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Changing Role of Non-Timber Forest Products (NTFP) in Rural Household Economy: The Case of Sinharaja World Heritage Site in Sri Lanka

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ABSTRACT / This paper examines the modified patterns of utilizing non-timber forest products (NTFP) and associated behavioral changes around tropical forest areas in the context of conservation-related objectives and other commercially driven objectives. Our study introduces a conceptual framework based on the household production theory and tests empirically the hypotheses drawn at Sinharaja World Heritage in Sri Lanka. The results show that conditions introduced by forest conservation programs and the spread of small-scale commercial tea cultivation are transforming the economy around Sinharaja. The process is an economically rational one where resident communities decide upon their actions based on the opportunity cost of time involved with NTFP in the absence of observable prices. Although the process, overall, has led to a decline in the role of NTFP in the household economy, its impact over different NTFP are not uniform, leaving sustained demand for certain NTFP. This situation calls for a multifaceted approach in forest management programs to address the various household needs fulfilled by NTFP-based activities.

Non-timber forest products (NTFP) have recently gained an important place in tropical forest management. This is as a result of certain practical conditions associated with tropical forest management programs. First, rural NTFP gatherers are the closest inhabitants to natural forests, a fact that gives them a dual role as extractors and custodians of forest resources. Second, they comprise the group that feels the immediate welfare impacts, often negative at least in short run, generated by tropical forest management programs (Gunatilake and others 1993, Nepal and Weber 1995, Studsrod and Wegge 1995). Therefore, welfare concerns of peripheral communities have emerged as a critical issue that determines the success of such programs. Looking for solutions, policy-makers and scholars turned into NTFP, which they presumed was a sustainable alternative for destructive forest uses such as logging or conversion into agriculture while being a useful way to raise rural incomes (Godoy and Bawa 1993). Based on this presumption, a number of strategies in which NTFP plays a vital role appeared and are currently in operation in many areas in the tropics. A few examples are extractive reserves, buffer zones around protected areas, multiple forest management programs, commercial integrated conservation and development programs (ICDP), and market promotion programs for selected NTFP (Barrett and Arcese 1995, Butler 1992, Padoch 1992, Richards 1993, Schwartzman, 1992).

Any forest management program inevitably brings changes to prevailing socio-economic realities faced by NTFP gathering communities. Not only the forest management efforts but also various other socio-economic forces operating locally and nationally also transform the economies around forest areas. Such changes alter the opportunities for and constraints on members of rural communities, and they react by modifying and adjusting their behavioral patterns to face new realities. As a result, conventional patterns of utilizing NTFP undergo changes and are subjected to various modifications. The modified use patterns of NTFP, in effect, lead to alterations in "demand" for different forest products, thus affecting the achievement of declared objectives of forest management programs and ultimately determining to a large extent the success or failure of such programs.

Modified patterns of utilization of NTFP and associated behavioral adjustments in response to changing socio-economic conditions in peripheral areas are two of the least understood aspects of tropical forest management. They introduce a form of dynamism into the forest edge, while presenting management challenges

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for managers of tropical forests and policy-makers. Socio-economic conditions that give rise to such modifications and adjustments are not uniform everywhere and are themselves subject to continuous alteration. Further, many NTFP-gathering activities are associated with non-market, subsistence behavioral patterns that are linked to complex household economic (survival) strategies. Therefore, dynamic socio-economic factors, in interaction with varied site-specific conditions and complex subsistence behavioral patterns, present an even greater challenge for socio-economic analysts.

The objective of this paper is to examine modified patterns of NTFP utilization and associated behavioral adjustments taking place in the periphery of the forest as a result of new realities brought about by forest management objectives and other socio-economic changes. We assert that the best way to approach the problem is to choose a conceptual framework, which deals with fundamental aspects of the economic behavior of NTFP gatherers, disregarding specific local conditions or different socio-economic conditions transforming them. We expect that such an approach will generate useful insights that can generally be applied beyond the specific local conditions while contributing to the existing knowledge on human–forest interrelationships based on NTFP. The ultimate goal of the whole exercise is to identify appropriate new strategies that can be adopted in proposed and on-going tropical forest management programs so that the chances of their success are increased. With this objective in mind, in the next section, we set out to review the outcome of past studies on NTFP relevant to this objective, and simultaneous laying the foundation for a conceptual framework that will guide this study.

Review

Since the pioneering study of Peters and others (1989) on valuation of NTFP in the Amazon, a multitude of socio-economic literature appeared on NTFP, of which a large majority was devoted to assess the non-timber value in different locations. These valuation studies, noted for their initial optimistic views on economic value of NTFP, seem to have undergone almost a paradigm shift later on, signaling contrasting policy implications (Sheil and Wunder 2002, Godoy and others 2000). Nevertheless, the significance of NTFP in tropical forest management cannot be overlooked on the basis of economic value considerations alone, given their strong relationship to life-styles in the surrounding areas. Thus, researchers have indicated the necessity of testing the other hypotheses that relate to NTFP and forest management in the context of the role they play in the peripheral household economy, such as contribution to household income, specialization, sustainability, cost of extraction, commercialization, domestication, depletion and deforestation (Godoy and Bawa 1993). A brief review of the outcome of a limited number of studies that dealt with such aspects provides a good starting point for understanding the significance of issues considered in this study.

Researchers have observed that certain NTFP products have undergone historical evolution in the patterns of their utilization (De Beer and McDermott 1989; Homma 1992). Some of the factors that led to changes are a decline in forest cover, commercialization of rural economies, resettlement schemes, transformation of land tenure, population increase, rural migration, and introduction of technologies (De Beer and McDermott 1989). These factors usually represent long-term changing agents that bring wide-scale transformation into peripheral areas and gradually spread over lengthier periods of time. While such factors are useful in predicting long-term trends in utilization of NTFP, they often envisage economy-wide policy implications, which cannot be dealt with effectively by sector-based forest management policies alone. As remarked by Pearce (1994) on deforestation issues, such broad-based explanations point towards impossibly grand solutions, while diverting the attention away from the immediately effective policy. Hence, observations on such wide-scale, long-term changing agents provide little help in formulating well-focused, sector-based forest management policies.

Probing further into changing patterns of NTFP utilization, analysts have recognized that often such evolutionary long-term changes are underlain by a host of short-term factors and mechanisms. As De Beer and McDermott (1989) pointed out, it is in response to the short-term factors that individual households actually make decisions, and the aggregate effects of such short-term responses lead to long-term changes. While such long-term changes are very discernible, the short-term agents and mechanisms that give rise to these long run changes are scarcely understood.

We perceive that short-term agents that give rise to modified patterns of NTFP use by local communities can be broadly divided into two. They are conditions imposed by forest management programs operating in respective areas, and other major socio-economic forces that are capable of generating observable behavioral adjustments in rural household strategies.

Conditions imposed by forest management programs usually have immediate repercussions on existing patterns of utilizing NTFP and the behaviors linked to them. Such conditions with direct impact over NTFP

may include restrictions on access to certain products or product categories; introduction of new laws, regulations and rules replacing the usufruct patterns of NTFP uses previously governed by customary rights; supply (or restriction) of rural infrastructure facilities; market support for selected NTFP and incentives for domestication, etc. Overall, such conditions usually give rise to restrictive impacts over quantity and composition of products extracted by a given household with or without having alternative avenues to compensate for them.

On the other hand, conditions created by other socio-economic factors operating on the periphery are much less controlled and dynamic, and therefore less predictable. They may comprise situations such as increased short-run demand for local products (including NTFP) from outside sources, increase in wage rates due to opening up of new avenues of employment opportunities, opportunities (or constraints) to access land resources or changes in tenure, improvements in access to urban markets due to new infrastructure developments.

Impacts of both forest management efforts as well as other socio-economic factors on existing patterns of NTFP utilization are usually felt over the cross section of households, and researchers have attempted to understand the impact of such factors by observing the cross-sectional differences of household behavior in utilization of NTFP. Some studies have shown that people decrease their dependence on NTFP when their incomes increase (Godoy and Bawa 1993; Gunatilake 1998, Gunatilake and others 1993). The usual observation is that poorer households gather more NTFP, often of low value, to meet a wide range of domestic needs. In contrast, the role played by various NTFP in fulfilling daily household needs in rich households seems marginal. Gunatilake (1994, and 1998) identified that household debt level, labor availability, and male/female ratio lead to an increase in the dependency on NTFP, while household income, education level, distance to the forest, involvement with non-agricultural activities, productivity of agricultural activities, and incorporation to the market economy have an overall negative impact. Pattanayak and Sills (2001) suggest that NTFP act as a "natural insurance" against agricultural shocks, especially for poor households that have limited options for other types of consumption-smoothing alternatives. Such studies have highlighted the vulnerability of poor households and also recommended the necessity of looking for alternative means to compensate their welfare losses when impending changes compel reduction of their dependency on forests.

While these findings are enlightening from the perspective of tropical forest management, we assert that the emphasis on "overall forest dependency" could, in certain cases, yield misleading interpretations due to aggregation of a diverse mix of products in single bundle, which play different roles in household economy. Researchers have opted for this nonselective aggregate approach due to the obvious advantage of the ability to generalize the findings over a wide range of locations. However, NTFP, as a single entity, is a highly arbitrary category and does not transcend anything other than their common origin. Once harvested from this common source of origin, they go on to fulfill widely differing roles in the household economy where their common origin scarcely matters.

Usually rural households in peripheral areas maintain complex economic (survival) strategies and NTFP play a multifaceted role there. There, NTFP are utilized in close association with products (inputs) from other sources, such as markets or home gardens, and they may complement or substitute each other helping to maintain an overall household economic (survival) strategy regardless of origin. Some NTFP may support market-based activity while others are used purely on a subsistence basis. Hence, from the point of view of household economy, it is correct to presume that different short-term socio-economic factors may affect the patterns of utilization of different NTFP in a non-uniform manner. Households adjust their behavior towards various types of NTFP accordingly. These adjustments give rise to modified patterns of utilization of NTFP at household level, with far reaching consequences to forest management objectives. Therefore, the key to understanding modified patterns of utilizing NTFP and their implications on forest management objectives is to study how different NTFP (or specific groups of products) are affected by various socio-economic factors in relation to the widely differing roles they play in the rural household economy. In the current study, an attempt is made to achieve this objective using a simple, generalized conceptual framework. The special feature of this approach is that it attempts to capture the context of overall household economic strategy using this simple framework.

Conceptual Framework

In rural economies people show a demand for NTFP to fulfill their household needs as they do for various goods and services in the market. One distinctive feature that makes household demand for NTFP different from usual market-based demand decisions is that these decisions are not always backed by observable monetary

prices that are determined by the factors exogenous to the household. Instead, often such decisions are backed by "shadow prices", which reflect the opportunity cost incurred by households with respect to a given NTFP. Such shadow prices are determined by factors internal to the economic strategies of different households, and therefore the shadow price paid for NTFP is usually a household-specific price (Butry and Pattanayk 2000). Thus, the key to the household-level adjustments of utilization of different NTFP in response to short-term socio-economic changes lies in understanding the household economic mechanisms that determine the price of a particular product in a given household.

In this context, household production theory provides a useful theoretical tool that can shed some light on the problem (Becker 1965, Deaton and Muellbauer 1980). This theory helps to overcome certain limitations of the conventional microeconomic theory resulting from by noninclusion of allocation of time (Becker 1965, Michael and Becker 1973, Stigler and Becker 1977, Gronau 1980). It introduces the concept of household production, where goods are combined with time and other factors such as skills to produce "commodities" that ultimately generate utility for their producers (Becker 1965). Individuals, maximizing their utility, have to allocate their time in a rational manner along with other resources to gain the highest satisfaction subject to constraints of time and other physical and human resources.

According to the conceptual framework introduced by the household production theory, NTFP, like other market-based products, are "inputs" of the household production process that are used to produce commodities which ultimately generate utility for their producers. NTFP may be associated with either subsistence or market based activity they are usually made available for household use through the expenditure of labor time for extraction, processing, utilization, or market delivery. Hence, the household production theory helps to organize the whole problem in the context of household demand for NTFP where the price of NTFP is determined mainly by the opportunity cost of time. Accordingly, the price of a commodity produced using a forest product has two major components, namely, monetary and time expenses as follows.

$$P_z = \sum P_i a_i + Wb_i \qquad (1)$$

Where P_i is the price of the i^{th} product used to produce commodity Z (could be zero), a_i is the amount of the i^{th} product needed for a unit of Z, W is the wage rate, and b_i is the amount of time needed to produce a unit of Z using the i^{th} forest product (In reality, a considerable number of NTFP may have a collective price based on the time cost alone).

The time component associated with utilization of NTFP has important opportunity cost implications. If the opportunity cost of the time involved in any NTFP is high, it leads to an increase in the relative price of the commodity produced using a given NTFP. This leads ultimately to a decline in the household demand for a particular NTFP. Therefore, there is an inverse relationship between household demand for NTFP and the opportunity cost of time incurred behalf of that NTFP.

The opportunity cost of time spent on a NTFP has some major aspects of interest. First, opportunity cost of time in the utilization of NTFP may vary across households. Therefore, the price of a forest product is unique for a given household, inducing household specific responses. In other words, demand for NTFP may vary among households, depending on the factors that affect the opportunity cost of the time in utilization of NTFP in a given household.

The second aspect, which is given more attention in this paper, is related to the impact of various socio-economic factors on specific types or categories of NTFP. A conceptual framework based on the opportunity cost of time helps to explain certain behavioral adjustments of rural forest extracting communities towards specific groups of NTFP depending on the role they play in household economy. We recognize this aspect is of primary importance given that what matters ultimately from the forest management perspective is how the demand for various NTFP are gong to be affected by impending socio-economic changes.

With the stated objectives of the study in mind, we investigate how the patterns of utilization of different groups of NTFP are going to be affected as a result of changing socio-economic factors that operate in the forest periphery. It should be noted that it is not the physical differences among products but the economic roles they play in household economy in interaction with other non-forest activities that are emphasized here. In this regard, we identified four groups of product categories depending on their competition for labor, substitutability by products from other sources, scarcity in sources outside the forest, and the durable nature of use in the household. Hypotheses developed using the conceptual framework of these groups of NTFP are discussed in the next section.

Hypotheses

The following are the main hypotheses that have been developed for empirical testing.

1 **NTFP with competitive demand for labor:** The spread of commercial agriculture negatively affects some of the cash earning forest-gathering activities, which compete for household labor with cash crops due to the increasing opportunity cost of time in relative terms. However, activities, which can be carried out in a flexible manner without significantly compromising labor time with respect to cash crops, may continue to flourish.
2 **NTFP that are substitutable by products from other sources:** NTFP used to fulfill certain household requirements that could be attained from sources other than forests (e.g. market, village sources) would be substituted by alternatives with minimum opportunity cost in terms of household labor time.
3 **Products for which sources other than forest are limited:** When available sources for certain products are limited outside the forest, people develop behavioral patterns that help minimize the opportunity cost involved with respective forest gathering activities.
4 **NTFP with durable uses:** In the case of NTFP of a durable and capital good nature (e.g. poles and pillars for construction and agricultural uses, thatching and roping materials), the implications of the opportunity cost of labor time becomes a less significant parameter.

The Study

Study Area and Sample

The study site, Sinharaja, is the only remaining, relatively undisturbed, and sizable patch of tropical humid wet evergreen forest (tropical rain forest) in Sri Lanka (Forest Department 1986). It altogether covers an area of 11,000 ha, including the peripheral patches that have recently been brought under the Sinharaja Management Plan. Sinharaja has been noted for its biological richness, particularly for the high level of endemic fauna and flora, and was declared a Man and Biosphere (MAB) and a World Heritage Site. It is the first forest reserve in the island to be brought under the purview of a special management plan in addition to enforcement of the national forest legislation (Bandaratilake and others 1995).

The current study was conducted in the periphery of the main patch, which is surrounded by 22 villages located along the perimeter. These communities have maintained long-standing interrelationships with the forest, of which NTFP represents a vital one. A random sample of 305 households from this peripheral community was interviewed in a field survey. A total of 1563 members live in the sample households, 808 males and 755 females.

Data Sources, Collection, and Analysis

The major source of primary data was a field survey conducted in the peripheral villages around Sinharaja. Data gathered in the survey included (1) household information and asset profiles (including details of home gardens and other non-forest activities). (2) flow of NTFP in households, (3) channels of marketing NTFP, and (4) availability of basic social facilities in the area. Data from the survey is cross-sectional and therefore reflects only the current patterns of NTFP utilization. Hence a series of informal discussions were held with knowledgeable villagers (key informants) to elicit the information on changing patterns of rural life styles. In addition, researchers made important observations on behavioral aspects of NTFP utilization. Data were gathered from secondary sources such as various records and past studies to identify major socio-economic changes taking place in the area.

Data gathered in the survey were tabulated and used to prepare summary tables to recognize the current role played by NTFP in the household economy and to examine their interrelationship with other nonforest economic activities. Information from key informants, secondary data from village records, and results of past studies together with researchers' observations have been used to trace the changing patterns of NTFP utilization, household behavioral adjustments, and associated socio-economic changes that took place in the area. Insights gained from the conceptual framework were used to explain how the major trends identified from those sources have been instrumental in giving rise to current patterns of NTFP utilization as pictured in the survey.

Socio-economic Changes in the Study Area

Conditions Imposed by the Sinharaja Management Plan and Other Forest Laws

Sinharaja has been placed under different management strategies from time to time, ranging from the present strictly reserved forest status to state sponsored logging conducted during the early 1970s. At present it is being managed as a strictly reserved forest with a special conservation plan. According to this conservation plan, there are two types of legally designated areas, namely a strictly reserved area and a buffer zone. Responsibility for the implementation of national forest legislation as well as the conservation plan lies with the Forest Department. The buffer zone represents a

legally less restricted area for utilization by peripheral communities.

Extraction of timber is the most severe forest offense, and strict enforcement is in operation. In addition, restrictions on extraction of cane, hunting wild animals for meat, and gem mining inside the forest are also strictly enforced. On the other hand, licenses are granted annually for tapping Kithul trees (*Caryota Urens*) inside the forest.

Despite the legal restrictions imposed on forest uses, it became evident in the survey that, in practice the use of forest resources is highly dependent on the type of product and the method of extraction used. As far as gathering of various NTFP is concerned, products such as fruits, vegetables, green leaves, mushrooms, medicinal plants, resins, etc., seem relatively less affected by legal restrictions. According to the survey, such a situation exists mainly due to the following reasons: (1) Gathering and delivery of most products are done on a small scale, in an irregular manner. Therefore, the chances of being detected by the authorities for such offences are low. (2) The irregular nature of such activities makes monitoring by authorities difficult. (3) Once delivered, these products are consumed quickly, leaving little evidence for later inspections. Occasionally they are consumed on the way. (4) Due to the seemingly less harmful nature of these activities also, officers themselves are less concerned about them than activities such as logging or hunting. Therefore, practically, open access conditions prevail for the most of NTFP from the forest. Although such a liberal attitude does not prevail regarding the collection of poles, pillars, roping material, and minor construction materials, people manage relatively free access to them on a small scale.

One of the major changes brought about by the forest management program in Sinharaja is the banning of shifting cultivation. Shifting cultivation used to be traditionally the main source of highland crops for rural households, not only in Sinharaja but in other parts of the island as well. It played an important role in household food security. Information gathered during the survey suggests that in Sinharaja shifting cultivation had been widely practiced by the resident community before it was made illegal. According to one estimate, one third of Sinharaja has been affected by shifting cultivation during the period 1956–1983 (Bunyard and Fernando 1988). The household survey indicated that over 90% of households had previously been involved in shifting cultivation. The practice ended in an abrupt manner due to regulations. The last sampled household to abandon it did so in 1986. The greater part of the land disturbed for shifting cultivation has now been brought under the buffer zone and reforested with *Pinus* and other species.

Overall, conditions imposed on rural life-styles by forest management efforts in Sinharaja can be summarized as follows. People had to abandon the major source of food security provided by shifting cultivation. Further, they lost their access to timber, cane, wild meat, and the opportunity for gem mining inside forest lands, although a few people are still engaged in these activities albeit in a surreptitious manner and on a minor scale. As far as other NTFP are concerned, even though many of them are illegal, people enjoy relatively free access for the reasons mentioned above. In summary, conditions imposed by forest management have a restrictive impact on the surrounding rural economy, creating a net welfare loss, at least in the short run.

Other Socio-economic Changes in the Area

The survey has provided a broad outline of the current status of the rural economy in the area. According to the survey, eight major groups of economic activities can be identified. These activities can be broadly categorized into three areas: (1) *farming activities*: commercial crop cultivation (92%), home gardens (92%), and paddy cultivation (58%); (2) *extraction of forest products*: extraction of NTFP (100%-at least one NTFP by each household) and extraction of timber, and (3) *off-farm work other than forest extraction*: boutiques and other self-employment (9%), working as hired laborers (18%), and wage work (7%). In addition, a limited amount of livestock activity (1%) was reported.

At present, a commercialized economy is emerging along the perimeter of Sinharaja based on small tea plantations. Even casual observations in the area confirm this fact. A rapidly spreading commercial tea economy has its roots in the low-country tea boom, which started in the early 1980s. As Sinharaja is located in the heart of the low-country wet zone, surrounded by three major districts where cultivation of tea predominates (Ratnapura, Galle, and Matara), the attraction of villagers towards tea is not an accident. The survey findings suggest that commercial cultivation of tea is fast becoming the major cash earning activity in the area. Of 305 member households in the sample, 282 (92%) owned tea cultivations ranging from 0.12 to 19 acres. Of these 282 households, tea became a major cash earning activity for 242 (86%).

It should be noted that tea was not the only commercial crop that attracted the villagers, attention. Before tea, at least two other commercial crops, rubber and cinnamon, attracted the attention of some village landowners and are still practiced by a few. However they failed to make any significant and lasting impact

Table 1. Summary of the Role of NTFP in Households[a]

Household requirement	Types of NTFP	Remarks
Earning cash	Kithul products, cane and cane products, resins, wild spices, wild meat, honey	Kithul has the highest potential and economic viability among the NTFP categories.
Nutrition	Fruits, vegetables, yams, greens, spices, meat, fish, mushrooms, honey	Mainly fulfills subsistence requirements. Provides side dishes, condiments, snacks and fruits. Some are marketed when available in surplus, but rarely. Many are substitutable from other sources.
Energy	Fuelwood	Fuelwood from forest fulfills a major part of domestic energy requirement. Abundant village-based sources also exist. No market involvement.
Health	Medicinal herbs, parts of woody perennials, wines, etc.	Serve as medicines of the indigenous system. The indigenous system is gradually being replaced by the Western medical system and, therefore, the use of medicinal NTFP is declining.
Construction	Thatching materials, roping materials, poles, pillars, canes	Poles and pillars from forest play a useful role in minor construction. Use of thatching and roping materials is declining. Alternative means from other sources have become popular (i.e., coir ropes).
Agriculture and livestock	Woody material for agriculture equipment, roping, fencing	Can be easily substituted by home garden and other village sources. Utilization in commercial crops is low.
Ornamental	Wild flowers and foliage	Used for religious and cultural purposes.

[a]Source: Survey data

compared with tea, in terms of the scale of the change they brought into rural household economies.

Being the major commercial force that is transforming the economy around Sinharaja, tea makes its impact felt at two levels. First, the impact is on the overall rural economy, speeding up the commercialization process through creation of new rural infrastructure, vehicle transportation, communication facilities and spread of financial transactions. These features, while helping in the efficient running of the tea economy in the area, act also as agents of change that transform the other aspects of traditional rural life styles.

The second level, which is given more attention in this paper, is the impact of commercial tea cultivation at household level. Tea is a perennial crop, which demands a high intensity of labor for cultivation, maintenance, harvesting, and daily delivery. Therefore, other activities that compete for labor with tea are affected by the increased opportunity cost of labor time with respect to the economically more rewarding tea crop. According to the conceptual framework, this leads to an increase in the internally determined price of NTFP due to the increase in of value of the time component attached to it. This has a negative impact on utilization of particular types of NTFP depending on their level of competition for household labor with tea.

On the other hand, the increased cash income made available by tea opens up a whole range of market options for fulfillment of various household needs, which have previously been attained through subsistence means, including NTFP. These two aspects will be discussed in detail below, highlighting their importance in understanding patterns of modified NTFP utilization in relation to Sinharaja.

NTFP in the Household Economy

It was identified that NTFP plays a role in providing cash income, nutrition, energy, health requirements, construction and agricultural materials, and ornamental requirements of the household. A total of 114 products, which serve different household needs, were recorded in the survey. Table 1 shows the recognized categories of NTFP and their uses in household strategy.

The following observations were made regarding the role of NTFP in fulfilling these household needs. (1) Several species or groups of NTFP species may serve to fulfill a single household requirement. (2) Certain species help to fulfill more than one household requirement. (3) Alternative means are available in market and village sources to meet household requirements that are fulfilled by certain NTFP. These three aspects associated with NTFP have important repercussions over the changing patterns of rural livelihoods around Sinharaja. We shall consider a few of the relevant facts in detail in the next section.

Modified Patterns of NTFP Utilization and Associated Behavioral Changes

It is evident that two major forces, the forest management program under the Forest Department and commercial tea cultivation, have transformed the economy around Sinharaja. As discussed previously, the conservation program has a prohibitive impact on the rural economy due to restriction of access to certain forest-based products. On the other hand, commercial tea cultivation is opening up fresh avenues of cash income for previously subsistence households, rearranging household economic activities according to a new order of priorities. Although the long-term repercussions of these developments are not very clear at the moment, there is little doubt that the achievement of conservation goals in Sinharaja will be strongly influenced by the interplay of these forces. The impact of these forces on traditional patterns of utilizing forest resources and the response of resident communities in facing these changes are two vital factors that determine the success of sustainable management of forest resources in Sinharaja. Given the situation, the forthcoming analysis of the hypotheses helps to recognize certain less distinct mechanisms of this process of transformation that is currently underway in Sinharaja area.

NTFP with Competing Demand for Labour

According to the survey, Kithul is the major cash-earning NTFP in the area. Compared with other forest-based activities, Kithul commands substantial demand from local as well as from outside markets, with 143 (47%) respondents of the sample recorded as being involved. Three major products made from the sap of the Kithul inflorescence: jaggery (a local sugar substitute), treacle (a syrup like honey), and toddy (a fermented beverage) are sold in the market. Of 143 Kithul tappers, 142 (99%) sold at least one of the three products with jaggery is the most prominent. An extractor who sells at least one of the three products earns, on average, US$456/yr.

Cane and wild meat are the other two NTFP-based activities with high cash-earning potential. Both of these activities now have been effectively controlled by strict enforcement of forest regulations. Our investigations revealed that from the 1950s to the 1970s, rapid exploitation of cane in response to outside commercial demand had reduced the populations of certain cane species to threshold levels. Despite the high cash-earning potential, exploitation of cane and wild meat are currently confined mainly to the fulfillment of domestic needs, also in a few households only.

Table 2. Other NTFP Based Cash Earning Activities

Type of product	Sold by no. of households	Average income (US$/yr)	Average price US$/kg
Resins	55 (18%)	27.5	1.12
Enasal (wild cardamom)[a]	49 (16%)	30.00	5.90
Bee Honey	43 (14%)	11.00	2.63
Athuru hathu (mushroom)	35 (11%)	28.00	1.15
Beraliya[b]	26 (09%)	2.00	0.24
Goraka[c]	13 (04%)	6.00	0.21

[a] *Elettaria cardmomum.*
[b] *Shorea megistophylla.*
[c] *Garcinia quaesita.*

The other cash-earning NTFP recorded in the survey are based on gathering activities (i.e., resins, wild spices, mushrooms, and honey) that are practiced on a non-regular basis. The small number of gatherers reported for these products indicates this activity is less popular among peripheral communities (Table 2). Some products such as wild cardamom, resins, and honey fetch relatively high prices (e.g., US$ 5.90/kg for wild cardamom), whereas other products, like Beraliya (*Shorea megistophylla*) or Goraka (*Garcinia quaesita*) have relatively low prices.

Accounts by key informants suggest that the current contribution by NTFP to household cash income is substantially diminished compared with that in the past. The apparent loss of income from restricted activities, particularly cane and wild meat, is one reason. However, this is not the only reason and probably not the most important one. We perceive that a more in-depth process of change that is associated with the emerging tea economy plays an important role here, and the process is continuing. An explanation of the logical conditions that led to the current situation described above can highlight the key features of this process.

The cash-earning activities mentioned in Table 2 are gathering activities that demand a share of family labor with an associated opportunity cost in relation to other economic activities. In the past, with limited cash-earning options available, the opportunity cost of labor time spent for these activities remained relatively low. Further, with shifting cultivation being a major household economic activity, a large number of regular visits were made to the forest, thus requiring a little additional time to collect these NTFP. However, with the banning of shifting cultivation and the simultaneous spread of commercial tea cultivation, a dramatic turn of events has taken place as concerning implications for the op-

Table 3. Utilization of Forest Foods

Type of food	Species recorded (*N*)	Average Gatherers per species (*N*)	Species recorded for marketing (*N*)	Species with maximum gatherers recorded
Fruits	20	73	4	Hal (*Vateria copallifera*)
Vegetables	5	104	0	Thibbotu (*Solanum indicum*)
Greens	6	110	0	Hathawariya (*Asparaghus racemosus*)
Spices	7	6	7	Cardamom (*Elettaria cardmomum*)
Yams	10	29	1	Gonala (*Diascoria intermedia*)
Meat	7	29	3	Sambhar (*Cervus unicolor*)
Fish	10	19	6	Horapolaya

portunity cost of labor used to gather these products. Further, compared with an activity such as tea, with more secure and regular returns, these gathering activities always involved an element of uncertainty in terms of low probability of occurrence that could lead to low expected income. All these factors acted together to bring the household demand for these products to their present low levels.

The situation could be better understood by considering the conditions associated with Kithul. In addition to higher economic returns in relative terms, the nature of the operation involved in the extraction of Kithul also fulfills the conditions necessary to accommodate it along with other cash earning activities. Making Kithul products provides practitioners flexibility: they can arrange their time along with other activities by distributing operational time among different members of the household and arranging operations so that it minimizes the opportunity cost involved.

Kithul tapping is normally done twice a day, once in the morning and again in the evening (tapping time takes 2–3 hours maximum per day unless trees are located very deep in the forest). This has a low opportunity cost compared with the daytime collection. Therefore, they have ample time to attend to other activities such as tea cultivation in between tapping. A more time intensive operation is heating the Kithul sap. It demands considerable time for the operation itself and to gather fuelwood, but the fact that heating is a homebound activity again provides the necessary flexibility to arrange the operation in a way that minimizes opportunity cost. Therefore, people could distribute the operational time among members of the family (especially among housewives and female children) who can attend to this task along with other home-based activities.

Substitution of NTFP by Products from Other Sources

While the demand for certain NTFP with cash-earning potential diminishes due to competition for labor with the major cash crop, tea, the increased cash earnings enable the substitution for some other categories of NTFP, mostly used for domestic consumption, of products from market sources. Major examples are found in household nutrition and health.

Some of the information gathered in the survey regarding forest foods is presented in Table 3. Eighty-two species of NTFP, which help to fulfill household nutritional requirements, were recorded. Many of these products are used only for domestic consumption. Except for wild meat, other forest foods, in general, represent a category with relatively free access, compared with other forest-based products.

A few important observations can be made regarding the information given in Table 3. First, the nutritional role of NTFP is mostly as side dishes to major meals, condiments, snacks, or fresh fruits. The only item considered a staple diet item was yams, gathered by a very small number of people. Discussion with respondents revealed that many of the forest yam species are considered famine foods, towards which people turn when other means of food security are threatened. Species that have been extracted by a larger number of respondents were recorded under the categories of greens, vegetables, mushrooms, and honey. However, the relative numbers of gatherers recorded even for commonly used food items such as greens and vegetables can be considered low (roughly one third of the total number in the sample). Gathering of spices as food items is the least common, and the number of households involved in extraction of meat and fish is also relatively low, indicating that the forest's role as a source of protein is a minor one (Table 3). It can be safely concluded that the role presently played by forest foods in household nutrition is limited.

All comparative accounts made available by various sources suggest that the share of market and village sources in fulfilling household nutritional requirements has gradually been increasing compared with forest sources. This takes place as the substitution of

forest foods by products from other sources. A few facts govern the process.

Before adopting commercial tea cultivation as the major economic activity, life-styles had been associated strongly with the forest. Chena (shifting cultivation land) was one link, which intensified dependence on the forest. Given the low cash incomes, shifting cultivation used to be an important part of the household food security and villagers had to pay more visits to the chena, which were often located close to the dense forest. They needed little extra time to visit the forest during their regular visits to the chena. Therefore, the opportunity cost of the time spent on forest-based activities was not as high as today due to the low input of time required for gathering activities and the unavailability of market-based alternatives. With the ban on shifting cultivation and restrictions on other forest uses (although not substantial in case of forest foods), the importance of home gardens and market sources increased as alternative sources to meet household nutrition requirements (Caron 1994).

Cash income earned from tea cultivation (and also from Kithul) provides the access to alternative market sources for substitute food items. According to Caron (1994), the expenditure on food purchases are strongly correlated with the extent of tea cultivation and the income from Kithul tapping. Cash income also enable people to obtain more desirable and easy to prepare food items from the market. Therefore, certain forest-based items extracted in their raw forms may be regarded as inferior goods compared with their market-based counterparts. However, this is not true for all food items from the forest. For instance, many respondents stated that certain types of mushrooms they gather from the forest are rare delicacies for which no better market product exist. Hence, this depends on the type of food concerned.

The other category of forest-based products being replaced by products from other sources is medicinal products. There are two major systems that help villagers to obtain essential economic commodities of good health through the prevention and cure of disease. They are the Western medical system represented by the government hospitals, medical centers, maternity homes, family health officers, clinics and government and private dispensaries; and the indigenous medical system represented by the resident practitioners in the village. The survey recorded information on 19 such indigenous medical practitioners in the area, including 5 general practitioners and 14 others who specialized in indigenous treatment for snakebites (6), orthopedic disorders (5), eye ailments (2), and tumors, ulcers, or boils (1).

The Western medical system has practically no involvement with local forest products. In contrast, the indigenous drug prescriptions and treatments are often associated with herbs, plants, and materials of animal origin that are obtained from the forest. Survey findings reveal that, in addition to the forest, there are few other sources that supply ingredients for the indigenous treatments. They are home gardens, other village sources, other nonherbal materials obtained from various sources (i.e., bees' honey), and village boutiques and indigenous drug stores at urban centers. According to the survey, 46 (15%) respondents extract only Weniwel (*Coscinium fenestratum*) on a regular basis from the forest. It is used as a health drink by some of the respondents.

The survey indicates that current activities in the fulfillment of health requirements are complex and influenced by different factors. Observations and responses of the survey suggest (although not in a quantitatively exact manner) that people are being attracted more towards Western medical facilities for practically all medical problems. It is difficult to distinguish the factors that influence the patterns of peoples' use of medical facilities available from different medical systems. However, based on the observations one can suggest some reasons among which economic considerations are only one.

Local methods of treatment often involve drug prescriptions with lengthy lists of medicinal items. Therefore, in indigenous treatment, a considerable amount of time cost is expended in seeking, preparing, and processing drugs compared with the pre-manufactured, easy to use drugs in the Western medical system. However, in general, selection of the treatment may depend heavily on factors such as peoples' experience regarding the comparative desirability of different medical systems, beliefs, education and knowledge, and urgency of treatment, which outweigh purely economic considerations. Therefore, in addition to economic reasons there are several others that may influence a household's selection of medical facilities, and this merits research attention.

Products for Which Supply Sources Other Than the Forest Are Limited

Fuelwood is the major source of domestic energy in the area. All households used a combination of energy sources, of which fuelwood (100%) and kerosene (99%) are the most essential types. The number of households with electricity was very low (2%), and a few others had small generators (4%). The two major uses of fuelwood are cooking meals and processing Kithul products. The forest provided 49% of total fuelwood

used and 230 households (75%) reported gathering fuelwood from the forest. On average, a family extracts 20.65 cubic meters of fuelwood per year from the forest. Therefore, the forest still plays an important role in the supply of household energy. Fuelwood is used only for domestic consumption and there was no record of anyone purchasing or selling fuelwood.

Gathering fuelwood is done mainly at the expense of labor time. In procuring fuelwood, the main objective of the household is to minimize the opportunity cost of gathering, and a normal pattern of fuelwood utilization has been organized in such a way as to do this.

At least a small stock of fuelwood is maintained in all houses, and members of the household keep replenishing it continuously. In this way members of the household can use the time periods that have minimum opportunity cost to collect fuelwood. According to the survey, labor time for gathering fuelwood is distributed among household members in the following manner: wife, 51%; husband, 33%; children, 14%; and others, 1%.

Members of the family have developed practices that help minimize the opportunity cost of gathering fuelwood. For instance, many respondents have stated that they fetch fuelwood in small quantities from their daily visits to the tea land or occasional visits to the forest or even from the roadside if available. Often the delivery of fuelwood has been in small or medium sized bundles of sticks or a few large pieces. Adopting such a behavioral pattern, people are able to minimize the opportunity cost incurred in gathering fuelwood.

NTFP with Durable Uses

There are some important categories of products that are used as inputs for more or less durable construction and household uses. Construction materials obtained from the forest (except timber) for minor construction and agricultural purposes are considered here. Although some of these products closely resemble timber in their woody physical nature, they are considered here given the minor scale of operations involved, and the multifaceted role they play in the household economy. The following materials are identified in the survey under this category: (1) poles and pillars, which are used for construction of temporary huts, materials for house construction, and materials used for ladders, fences, water lines; (2) thatching materials used for roofs of temporary huts and houses; (3) materials used as roping of construction and for other domestic purposes; and (4) materials of wood required for agriculture equipment such as plows, leveling planks, mamoties (weed clearing and soil cutting tool), threshing floor sticks and brooms.

The use of poles and pillars is prevalent in the area. Ninety percent (90%) of households extract materials from the forest. There are three sources of poles, pillars, and other minor wood requirements: forest, home gardens, and other village-based sources. Home gardens have a limited number of species to choose from, given that the major function of home gardens is to fulfill nutritional requirements. In contrast, the immense diversity of species available in the nearby forest provides ample choice of material to fit the specific qualities demanded by various construction and agricultural purposes. Fourteen (14) commonly used species have been identified for their useful qualities.

The utilization of forest based roping material (44%) is more prevalent than thatching material (16%). Two major types of roping materials could be identified: material used for minor uses such as fences, etc., where vines of species such as Bandura (*Nepenthes distillatoria*) and Kiri wel (*Ichnocarpus frutescens*) are used directly without producing ropes out of them; and strong ropes produced of either woody liana such as Weniwel (*Coscinium fenestratum*), cane (*Calamus* spp.), Pattikka (*Artobotrys zeylanica*) or barks of species such as Gedumba (*Trema orientale*) and Thiniya (*Shorea affinis*). According to the respondents' accounts and informal discussions, it became evident that the latter type is widely being replaced by coir ropes purchased at the market. Considerable effort in the collection and seasoning of the materials and in production is required in making such ropes, whereas equally strong coir ropes can easily be purchased cheaply from village shops or nearby towns.

There are a few factors that govern the utilization of those products. Once built, another round of these materials is needed only after a considerable period of time either for repairs or for new constructions (capital goods). Part of the requirement of these materials is supplied from home gardens and other village sources, but the forest still is the most favored source. Substitutes available for them in the market (i.e., roofing materials such as tiles, asbestos sheets, galvanized iron sheets, or PVC water lines, etc.) are normally expensive and often associated with high value construction.

In the utilization of these materials from forest-based sources, the major cost, as usual, is the opportunity cost (time for the extraction, processing, and construction) whereas some monetary expenses may be involved if hired labor is used. Due to the relatively durable nature of their uses, regular visits to the forest are not needed. This reduces their competition for labor time with commercial activities such as tea, providing some flexibility in arranging operations so that opportunity cost is minimized. Therefore, demand for

these products is less vulnerable and can be expected to continue for a longer period of time in future.

Conclusions and Policy Implications

The rural economy in the Sinharaja is gradually undergoing widespread changes, which are governed by conservation-oriented objectives on the one hand and market-driven commercial objectives on the other. Both these forces, although not in an interconnected manner, are giving rise to a modified role for NTFP in the household economy. Despite that, NTFP still play a more or less significant role in household cash income, nutrition, energy, health, minor construction, agricultural uses, and ornamental purposes.

The modification of NTFP utilization patterns is a process governed by clear rules of economic rationality, which underlie the seemingly ad-hoc behavioral patterns adopted by community residents. In this process people rationalize their actions relating to gathering of forest products using criteria based largely on the opportunity cost of time allocated for NTFP utilization. According to this rationalization process, harvest rates of NTFP are affected differently by various socio-economic factors based on the nature of extraction activities involved and specific roles the products play in the household economy.

The process may eliminate the products that directly compete with the emerging commercial crop cultivation activities for labor time and the products for which cheaper substitutes are available from sources other than the forest. Cash-earning forest-gathering activities, many forest-based food products, medicinal herbs and related products, roping and thatching materials, etc., are examples. On the other hand, certain other forest products could be expected to remain in demand by rural communities for the foreseeable future. Kithul products, fuelwood, and minor construction material are few examples. Such a situation arises from: (1) the forest being still the cheapest source compared with other sources (i.e., market or village); (2) the ample choice for variety and quality available in the forest sources; or (3) nonregular extraction of durable products that does not lead to high opportunity cost implications. In addition, certain forest products (e.g., mushrooms) are in demand due to their unique quality despite the substitutability by products from other sources. Demand for such products could be expected to be sustained and even to increase in the future with the increasing population.

Viewing the situation from a forest management perspective, these facts highlight the need of a multifaceted approach to conserve unique ecological resources while the economic welfare of surrounding communities also is maintained. Our results indicate that improved and reliable opportunities for cash income outside the forest will decrease pressure on the forest. Therefore, the identification and the provision of necessary incentives to promote suitable cash income sources would help to reduce the pressure to a certain extent, provided such activities possess a reasonable cash-earning potential and have a relatively low opportunity cost compared with emerging commercial tea cultivation practices.

For forest products with sustained demand, measures should be taken to augment the supply of such products from nonforest sources. If this does not happen, strict enforcement of legal restrictions alone would infringe on the right to practice traditional lifestyles and perhaps may not be adequate to overcome the strong demand for them in future. Among the major options available for such products are to introduce them into home gardens and other village-based agricultural systems whenever possible, encourage cultivation of suitable species in mixed perennial agroforestry models, and enhance the supply of such products from buffer zones.

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