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THE *KITUL* PALM: ETHNOBOTANY OF *CARYOTA URENS* L. IN HIGHLAND SRI LANKA

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ABSTRACT.—*Caryota urens,* known as the *kitul* in Sri Lanka, is a native rainforest species of tropical Asia. It is also one of the most common trees in the perennial forest gardens of highland Sri Lanka. *Kitul* is traditionally tapped for sap from which sweet syrup, sugar, and alcoholic beverages are prepared. The syrup and sugar have a special richness and are highly valued for culinary purposes in Sri Lanka.

Tapping palms is the domain of "toddy tappers" who traditionally divide the yield with palm owners. This paper focuses on the tappers' knowledge and management of *kitul* palm, its products, and tapping and processing activities. The potential economic value of *kitul* is assessed. The ecological and economic importance of developing markets for *kitul* and other forest garden products in relation to forest and landscape conservation in highland Sri Lanka are emphasized.

The paper is based upon the author's interviews with tappers and palm owners, study of *kitul* yields and participant observation during dissertation field research on home gardens in highland Sri Lanka in 1989–91[1].

RESUMEN.—La *Caryota urens,* conocida como *kitul* en Sri Lanka, es una especie nativa de los bosques lluviosos del Asia tropical. Es también uno de los árboles más comunes en los huertos forestales perennes de la zona alta de Sri Lanka. El *kitul* es sangrado tradicionalmente para obtener su savia, de la cual se preparan jarabe dulce, azúcar y bebidas alcohólicas. El jarabe y el azúcar tienen especial riqueza y son altamente valorados para fines culinarios en Sri Lanka. El sangrado de las palmas es el dominio de los "palmeros de vino," quienes tradicionalmente dividen el producto obtenido con los dueños de las palmeras. Este artículo se centra en el conocimiento de los palmeros y el manejo de la palma *kitul,* sus productos, y las actividades de sangrado y procesamiento. Se evalúa el valor económico potencial de *kitul.* Se enfatiza la importancia ecológica y económica de desarrollar mercados para el *kitul* y otros productos de los huertos forestales en relación a la conservación de los bosques y el paisaje en la zona alta de Sri Lanka. El artículo está basado en las entrevistas de la útora con palmeros y dueños de palmas, el estudio de los rendimientos del *kitul,* y la observación participativa durante la investigación de campo para su tesis doctoral sobre los huertos familiares en la zona alta de Sri Lanka de 1989 a 1991.

RÉSUMÉ.—*Caryota urens,* connu sous le nom de *kitul* au Sri Lanka, est une espècê de palmier native de la forêt des pluies de l'Asie tropicale. Egalement un des arbres les plus nombreux des jardins vivaces forestiers dans les hauteurs du Sri Lanka, le *kitul* est traditionellement gemmé pour son nectar dont le sirop, le sucre, ainsi que des boissons alcoholiques sont préparés. Le sirop et le sucre ont un goût distinctif, très apprécié dans la cuisine du Sri Lanka.

Le tirage du nectar est le domaine des *"tappers"*, qui traditionellement partagent le produit avec les propriétaires des palmiers. Nos recherches se concentrent sur le savoir-faire des *tappers*, l'exploitation du *kitul*, et la préparation des produits palmiers. La valeur économique potentielle du *kitul* est évaluée. Nous soulignons l'importance écologique et économique du développement de marchés pour le *kitul* et d'autres produits jardiniers forestiers, à l'égard de la protection écologique dans les hauteurs du Sri Lanka.

Ces recherches sont fondées sur les interviews de l'auteur avec des *tappers* et les propriétaires des palmiers, des recherches sur la préparation des produits à base de*kitul*, et des observations participantes faisant partie des recherches de thèse sur les jardins forestiers des hauteurs du Sri Lanka.

INTRODUCTION

In Sri Lanka palm treacle (syrup) and jaggery (sugar) are important traditional sources of sweeteners. In arid areas treacle and jaggery are produced from palmyra (*Borassus flabellifer*), in the coastal zone from coconut palms (*Cocos nucifera*), and in the wet interior and highland regions from fishtail palms (*Caryota urens* L.). Thus sugar can be locally produced from one or another palm on most parts of the island (Fig. 1). The fishtail palm or *kitul*, as it is locally known in Sinhalese (*tippilipana* in Tamil), is a very common tree in the lowland rain forest and in mixed species forest gardens managed in highland Sri Lanka. This palm yields a rich, dark syrup with a highly valued, distinctive taste. In comparative testing of raw sugars reported from the Fairchild Botanical Gardens in Florida, *kitul* jaggery ranked among those of highest quality (Lotschert 1985). Its export potential is being tested with success in the Australian consumer market.

The purposes of this paper are twofold. First, to present an ethnobotanical description of the *kitul* palm, and second, to discuss the palm in its ecological and socioeconomic context as one of many species with potential market value found in the forest gardens of highland Sri Lanka. The topic is important as there is considerable economic pressure to convert existing forest gardens to less diverse and less ecologically valuable annual cropping systems. I gathered data during field research on forest gardens in the Welimada and Kotmale areas of the Upper Mahaweli Watershed in the Central Highlands from 1989–1991.

BOTANY AND ECOLOGY OF *KITUL*

Caryota urens is native to lowland rain forests of tropical Asia including Sri Lanka (Fig. 2). The genus *Caryota* has 27 species found across tropical Asia to the Malay archipelago, Australia, and New Guinea. (Lotschert 1985). The name *Caryota* stems from the Greek *karyotes*, meaning "nutlike." This is in reference to the small, hard fruits of the palms. *Urens* translates as "burning," and is linked to the irritating, needle-like crystals found on the outer shell of the fruits (McCurrach 1960). A tall, unarmed palm, *kitul* grows to an average height of 15–20 m and diameter of 30–50 cm. It has a sparse crown of very large bipinnate leaves, often 2–3 meters long and 1–2 meters wide (Jayaweera 1982). The leaves are glabrous, dark

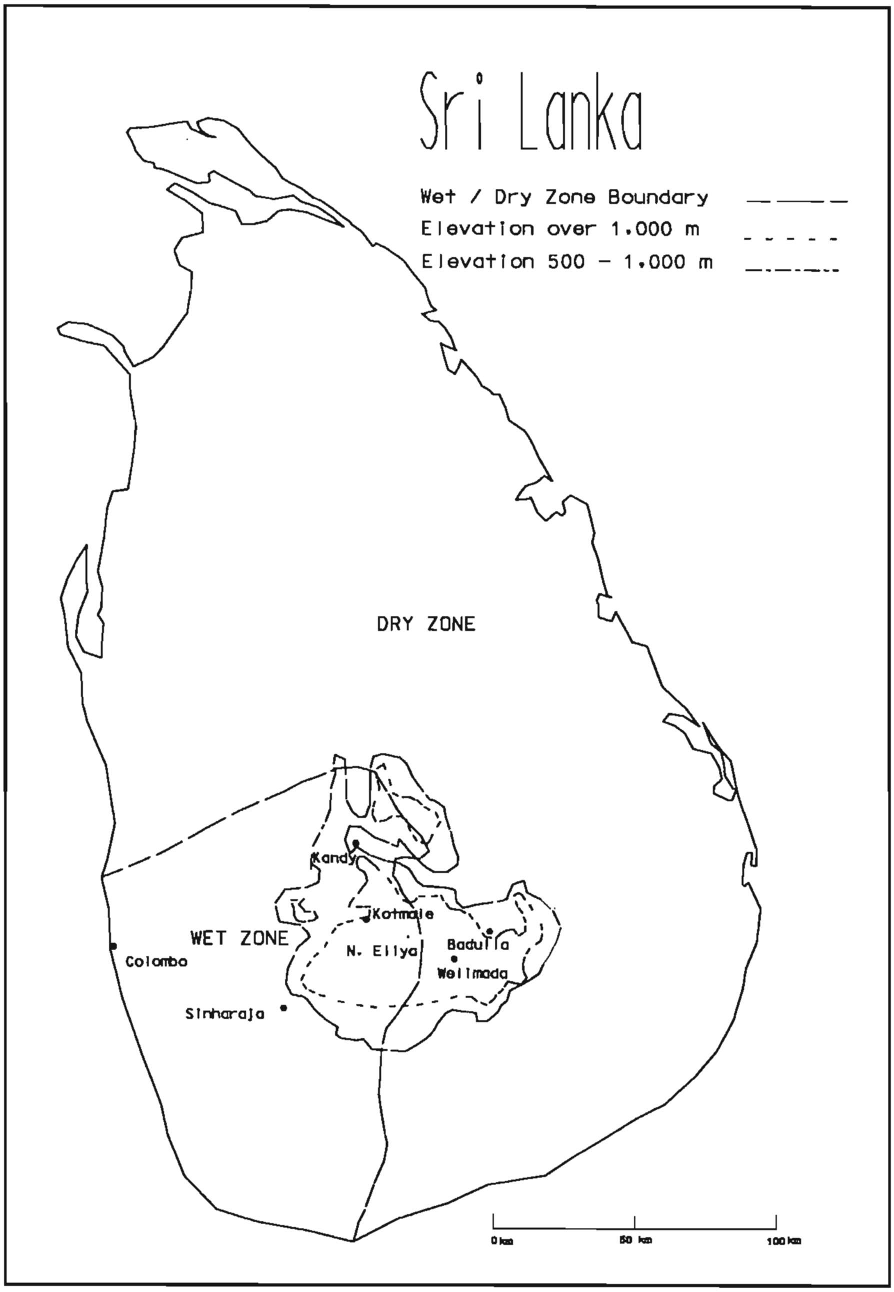

FIG. 1.—Areas Studied in the Sri Lanka Highlands.

FIG. 2.—The Kitul palm (*Caryota urens* L).

green, and shiny. The fishtail-like shape of the outward-turned 15 cm long leaflets give the palm its English name.

Blatter (1926) reports that *kitul* reaches maturity and begins flowering after 10–20 years. Flowers appear from the upper leaf axils and bloom successively downward to the mainstem. The inflorescence is a stalk 3–4 m long on which male and female spadices alternately bloom. An average flower lasts for 3–4 months and several flowers may bloom simultaneously from the main stalk. Therefore, the same individual may bear buds, flowers, and fruits at the same time. McCurrach (1960) suggests that *kitul* typically blooms for a year or two, though a palm may flower periodically for up to seven years as the leaves successively drop. When the last bloom appears above the mainstem and produces fruits, the palm dies. Sri Lankan farmers substantiated these reports during my interviews, and also said that they estimate how many florets a palm will have from the head of the first flower to emerge—usually from one to twelve flowers (as described below).

FIG. 3.—A species diverse, uneven-aged forest garden in highland Sri Lanka.

In Sri Lanka *kitul* palms are common in the mid and low country interior up to 1,500 m. In the lowlands, the palms occur predominantly in the natural forest. In contrast, in the largely deforested mid-elevation highlands palms are managed in small holder forest gardens. These planted gardens are dense stands of uneven-aged, mixed species of perennials surrounding individual family homes (Fig. 3). The gardens are on average less than 0.5 ha in size and typically include 25–35 different species of woody perennials, along with many herbaceous and annual plants. Density of trees is high, ranging from over 350 individuals per 0.5 ha in the intermediate rainfall zone represented by Welimada Division, to 500 per 0.5 ha in a high rainfall area such as Kotmale Division (Everett 1993). Tree canopies on adjoining plots commonly blend together into neighborhood patches of forest-like vegetation.

This vegetation structure provides a suitable habitat for the 17% of garden trees that are remnants of the native forest flora and are not specifically planted but rather persist as self-seeding or animal dispersed "volunteers" (Everett 1987). The *kitul*, dispersed by civet cats (*Civettictis* sp.) and only occasionally transplanted, is one of the most common volunteers.[2] In a survey of woody perennials in 173 gardens in three highland climatic regions, *Caryota urens* ranked eleventh in overall species frequency, with a high abundance, averaging 18 palms per garden (Everett 1993). In surveyed areas with more than 2,300 mm of annual rainfall, *kitul* occurred in all gardens with mature perennial vegetation.

Kitul palms are an economic windfall for their owners. When interviewed about tree species growth requirements and forest garden management practices, 89% of the respondents said the *kitul* needs no attention at all. The remaining gardeners said that they might occasionally spread leaf or household compost under the palms to enhance their growth. This is a marked contrast to other common garden trees and shrubs that produce a cash crop, such as coffee (*Coffea arabica* and *C. robusta*) and cloves (*Eugenia caryophylla*). These are usually raised from seed, or increasingly from packeted seedlings purchased or provided as a subsidy from government extension programs. They require watering when young, and receive regular maintenance inputs, sometimes including chemical fertilizers.

TAPPING PALMS FOR SUGAR

The *kitul* converts starch reserves to large quantities of sugary phloem to fuel the growth of the stem apex or inflorescence (Corner 1966). This sap or "sweet toddy" is tapped through the flower and then boiled down to produce syrup and raw sugar.

Unlike some other sugar palms, *kitul* is not easy to tap. The process of tapping the sensitive *kitul* flower and maintaining the flow of sweet sap requires skill and experience. A specialized occupational caste of tappers has emerged as a traditional cottage industry of sugar and alcohol producers in Sri Lanka. In some areas, a unique set of tenure relationships between palm owners and tappers developed.

In the past, tapping was a major source of income for many people in the lowlands, particularly in villages bordering the forest. Many tappers traditionally gleaned their toddy from palms inside the forest. Present day tapping inside the Sinharaja forest has been described recently (De Zoysa 1992). Today, the forests are government owned and, as large areas are classified as reserves, would-be palm tappers must have a license.[3]

In the highlands, a different culture of tapping has emerged. Typically there will be several people in each village known as tappers who tap all of the palms in their neighborhood. Here the palms are found in privately owned forest gardens. In this case, the tree belongs to the landowner. When a palm appraoches flowering, the owner notifies a tapper. In general, from the time of the first sweet toddy production, the tapper and the tree's owner then share the yield equally by alternating days.

The process of tapping varies in some specifics among individual tappers and between regions (e.g., De Zoysa 1992). The following descriptions are based predominantly upon my interviews with tappers in the Welimada area at the edge of the *kitul* range in the Intermediate climatic zone of the highlands (elevations of over 1,000 m and average rainfall below 2,000 mm per annum).

The tappers' skill lies in maximizing the sap flow to the inflorescence while retarding flower extension. When a palm is about to flower, the inflorescence becomes visible in the tree top. About two months after a young inflorescence first emerges, the tapper climbs the palm and carefully removes the outer layers of the sheath or spathe protecting the flowers. As discussed below, tapping activities are typically carried out by men. The tapper ties a forked stick into place under the inflorescence to replace the spathe's supportive function. Next, he gently cuts and removes the very hard, protective interior spathe layers covering the inflorescence. Tappers say that the number of layers indicates the number of individual flowers to come from the inflorescence, ranging from one to twelve. The tapper makes a roughly 15 cm long, 5 cm wide, and 2 cm deep incision in the side of the flower.

Tappers apply a special "medicine" in this cut to stimulate sap flow. The exact recipe for the medicine is the individual tapper's secret. In the Welimada area, the ingredients include chilies, pepper, salt, garlic, mustard seed, ginger, cloves, coconut grounds, citrus fruit, and vinegar. Salt, lime, saffron, and lime juice are used in other areas (Nonis 1989). The ingredients are ground to a pulp, rolled into a ball, wrapped in a banana leaf, and briefly placed in the hot coals of a fire. The tapper applies the resulting paste in the incision on the flower and tightly packs the hole with fluffy fibers from the inside of the palm bark. Tappers report that the paste seals the cut and keeps the area clean; thus, rotting is reduced. The tappers say that the medicine's function is to "soften" the flowers.

Once he has applied the paste, the tapper gently taps the flower stalk with a special mallet to bruise the area between the stem and the incision. He inserts three needles made from *kitul*, citrus wood, or bamboo on top and on the two sides of the flower between the palm stem and the hole. More of the medicinal paste is spread over this area. Next, he takes strips of cloth and tightly wraps them around the flower base and up over the incision. Agave fiber, *kitul*, or coconut twine are then wrapped around the cloth. Then he places four 30–40 cm long sticks cut from *kitul* leaf stalks on each side of the flower, tying them tightly to give the inflorescence support and avoid wind breakage. Beyond the first hole and tied area the tapper cuts a new incision about 5 cm long, 3 cm wide, and 2 cm deep. Again, he applies the medicine in the hole and carefully inserts a needle of citrus, bamboo, or *kitul* through the flower at the incision point. The hole is tightly sealed with fluffy fiber. To keep the flower stalk from further flowering, the tapper wraps cloth tightly around the inflorescence. Then he cuts off the end of the inflorescence (about 30 cm) and a bit of sap flows out. Three days later the tapper climbs the tree again and cuts a thin slice from the end of the inflorescence. The next day the tapper checks his work. If he finds a small 1/2 cm shoot emerging from the cut, or if the cut is covered with small droplets of sap, the tapper has succeeded. If on the other hand, a longer shoot has emerged, then the treatment has failed and repairs must be undertaken. In the latter case, the tapper takes three needles soaked in salt water and rubbed with coconut oil and inserts them around the second incision. He then waits for three more days in hopes that he will block further growth. If the process is successful, a clay pot covered with wire mesh to keep out insects and squirrels is hung below the end of the inflorescence by tying it with *kitul* or coconut coir rope to the leaves. The tapper then cuts a thin slice off the end of the inflorescence every evening. He climbs the tree twice daily, in the early morning and in the late afternoon to empty the pot which fills with sweet toddy in the interim.

The quality and quantity of sap flow differs considerably with geographic location, season, site quality, and probably with as yet unstudied genetic variation in the palms. Results based on interviews with tappers and farmers in two climatic regions indicate that palms begin to flower sooner and give higher yields in the Kotmale area than in the Welimada area (Table 1).

According to farmers, palms with a large circumference have high yields. Thus short and thick stem form is better than tall and thin. *Kitul* near water have more sap but it is watery. Palms on rich soil with compost produce high yields but

TABLE 1.—Comparison of *kitul* flowering and yields in different climatic regions.

Region	Rainfall (mm)	Average Flowering Age (years)	Average Sap Yield (750 ml bottles)
Kotmale (n = 17)	3,607	11	13
Welimada (n = 10)	1,610	16	7

the toddy's flavor is not as good as from lower yielding trees on harsher sites. Tappers interviewed said that while *kitul* is shade tolerant and commonly grows up through the understory to reach the canopy at maturity, a sunny location, especially with early morning light, enhances the quality of the sap. Elsewhere, research shows soils rich in carbonate of lime to be particularly suitable for *kitul* (Nonis 1989).

Tappers suggest that *kitul* will yield throughout the year, but the best quality sap flows in the dry season, though the flower is more brittle and applying medicine is tricky at this time.[4] During periods of high humidity and rain, the supply of sap increases noticeably. Informants said that sap flow can be a weather indicator. However, the rainy season nectar is watery and more is needed to produce a good quality syrup.

There are other influences which affect sweet toddy yields. Lightning strikes and strong winds can break the flowers. Bumblebees often eat the new shoots of leaves and flowers. One indigenous remedy for bees is to take a ball of cow dung mixed with hair and place it around the shoots. The bees are attracted to the dung but then entangle themselves in the hair and can be removed. In or near natural forests, monkeys can compete with tappers for the sweet nectar. Tappers sometimes hang traps below their toddy pots to snare monkeys.

Tappers also take certain precautions to avert the influence of supernatural forces from their palms. Many believe that the "evil eye" or a greedy look at a flowering tree can stop the toddy flow. *Pirith* water, blessed by Buddhist monks, is sprinkled on the flower and recitations are made to preclude this problem. Before climbing a palm, the tappers may invoke the locally worshipped Hindu gods and the Buddha. Tappers bless and chant over the knife with which they make incisions in the *kitul* flower. The knife is never made of iron, which the tappers believe would stop nectar flows.

PROCESSING SWEET TODDY TO SYRUP AND SUGAR

Household labor used to produce *kitul* syrup and sugar is divided along gender lines. Men climb palms and tap flowers, women process the sweet toddy to syrup. Every morning and evening the fresh toddy is brought home from the palms and handed over to the women. The fresh toddy is sweet, but in the course of a few hours it begins to ferment and becomes cloudy, going completely sour in 24 hours. Processing the toddy into syrup pre-empts this fermentation. Alternatively, when alcoholic beverages are the desired end product, the nectar may be allowed to ferment to the mildly alcoholic "toddy" or be further distilled. Women are usually less involved in processing for alcohol, as social norms against women drinking or even being exposed to alcohol production and consumption are strong in many rural communities.

When producing sugar in the morning or evening, a woman filters the fresh toddy and pours it into a clay pot. She places the pot on a hot, fast burning fire. When foam begins to appear on the surface of the liquid, it is skimmed off with a spoon. Once the foam has been removed, she blends that toddy with any remaining sweet toddy supply. From then on she keeps a low fire going and stirs the pot about every 20 minutes as the nectar boils down. The exact proportions of nectar to syrup vary with the quality of nectar and the individual family's assessment of "good" syrup. In an 11-week yield study of one household in the Welimada area, on average six bottles of nectar produced one bottle of syrup (roughly 0.75 liters). In Kotmale villages people most commonly spoke of a low 1:8 ratio of syrup to toddy. If the local wisdom holds that drier sites produce lower yields but higher quality, this low ratio of syrup to toddy from the wetter Kotmale area is to be expected. In general, the boiling process takes 2.5 to 3.5 hours. When completed, the syrup is poured into bottles and left to cool. Finally, they are sealed with wax. People say that a properly sealed bottle of syrup will keep for three months.

Alternatively, the syrup may be further boiled down to create "jaggery," or crystallized palm sugar. In this case, once the syrup stage is reached, the fire is reduced to a low flame and the syrup is stirred every five minutes or so. Once it approaches the desired viscosity, the syrup is pulled off the fire and continuously stirred. As it cools, the syrup thickens and is finally poured into molds for hardening. The traditional mold is a coconut half-shell, called a *hakuru essa*. Two halves make a *hakuru mula*. Scrapings from the pot can be rolled into small balls for home consumption. The informants' estimates (averaged for the yield study) was that six bottles of nectar would produce one bottle of syrup or 525 g of palm sugar. The lower the moisture content of the sugar, the longer it will keep. A content of 6.9% moisture is commercially permissible (Nonis 1989).

If not boiled into syrup or sugar within a day, sweet toddy ferments into a mildly alcoholic, beer-like beverage also known as toddy. This toddy is always drunk in the evening of the same day it was tapped. Additional left over toddy, by this time fermenting rapidly, is sometimes crudely distilled into a much higher proof alcohol known as *Ra*. Two bottles of toddy yield one bottle of *Ra*.[5] Partially due to the danger of alcohol poisoning stemming from use of toxic substances to control the fermentation process during distilling, and also in order to tax marketing of alcohol, the production and sale of homemade liquor without license is illegal and fines imposed on moonshiners are heavy. *Arrack*, the well known commercial palm liquor, is produced in a similar, though more carefully controlled fermentation and distillation process, most commonly from coconut palm toddy.

ESTIMATING THE ECONOMIC POTENTIAL OF *KITUL* SYRUP AND SUGAR

The major factors to be taken into account in assessing the economic potential of *kitul* for local producers are the average yield of salable product for a given climate, and production and marketing costs, which primarily consist of labor and fuelwood inputs. Estimates of gross yield value are presented here for areas with two different climates, Kotmale (relatively wet) and Welimada (higher elevation and drier). I also discuss the valuation of input costs in the areas studied.

Average yield per palm per day.—As noted above, yields of sweet toddy and syrup vary considerably by site and region. Nonis (1989) cites cases in which 20 bottles (750 ml per bottle) of sap flow from one palm in one twelve hour period. Other estimates include a high of 12 gallons (45 l) per day—probably from a palm with several flowers (McCurrach 1960), and 7–14 l in 24 hours from an average flower (Corner 1966). This latter closely approximates the estimates I gleaned from interviews with people in the Kotmale area, who indicated yields of 10–15 bottles per day. As indicated above, the estimated sap yields for the Welimada area are lower, around 7 bottles per day.

Assuming that one flower produces 12.5 bottles of sap per day in Kotmale and 7 bottles in Mirahawatte, and that one bottle is equivalent to 750 ml, then in Kotmale daily sap yield is 9.4 liters, and in Mirahawatte 5.3 liters. Tappers' responses on estimated syrup yields for Kotmale were one bottle of syrup from eight bottles of sap; for Mirahawatte one bottle of syrup from six of sap. Thus estimated, daily syrup yields are 1.2 liters per day for Kotmale and 0.9 liters per day for Welimada.

Average total yield and discounted value per palm.—An average *kitul* has three flowers that each produce for an average of three months, or roughly 270 days of yield per palm. The total syrup yield for an average palm during the course of its flowering in Kotmale is estimated to be 324 l, in Welimada 243 l. At the average 1990 price of Rs 53.3 per liter, the gross value per palm would be Rs. 17,269 in Kotmale and Rs. 12,952 in the Welimada area. The gross value per palm discounted to the present using the 1988 bank interest rate of 10% (Central Bank of Sri Lanka 1989) would be Rs. 6,059 in Kotmale and Rs. 2,749 in Welimada. Considering that per capita gross national product for Sri Lanka in 1988 was Rs. 11,939 (Ibid.) the value of only one palm is indeed significant. As noted above, most forest gardens have many palms. In Kotmale, the average number of *kitul* was 18 of varying age classes per household. If the palms are distributed evenly across age classes, with mature palms bearing between the ages of 11 and 20 years, each household would have an average of one mature palm per year. These calculations are based on rough estimates and are intended only to convey the palms' high potential value when economic analyses are applied.

Input costs.—Input costs in this rural economy are difficult to assess. The two key costs in syrup production are fuelwood and labor. Estimates from a series of trial tests show that it takes about 0.25 cubic meters of fuelwood to produce one liter of syrup or 700 gr. of jaggery (Ajit Lokuge, personal communication, 1991). For boiling syrup, women select good quality firewood; mixes of hardwoods from fruit trees such as *jak (Artocarpus heterophylla)* and mango are common. In the study areas, one or more of these species are easily available in most forest gardens. Survey results for this area indicate that 75–100% of village firewood comes from private forest gardens, with the remainder supplied by bush prunings from local tea plantations (Everett 1987, 1993). None of the households reported buying wood. Furthermore, none of the households in the area sell wood, despite the fact that in the Welimada area the market price for wood in the closest towns (11 km away) was Rs. 75–100 per m^3 in 1990/91. This is an indication that transport costs from these areas to town are still prohibitive. In effect, fuelwood is still a surplus commodity in the study areas and has zero market value, though the situation may change in future. Fuelwood is a major input in syrup and jaggery processing, and its scarcity could quickly make production uneconomic at present prices.

The second major input in processing is labor. As noted above, production tasks differ for men and women. The male tapper may spend as much as a few hours per day going to and from palms in the morning and evening, climbing the trees, and bringing the sweet toddy home. Local wages for day laborers during 1990/91 averaged Rs. 32 for an eight hour day or Rs. 4 per hour. If a typical palm yields for 270 days, then a very high estimation of the cost of the tapper's labor per palm at one hour per day is Rs. 1,080, or about 18% of the gross value of a palm's yield in Kotmale and 39% in Welimada. At the same time, because tapping goes on in the early morning and evening hours, in most cases the tappers' work does not conflict with other income earning opportunities. Many tappers work full time at another occupation, usually as farmers or day laborers.

Assessing the value of women's labor is complex. For example, the processing effort (largely supervising the boiling pot) for one palm is not doubled by adding toddy from an additional palm. Boiling syrup, gathering wood for the syrup fire, and cleaning and storing bottles takes an average of 3 hours per day. Women carry out many other household tasks while the pot is on the fire. They spend a large portion of most days at home preparing food, supervising children, tending the garden, and so forth. *Kitul* processing adds to the workload but does not directly replace other income earning potential, as the other household tasks must be taken care of anyway and no other cottage industry activity is available. Thus it is difficult to put a reasonable value on women's labor input for *kitul* processing.

An additional factor to be considered is marketing cost. At the present small scale of operations, marketing costs for most producers are minimal, since they sell jaggery and syrup to local traders. Larger scale production issues, including how to increase quantities for a steadier supply to urban and export markets are now being addressed in Sri Lanka. In the past in this very decentralized production system, it has been difficult to gather the larger quantities of high quality syrup required for export to larger markets that might bring increased returns to producers. Cooperative marketing might provide an answer to this problem. The government of Sri Lanka has responded by making jaggery production a component of at least one model village in the Agricultural Production Village (APV) Program initiated during the late 1980s in cooperation with international donors. In early 1990 in Wijebahukande, an APV in the Kotmale area, 25 families were involved in a cooperative syrup collection and marketing effort. Participants interviewed were enthusiastic about the program and more families were expected to join in.

The major problem in cooperative scale production is quality control. There is a certain amount of natural variation in syrup from the undomesticated palms. In addition, it is very easy for producers to stretch the yield of syrup by adding cheaper cane sugar. The adulteration is not always easy to detect in syrup, though the cane sugar crystals are coarser in jaggery. To my knowledge, a low cost, efficient method for testing supplies as they are brought to the collection point had not yet been applied in Sri Lanka in 1990.

The market potential for *kitul* products seems assured, if reliable quality and supply can be achieved. In Australia, for example, the large expatriate community from Sri Lanka is already buying the limited quantities of syrup and sugar imported from home.

OTHER USES OF *KITUL* PALM

While syrup, jaggery, and alcoholic beverages are the most important products from *kitul*, there are many others. When mixed with chilies and spices, toddy turns into a very good vinegar in 2–3 weeks' time. *Kitul* wood is very dense and hard, making excellent tool handles, plows, and mortars for pounding rice. Leaves are used for roof thatching. The nearly one meter long black bristle fibers from the *kitul* leaf base produce better quality string and brooms than does coconut coir. *Kitul* fibers are used in Sri Lanka today and in the past were exported to England for brushes. In the late nineteenth and early twentieth centuries, strands of 5–6 fibers twisted together were a valued substitute for whalebone in women's corsets (Blatter 1926).

The heart of the *kitul* palm can be processed to *kitul* flour, a starch which mixed with *kitul* syrup makes locally esteemed porridge and sweetmeats. The processing is rather laborious but is commonly undertaken for festival days. Men fell and split a young *kitul* palm. They scrape out its heartwood pulp and pound it very thoroughly in a mortar. They mix water into the pulp and then strain the liquid through a soft cloth into a pot. The flour settles at the bottom of the pot and the water can be skimmed off. Finally, the flour is put in the sun to dry.

Kitul products have medicinal properties, and are used in treatments in the ayurvedic medical system practiced in Sri Lanka. Uses recorded in National Science Council of Sri Lanka publications (Jayaweera 1982) include applying root bark and the "cabbage" or terminal bud of the palm to treat rheumatic swellings and snake bite. The cabbage is also employed for gastric ulcers. Treatments for boils call for *kitul* bark and seed. The root is used for tooth ailments.

A variety of religious rituals incorporate *kitul* sugar. The syrup is commonly presented in *puja* offerings at temples and plays special roles in certain rites including the *Kiriamma dane* and the *Malamma dane*. Last but not least, the *kitul* cabbage is a favorite food of the Sri Lanka elephant.

KITUL IN THE CONTEXT OF FOREST GARDENS

Kitul is just one of many potentially valuable multi-purpose perennials found in forest gardens. Farmer knowledge of individual species and varieties, their uses, and the growth requirements of a species for a given purpose is often highly sophisticated and systematically applied in garden management. Detailed interviews in which numerous species were cross-referenced demonstrated that farmers are highly aware of potential light, nutrient, and root competition among trees of various species and design, that to an untrained eye appear to be random and wild looking (gardens accordingly) (Everett 1991). A *jak* tree, for example, might be grown either in a dense stand with other trees to encourage a tall growth form for timber, or given a location in the open where it would receive good light and produce a large fruit crop. Farmers also take full advantage of successional processes in garden development. Use of fast growing species such as bananas (*Musa* spp.) as "nurse" plants to create shade for fruit tree seedlings is very common.

Once fully established, each small garden, which is usually less than 0.5 ha in size, represents a spatial mosaic of vegetation patches of various ages. The earliest successional stage, represented by a few vegetables, tubers, medicinal herbs, flowers, and papayas (*Carica papaya*) for household consumption, grows in a sunny patch close to the house. Surrounding the house, there are typically a series of orchard-like clusters of fruit trees of varying ages and maturation rates that gradually lead into dense stands of comparatively mature, tall trees with timber value. The latter patches include canopy species such as *Michelia champaca, Cedrela toona* or *jak*, and *kitul* and areca nut palms (*Areca catechu*), with understories comprised of native forest trees such as *Neolitsea involucrata* and shade-loving cash crops such as cardamom (*Elettaria cardamomum*). The standing timber functions both as a source of wood for household construction and as a relatively easily liquifiable asset when a family needs cash. Often the dense stands of large trees are located quite distant from the dwelling and along property boundaries. As several neighbors repeat this pattern, the back yard and garden border areas in a hamlet begin to resemble networked patches and corridors of natural forest. The longer an area has been settled, the larger the proportion of mature trees in gardens. In the heart of an old village, rooftops may be hidden beneath a nearly closed canopy.

Gardens include endemic and native trees as well as many introduced species. All of the cloves, nutmeg, and cinnamon; and most of the pepper, cardamom, coffee, and fruit (e.g., avocados, guavas, mangos, mangusteen, rambutan, citrus) produced in Sri Lanka are grown in small holder forest gardens throughout the island. In addition, the potential economic value of species with medicinal properties is increasingly apparent (e.g., King 1992).

While the spice crops thrive primarily in the lowland Wet Zone, there is much unexplored potential for gardens in higher and drier regions as well. Two species of known economic value, the *nelli* fruit (*Phyllanthus emblica*) and sandalwood (*Santalum album*), are well suited to the Welimada region, which being drier than the Kotmale area, is not the best place to grow most spice crops. Both species are found in the Welimada area (sandalwood is currently rare), but neither is managed or marketed effectively. Meanwhile, large quantities of both are imported to Sri Lanka from India. There is a national and possibly international demand now for products from other common forest garden trees, including *Citrus aurantium, Erythrina variegata, Mangifera zeylanica, Gmelina arborea, Gmelina asiatica, Thespesia populnea, Garcinea morella, Ficus hispida, Myristica dactyloides, Pongamia pinnata, Mesua ferra*, and *Cassia auriculata* (G. de Silva, personal communication, 1990). In addition, some timber and firewood species are major garden products that are undervalued since they are not commonly bought and sold in the cash economy.

THE ROLE OF FOREST GARDENS IN CONSERVATON

Studies of forest gardens in the highlands have demonstrated the ecological importance of this land use for the maintenance of biodiversity, watershed protection, and other environmental values (Senanayake 1987; Everett 1987, 1991, 1993). Homestead forest gardens make up about 15% of all land use (NARESA 1991:98, 108). In the highland region specifically, which was once 100% forested, only 12% natural forest with 2–4% forest plantations of exotics remain in a landscape now dominated by large scale tea plantations and annual vegetable cultivation. Here, where they make up as much as 23% of land use, forest gardens play a significant role in sustaining biodiversity by providing habitat for native plant and animal species. Further, research demonstrates the fundamental importance of these gardens—in which nearly all species have some utility value—for rural and suburban household subsistence (Wickramasinghe 1990).

Yet, as the rural highland economy becomes increasingly cash oriented, the longer term ecological and subsistence values of the gardens in some areas no longer suffice for their retention. In the Kotmale area conversion to tea production is common. In the Welimada area, landowners can earn quick returns from replacing gardens of trees and shrubs with fields of annual crops. Well developed market linkages for vegetable crops, ready supplies of seeds and agricultural inputs as well as government agricultural policies all encourage farmers to step in this direction. The localized costs of this land use conversion in terms of soil erosion from the steep highland slopes are already very visible in denuded slopes. The impact on the national water supply of the degradation of the highland water catchment zone, measured, for example, in high siltation rates for downstream dams and the effects of the heavy use of chemical fungicides, pesticides, and fertilizers, have not begun to be assessed seriously.

If forest gardens are to persist, government policy makers and land use planners must focus attention on them. The viability of the ecologically valuable garden systems now depends upon the promotion of a range of sustained yield cash crops that can compete with monocultures of tea and annual vegetables or tobacco. A variety of factors have long served to divert institutional attention away from forest gardens. These gardens have acquired the aura of backwardness. Research and development efforts, including allocation of subsidies to farmers in agriculture, have predominantly focused on rice and vegetable field crops or on the three key plantation export crops: tea, rubber, and coconut. Research and development in forestry have emphasized timber production in large scale monoculture plantations to the exclusion, until very recently, of nonindustrial private forests or forest gardens.

Efforts to promote horticultural crops, mainly through the Department of Export Agriculture, have had much smaller portions of research funding and have focused on a few well known minor exports of limited climatic range, particularly spices. Still, many farmers have benefited from these efforts, and by incorporating higher yielding varieties of crops such as coffee, pepper, and cloves into their gardens, now receive increased cash incomes, while retaining the ecological value of mixed gardens. In other cases, a less encouraging agronomic approach to management of a narrow range of species (with government subsidies to support them) has encouraged farmers to replace their complex multitiered agroecosystems with single or few species production plots.

A broader, systems approach to "analog forestry" (Senanayake 1987) is needed that would emphasize forest gardens as a complex and diverse forest management system, and seek ways of increasing yields of salable products from them while maintaining their ecological structure and function. Analog forestry techniques, some of which are being tested in cooperation with local farmers by the NeoSynthesis Research Centre, a private nonprofit research station located in the Central Highlands, include identification of products with existing or potential market values. Management can include a range of activities from basic husbandry to programs for genetic improvement of cultivars. Introductory trials of shade tolerant species with economic value, such as understory herbs, flowers, mushrooms, or epiphytes, are currently underway.

The development of marketing structures compatible with the small scale and dispersed culture of forest garden production is vital as access to national and international markets depends upon supplies of adequate quantity and quality. Cooperative collection and marketing is one approach that is being tested by the Department of Agriculture in an Agricultural Production Village in the Kotmale area for the case of *kitul* syrup and jaggery production. Cooperative structures have already proven very successful for other commodities in the region, most recently for milk production. Forest garden market cooperatives will ideally accommodate a large variety of products from a given area.

The potential for enhanced cash earning for forest gardeners is clear. Whether the immediate returns will be competitive with the value of conversion to annual vegetable cropping, particularly outside the narrow range of the spice growing areas, remains to be seen. Other institutional responses in the form of land use policy may be required. For highland Sri Lanka the issue has many of the well known ramifications of tropical deforestation and valuation of non-timber forest products, one of which is that you often don't know what you've lost until it's gone.

NOTES

[1]This paper was presented at the 1992 Society of Ethnobiology Annual Conference, National Museum of Natural History, Smithsonian Institution, Washington, DC.

[2]People say that *kitul* seed is difficult to germinate and that it requires passing through animal dispersal agents (e.g., civet cat, known locally as "toddy" cats). Therefore, the preferred method for planting *kitul*, which is not common, is to transplant young seedlings. Great care must be taken not to damage the roots in the process.

[3]One study showed that 25% of 67 households interviewed near Sinharaja forest held such a license, but there may be a good deal of illicit tapping and estimates of yields from the forest are difficult to make (McDermott 1986).

[4]The dry season is from May through August in the Sri Lanka Intermediate climate zone near Welimada, and from January through February in the Wet Zone, including Kotmale.

[5]In 1990 a bottle of toddy typically sold in this area for 5 Sri Lanka Rupees (Rs). A bottle of *Ra* sold for 6 Rs.

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