essential oils, and medicinal plants.

To achieve these objectives, the program has outlined a strategy for ensuring the continuous supply and conservation of the resources. This is to be achieved through sustainable management of resources, the utilization of non-commercial species, improved harvesting and utilization technologies, plantation development and strict implementation of existing regulations.

Over-exploitation and the conversion of forest to other uses have brought about the rapid depletion of the country's forest resources, including non-wood forest products. There is a need to manage NWFPs on a sustained yield basis to ensure an adequate and continuous supply of raw materials. The ban on logging of primary forests, as of January 1992, is expected to contribute to conservation of the NWFPs, for a substantial quantity of these valuable resources are destroyed during logging operations.

Many species of NWFPs are not being utilized at present. The country's NWFP program seeks to promote the commercial utilization of these species. This is expected to ease the pressure on species which are in great demand and at the same time expand the resource base of local industries.

Inefficient harvesting, handling and storage have also contributed to the fast depletion of NWFPs. To ensure sustainability, the program seeks to minimize waste.

To ensure a sustainable supply of NWFPs, the program encourages the establishment of plantations. Currently, the government, through the DENR, is negotiating with the Asian Development Bank and the OECF a concessionery loan to finance and expand industrial forest plantations, including rattan and rubber plantation development. To encourage the private sector to invest in plantation development, several incentives are being offered such as tax rebates, low interest loans, long-maturing loans and security of tenure.

Profitability analyses of NWFP plantation development have disclosed a potential financial rate of return of 16.8 percent for rattan and 28.5 percent for bamboo. The National Development Corporation, a government-owned corporation, pioneered the development of large-scale rattan plantations in the Philippines. The corporation started its rattan plantation project in 1983 in Bislig, Surigao del Sur, Mindanao. As of 1988, some 4,000 hectares had been planted to rattan.

The Ecosystems Research and Development Bureau (ERDB) has established experimental plantations of rattan, bamboo and medicinal plants. A DENR bamboo development program is being implemented by ERDB with support from UNDP and FAO. Research into propagation techniques, taxonomy and phenology is being conducted

by ERDB. Among the accomplishments of the ERDB program is the development of a technology to hasten the germination of seeds of some rattan species. By removing the seeds' cover, the germination period of palasan (*Calamus merrillii*) seeds has been shortened from 120 days to 2 days with 97.5 percent germination success.

Equal access to opportunities

In the granting of privileges to gather and utilize NWFPs, as in the leasing of areas for plantation development, local communities will be given priority.

The development of local industries to utilize NWFP raw materials will be encouraged under the program. Incentives similar to those granted under the Industrial Forest Plantation Program will be given to would-be investors. Establishment of cottage industries in local communities will be undertaken, including the development of market linkages.

Upgrading Non-Wood Forest Products Development

This would require the establishment of policies as well as a national program directed toward non-wood resources development.

The non-wood forest-based industry program, which will continue until the year 2015, will require some US$ 1.5 million of financial support per year. The bulk of this amount (88 percent) will be invested in rattan and bamboo plantation development.

To support the government's program to develop the local forest-based industries, the Forest Products Research and Development Institute (FPRDI) has been conducting research into the utilization of forest resources, including NWFPs. This has led to the development of new products as well as the commercial utilization of previously ignored species.

SUMMARY AND CONCLUSION

With the declining importance of wood-based industries, and the prospect of more restrictive logging bans, attention has shifted to the development of NWFP-based industries. Wasteful utilization and the destruction of much of the country's forests have also resulted in depletion of the NWFPs and threatens the existence and development of industries using them.

As part of the government's program to provide low-cost medicine to the people and to reduce dependence on expensive synthetic and imported drugs, the Department of Health has recently established facilities for manufacturing medicines from plants. Medicinal plants from the forest, or cultivated in plantations, are used as the raw material of these new facilities.

To ensure the adequate and sustainable supply of raw material to NWFP-based industries, a Non-Wood Forest Products Development Program has been incorporated in to the recently completed Philippine Master Plan for Forest Development. The success of the program, however, hinges on the availability of funds to finance it.

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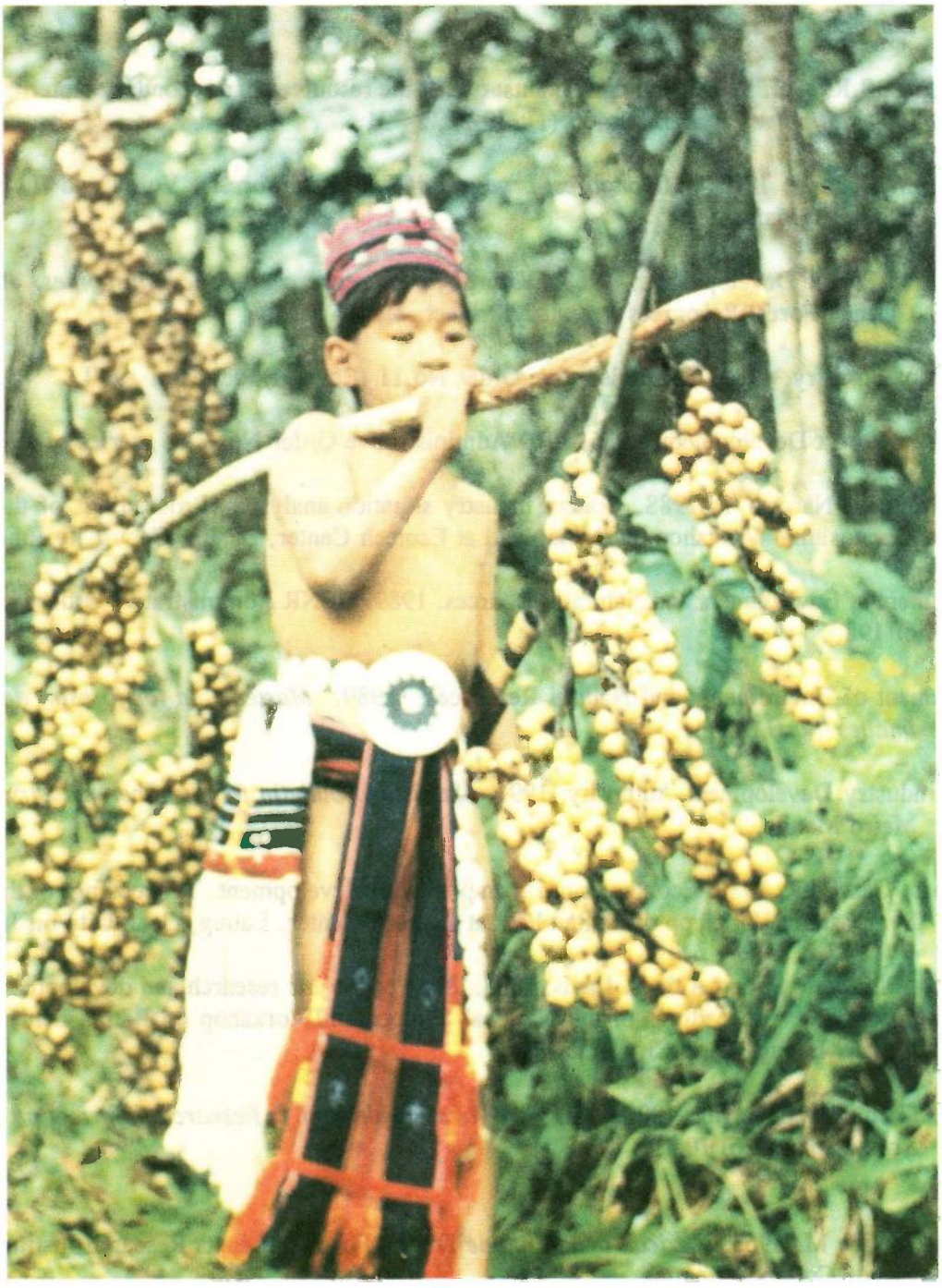

Forest fruits supplement diets and incomes throughout the region.

SRI LANKA

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INTRODUCTION

According to the Forest Ordinance of Sri Lanka the following materials are declared "Non-wood Forest Produce:"

(a) Leaves, flowers and fruit, seeds, juice, caoutchouc, catechu, wood oil, resin, natural varnish, bark, lac, gum and myrabolans;

(b) plants that are not trees, including grass, creepers, reed moss and all parts or produce of such plants;

(c) tusk horns, shed horns and edible birds' nests;

(d) peat, surface soil, rocks and minerals, including limestone, laterite, bitumen, bituminous shale, asphalt, mineral oils and all products of mines or quarries.

The forests of Sri Lanka contain a large number of trees, shrubs and herbs which provide various products other than wood. These products are commonly known as "minor forest products" or "non-wood forest products." A number of such non-wood forest products are used locally, while a few enter the export market. These products have numerous direct and indirect uses, and are of immense benefit to the people who live close to forests and also to those who live in cities.

Little reliable, detailed information pertaining to these valuable products is available. Few studies have been carried out in Sri Lanka on the economics and management of non-wood forest products. Efforts in this direction could bridge the wide gap between people and forests. The Ministry of Indigenous Medicine, however, has started research into the medicinal aspects of non-wood forest products.

This paper will assess the following aspects of non-wood forest products in Sri Lanka.

- Classification of products, their availability and value;
- Export in quantities and value;
- Collection and processing;
- Employment generation and social benefits from non-wood forest products; and
- Future directions to promote non-wood forest products;

CLASSIFICATION OF PRODUCTS

Gum, resins, and oleoresins

There are several tree species in Sri Lankan forests from which gums and resins are

collected, e.g. dawn (***Angeissus latifolia***), **hik** (***Linnea coromandelica***) and gammalu (***Pterocarpus marsupium***). The resin obtained from the latter is widely used in Sri Lanka to treat diabetes. Gum obtained from kaju (***Anacardium occidentale***) is used locally as an adhesive. This species is widely planted as an export crop for its nuts, but few trees occur naturally in the forests. Another gum locally used as an adhesive is kohomba gum (***Azadiracta indica***).

Resin from pine (***Pinus caribaea***) raised in forest plantations is now entering the export market.

Except for pine resin, none of the other gums and resins is collected on a large scale. **Damar resins** are produced by various species of dipterocarps. The best known product, dorana oil, is obtained from the dorana tree (***Dipterocarpus glandulosus***). This oil mixed with other organic substances was used to paint murals in ancient temples in Sri Lanka.

Kekuna (***Canarium zeylaicum***) produces an oleoresin which is collected in small quantities and used as incense. When distilled, kekuna oleoresin yields phyllandrin which is exported. The residue after distilling the phylladrin is suitable as incense.

Dipterocarpus and ***Canarium*** species have been heavily exploited for timber in the wet evergreen forests of Sri Lanka. Of the dipterocarps, only about one tree per hectare greater than 120 centimeters in diameter can be found in natural forests from which to extract damar resin.

Bark, fruits and seeds, flowers, leaves

Bark is the source of tannin and Ayurvedic medicines. The main tannin-producing barks are kadol (***Rhizophora spp.***), ranawara (***Cassia auriculata***), and wattle (***Acacia decurrens***). These species are locally used in limited quantities for leather tanning and tanning of fishnets.

In indigenous medicine, bark of the following species is used:

- Etdemata (***Gmelina arborea***)
- Kumbuk (***Terminalia arjuna***)
- Madan (***Syzygium cumini***)
- Kohomba (***Azadirachta indica***)
- Ankenda (***Acronychia pedunculata***)
- Mi (***Madhuca longifolia***)
- Bakmi (***Nauclea orientials***)
- Beli (***Aegle marmelos***)
- Kokum (***Kokoona zeylanica***)
- Kahata (***Careya arborea***)

Bark of godakaduru (***Strychnos nux-vomica***) is exported from Sri Lanka for the extraction of strychnine.

Several varieties of wild fruit are collected by villagers. Some of these fetch high prices in the local market. The popular varieties of wild fruit are:

- Mora (***Nephelium***)
- Palu (***Manilkara hexandra***)
- Wira (***Drypetes sepiaria***)
- Madan (***Syzygium cumini***)
- Katuboda (***Culleia ceylanica***)
- Beraliya (***Shorea dyeri***)
- Jack (***Artocarpus heterophyllus***)
- Wood apple (***Ferronia limonia***)
- Beli (***Aegle marmelos***)

The fruit and seeds of jack are popular food items in Sri Lanka.

Several varieties of seeds are used in Ayurvedic medicine. The more popular varieties are:

- Ingini (***Strychnos potatorum***) to purify water in wells
- Madan (***Syzygium cumini***) for treatment of diabetes
- Pus Wel (***Entada phaseoloides***) in ayurvedic treatment
- Attaa (***Datra metel***) for treatment of nerve diseases
- Kapukinissa (***Hibiscus abelmschus***)
- Domba (***Calphyllum inophyllum***)
- Kina (***Calophyllum walkeri***)
- Mi (***Madhca longifolia***) to extract cholesterol free oil and cattle feed
- Kohomba (***Axadurachta indica***) to extract medicinal oil
- Jayapala (***Croton tiglium***) as a laxative
- Godakaduru (***Strychos nux vomicca***) to extract strychnin
- Myrabolams including Aralu (***Terminalia belerica***), Bulu (***Terminalia chebula***) and Nelli (***Phyllanthus emblica***)

Many wild flowers produce medicinal beverages. The more important ones are:

- Ranawara (***Cassia auriculiformis***)
- Beli (***Aegle marmelos***)
- Mi (***Madhuca longifolia***) for strong beverage
- Kohomba (***Azadirachta indica***) for savoury food
- Malitha (***Woodfordia fruiticosa***)
- Malia (***Bauhima racemosa***)

Kitul (***Careota urens***) is abundant in the wet evergreen forests. Flowers, or more correctly inflorescences of kitul, are tapped to obtain phloem sap which produces a range of products such as jaggery, alcoholic beverages (toddy) and vinegar. Kitul flour obtained from the juvenile core of the tree is a well-known medicine for giddiness.

Forest tree leaves are widely used in Oriental medical treatment. A few are also used as wrappers and as leaf vegetables.

The more important species and their uses are:

- Bidi leaf (***Diospyros melanoxylon***) to wrap bidi, a cheap smoke
- Kenda (***Macaranga peltata***) to wrap jaggery and other sweetmeats
- Beru (***Agrostistachys hookeri***) for thatching huts
- Bata leaves (***Ochlandra stridula***) to thatch village houses
- Madurutala (***Hortonia floribunda***) a mosquito repellant

The leaves of blue gum (***Eucalyptus globulus***) are used to distill oil which contains cineole. The quantity involved is comparatively small.

The non-wood forest products discussed above have been over-exploited because there has been no planned management. As a result, many herbal medicines that could be grown in Sri Lanka are now imported. One example is kohomba (***Munronia pumila***), which was available in the dry zone and the mid-country but is now almost extinct. This valuable medicinal herb is now imported from India at a cost of about Rs1000 per kilogram.

Grass, Bamboo, and Cane

Various sedges are used for handicraft industries such as basket making, hat making, and mat making.

Bamboo is used in building, scaffolding, ladders, bridges and fences. Numerous articles of daily use such as brushes, tool handles, toys, musical instruments etc. are made of different bamboo species. The traditional industry of basketware and bamboo flutes is based almost exclusively on a single native species, bata (***Ochlandra stridula***). ***Davidsea attenuata*** and ***Pseudoxytenantherea monadelpha*** are two other local species used to produce crude basketware. Four bamboo species, ***Ochlandra stridula***, ***Davidsea atteuata***, ***Bamboosa vulgaris***, and ***Dendrocalamus giganteus*** are widely used in cottage industries.

The rattan industry of Sri Lanka depends on 10 native species. The following species are widely used commercially.

- Thambotu wel (***Calamus zeylanicus***)
- Sudu wewel (***Calamus ovoideus***)
- Heen wewel (***Calamus pseudotenuis***)
- Ma wewel (***Calamus thwaitesii***)
- Kaha wewel (***Calamus rivalis***)
- Narawel (***Calamus delicatulus***)
- Wewel (***Calamus rotang***)
- Kukuluwel (***Calamus pachystemonus***)

An important species is weniwel (***Cosciniun feenestratum***), which is a woody climber growing in the rain forests. The stem is used as a diuretic and as an anti-tetanus drug. This, too, is over-exploited and the Forest Department has enforced controls on its collection. A breeding program is now underway.

EXPORT QUANTITIES AND VALUES

Few non-wood forest products enter the foreign market, with the exception of handicrafts made from bamboo and rattan. Bamboo and rattan goods earned Rs2.5 million in 1986. There has been a 50 percent reduction in sales over the last few years.

All products of mines or quarries are defined as forest produce in the Forest Ordinance. In this context gem stones, graphite and the like obtained from within the forest areas could be defined as non-wood forest products. This paper does not consider the exports of gem stones and similar products, as they do not relate to these materials.

COLLECTION AND PROCESSING

After receiving royalties, permits are issued by the Forest Department to collect products from forest preserves, while the District Office issues permits to collect products from state forests not managed by the Forest Department.

Non-wood forest products are almost exclusively gathered by local entrepreneurs. Little processing is done prior to their sale.

EMPLOYMENT GENERATION AND SOCIAL BENEFITS

Most industries based on non-wood forest products generate only part-time employment, with the exception of bamboo

and rattan industries, which employ 3,000 people full time. Additional part-time workers are often seasonally employed.

The most common production unit is home-based. The employment pattern for non-wood forest products industries have not been carefully studied, except for bamboo and rattan. Actually there is an estimated surplus of 900 trained workers in the craft industry based on bamboo and rattan. This is mainly caused by the difficulty in obtaining raw materials, the lack of capital to pay for them, and a shortage of tools.

FUTURE DIRECTIONS TO PROMOTE NON-WOOD FOREST PRODUCTS

Almost all non-wood forest products are obtained from natural forests, and some effort has been made to assess the present stock. Although the legal protection of these species is well defined, illegal exploitation is common mainly because of the high demand for these products. As a result, some species are almost extinct. The following aspects have to be studied to ensure proper management of remaining resources:

Survey of Existing Stocks

A comprehensive survey is needed to assess the present stock of non-wood forest products and to study the employment generation pattern of this industry. Both quantitative and qualitative data are needed.

The status of individual species has to be ascertained so that vulnerable species and areas can be protected from over-exploitation.

Awareness Programs

Industries based on non-wood forest products are confined to households; the traditional methods used for collection and processing have not changed over the years. The waste of raw material during harvesting and processing could be reduced through awareness programs of propagation and harvesting techniques. Cultivation of rare species and the use of alternative species have to be promoted to reduce the pressure on species in natural forests.

Most non-wood forest products do not fetch their proper prices in the market because of poor quality. People engaged in this industry have to be educated to new methods to improve the quality of the produce.

Some species are underutilized because of ignorance of processing methods. Katu una (***Bamboosa bamboos***), found in the dry zone for example, is underutilized. In India and other countries in the region, the same species is used for weaving mats. The existing techniques in the region could be used to overcome this problem.

Research

Research programs have to be strengthened to propagate the rare and very important non-wood forest products. More assistance is required for continuing research carried out by the universities and the Forest Department.

The ADB-funded Participatory Forestry Project of the Forest Department, to commence at the beginning of 1992, will provide opportunities for the development of non-wood forest products at the village level. Special attention will be given to the

medicinal herbs which are in high demand. Propagation of the herbs at the village garden level will contribute towards *ex-situ* conservation of these rare herbs and generate income for the rural poor.

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Links between producers and markets are crucial for successful NWFP development.

Annex I. Forest Herbal Materials Utilized by the Ayurvedic Corporation of Sri Lanka and their annual requirements

No.	Local Name	Botanic Name	Annual Requirement (kg)
1.	Aralu	*Terminalia chebula*	10,000
2.	Adhathoda	*Adhotoda visica*	300
3.	Etdemata (root)	*Gemlina arborea*	1,500
4.	Aswenna	*Alysicarpus vaginalis*	1,500
5.	Iriveriya (dry)	*Plectranthus*	500
6.	Inguru piyali	*Knoxiaa zeylanica*	400
7.	Ela batu (root)	*Solanum xanthocarpum*	1,500
8.	Endaru (root)	*Recinus communis*	500
9.	Endaru (seed)	*Recinus communis*	200
10.	Palol	*Sterospermum suaveolens*	1,500
11.	Polpala	*Eerva lanata*	1,500
12.	Beli (raw fruit)	*Aegle marmalos*	1,500
13.	Bulu	*Terminalia belerica*	10,000
14.	Beli (root)	*Aegle marmalos*	1,500
15.	Binkohomba	*Munronia pumila*	800
16.	Bebila (root)	*Sida racemsca*	5,000
17.	Midi (root)	*Prema ceratifolia*	1,500
18.	Thotila (root)	*Orolylum indicum*	1,500
19.	Nas Narang (root)	*Citrus japonica*	100
20.	Na (flowers)	*Messua ferrea*	600
21.	Na (stamens)	*Messua ferrea*	500
22.	Nalum (petioles)	*Nelumbo nucifera*	100
23.	Gas Karalheba	*Achyrathes aspera*	120
24.	Heen aratta (yam)	*Ophiorrhiza mungos*	3,500
25.	Matu karandu (root)	*Barlerica prionitis*	150
26.	Kiratha	*Swertia zeylanica*	1,000
27.	Kohoba (bark)	*Azadirachta indica*	2,000
28.	Kollan (leaves)	*Pogostemon heyneanus*	500
29.	Kumbuk (bark)	*Terminalia arjuna*	500
30.	Kohomba (seed)	*Azadirachta indica*	100
			...

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Annex I. Forest Herbal Materials Utilized by the Ayurvedic Corporation of Sri Lanka and their annual requirements

No	Local Name	Botanic Name	Annual Requirement (kg)
31.	Kotala Himbatu (root)	*Saracia reticulata*	200
32.	Dummella	*Trichosanthescucumerina*	300
33.	Diyamitta	*Cissampelos pareira*	500
34.	Nika (root)	*Itex negundo*	100
35.	Ranawara (root)	*Cassia auriculata*	100
36.	Ratnitul (root)	*Plumbago indica*	1,000
37.	Rasakinda (dry)	*Tinosora cordifolia*	5,000
38.	Rukattana (bark)	*Alstonia scholaris*	100
39.	Ruk mal (flower)	*Horsfieldia iryaghedi*	300
40.	Wenivelgeta	*Coscinium fenestratun*	7,000
41.	Welkahambiliya	*Fleurga interrupta*	750
42.	Weltibbotu (root)	*Solanum trilobatum*	350
43.	Detta (yam)	*Baliospermum montanum*	400
44.	Delum (peel)	*Punica grantum*	350
45.	Gon Kekiri (yam)	*Cucumis melovar*	150
46.	Gokatu	*Garcinia mrella*	500
47.	Hal Dummala (Damar)	*Vateria copallifera*	350
48.	Hatavariya (yam)	*Asparagus racemosus*	260
49.	Lunuwila	*Bacopa monniera*	100
50.	Lunuwarana (bark)	*Crateva religiosa*	100
51.	Jatamansa	*Nardostachys jatamansi*	500
52.	Kiribadu (yam)	*Ipomoea mauritiana*	500
53.	Sudu Handun (wod)	*Santalum album*	800
54.	Sevendara (root)	*Vetiveria zizanioides*	400
55.	Siviya (root)	*Piper chaba*	300

Annex II. Imported Medicinal Herbs Obtained from Natural Forests

Herb	1987		1988		1989	
	Quantity (kg)	Value (Million Rs)	Quantity (kg)	Value (million Rs)	Quantity (kg)	Value (million Rs)
Tippili (*Piper longum*)	15,125	1.61	13,708	2.89	13,976	1.59
Spikes Roots	5,300	0.11	4,750	0.10	6,500	0.09
Pathpadagum (*Mollugo carviana*)	53,500	0.52	77,293	1.00	56,820	0.89
Katuwalbatu (*Solanum xanthocarpum*)	92,500	0.70	170,288	1.46	66,488	0.71
Devadara (*Erythroxylum monogymum*)	14,203	0.17	21,246	0.32	28,287	0.45
Walangasal (*Embelia ribes*)	8,550	0.24	17,450	0.59	10,500	0.36
Tirastavalu (*Operculina turpethua*)	11,328	0.26	25,350	0.54	9,000	0.21
Welmadata (*Rubia cordifolia*)	6,198	0.15	15,627	0.37	4,600	0.16
Kumburueta (*Caesalpinia bonduc*)	5,100	0.06	6,985	0.16	9,250	0.13
Malithamal (*Woodfordia fruticose*)	16,050	0.16	13,000	0.14	9,550	0.13
Walgammiris (*Piper argyrophyllum*)	600	0.15	1,245	0.12	2,000	0.11
Nelli (*Phyllanthus emblica*)	57,068	0.76	56,973	0.75	3,825	0.05
Geewanthi (*Terminali chebula*)	-	-			1,689	5.00

Marketing rattan in the Philippines.

THAILAND

Wanida Subsansenee
Non-Wood Forest Products Sub-Division
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Royal Forest Department

INTRODUCTION

Non-Wood Forest Products (NWFPs), as defined in Thailand, refer to all forest products other than timber, small wood and fuelwood. NWFPs are essential to the livelihood and well-being of Thai rural communities. In the past, NWFPs received only modest attention from the Royal Forest Department (RFD), and the quantity and diversity has decreased drastically for four reasons:

- Adverse impact of deforestation and environmental degradation;
- Over-exploitation;
- Use of traditional, unimproved methods in harvesting; and
- Lack of information and inadequate training.

Now, the direct and indirect values of NWFPs are more clearly recognized and are receiving interest from the government of Thailand as well as from other tropical countries and international agencies. Compilation of data on NWFPs, improved cultivation practices, and determination of accurate yield estimates are current priority activities. The direct and indirect benefits of NWFPs to rural communities are being assessed with a view toward product improvement, management and marketing of NWFPs.

Because of the diversified nature of NWFPs, it is difficult to assess their value. Uses of NWFPs in rural communities differ greatly from one area to another. NWFPs are normally used for subsistence purposes, but some are also traded. Requests to RFD for NWFP harvesting permits are few in number and are considered unnecessary by local users. Thus, accurate data on NWFPs are difficult to maintain.

OFFICIAL CLASSIFICATION OF NWFPs

According to Forest Act B.E. 2484 (A.D.1941), NWFPs are divided into two categories as follows:

- **Protected NWFPs** including wild orchids, aromatic wood (*Dracaena loureire*), agarwood (*Aguilaria sp.*), sappan (*Caesalpinia sappan*) charcoal, yang oil (gurjan), some palm leaves, some bark (*Gasternopsis* spp., *Hopea* spp., *Persea* spp., *Artocardus* spp., *Cinnamomum* spp., etc.), *Platycerium* spp., gums, resin (gutta percha, jelutong, lacquer resin, oleoresin), some ferns, and rattans.
- **Unprotected NWFPs**: All others not specified above.

BENEFITS AND IMPORTANCE OF NWFPs

NWFPs are important in providing the following benefits in Thailand:

- Food and household use;
- Supplements to family earnings from trade at local and domestic levels;
- Generation of rural employment;
- Foreign exchange earnings from exports; and
- Enhanced forest conservation.

The extent of the social value of NWFPs is not known, but by indirect and subjective assessment based on records from the Forest Management Division, there are about 9,500 villages with 862,500 families and 4.85 million residents living in reserve forests in Thailand. Assuming that in each family one member works at harvesting and utilizing NWFPs, approximately one million jobs are dependent on NWFPs.

Important Thai NWFPs in the international market are shown in Table 1. These include rattan, bamboo, lac, honey, gum, resins and bark. Other NWFPs utilized for food, spices, medicinal plants, and orchids will not be elaborated on in this paper as many of them are now cultivated plants.

Rattan

There are 6 genera and 55 species of rattan in Thailand, the most important being ***Calamus, Korthalsia, Daemonorops, Plectocomia, Myrialepsis*** and ***Plectocomiopsis***. Rattan is found from sea level up to 3,000 meters. In Thailand most rattans are found in the south, north and central parts of the country. They grow in swamp, evergreen, dry evergreen and mixed deciduous forests.

Rattan has been used for centuries in Thailand. It is used for:

- Handicrafts such as rattan canes, hats, baskets, ropes and mats;
- Furniture;
- Medicines for treating rheumatism, asthma, diarrhea, snake bites and intestinal disorders. (***C. rotang, C. ceasius,*** and ***C. triginus***; and
- Edible fruit and shoots.

Rattan furniture is currently very popular in a number of international markets and has a promising future. The most important large cane species in Thailand used for furniture (Vongkaluang, 1986) are kampuan (***C. longisetus***), namphung (***C.*** sp.), keesean (***C. rudentum***), kordam (***C. manan***), and nguay (***C. peregrinus***).

The most important small rattans are takathong (***C. caesuis***), keephung (***C. blumei***), lek (***C. pandanosmus***), and keereh (***C. densiflorus***).

Rattan harvesting. In the past, all rattans except ***C. caecuis*** were unprotected NWFPs. People could collect without permits (except in reserved forests). In 1988, however, all rattan was classified as a protected NWFP because of over-exploitation. Permits are now required

Table 1. Non-wood forest products exports from Thailand, 1979-1988 (million baht)										
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Lac	89.88	111.43	84.97	141.36	278.71	479.45	582.09	395.11	287.18	121.61
Bamboo	13.29	3.55	17.76	19.49	24.00	22.08	21.59	19.58	30.50	22.79
Gum	8.24	13.57	14.15	22.82	14.48	13.89	21.91	30.97	29.40	24.96
Rattan	-	-	-	-	-	-	-	-		
Rattan									0.65	0.02
Furniture	-	-	-	-	-	-	441.13	520.72	712.59	479.30
Honey	0.09	0.002	0.004	0.23	0.10	0.16	5.19	4.80	11.46	24.55
Resins	0.02	0.28	0.09	-	-	0.07	0.04	0.11	0.76	0.50
Spices	12.79	18.13	65.15	108.19	106.62	150.94	129.80	57.48	26.14	137.72
Kobuak	58.82	-	-	52.65	48.63	42.53	48.53	50.08	-	47.89
Total	183.32	146.962	182.124	344.74	473.55	708.7	1260.28	1068.85	1099.04	859.34

from the Forest Department for harvesting quantities exceeding 10 kilograms. Enforcement of this regulation is weak, resulting in illegal harvesting in most areas. Accurate production records are not available. Legal harvests are given in Table 2, but these levels are believed to vastly underestimate actual harvests.

Table 2. Legal rattan cutting in Thailand

Year	Quantity (1000kg)	Value (Baht 1000)
1967	34,347	30,014
1968	34,195	29,876
1969	3,037	3,038
1979	37,000	37,955
1971	14,897	12,509
1972	23,839	20,017
1973	23,369	22,591
1974	64,894	70,302
1975	8,429	9,132
1976	4,752	5,148
1977	8,150	9,237
1978	11,112	12,964
1979	3,152	4,203
1980	2,320	4,640
1981	205	1,516
1982	385	3,374
1983	2,924	35,088
1984	1,303	15,637
1985	2,588	30,338
1986	3,147	37,633
1987	5,960	74,500
1988	3,558	46,254
1989	1,235	16,670

Source: Royal Forest Department
Notes: 1) Rattan was declared a protected NWFP in 1988.
2) Commerical logging in natural forests banned in 1989.

Exports and imports. Thailand imports a large volume of raw rattan from Myanmar, Vietnam, Laos, Singapore, Indonesia, Hong Kong, Malaysia and others. As rattan furniture for export has grown in popularity, the quantity of raw rattan imported has increased rapidly (Table 3). In 1967, the quantity imported was 64.2 tons, valued at Bt618,300. By 1988, the quantity imported had grown to 29,339 tons, valued at Bt224 million. These figures indicate that a great quantity of rattan was imported to serve the increasing demand of the rattan furniture industry.

Very little raw rattan is exported from Thailand. The largest quantity was in 1977: 436.7 tons valued at Bt729,500. The export of raw rattan was banned in 1978.

Collection and processing. The Ministry of Agriculture and Cooperatives has established temporary regulations for harvesting. When better data and information on growth rates and cutting regimes becomes available, these regulations may be revised. The current regulations direct collectors to:

- Cut only mature cane of at least 8 meter in length.
- Leave half of the stems in the clumps.
- Clear the area under the clumps after harvesting.
- Follow a felling rotation of 5 years.

Rattan canes are easily recognized as being mature when the leaf sheath has fallen. The best time for cutting rattan is from November to March. Sometimes peeling and splitting of cane is done in the field with ordinary knoves prior to transporting to the factory. In the factory, peeling and splitting of cane are done by machine.

Table 3. Exports and imports of raw rattan and furniture, Thailand

Year	Exports			Imports	
	Raw rattan		Rattan furniture	Raw rattan	
	Quantity (tons)	Value (1000 baht)	Value (million baht)	Quantity (tons)	Value (1000 baht)
1967	16.8	14.2	-	64.2	618.3
1968	25.0	13.6	-	66.8	689.0
1969	50.3	30.1	-	78.7	913.8
1970	62.8	366.4	-	84.8	836.3
1971	-	-	-	67.8	622.0
1972	6.8	6.2	-	76.7	679.4
1973	-	-	-	62.5	572.8
1974	10.2	9.0	-	61.1	564.9
1975	39.0	100.4	-	96.3	1,054.7
1976	58.1	47.6	-	194.5	2,091.6
1977	436.1	729.5	-	219.0	1,781.7
1978	244.2	705.5	-	263.9	2,350.7
1979	-	-	-	348.6	6,816.8
1980	-	-	-	411.0	10,222.7
1981	-	-	-	841.1	17,608.9
1982	-	-	-	3,163.7	29,123.3
1983	-	-	-	6,571.8	51,014.2
1984	-	-	-	5,389.6	58,767.6
1985	-	-	-	7,391.7	74,485.2
1986	-	-	520.7	11,029.0	93,516.0
1987	-	-	712.9	18,443.0	142,233.0
1988	-	-	479.3	29,338.9	224,446.4
1989	331.0	4,810.0	369.3	27,187.6	164,063.0
1990	0.3	120.9	279.9	15,977.4	136,268.2

Source : Office of Agricultural Economics
Note : (1) Export of raw rattan was banned in 1979

After harvesting, there are many methods of treatment including:

- Drying in the sun until the moisture content is 5 to 10 percent;
- Washing in water, rubbing with sand and coconut husk, and drying in the sun until the moisture content is 5 to 10 percent;
- Washing in water, fumigating with SO_2, drying in the sun, washing in water, and rubbing with sand and coconut husk;
- Immersing in sodium hypochlorite for 1 hour, washing in water, fumigating with SO_2, drying in the sun;
- Boiling in a mixture of diesel and coconut or palm oil 30 to 40 minutes at 70 to 120° C, rubbing with coconut husk, drying in the sun.

Employment generation. Chuntanaparb, et.al (1985) estimated that the local productions of rattan was 5 to 6 million kilograms per annum, with an estimated value of Bt40 million, creating about 35,000 person-days of employment each year in harvesting and transport and about 400,000 person-days of employment in furniture production.

Recommendations. Rattan production in Thailand comes almost entirely from the wild and is insufficient to meet the demands of the rattan industry. Rattan harvesting permits have decreased rapidly as diminishing forest resources and uncontrolled exploitation have seriously depleted the stock of wild rattan. Plantations of rattan are not yet well established. It is necessary to find appropriate methods for the successful establishment of rattan plantations, and to find appropriate technologies for harvesting, post-harvest, and pre-factory treatment.

Bamboo

Bamboo is found throughout Thailand, mostly in mixed deciduous forests. It covers about 810,000 hectares (5.5 percent of the forest area). Thirteen genera, with more tham 60 species, are found in Thailand, including ***Arundiaria, Bambusa, Cephalostachyum, Dendrocalamus, Dinochloa, Gigantochloa, Mclocalamus, melocanna, Neohouzeaua, Pseudosasa, schizostachyum, Teinostachyum*** and ***Thyrsostachys***.

Bamboo has many uses. The culms are used for house construction, scaffolding, props, ladders, fencing, containers, pipes, toys, musical instruments, furniture, wicker work, partitions, house walls, fuel and raw material for pulp and paper making. Shoots are a popular food, used in fresh and preserved foods. Bamboo serves as fencing, windbreaks, and to prevent river bank erosion. The best known species are ***Thyrsostachys siamensis*** and ***Dendrocalamus asper***. ***Thyrsostachys siamensis*** is mostly collected from natural forests. The species is tolerant of drought and saline soil. It was the primary raw material for pulp and paper making in Thailand from 1939 to 1984. Each year, over 5 million culms were required for the pulp and paper industry. Owing to the strong demand for bamboo stalks, this species is diminishing.

Dendrocalamus asper is a favourite species for bamboo plantations. The advantages of

their species are simple propagation requirements, a short cutting cycle, and high yields of quality young shoots. The culms are suitable for building materials and toothpicks.

Bamboo harvesting. The culms removed from forest under RFD permits are showed in Table 4.

Table 4. Official records of bamboo culms removed from natural forests in Thailand

Year	Quantity (1,000 culms)	Value (1,000 baht)
1979	14,711	88,272
1980	2,260	15,825
1981	2,173	15,216
1982	16,003	160,030
1983	1,102	13,227
1984	555	6,661
1985	8,884	106,614
1986	6,485	77,823
1987	13,495	202,426
1988	18,863	339,551
1989	15,597	311,959

Source: Royal Forest Department

The annual demand for bamboo is much greater than the volumes indicated in Table 4, so these data should be considered only a potential indication of harvest levels. Some bamboo species are not on the protected list and are therefore not reflected in RFD statistics. Official bamboo harvest levels peaked in 1988 at 18.9 million culms, valued at Bt 339.6 million.

Exports and imports. Table 5 shows the total quantities and value of bamboo exports and imports, including, bamboo stalks, bamboo shoots, bamboo poles, and toothpicks. Dried bamboo shoots are the main import item.

Table 5. Exports and imports of bamboo and bamboo products

	Exports		Imports	
Year	Quantity (tons)	Value	Quantity	Value
1979	6,552	13,286	468	16,009
1980	198	3,546	138	9,859
1981	6,230	17,762	242	11,390
1982	5,733	19,491	136	9,637
1983	8,306	23,997	200	16,315
1984	3,246	22,076	231	25,028
1985	9,667	31,592	6	262
1986	4,836	19,584	98	10,594
1987	5,735	30,496	187	10,265
1988	292	22,789	280	13,492

Source: Department of Customs

In the last decade, exports surpassed imports in every year except 1980.

Collection and processing. Bamboo harvesting is carried out by selective cutting. The one-year old culms should not be harvested in order to maintain growth. Cutting is generally done by using a small axe, machete, bill hook or saw.

The first harvest is between the third and fifth year of growth. There are up to 5 shoots from each culm in the first and second year. Mature culms are at the center of each clump, and are surrounded by up to 5 new shoots each year. The 2-to 3-year old clumps are cut for bamboo stalks, poles, construction work and wicker work. The clumps should be cut at the bottom close to the ground. Quality decreases if over-aged clumps are left uncut. These clumps become brittle while the immature ones are not durable. Cutting is easier from November through March. Studies have indicated the suitability of a 3-year cutting cycle for ***Thysostachys siamensis*** in natural forests conditions. Consecutive cuttings 3 years

apart each yielded more than 10,000 culms per hectare with no reduction in stem quality (Suwannopinan, et al, 1982).

De-branching of the culms is done immediately after cutting. The culms are then cut to the desired length. Bundling may or may not be done before the poles are transported to the roadsite or the yard.

It is important to keep the poles free from insect infestation and deterioration. The general practice are:

- Upon reaching the yard, poles are graded according to size, length and defects.
- Poles are dried by sun, air seasoning, or in an oven.
- Poles are dipped into diesel fuel to protect them from insect infestation and again dried by air.
- Poles are bundled for sale and delivery.

Bamboo shoot harvesting is done from May to October (the rainy season). Shoots can be collected from the clumps daily, or twice a week. In bamboo plantations, 1- or 2-year old stalks of ***Dendrocalamus asper***, each yield about 5 or 6 shoots per year. Bamboo shoots can grow 90 to 120 centimeters per day under ideal conditions. For export, the average weight of shoots should range from 0.4 to 2.0 kilograms.

Shoot processing includes:

- Removal of the leaf. Leaf sheath and oral setae;
- Boiling of the shoot in water, followed by drying or fermenting;
- Cutting into appropriate sizes and lengths;
- Packing for delivery.

Recommendations. The availability and production of local bamboo do not meet the demand. Corrective measures should include:

- Increasing the size of the bamboo plantations. Suitable species and spacing for various purposes and sites should be determined.
- Improved management techniques. The recommended schedules and methods of harvesting should be followed. Extension and training are needed.
- Employing suitable harvesting and processing techniques. It is important to keep the poles or shoots in their best condition. Practical and economic methods should be devised.

Lac

Lac is an unprotected non-wood forest product. It is the resinous protective secretion of the lac insect, ***Laccifer lacca***, found in India, China, Laos and Burma. The largest lac producing areas are in the North and Northeast. Lac can provide extra income for farmers in rural areas and for the people collecting NWFPs from the forest. Lac is used for various products including:

- **Lac dye**: lac dye is fast in animal fibres such as wool and silk and has a bright red colour. Different attractive shades may be obtained by using different mordants. The silk cottage industry in many villages uses stick lac for colour-fast dyeing of silk. Lac dye is edible, therefore, it can be used for colouring soft drinks and food.

- **Shellac**: used for painting and furniture manufacturing.

- **Bleached shellac**: used the same as shellac. Currently, light coloured furniture is popular and bleached shellac is in demand.

Lac production. Production of lac fluctuates dramatically (Table 6). The highest production ever recorded in Thailand was about 24,000 tons in 1974/75. The lowest production, in 1980/81, was only about 800 tons, due to unfavourable weather. The average production over the last 10 years was about 7,000 tons. The major areas of lac cultivation are in the North, which produce about 84 percent of the lac crop (Wanida, 1986).

Exports and imports. The quantity and value of lac exports fluctuates according to the production and the world market price (Table 7). In 1983, lac exports totalled 9,423 tons, valued at Bt279 million. In 1985, the exports were 6,258 tons valued at Bt582 million. Exports decreased in 1988 to only 3,483 tons, valued at Bt122 million. The amount of lac imported is very small.

Collection. Normally there are 2 broods of lac in a year; in May and June, and November and December. However, lac is cropped only once a year, from September to December.

There are a large number of trees and shrubs which are the hosts of lac insect. The major lac host tree in Thailand is the rain tree (*Samanea saman*). Other suitable lac host trees are *Albizzia lucidior, Combretum quadrangerlae, Zyzyphus mauritiana*, and *Croton arguratus*.

Lac host trees should be pruned 1 to 2 years before inoculation. The brood lac to be used for the infection of the new trees should be healthy and uninfected by pests. The brood lac selected should be cut into a length of about 6 inches and tied with string at the end of the twig and covered with a straw basket. Brood lac should be tied to the tree, vertically or as near as possible to the branch to which the young are to settle.

Brood lac should be left on the branch about 1 week, then moved to another branch. It should be left on the tree no longer than 3 weeks. Care must be taken not to over-infect the host. The lac insect will complete its generation within 6 months. Then the lac can be cropped or left on the tree for self-infection for a second cropping cycle. A 3-year rotation for host trees should be used.

Lac is cropped from trees both for use as brood and for use in industry. The methods of collecting are different.

For use as brood, lac should be left on the tree until the lac are ready to swarm. It is harmful to cut the lac before or after it matures. Premature cutting of the lac is harmful because the females are cut off from their food supply and become weak. Late cutting is also harmful because the

Table 6. Stick lac production in Thailand

Year	Production			Value	
	North (1,000 kg)	Northeast (1,000 kg)	Total (1,000 kg)	Unit value (baht/kg)	Total (1,000 baht)
1979/80	3,800	-	3,800	-	-
1980/81	400	400	800	-	-
1981/82	3,500	400	3,900	-	-
1982/83	11,000	1,500	12,500	6.50-10.00	103,125
1983/84	1,000	300	1,300	24.00-27.00	33,150
1984/85	7,000	1,000	8,000	28.00-80.00	432,000
1985/86	14,000	1,500	15,500	15.00-35.00	348,750
1986/87	9,000	1,000	10,000	11.00-17.00	140,000
1987/88	4,000	800	4,800	16.00-25.00	98,400
1988/89	3,500	1,000	4,500	8.00-12.00	45,000
1989/90	6,550	700	7,250	6.50-9.50	58,000
1990/91	5,250	650	5,900	9.00-11.00	59,000

Source: Thai Lac Association

Table 7. Exports and imports of lac products

Year	Exports		Imports	
	Quantity (tons)	Value (1,000 baht)	Quantity (tons)	Value (1,000 baht)
1979	7,359	89,884	15	292
1980	5,526	111,432	7	282
1981	2,642	84,970	3	247
1982	6,361	141,363	3	224
1983	9,423	278,714	10	49
1984	9,628	479,452	68	258
1985	6,258	582,090	8	1,523
1986	8,055	395,112	5	1,668
1987	7,685	287,184	2	1,075
1988	3,483	121,616	8	1,353

Source: Department of Customs

young larvae will be lost before the lac is cut. The most appropriate method for cutting brood lac is by examination of the orange yellow spot area of the female lac cell. With the appearance of cracks in the encrustation, the encrustation can be pulled off from the host twig.

For industrial havesting, lac should be cut just a short time before swarming is due to occur. For use as lac dye, lac should be collected before swarming, because at this period the lac cell contains the highest content of dye.

Precautions in collection and storage. After lac is cut, it should be scraped from the twigs as soon as possible with sharp knives. To prevent lac from forming blocks it should be spread on a clean floor and air dried away from direct sunlight.

The lac may be spread in layers about 4 inches deep to prevent it from sticking together when freshly cut. Lac may be raked once a day until it is dry, then raked once every 3 to 4 days. If the lac has already formed blocks, they should be broken at once. Blocky lac makes processing difficult and the lac also loses chemical and physical properties, causing its price to decline.

Lac should be stored in a cool and ventilated room, and should be fumigated with carbon bi-sulphide to protect against insect attack. Lac can easily deteriorate if stored improperly.

Seedlac processing. After scraping the lac from the twig, the dust and stick should be collected by hand. Then the sticklac is crushed by a lac crusher, after which it is ready for washing. Crushed lac is placed in a cement tank and washed. Lac can be washed with plain water or soda ash can be added to make it clearer. Then the water containing the lac dye is allowed to run off. This process is repeated three or four times until most of the lac dye has been removed. The material left over is called seedlac. The seedlac is dried on a cement floor.

Shellac processing. Seedlac is converted to shellac by a steaming process. The seedlac is passed through a sieve after melting by a steaming process using 40 to 50 pound per square inch of pressure for 1 1/2 hours. The processed material is called shellac. After the hot shellac tray is removed from the steaming process, the tray is placed in water and the cooled shellac is pulled from the tray.

Flake shellac can be made by heating shellac over a fire (if a yellow colour is desired, it is mixed with yellow arsenic sulphide). Then the molten shellac is transferred through the cooling rollers of a sheeter and passed along a belt conveyer to obtain a sheet of shellac. The shallec is then dried, broken into small chips, and stored in an air-conditioned room at a temperature of 10^0 to 20°C.

Bleached shellac processing. To produce bleached shellac, seedlac is dissolved in a hot solution of soda ash at a temperature of 70 to 80^0C and boiled for about 1 hour. After all the lac is dissolved, the lac solution is filtered through a nylon (cloth to remove the impurities) and allowed to cool. Bleach liquor is added until the lac solution is fairly well bleached. Dilute sulphuric acid is slowly added to the solution until it is neutral. Bleached shellac forms in a fine granular size, then it is filtered through a muslin bag and thoroughly washed in cold water. The precipitated bleached shellac is

squeezed out, dried, crushed into powder, and kept in a cool place.

Employment generation. In 1989, the Forest Products Research Division of the Royal Forest Department surveyed the families involved in lac cultivation in Phrae, Lampang, Phayao and Tak Provinces. It was estimated that about 2,100 tons of lac production created jobs for 15,400 families. In 1989/90, the production of 7,250 tons created employment for 53,200 families.

Recommendations. After logging concessions were closed in 1989, rain tree (*Samanea saman*), the lac host trees, became very popular for wood carving, handicraft manufacture, and furniture. Large trees now sell for Bt 20,000 as timber, and smaller trees sell for Bt 2,000 to Bt 3,000. Because of the resulting harvest of rain tree for other uses, the number of lac host trees has drastically declined. It is necessary to promote rain tree plantations in rural areas, especially in the areas lac had previously been cultivated. Research on lac production in all the aspects should be initiated.

Honey

Honey was previously classified as a protected NWFP but in 1988 it was reclassified as an unprotected NWFP. There are four species of honeybee in Thailand. Three species occur naturally in forests: the giant bee, or rock bee (*Apis dorsata*); the hive bee (*A. cerana*); and the little bee (*A. florea*). A fourth species (*A. mellifera*) has been introduced for honey production in Thailand. Here are seven commercial products from bees. Honey is the main product. The others are wax, pollen, royal jelly, propolis, venom and bees themselves.

- **Honey** is used as food or sweetener in medicines.
- **Wax** is used for polish, cosmetics, candles, and comb foundations for beehives.
- **Pollen** is used as a dietary supplement and in herbal medicine.
- **Royal jelly** has a reputation as an aphrodisiac, a panacea and a rejuvenator.
- **Propolis** is used on a small scale medicinally for its bacteracidal properties.
- **Bee venom** is used medicinally for desensitizing people hyper-allergic to bee stings and as a folk medicine to prevent arthritis.
- **Bees** are sold to other producers to form new hives.

Bees and bee products can provide extra income for people in rural areas. In some cases, beekeeping can be a full-time occupation (Chuntanaparb, et al., 1985).

Honey production. The official production and value figures for honey collected from natural forests with RFD permits are given in Table 8. The figures significantly underestimate total production.

No estimates of the amount of honey from beekeeping throughout the country are available. It may be assumed that northern Thailand is the best place for beekeeping.

Table 8. Honey production in forest areas of Thailand

Year	Quantity (tons)	Value (1,000 baht)
1979	23.80	1,904.0
1980	0.03	4.2
1981		
1982		
1983	1.00	121.2
1984	0.50	64.8

There are about 50,000 hives in the North, and 3,000 to 6,000 hives in the south. It is estimated that 1 hive produces about 40 kilograms of honey. Therefore the honey production from beekeeping could be estimated at about 2,000 tons per annum.

Exports and imports. In 1988, 1,750 tons of honey, worth 24.5 million baht, were exported. The quantity of honey exported increased rapidly between 1987 and 1988 reflecting the considerable promise of honey export markets. Imports decreased from 1,240 tons in 1986 to only 143.2 tons in 1988 as domestic production increased.

Collection and processing. For wild honey, hives are smoked with a torch made of fresh leaves and dry grass until the bees flee from the hive. The honey is then removed from the hive. This method is used for ***Apis dorsata*** and ***A. cerana*** hives. For ***A. florea***, a cigar is used instead of a torch. The honey is then extracted, filtered and placed in jars. Harvest time is from April to June.

For beekeeping, combs should be removed from the colony to extract the honey. The honey combs are brought into a bee-tight room for uncapping and extracting. The uncapping tool is a sharp knife heated by hot water. The honey is extracted by centrifugal force. The extracted honey is left in a honey storage tank for several days to allow air bubbles, bits of wax, and any fine particles to rise to the top. These are skimmed off before bottling.

Table 9. Exports and imports of honey, 1979-1988

Year	Exports		Imports	
	Quantity (tons)	Value (1,000 Baht)	Quantity (tons)	Value (1,000 Baht)
1979	.640	88	137.237	8,555
1980	.012	2	66.428	1,296
1981	.010	4	31.472	5,620
1982	12.142	234	123.002	5,139
1983	69.829	1,104	192.346	7,290
1984	116.899	160	3,378.359	3,788
1985	288.900	5,199	130.359	5,267
1986	139.517	4,797	1,240.007	24,080
1987	748.813	11,464	148.579	6,922
1988	1,749.762	24,548	143.236	5,088

Source: Department of Customs

Recommendations. If beekeepers want to achieve the maximum high-quality honey production, they must have information on pollen and nectar sources. It is, therefore, essential to support additional study of the phenology of flowers.

Gums and Resins

Gums and resins are products obtained from the exudation of plants. Resins from different sources show great differences in their chemical composition and properties. The most important resins produced in Thailand are naval stores (oleoresin), used in the paper, rubber, ink, and adhesive industries; and yang oil or "gurjan," produced from the resin of ***Dipterocarpus alatus*** Roxb. and other dipterocarps, which is used for making varnish.

Other gums and resins produced in Thailand include gamboge from ***Garcinia hanburvi***; Chinese lacquer from ***Melanorrhoea usitata***; wall benzoin from ***Styrax bezoin;*** gutta percha from ***Palaguium obovatum*** Engler; Jelutong from ***Dyera costulata***; and other dipterocarp resins. Gum damar from dipterocarps which can be used for the manufacturing varnish can also be collected in Thailand.

Gum oleoresin in Thailand is tapped from ***Pinus merkusii*** Jungh. It is found in natural forests, on mountains more than 700 meters above sea level, or on high plateaus about 100-200 meters above sea level.

There are two products of gum oleoresin in Thailand:

- **Gum rosin**, which is used in making paper, paints, and adhesives. and
- **Gum turpentine**, which is mostly used in paint manufacturing and pharmaceuticals.

Gurjan or yang oil is also tapped from various ***Dipterocarpus*** species. It is used to make torches, varnish, printing ink, and (mixed with gums damar) to caulk boats and waterproof bamboo baskets. It is commonly used as a preservative for wood and bamboo. Recently, yang oil has been used to produce balsam oil for perfume base. Yang oil and gum oleoresin are protected NWFPs.

Gum and resin production. In 1989, the production of yang oil was 639.5 tons, valued at 16 million baht (Table 10). Gum oleoresin production was 271.3 tons, valued at 8 million baht. Permits are no longer needed for other resins, so production data are not available.

Exports and imports. Thailand imports a large quantity of gum oleoresin (Table 11) gums, resins, and chinese lacquer (Table 12), although quantities fluctuate considerably from year to year.

Collection and processing. Gum oleoresin and yang oil are protected NWFPs. Permits are required from the Royal Forest Department for harvesting. People are allowed to collect up to 10 kilograms without a permit.

Tapping is by traditional methods. For pine, tapping is by cutting into the trunk of the tree. The first cut is usually 15 centimeters long, 10 centimeters wide, and 3 centimeters deep. Every 7, days the resin is collected and and the wound is enlarged with a fresh cut. After 1 year, the wound should not be longer than 30 centimeters. The width and the depth should not be more than the first cutting. Only trees of a minimum girth of 120 centimeters are allowed to be tapped. Resin is tapped only from trees in the natural forest.

To tap yang oil, a hole about 30 centimeters wide by 30 centimeters high and 20 centimeters deep is made in the trunk of the tree. The tapper collects the oil every 10 to 15 days. At each collection, a fresh fire is lit for 2 minutes to melt the hardening resin and stimulate flow. Only trees with a minimum girth of 200 centimeters are allowed to be tapped.

Recommendations. Traditional resin tapping methods are very harmful to trees, thus the opportunities for expanding production under current methods are limited. Training and extension in improved tapping techniques are needed.

Table 10. Gum and resin production in Thailand, 1986-1989

Year	Gum oleoresin		Yang oil (gurjan)		Other resins	
	Quantity (tons)	Value (1,000 baht)	Quantity (tons)	Value (1,000 baht)	Quantity (tons)	Value (1,000 baht)
1986	245.6	6,877.7	682.4	10,918.8	31.50	851.2
1987	254.3	7,121.4	661.9	11,897.3	0.01	0.2
1988	313.6	8,781.7	531.9	10,107.2	-	-
1989	271.3	7,597.4	639.5	15,986.9	-	-

Table 11. Exports and imports of natural resins and spirits of turpentinne

Year	Exports		Exports	
	Quantity (tons)	Value (1,000 baht)	Quantity (tons)	Value (1,000 baht)
1979	1	18	220	3,175
1980	17	275	212	3,480
1981	1	85	218	3,829
1982	-	-	97	1,125
1983	-	-	339	5,812
1984	1	69	1	191
1985	1	42	262	4,720
1986	2	105	73	2,442
1987	6	756	126	1,884
1988	17	499	230	3,137

Source: Department of Customs

Table 12. Exports and imports of gum, resins and chinese lacquer

Year	Exports		Imports	
	Quantity (tons)	Value (1,000 baht)	Quantity (tons)	Value (1,000 baht)
1979	783	8,245	347	6,027
1980	1,321	13,565	372	10,410
1981	766	14,146	200	18,509
1982	1,453	22,821	671	5,905
1983	1,442	14,490	356	6,019
1984	1,565	13,891	551	18,153
1985	2,176	21,905	529	16,163
1986	2,093	20,965	892	18,600
1987	1,947	29,395	2,300	23,454
1988	2,348	24,957	739	18,127

Source: Department of Customs

Table 13. Uses of selected bark species in Thailand

Local Name	Botanical Name	Family	Utilization
Mahaat	*Artocarpus lakoocha* Roxb	Moraceae	Tannin is used for astringents.
Paper Mulberry (Po krasaa)	*Broussonetia papyrifera* Vent	Moraceae	Bark is raw material for paper-making, rope making and fibre material for other industries.
Up choel	*Cinnanonum bejolghota* Sweet	Lauraceae	Spice and flavour
Khian	*Cotyleloblum lanceolatun* Craib	Dipterocarpaceae	Tannin is used for tannery, astringent and anti-fermentation in palm juice.
Phayon	*Shorea floribunda* Kurz.	Dipterocarpaceae	Tannin is used for astringent and anti-fermentation
Takhian	*Hopea odorata* Roxb.	Dipterocarpaceae	Tannin for tanning
See siat	*Pentace buranica* Kurz.	Tilliaceae	Tannin for tanning
Sanae	*Ceriops tagal* (Perr.) C.B. Rob	Rhizophoraceae	Tannin for tanning
Mangrove	*Rhizophora candelaria* DC. (*R. conjugata* Kurz.)	Rhizophoraceae	Tannin for tanning dyeing astringent and cure diabetese mullitus
Red Mangrove	*Rhizophora nucronata* Lank. (*R. longissina* Blanco)	Rhizophoraceae	-
Ko	*Castanopsis indica* A. DC	Pagaceae	Tannin is used as an astringent
Yaang Bong	*Persea kurzii* kostern.	Lauraceae	Joss sticks

Bark

Bark is a source of tannin and natural dye. Some bark is used medicinally or as spices (Table 13). Permits are required for harvesting some species such as ***Artocarpus lakoocha*** Roxb., ***Broussonetia papyrifera*** Vent., ***Cinnammom bejolghota*** Sweet, ***Shorea floribunda*** Kurz., and ***Pentace burmanica*** Kurz.

Persea kurzii Kosterm (yang bong), which is one of the elements of kobauk, is the most important bark harvested from Thai forests. Kobauk is a binder compound composed of yang bong bark and saw dust used for making joss sticks.

Bark production. The production of bark in 1979 was 1,997.1 tons valued at Baht 7.1 million. Production has decreased substantially to only 55.6 tons, valued at 778,000 baht in 1989.

Exports. The quantity and value of exports of kobuak is very high, surpassing 5,000 tons and 40 million baht in most years (Table 15).

Collection and processing. Permits are required for harvesting some types of economic bark.

The method of de-barking makes use of a sharp knife to peel along the trunk of the tree. The size of the wound should not be more than 20 centimeters wide by 80 centimeters long and 1 centimeter deep. The space between each wound should be more than 30 centimeters. After peeling, the wound should be painted with tar oil or anti-fungus solvent to prevent fungi attack. Bark is dried in the open air.

Recommendations. Bark is a good source of tannin for the tanning industry, but Thailand thus far has not succeeded in producing commercial quantities to meet local needs. Thailand has to import considerable quantities of tannin. More than 30 centimeters. After peeling, the wound should be painted with tar oil or anti-fungus solvent to prevent fungi attack. Bark is dried in the open air.

Agarwood

Agarwood is the trade name of aromatic resin permeated wood of ***Aguilaria*** spp., family Thymelaeaceae. The tree is a large evergreen 18 to 21 meters tall, and 1.5 to 1.8 meters in girth, distributed throughout India, Pakistan, Nepal, Bangladesh, Sri Lanka, China, Malaysia, Indonesia, Cambodia, Vietnam, Myanmar and Thailand.

Table 14. Bark production from forest areas in Thailand

Year	Quantity (1,000 kg)	Value (1,000 baht)
1979	1,997.1	7,147.3
1980	960.9	4,347.3
1981	170.1	1,147.4
1982	316.3	3,479.5
1983	145.3	1,743.2
1984	499.6	5,995.4
1985	618.9	7,426.3
1986	201.0	2,412.4
1987	232.3	2,787.6
1988	62.1	807.7
1989	55.6	777.8

Agarwood can be used in different ways. Low grade agarwood is distilled to produce agar attar, which is used in the perfume and tobacco industries. High-grade agarwood is exported to Arab countries, where it is used as incense and in the manufacture of joss

Table 15. Exports of kobuak powder

Year	Quantity (tons)	Value (1,000 baht)
1979	7,983	58,823
1980	-	-
1981	-	-
1982	5,345	52,646
1983	4,804	48,634
1984	3,946	42,106
1985	5,346	48,534
1986	5,045	50,067
1987	-	-
1988	5,003	47,891

sticks. The wood has been variously described as a stimulant, a tonic and a carminative, and is an ingredient of several medical preparations for rheumatism, body pains, and heart palpitation. Agarwood sells for US$15-692 per kilogram, depending on quality, while oil distilled from the wood sells for US$ 154-192 per 10 millimeter bottles.

Collection and processing. To collect agarwood from the forest, villagers fell the trees to look for it. Most trees will yield no agarwood, but a well-laden tree can provide several thousand dollars worth of wood. This illegal activity causes serious ecological damage and the loss of the trees. Therefore, much research has been done to find ways of changing normal wood to agarwood. Some success has been attained in inducing agarwood formation by wounding trees. Introduction of fungi on the trees also appears to enhance agarwood formation.

Agarwood to be used as incense is sold in unprocessed form. For medicine, the wood is ground or chipped. For essential oil, the wood is ground and steam distilled. The wood powder, after oil is distilled, is used in making joss sticks.

Edible Mushrooms

Mushrooms have become an important forest product in Thailand and have recently earned the country substantial money from exports.

In Thailand, mushrooms are found in forests in all regions, especially during the rainy season. Some wild mushrooms such as ***Termitomyces*** spp., and ***Russula delica***, are delicacies and are sold.

Many edible mushrooms are ectomycorrhiza, such as ***R. delica***, which, mycorrhizae with dipterocarp species, help trees to up take phosphorus. ***Boletus griseipurpureus*** also forms mycorrhizae with various trees, including ***Acacia auriculaeformis, A. mangium*** and ***Melaleuca leucadendra***. It is estimated that this mushroom can earn Bt2,000 to 3,000 per rai, at a selling price of Baht 40 to 60 per kilogram.

Medicinal Plants and Spices

Humans have used plants as traditional remedies for centuries. In the proper and safe use of plants for medicine, it is necessary to know plants well. There are many kinds of medicinal plants in the forests of Thailand. Of 5,800 plant species indigenous to Thailand, 1,900 species have already been studied for their medicinal value. Over 800 species are described in Thai traditional recipes. About 400 species are available from traditional drug vendors, and about 50 species are used by traditional medicine manufacturers.

Drugs are derived from various parts of plants including fruits, flowers, leaves, stems and roots of trees, vines, shrubs and

herbs. These raw materials are exported or processed into modern and traditional medicine. Traditional medicines include drugs from nature which can be used in their natural state or slightly modified.

The most important active constituents are alkaloids such as reserpine, saponin, colchicine and peperazine. Some traditional medicinal plants with potential commercial value include: ***Rauvolfia serpentina, Gloriosa superba, Cassia angustifolia, Amomum krevanh, Dioscorea*** spp., ***Cartharanthus roscus, Strychnos nux-vomica, Diospyros mollis, Costus speciosus, Derris elliptica, Hydrocarpus anthelmintica, Calophyllum inophyllum,*** and ***Stemona tuberosa.***

Spices are used for artificial flavoring to enhance taste and aroma, and to stimulate enzymes for digestion. Most spices thrive in the tropical zone of Asia.

Most spices consist of essential oils. Some important species from the forest are ***Amomum krevanh, Cinnamomum iners,*** and ***C. bejolghota.*** Some cultivated spice trees in the country are exotic species. These are ***Eugenia caryophyllus, Apium graveolens, Cinnamomum verum,*** and ***Myristica fragrans.***

In most years, Thailand has exported more spices than it imports. Export quantities peaked in 1982 at 8,240 tons. Quantities of spices exported declined significantly since the mid-1980s, but revenue reached nearly Bt140 million in 1988 as higher-value spices were exported (Table 16).

FUTURE DIRECTIONS FOR DEVELOPING NWFPS

Statistics and data in this paper illustrate that the uses of NWFPs are widespread, especially in rural areas of the country. People can readily collect bamboo, rattan, gums and resin, bark, lac, honey, etc. for extra income. Statistics show that for some species, such as rattan, the availability of raw materials is limited. For certain other species, however, the export potential is promising. Unfortunately, it is difficult to get data on the actual production of NWFPs, because most harvesting is done illegally. Collection methods are still primative for most NWFPs. Many wild species are ignored because little is known about them. Recommendations to promote NWFPs are as follows:

- Improve the statistical data on productivity, domestic uses, imports, and exports of NWFPs. To understand the demand for NWFPs and the potential supply through proper management, systematic studies should be undertaken. Case studies of each major product could be useful.

- Study the marketing of NWFPs. The details on product requirements and market preferences are important for the promotion of NWFPs.

- Promote the cultivation of NWFPs by focusing on:

  - multi-purpose trees; including rattan, bamboo, rain tree, and *Acacia catechu*;

Table 16. Exports and imports of spices

Year	Exports		Imports	
	Quantity (tons)	Value (1,000 baht)	Quantity (tons)	Value (1,000 baht)
1979	262	12,791	1,046	26,624
1980	283	18,125	720	19,763
1981	356	65,148	710	20,909
1982	8,240	108,191	857	28,874
1983	582	106,619	1,004	32,243
1984	2,203	150,942	1,231	31,420
1985	2,315	129,800	854	36,434
1986	1,123	57,481	888	27,555
1987	771	26,143	1,094	30,293
1988	410	137,722	235	13,441

Source: Department of Customs

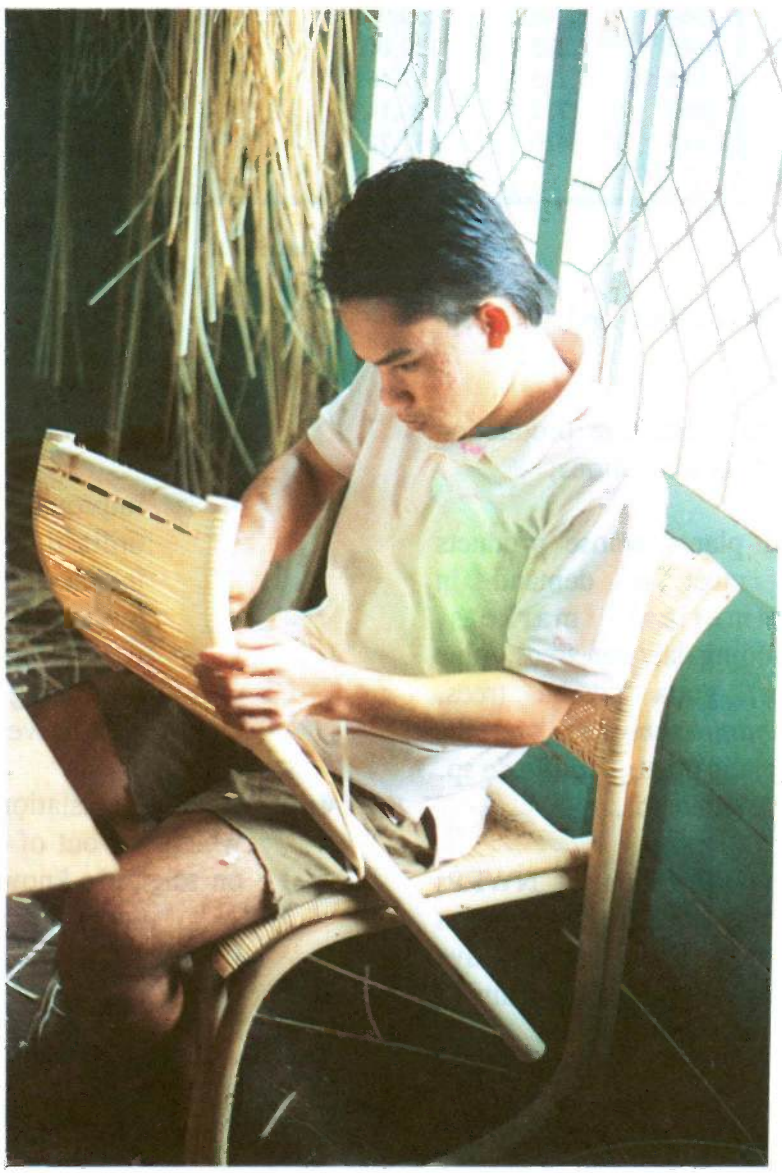
- lac cultivation and beekeeping;
- edible mushroom production in forest plantations;
- wild plants whose products are most in demand in commerical markets, including lacquer trees, pine trees, gutta percha trees, *Cinnamomum* sp., and the aromatic plants (*Aquilaria* sp. and *Persea* sp).

- Promote the utilization of NWFPs without cutting trees (e.g. utilization of bark for tannin extraction; dye making from bark, leaves or fruits of trees; varnish production from natural gums and resins).
- Research support on:
  - natural NWFP resources, their abundance, distribution, ecology, propagation, and reproduction;
  - methods of cultivation;
  - improving the processing and utilization of NWFPs to increase their quality and market value;
  - improving harvesting and post-harvest techniques.
- Revise legislation and regulations which are out of date and not based on scientific knowledge.
- Impose strict controls to reduce illegal transport and illegal harvesting.
- Introduce improved technologies to villagers through training courses and study tours.
- Establish a NWFP centre in

Southeast Asia to exchange research findings and share information among countries.

Currency Equivalents

1 US$ = Bt 25.70
1 Baht = US$ .039
(July 1991)



High-quality bamboo and rattan furniture has become a major foreign exchange earner for Southeast Asian countries.

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VIETNAM

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INTRODUCTION

Forests in Vietnam, contain abundant animal and tree resources. Besides timber, the forests provide a wide range of NWFPs which in Vietnam are commonly referred to as "Special Forest Products."

These resources are diverse in species and form. They include:

- 113 producers of resins
- 458 producers of essential oils
- 473 species yielding fatty oil
- 800 species producing tannin
- 242 species producing fibre
- 557 species of drug plants
- 27 species producing starch

These NWFPs are highly appreciated for their social and economic values. Under the economic conditions in the remote mountain areas, communications and transport are lacking. Commerical wood extraction is difficult or impossible as the forest cover has been destroyed. The farming of NWFPs, therefore, has become an important business, for it requires less investment and lower transport costs and can provide large profits.

To take advantage of the resources available, NWFPs must be developed for export to meet the following objectives: earning of foreign exchange, balanced forestry development, social and economic development in the mountain areas, and increased employment opportunities for uplanders.

CURRENT STATUS OF FORESTS AND NWFP RESOURCES

The following statistics are relevant in considering NWFP development in Vietnam:

Total land area	330,363 km^2
Population	64,412,000
Population density	195 people/km^2
Forests and forest lands	57.7 percent of the total land area
Forested area per capita	0.14 ha
Timber reserves per person	9 m^3

During the tight economic conditions in recent years, the forestry sector has pursued a strategy of earning revenues from forests to develop forestry and society. However, the rate of deforestation during the 1980s was alarming: 60,000 to 100,000 hectares (or 0.7 percent of the forested area) per year. The total area of denuded hills and open land by now totals 9.75 million hectares (Table 1). The forest cover has been reduced by one-third in the past 45 years from 42 percent to 28 percent of the country's total area. The main cause of this is increasing demand for food and fuel. Forests have been encroached on and destroyed by shifting cultivation, wild fires, abusive exploitation, and careless wood harvesting.

Vietnam possesses significant bamboo resources (Table 2) which are of major importance for commerical and local use.

Table 1. Forests and forest lands in Vietnam, 1990	
Description	Area (1000 ha)
Natural forests	8,686.7
Plantations	629.0
Total forested area	9,315.7
Non-forested lands classified as "forest land"	9,750.0
Total forests and forest land	19,065.7

Table 2. Bamboo resources in Vietnam, 1989	
Total area	1,120,800 ha
Inventory in natural stands	5,590.2 million culms
Inventory in plantations	75.4 million culms
Total inventory	5,665.6 million culms

Table 3. Area under NWFPs production, 1989	
Pine	388,000
Cinnamomum cassia	10,700
Anise	10,000
Aleurites	24,900
Host trees for lac cultivation	3,600
Styrax	87,000
Cashew	100,000
Castor	2,000
Drug plants	
+Coscinum	5,000
+Ammomum	1,500
+Cinchona	100
Total	632,000

Most bamboo resources are grown in the central Highlands and the central coast.

Past forest inventories paid attention only to the supply of timber and bamboos. There is a severe shortage of information on NWFPs on a national basis. The limited information on NWFP production areas is provided in Table 3.

Vietnam has a wide range of NWFPs that are useful for the following purposes:

Extraction of essential oils:

- From roots and stumps: ***Cupressus funebris, Dianella ensifolia, Fokienia hodgensii, Aquilara crassna***
- From fruits: ***Litsea cubeba***
- From leaves: **mint, citronella, ocinum, cajenut trees**, ***Eucalyptus citriodora***

As medicinal plants:

- Fruit and/or seeds: ***Amomum*** spp., ***Cassia tora***
- Flowers: ***Sophora japonica***
- Bark: ***Eucmonia ulmoides, Phellodendron anurence***
- Roots: ***Morinda officinalis, Dioscorea persimilis***
- Leaves: ***Artemisia annua.***

As food crops:

- turmeric, ginger, cashewnut, chestnut and condiments, edible mushrooms,
- pythons, monkeys, birds, deer, geckos, honey.

As producer of fatty oils:

- ***Thea oleosa, Aleurites molucana.***

As producer of resins and gums:

- ***Toxicodendron succedanea, Liquidambar formosana, Canarium*** spp. ***Dipterocarpus alatus, Altingia takhtadjanii.***

As dye- and tannin-giving species:

- ***Rhizophora indigofera.***

As fiber producers:

- agave, ***Ceiba pentantra, Rhamnoneuron balansea.***

For making bamboo and rattan articles:

- fishing-rod bamboo, big-sized bamboo.

UTILIZATION OF NWFPs

Harvesting and processing

To support NWFP development on a sustained basis, the Special Forest Products Exportation Company was set up in 1976. Its main tasks are to manage, protect, farm, exploit, buy, and process NWFPs for domestic and foreign markets. It has developed three branches, in Hanoi, Quy Nhon and Ho Chi Minh City; two Forest Enterprises, in Sonla and Laichau Provinces;

and a shellac and vegetable resin processing factory at Hadon.

In 1990, three National Production Services, and Export-Import Forest Corporations (named NAFORIMEX I,II,III, respectively, were set up) in the Northern, Central and Southern provinces of Vietnam to provide a better network dealing with wood and NWFPs. Some provinces also have their own network of companies and factories dealing with these resources.

Supporting these institutions are various policies dealing with land allocation to collective cooperatives, individual households and private persons. Thus, the private sector has been developed hand in hand with the state-owned enterprises, providing a better opportunity for the development of NWFPs.

Table 4 shows the amount of NWFPs extracted and processed over the last five years. The collection, harvesting and processing of these products have been done by various forest enterprises, other industries, and provinces.

Vietnam has several factories which process NWFPs:

- Two factories for mechanical processing of pine resin at Quang Ninh (capacity: 1,500 tons of resin per year) and at Lam Doing, (capacity: 2,000 tons of resin per year).
- Nine other factories for manual processing of pine resin, with total capacity of 1,200 tons per year.
- Three factories for shellac processing - at Hadong (equipment from India through a UNDP/FAO project; capacity of 300 tons per year), and two plants at Sonia.
- One production line for processing and refining tung oil (capacity of 200 tons of oil per year) erected at Cao Bang. In addition, there is small-scale manual pressing of tung oil at localities where seeds are available in large quantities.
- One production line for the distillation of anise essential oil (capacity of 300 tons of essential oil per year) established at Langson. Eight manual processing lines are also located around Cao Bang and Lang Son.
- One rattan processing line with a capacity of 10,000 linear meters of end-products, established in Quynhon. Other rattan processing units are running in Hanoi, Ho Chi Minh City, and Thuanhai province with equipment imported from Taiwan.
- One pilot small plant in Ho Chi Minh City for mechanical processing of cashew nuts, with capacity of 400 tons of raw nuts. There are over 12 other processing units for cashew nuts, with a total capacity of 17,000 tons per year, but only 4 of these are running due to a shortage of raw nuts.

Table 4. Major NWFPs harvested and processed by the Forestry Sector

Products	Unit	1986	1987	1988	1989	1990
Cinnamomum bark	tons	1,520	1,450	1,080	1,901	2,100
Aloeswood	tons	78.5	81.7	45.4	36.9	20.0
Anise essential oil	tons	1,500	1,310	1,305	4,323	2,000
Tung seeds	tons	1,378	1,088	4,082	*	*
Tung oil	tons	150	90	60	10	10
Castor seeds	tons	250	190	210	229	230
Pine resin	tons	2,400	2,323	2,560	2,570	2,500
Rosin	tons	2,359	1,511	1,508	1,500	1,500
Turpentine	tons	868	378	401	50	100
Canarium resin	tons	58	100	153	*	*
Yang oil	tons	178	31	165	*	*
Damar	tons	213	411	375	*	*
Thick bamboo	million culms	135.2	121.9	131.2	128.7	132.7
Thin bamboo	million culms	179.0	155.7	177.1	149.5	149.5
Thick rattan	million meters	321.7	290.7	311.3	*	*
Thin rattan	million meters	7.7	8.7	8.4	*	*
Decorative bamboo	million culms	70.6	78.4	117.5	*	*
A. tsao kwa	tons	153	137	19	*	*
Amomum spp.	tons	103	114	83	*	*
Polygonum	tons	19	18	19	*	*
Morinda	tons	31	93	114	*	*
Other medicinal plants	tons	3,303	2,193	3,691	*	*
Mushroon	tons	108	161	134	*	*
Jew's ear mushrooms	tons	182	185	164	*	*
Fresh bamboo shoots	tons	25.1	24.2	25.1	*	*
Dried bamboo shoots	tons	975	475	321	*	*
Chestnut	tons	72	134	85	*	*
Sterculia nut	tons	232	239	234	*	*
cashew nut	tons	150	130	210	*	*
Sticklac	tons	89	143	92	*	*
Gecko	1000 pieces	44.6	22.8	106.0	*	*
Python	1000 pieces	10.7	6.6	8.3	*	*
Wild bor	tons	82	89	72	*	*
Wild meat	tons	597	860	619	*	*
Wild honey	tons	351	277	108	*	*
Cannery varnish	tons	10	8	8	*	*
Varnish for electric insulation	tons	15	15	22	*	*
Polish lacquer	tons	110	90	60	*	*
Electric insulation resin	tons	3	5	5	*	*

* data not available

- One factory in Hanoi for essential oil distillation managed by Vietnam National Institute of Sciences with equipment provided by UNDP/FAO project. The factory is producing over 12 different essential oils from forest plants and trees.

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NWFP exports

Previously, the export of wood and NWFPs was carried out by foreign trade agencies, with the Ministry of Forestry supplying the exports commodities as stipulated in state plans. At the beginning of 1985, however, the Ministry of Foreign Trade transferred the National Forest and Native Products Export-Import Corporation (NAFORIMEX) to the Ministry of Forestry. This has caused change in the forestry sector, allowing it to develop its organizational structures to promote the export of forest products. Since April 1990, three NAFORIMEX departments have been exporting forest products produced by this sector. The Forest Sector has supplied raw materials and helped other industrial agencies and provinces export their end-products, (e.g. BAROTEX for the export of bamboo and rattan articles, PROMEXIM for the export of wood and wood products, and ENTEROIL for the export of essential oils).

The export of forest products has contributed considerably to national development. The export value from these commodities accounts for 3.6 percent of the country's total foreign exchange earnings.

In past years, the markets for forest products were limited to the Soviet Union and Eastern Europe through protocols signed between governments. Recently, however, Vietnam has increasingly looked to other countries in selling its forest products. By 1990, two-thirds of all exports forest product were going to non-socialist countries.

Since 1981, the Ministry of Forestry has increased its focus on the protection and development of NWFP resources for export. During the late 1980s, the foreign earnings from NWFPs exports increased considerably and are now valued at more than $10 million per year, (not including earnings from bamboo and rattan exported by BAROTEX), making up a high percentage of total earnings in the forestry sector.

It is clear that NWFPs play an important role in Vietnam's foreign trade. The export of NWFPs should be given high priority in view of their potential to support non-destructive forest use.

Social and environmental benefits

According to statistics for 1989, 24.3 million Vietnamese live in or near forests, fully 38 percent of the country's population. The labor force in forestry amounts to 1.12 million workers, of which some 130,000 are working in the state owned-forest enterprises, and 990,000 work in the private and other sectors. During the last five years, some 500,000 shifting cultivators have been assisted in adopting fixed cultivation systems, thus raising the number of former shifting cultivators earning their

living from fixed cultivation systems to 1.9 million.

Of the country's 24 million inhabitants in or near forests, 2.9 million are still actively engaged in shifting cultivation in 90 districts of the high mountains.

Development of NWFPs is an important element of the strategy to settle shifting cultivators. Some examples include:

- At the commune of Kilplanhon Ha (Lam Dong Province), there are 1,300 people, of which 50 percent are in the Koho tribe. These tribesmen have been tapping pine resin, producing about 300 tons of resin per year, which has allowed them to buy over 150 tons of rice. In the entire province of Lam Dong, hill tribesmen produced at least 50 percent of all pine resin harvested.

- In the district of Vanyen (Hoang Lien Son Province), some 1,000 hectares of ***Cinnamomum cassia*** have been cultivated and maintained by the Dzao tribe. The money obtained from 1 hectare of *Cinnamomum* buys 2 tons of rice.

- Seventy percent of sticklac cultivators are from hilltribes. One kilogram of sticklac buys to 5 kilograms of rice; the yield from 1 hectare pays for up to 3 tons of rice.

- During the last five years, the tribal people in Thanh Hoa Province have cultivated thick-walled bamboo. Their cultivation extends over 20,000 hectares, accounting for 60 percent of the area under this kind of bamboo. Each year, 5 to 6 million culms are harvested, and thousands of tons of fresh bamboo shoots are collected.

- One hectare of mint can produce 50 kilograms of essential oil, the equivalent of 3 tons of rice.

- One hectare planted with ***Artemisina anua*** can produce 1 ton every 6 months, worth at 1.5 tons of rice.

It is clear that in mountain areas the production of NWFPs yields higher incomes potential than rice cultivation. When hill tribesmen become aware of the income from NWFPs, they are more willing to abandon their traditional shifting cultivation in favor of NWFP production. They can become the masters and the main beneficiaries of the forest resources, and this encourages them to protect and develop the forest resource for their own benefit.

More than 320,000 people are involved in NWFP production. Generally speaking, 1 hectare of NWFPs requires 3 laborers, which is 10 times the number needed for the cultivation of tree crops for timber. The promotion of NWFPs therefore, can provide more employment to the uplanders and facilitate the establishment of forest villages which provide better conditions for social and cultural development. By doing so, a better awareness of forest resource protection will prevail among the tribesmen, and environmental preservation will be improved over large areas. The resulting reliable supply of NWFPs will also encourage the establishment of new processing factories, providing additional employment opportunities and further supporting upland development.

GUIDELINES AND OBJECTIVES FOR NWFP DEVELOPMENT

If previously the forestry sector ignored NWFPs, it was because there was no awareness of the roles of these products in economic and social development and in environmental protection. Within the past 5 years, however, there has been a shift with the Ministry of Forestry now recognizing the potential value of NWFPs for export and for meeting the demands of the domestic market.

The Ministry of Forestry has formulated a programme on export of NWFPs for the period 1986 to 1995. There are, however, a number of problems to overcome:

- There is no coordination of the production of NWFPs in the foretry sector, and no clear division of responsibilities between the central and provincial agencies, and the forestry sector and other sectors of the national economy. This leads to *ad hoc* and uncoordinated marketing, and subsequent resource depletion.
- The network of production units dealing with NWFPs is poorly structured, with little planning for forestry zones and enterprises. Investment to develop the resource base is lacking.
- Policies currently in force do not create adequate incentives for various sectors to develop and cultivate NWFPs.

General guidelines and key tasks

The following guidelines and tasks are proposed for effective development of NWFPs in the next decade:

- Sustain efforts to protect and enrich existing forests for higher production of NWFPs through appropriate management plans.
- Establish new plantations to consolidate the production of NWFPs into new key production zones.
- Emphasize short-term crops, especially through interplanting in rehabilitated forests, or intercropping in various agroforestry systems, and with trees planted through various social forestry programmes.
- Promote improved NWFP harvesting techniques. Technical assistance should reach every forest enterprise, cooperative, and household interested in growing NWFPs.
- Intensify the processing of NWFPs to enhance their value, to make them suitable for foreign markets, and to produce new commodities of higher value, even from second-rate raw materials.
- Research the flows of NWFPs into and out of the country to determine appropriate levels of production.
- Collaborate more closely with various programs on settling shifting cultivators to motivate them to adopt NWFP production systems.
- Take greater advantage of technical assistance from international organizations, of joint ventures with

foreign companies, and of loans from international banks.

Building up the NWFP resource base

The Ministry of Forestry has submitted to the Government a program to "build up 5 million hectares of forests on denuded hills and open lands" which includes the establishment of 500,000 hectares of forests for the production of NWFPs. The plan is to create 14.3 million hectares of forests as forest estates and to increase the national forest cover to 43 percent.

Based upon the natural, economic, and social conditions for the production of NWFPs and the marketing situation that prevails, significant expansion of NWFPs is planned between now and the year 2000 (Table 5).

Table 5. Planned expansion of NWFPs production in Vietnam, 1991-2000

Description	1991-1995 (1,000 ha)	1996-2000 (1,000 ha)
Cinnamomum cassia	10	20
Pinus merkusii	100	150
Host trees for lac	2	3
Tung tree	10	20
Castor tree	5	10
Cashew tree	30	50
Products of ess. oil	7	10
Anise	1	2
Medicinal Plants	1	1
Rattan	2	3
Bamboo	10	15
Other	22	16
Total	200	300

Management and operation planning

It is necessary to quickly inventory the areas, yield and quality of NWFPs in Vietnam. This will be the basis of various programmes for the cultivation, harvesting and processing of the resources. Valuable non-wood forest products should be carefully inventoried to support their sustainable development.

Adequate investment and vertical expansion should be encouraged for the production of the valuable NWFPs, both natural and cultivated.

The three corporations dealing with the production, processing and export of forest products should give high priority to establishing long-term co-production agreements with provinces, which are the main producers of NWFP raw material.

Incentives

Research should be carried out to elaborate incentive policies to encourage NWFP production, especially for the mountain areas and for tribal groups. Forest and forest lands should be allocated to individual households (which, in the mountain areas, are the basic units for land use and farming), according to policies now in force.

Strengthening and consolidating state-owned forest enterprises should be accelerated to provide needed technical assistance and product marketing in the NWFP areas.

Investments should be made for comprehensive implementation of various projects related to the production of non-wood forest products of major importance, following approved feasibility studies. An investment of about $300 to $400 is needed to establish a 1 hectare plot for NWFP production. Individual households could be given $500 at the outset as financial assistance. For newly established settlement

areas in which people are willing to grow NWFPs for profit, assistance of about 500 kilograms of rice per hectare of new plantation, and 300 kilogram of rice per hectare of re-habilitated natural forests, should be provided as support and incentives.

RESEARCH AND TRAINING

There is a particular need to strengthen the research capability of the Special Forest Products Research Centre to enable it to more effectively support NWFP development and extension. Scientific workers and field officers should be trained and should attend refresher courses within and outside the country, with an emphasis on social forestry, which is new to most forest officers. The training of local extension technicians for various work with ethnic groups is also very important.

International cooperation

Under the present economic conditions, it is necessary to attract new sources of investment from international organizations and foreign entrepreneurs for joint ventures.

Several FAO/UNDP projects have provided valuable support in the development of Vietnam's NWFPs, including work in the areas of lac cultivation and cashew nut production. More efforts of these types are needed, including support for study tours and fellowships in foreign countries.

Vietnam is committed to the sustainable development of its NWFP resources. It is firmly believed that with the valuable assistance of FAO, UNDP, and other international organizations, the great potential of this field will be realized.

Bamboo—found throughout Asia—is perhaps the region's most commonly used NWFP.

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