

# EXTRACTION OF NON-TIMBER FOREST PRODUCTS IN THE FORESTS OF BILIGIRI RANGAN HILLS, INDIA.

## 1. CONTRIBUTION TO RURAL INCOME<sup>1</sup>

R. HEGDE, S. SURYAPRAKASH, L. ACHOTH, AND K. S. BAWA<sup>2</sup>

---

**Hegde, R.** (Tata Energy Research Institute, 50/2 Palace Road, Bangalore, 560 052, India), **S. Suryaprakash, L. Achoth** (Department of Agricultural Economics, University of Agricultural Sciences, Hebbal, Bangalore 560 024 India), and **K. S. Bawa** (Department of Biology, University of Massachusetts, Boston, MA 02125 USA.) EXTRACTION OF NON-TIMBER FOREST PRODUCTS IN THE FORESTS OF BILIGIRI RANGAN HILLS, INDIA. 1. CONTRIBUTION TO RURAL INCOME. *Economic Botany* 50(3):243–251, 1996. It is generally assumed that the sustained extraction and processing of non-timber forest products by local people can enhance their cash income and provide an alternative to tropical deforestation. However, the degree to which such products actually or may potentially contribute to rural incomes is poorly documented. We present the results of a study that seeks to evaluate the reliance of an indigenous group on non-timber forest products for cash income. Furthermore, we examine the effect of household variables on the cash income derived from collection and the price appreciation of non-timber forest products. These products account for nearly half of the gross annual income earned by the Soliga households in the Biligiri Rangan Hills of the Karnataka State in South India. Econometric models indicate that although income derived from the extraction of non-timber forest products is high in proportion to the time devoted to the collection, the extraction is not a preferred vocation. Furthermore, price appreciation for non-timber forest products varies for different products and, overall, the Soligas obtain essentially minimal wages for their extractive efforts. We discuss possible mechanisms for enhancement of Soligas' income and the involvement of Soligas in conservation efforts.

Extração de produtos florestais não madeiros nas florestas de Biligiri Rangan Hills, Índia. 1. Contribuição à renda rural. *E'de conhecimento geral que a extração sustentável de produtos florestais pode aumentar a renda do povo rural e oferecer uma alternativa ao problema de desmatamento nos países tropicais. No entanto, o grau, no qual tais produtos contribuem na renda rural, tem sido pobremente documentado. Nós apresentamos neste trabalho resultados sobre a dependência financeira de um grupo indígena em produtos florestais não madeiros. Nós examinamos o efeito de variáveis domésticas na renda monetária derivada da extração e também a apreciação de preços dos produtos florestais não madeiros. Estes produtos representam aproximadamente metade da renda anual bruta ganha por casa da tribo Soliga (Biligiri Rangan Hills, Estado de Karnataka—Índia). Modelos econométricos indicam que embora a renda derivada do extrativismo de produtos não madeiros seja alta em proporção ao tempo gasto na coleta, este não é o trabalho preferido pelos Soligas. A apreciação de preços varia entre os diferentes produtos extraídos. Os Soligas obtêm salário mínimo pela extração destes produtos. Nós discutimos mecanismos possíveis para aumentar a renda dos Soligas e o envolvimento dos mesmos em trabalhos de conservação da mata.*

**Key Words:** Soliga; NTFP; rural income.

---

Extraction of non-timber forest products (NTFP) has assumed considerable significance in global efforts to conserve biodiversity (Godoy and Bawa 1993 and references therein; Nepstad

et al. 1992; Panayotou and Ashton 1992). Judicious harvest of plant parts can be more sustainable than the harvest of whole adults, as is often the case when timber is harvested. The extraction of a wide variety of products can also result in greater economic diversification than the extraction of a single or a few products. A diversified economy based on forest products, partic-

---

<sup>1</sup> Received 19 December 1995; accepted 29 January 1996.

<sup>2</sup> Correspondence.

ularly at the local level, can, in turn, involve more people in conservation efforts than an economy based on mere timber extraction, often by non-local concessionaires and traders. A diversified economy can also buffer people against boom and bust cycles associated with single crops.

Although millions of people extract non-timber forest products worth billions of dollars throughout the tropics, little is known about the impact of extraction on local, regional, or national economies. Quantitative data on the rates of extraction and economic returns realized by local communities, in particular, are lacking. Nor do we know the extent to which local communities extract NTFPs sustainably and contribute to conservation. Furthermore, the effect of collection on the structure and composition of forests is poorly documented. Thus, the assumptions linking the extraction of non-timber forest products to an increase in rural incomes, to participation of local communities in conservation, and to overall conservation of biodiversity are largely untested and require rigorous examination (Godoy and Bawa 1993; Nepstad et al. 1992).

The Biligiri Rangaswamy Temple (BRT) Wildlife Sanctuary in southwest India is the home of an aboriginal tribe, Soliga. Approximately 4000 Soligas live in the 540 km<sup>2</sup> sanctuary and 11 000 in the periphery or areas surrounding the sanctuary. The Soligas have lived in the BRT forests for centuries, practicing shifting agriculture, hunting wildlife, and gathering a wide variety of products from the wild habitats. Starting from the early part of this century, the shifting agriculture was progressively curtailed and completely banned by 1972, when the area was declared a wildlife sanctuary. The Soligas are now being given small pieces of land (1–2 ha per household) to practice settled agriculture. The usufruct rights allow Soligas to continue gathering a wide variety of NTFPs from the state owned forest lands in the sanctuary. These products are marketed through cooperatives such as Large Scale Adivasi Multipurpose Society (LAMPS), which are partly controlled by the government. The LAMPS market the products without processing or value addition. The Soligas thus essentially receive wage labor for extraction of NTFPs.

Here we explore the economics and ecology of non-timber forest products extraction by the

Soligas. This and the following two papers explore: a) the role of NTFPs in the cash economy of the Soligas; b) the impact of extraction of NTFPs on the population structure and regeneration of extracted species; and c) productivity potential and the amounts harvested of a particular species and the mechanisms by which the indigenous communities may attain sustainability in extraction and, at the same time, enhance their income from the harvest of NTFPs.

In this paper we address the following three questions: (1) What is the contribution of NTFP extraction to the cash income of the Soligas? (2) How is the income derived from NTFPs influenced by variables such as opportunities for other vocation, education, and proximity to forest resources? (3) What is the level of appreciation in NTFP prices as the products flow through the market?

An answer to the first question provides basic information about the economic role of NTFPs in the livelihood of the Soligas. Obviously, without assessing the extent to which forest dwellers rely on NTFPs as a source of income, one cannot determine the type of interventions that might be required to implement a conservation strategy based on participation of the local people as well as the use of local forest products.

The second question is designed to determine the relationship between household variables and reliance on NTFPs. The relationship between household variables and the reliance on NTFPs provides insights into factors that regulate the extraction of NTFPs. For example, the dependence on NTFPs may decline with an increase in income from other vocations because of the greater opportunity costs associated with extraction of NTFPs due to variation in spatial and temporal distribution of NTFPs. With an increase in education, opportunities for other professional activities increase, with concomitant decrease in time devoted to extraction of NTFPs. In cases where extraction is unsustainable, a better understanding of the household variables influencing the collection of NTFPs can enable policy makers to focus on options that could decrease the dependence on NTFPs.

The answer to the third question is important for three reasons. First, to increase the economic stake in conserving biodiversity by the local people, it is important to know the total value that can be realized by the extraction of NTFPs. Second, if the economic gain to the local com-

munity is very low in relation to the final price of the product and if the extraction is unsustainable, products can be processed at the site and the level of extraction decreased. Value added at the point of origin by the local community can increase their income. Of course, an increase in income must be accompanied by regulation of open access to common resources so that pressure for over-exploitation of resources may be resisted. Third, information about market channels and price appreciation is critical for assessing the importance of NTFPs in local, regional, and national economies. Such an assessment, in turn, is essential for complete valuation of forests and forest products.

## MATERIALS AND METHODS

### STUDY SITE

The study was carried out in Biligirirangaswamy Temple Wildlife (BRT) Sanctuary, located between 11–13°N and 77–78°E in the south-east corner of Mysore district in the state of Karnataka, India. The terrain is a series of highly undulating hills with altitude ranging from 600 m to 1800 m above sea level. The climate of the area is tropical monsoonal with a rainy season extending from June to November, winter from December to February, and summer from March to May. The current natural vegetation of BRT sanctuary has been described by Ramesh (1989). It can be broadly categorised into five types: dry deciduous forest (61.1%), scrub jungle (28.2%), evergreen forest (6.5%), savanna (3.4%), and shola (0.8%, high altitude stunted mountain cloud forest). Our estimates of area under different forest types are based on the vegetation map constructed by Ramesh (1989).

### SAMPLING DESIGN

Two blocks of tribal settlements—one in the periphery and one in the interior part of the forest were formed. In order to obtain data on household income from NTFPs and to determine the effect of household variables on this income, households in two blocks of tribal settlements were sampled. Three tribal settlements which are located within a distance of 1 Km from the metallic road, together constituted the periphery block (Block I). Three other settlements which are located beyond 5–6 km from the metallic road constituted the interior block (Block II). Thirty households were selected from each block and selection of households was made on

the basis of number of households present in each settlement.

The two blocks were chosen on the assumption that the households located close to roads will have more chances of having greater exposure to the outside world than the households in the interior parts of the forest. Hence, a meaningful comparison can be made between these two groups of settlements with regard to their interaction with the outside world with respect to education, employment and income generation.

### DATA COLLECTION AND METHOD OF ANALYSIS

The study was conducted during April–June 1993. The data were collected from all the sample households by interviewing the local people. The data collected for the study included general information about the household such as literacy level, family size, the size of land holding, number of animals maintained by the family, sources of occupations such as agriculture, dairying, sheep-goat rearing, NTFP collection, labor employment and other sources of employment. With respect to NTFPs, data regarding the type of products collected, amounts of collection, marketing agency to which the products are sold, etc. were gathered. Data on price appreciation were collected by interviewing LAMPS agents in each settlement and by consulting LAMPS records. In order to confirm that the data obtained from the oral interview were correct, our data were cross checked with the data obtained by LAMPS daily collection reports.

### LOGIT MODEL

When the dependant variable is dichotomous in nature, the application of a linear regression model leads to erroneous results. Under such circumstances, binary choice models are used, which assume that individuals are faced with a choice between two alternatives and the choice they make depends on the characteristics of the individuals. The purpose of these models is to determine the probability that an individual with given set of attributes will choose one or the other alternative. The simplest form of the model involves the dependent variable assuming a binary response which takes values of 1 and 0. The commonly used qualitative response models in economic analysis are the linear probability model (LPM), logit and tobit models.

The linear probability model estimated through ordinary least squares (OLS) method suffers from some disadvantages: First, it assumes that the variance of the residual ( $\mu_i$ ) is homogeneous [ $\sum(\mu_i) = 0$ ]. Second, the assumption of normality is not tenable for LPM, because like  $Y$ ,  $\mu_i$  takes only two values. Third, estimated probabilities of dependent variables lie outside range of 0 and 1. Furthermore, OLS assumes that the probability increases linearly with the explanatory variable, i.e., the incremental effect of the explanatory variable remains constant, which does not happen in reality.

To overcome these difficulties, the logit and tobit models are preferred. In this study, the logit model was preferred over the tobit model because of computational ease. The objective of the logit model used here is to capture the qualitative response of dependent variables, i.e. the likelihood that a tribal household will earn substantial income from the collection of NTFPs. After the simplification of the formula for estimation purposes, we can write the model as:

$$\ln(P_i/1 - P_i)$$

where  $P_i$  is the probability that  $Y = 1$ , i.e., that the tribal household will resort to NTFP collection and earn an income of Rs 2500. The probability that  $Y = 0$ , i.e., that the household will not resort to NTFP collection at all or will earn an income less than Rs 2500, from the collection, is given by  $1 - P_i$ . As clearly seen from the data, a majority of the households collect NTFPs on a larger scale. These households are considered as NTFPs collectors and are given a score of 1. A few households do not collect NTFPs at all and a few others collect only one of them, in nominal amount, and not for income generation. Households from the latter group are treated as households not deriving any income from NTFP collection and are given a score of 0. The elasticity of probability (i.e. marginal effect of the  $i$ th variable on  $P_i$ ) is estimated as:

$$E_{p_i} = \beta_i(1 - P_i)X_i$$

where  $E_{p_i}$  is the elasticity of probability,  $\beta$  is the coefficient to be determined,  $(1 - P_i)$  is the probability that the household will not engage in NTFP collection, and  $X_i$  is the independent variable (Gujarathi 1978). The elasticity indicates the percentage change in probability due to a 1 percent change in the given independent variable.

The independent variables considered were as follows:

$X_1$  = Percentage educated adult members in the family. If this figure is high, a given household may tend to have less preference for NTFP collection, compared to a salaried job or other vocations. Hence, it is expected to have a negative association with the dependent variable.

$X_2$  = Family size. This variable is expected to be directly related to the dependent variable.

$X_3$  = Percentage of dependents (members less than 12 years and greater than 60 years of age) in the family. This is expected to be directly related to the dependent variable.

$X_4$  = Income from other vocations. This includes all sources of income excluding NTFP collection, and is expected to be negatively associated with NTFP collection.

Education, family size, and the number of dependent members within a family are often related to the sources of a family's income. Additionally, the availability of other income-yielding occupations influences the family's preferences for other occupations. All these variables were used to identify their degree of association with the collection of NTFPs, the dominant income-yielding vocation in the area.

Although many households in the study area have farm land, they have no clear-cut property right to that land. These areas are actually forest lands given to the people by the state forest department in order to stop the practice of shifting agriculture. In most cases, these lands are not measured and, due to illiteracy, the owner's figures for farm land area are often not the same as the actual farm size. As per rule of the state, the tribal people can cultivate this land by clearing the ground-level vegetation, excluding trees. Farming in the study area is purely subsistent in nature and there is no trade in farm produce. Produce is consumed if it is available from farming, but most tribal people can manage without it. Hence, the average market values of these farm produce are pooled to compute farm income, and farm size was not used as a variable. The same situation exists with livestock rearing. The animals owned by the respondents were given to them under developmental support programs implemented by the state. Markets for livestock products are absent and, because of the liberal distribution of milk and meat, it is difficult to determine the income generated by livestock rearing. Hence, both occupations were

TABLE 1. NON-TIMBER FOREST PRODUCTS AND THEIR EXTRACTION PATTERN BY INDIVIDUAL COLLECTORS.

Name of NTFP	Block	Qty. collected (kg) mean $\pm$ SD	No. of days spent in collection/year mean $\pm$ SD
<i>Acacia sinuata</i> (Soapnut)	exterior	5.78 $\pm$ 5.98	4.80 $\pm$ 3.92
	interior	12.13 $\pm$ 7.81	7.72 $\pm$ 4.23
	t-Value	4.34**	2.73*
<i>Decalepis hamiltonii</i> (Magaliberu)	exterior	11.22 $\pm$ 9.38	7.33 $\pm$ 4.42
	interior	8.97 $\pm$ 7.98	6.29 $\pm$ 4.83
	t-Value	1.33	1.15
<i>Phyllanthus emblica</i> (Amla)	exterior	70.11 $\pm$ 27.74	5.33 $\pm$ 1.60
	interior	72.98 $\pm$ 25.23	5.47 $\pm$ 1.08
	t-Value	0.60	0.24
<i>Sapindus emarginatus</i> (Soapberry)	exterior	9.02 $\pm$ 8.81	5.69 $\pm$ 3.63
	interior	12.94 $\pm$ 7.50	7.35 $\pm$ 2.18
	t-Value	2.75*	3.93**
<i>Strychnos potatorum</i> (Chilla)	exterior	0.44 $\pm$ 2.95	0.18 $\pm$ 1.18
	interior	8.73 $\pm$ 8.25	3.83 $\pm$ 2.71
	t-Value	5.39**	7.00**
<i>Terminalia chebula</i> (Arale)	exterior	10.22 $\pm$ 8.10	6.40 $\pm$ 3.20
	interior	16.13 $\pm$ 6.30	7.82 $\pm$ 3.62
	t-Value	4.94**	1.68
Honey	exterior	2.38 $\pm$ 2.00	18.67 $\pm$ 14.54
	interior	2.05 $\pm$ 1.85	18.87 $\pm$ 14.49
	t-Value	0.94	0.07
Lichens	exterior	3.02 $\pm$ 1.34	28.40 $\pm$ 11.14
	interior	2.97 $\pm$ 1.06	28.17 $\pm$ 6.73
	t-Value	0.27	0.11

\*\* and \* indicate the significance of means at  $P < 0.01$  and  $P < 0.05$ , respectively.

combined into a single variable, "other vocations."

## RESULTS

Approximately 800 species of flowering plants are found in the BR Hills (Ramesh 1989). The exact number of species that are used for one purpose or the other is not documented thoroughly for India but, as a whole, one out of every three species has some known use (CSIR 1986). In the BRT sanctuary, 8 species are extracted for commercial purposes and marketed

through LAMPS (Table 1). In addition, several species are traded through other channels. The number of species used by the Soligas for subsistence or medicinal purposes is perhaps substantial but unknown at present.

## HOUSEHOLD VARIABLES AND CASH INCOME

The general information about the households in two blocks is given in the Table 2. The two blocks show significant differences only with respect to the level of literacy, which is higher in

TABLE 2. GENERAL INFORMATION ABOUT HOUSEHOLDS IN THE TWO BLOCKS.

Characteristics	Exterior block mean $\pm$ SD (N = 30)	Interior block mean $\pm$ SD (N = 30)	t-Value
Size of household	4.67 $\pm$ 1.62	5.13 $\pm$ 1.80	0.518
% educated members	33.33 $\pm$ 35.55	14.33 $\pm$ 28.00	8.61**
Size of land holding	2.13 $\pm$ 1.89	2.03 $\pm$ 0.81	0.261
Number of cattle	0.90 $\pm$ 1.58	0.87 $\pm$ 1.69	0.077
Number of sheep and goats	0.60 $\pm$ 2.37	0.33 $\pm$ 1.19	0.54

\*\* Indicates significance at  $P < 0.01$ .

TABLE 3. CONTRIBUTION OF INCOME (%) FROM DIFFERENT SOURCE IN TWO BLOCKS.

Source of income	Exterior block mean $\pm$ SD (N = 30)	Interior block mean $\pm$ SD (N = 30)	t-Value
Agriculture	15.57 $\pm$ 14.06	20.18 $\pm$ 8.46	1.51
Subsidiary income	4.80 $\pm$ 9.88	3.26 $\pm$ 4.40	0.64
NTFP collection	47.63 $\pm$ 19.09	60.44 $\pm$ 14.19	2.90**
Labor	23.76 $\pm$ 13.50	14.66 $\pm$ 15.79	2.35*
Others	8.24 $\pm$ 24.79	1.44 $\pm$ 7.76	1.40
Gross income (Rs.)	13 157.87 $\pm$ 6530.16	13 141.40 $\pm$ 5134.44	
Gross income (US\$ = Rs 31.00)	424.45 $\pm$ 210.66	423.92 $\pm$ 165.63	

\*\* and \* indicate significance of means at  $P < 0.01$  and  $P < 0.05$  levels, respectively.

the exterior (33.33%) than in the interior block (14.33%).

The percentage composition of the household income is presented in Table 3. There is no significant difference between the two blocks in percentage income contributed by agriculture, subsidiary occupations (e.g., goat, sheep, and poultry rearing) and other sources of employment. However, the contribution of NTFPs to the household gross income is significantly less in the exterior (47.63%) than in the interior block (60.44%). In addition, wage employment contributes significantly more to the household gross income of the exterior block (23.76%) than the interior block (14.66%).

The percentage of days devoted to extraction of NTFPs parallels the relative income derived from NTFPs. As shown in Table 4, a greater percentage (54.46%) of days are spent extracting NTFPs in the interior block than in the exterior block (39.25%). In both the blocks the percentage of time spent in the collection of NTFPs is disproportionately less than the relative income derived from NTFPs: 54.46% versus 60.44% in the interior and 39.25% versus 47.63% in the exterior block. The relative amount of time spent on agriculture is significantly more in the inte-

rior block (20.95%) than in the exterior block (14.86%), whereas less time is devoted to the wage labor and "other" employment in the interior than in the exterior block (Table 4).

#### EXTRACTION OF NTFPS

People in the exterior block are engaged in collection of NTFPs for significantly fewer days (77.88) than the people in the interior block (91.97). The pattern of extraction of NTFPs by the individual collectors is indicated in Table 1. The quantity collected per day and the number of days spent in collection of the various NTFPs are significantly different for some products (Ar-ale, Chilla, Soapberry, Soapnut), but not for others (Gooseberry, Honey, Magaliberu, lichens).

#### LOGIT ANALYSIS

The logit analyses presented in Table 5 indicates the following trends: 1) As the percentage of educated members in the family increases, the probability that the households will extract NTFPs decreases in both blocks; 2) The family size influences the collection of NTFPs positively; 3) Income from other vocations has a negative influence on the extraction of NTFPs in both blocks. With a 1% increase in income from other

TABLE 4. PERCENTAGE-WISE EMPLOYMENT PATTERN OF TRIBALS.

Sources of employment	Exterior block mean $\pm$ SD (N = 30)	Interior block mean $\pm$ SD (N = 30)	t-Value
Agriculture	14.86 $\pm$ 11.73	20.95 $\pm$ 10.13	2.12*
Subsidiary	3.80 $\pm$ 6.74	5.20 $\pm$ 8.76	0.69
NTFP collection	39.25 $\pm$ 14.68	54.46 $\pm$ 15.75	4.58**
Labor	31.51 $\pm$ 16.84	18.40 $\pm$ 16.29	3.01**
Others	10.59 $\pm$ 28.17	0.81 $\pm$ 4.38	1.84
Total number of days	198.24 $\pm$ 49.23	168.88 $\pm$ 43.57	

\*\* and \* indicate significance of differences between means at  $P < 0.01$  and  $P < 0.05$ , respectively.

TABLE 5. MAXIMUM LIKELIHOOD LOGIT COEFFICIENT ESTIMATES: COLLECTION OF NTFPS BY THE TRIBAL HOUSEHOLDS OF THE TWO BLOCKS.

Independent variables	Exterior block			Interior block		
	Logit coefficient	Mean value	Elasticity	Logit coefficient	Mean value	Elasticity
Constant	-2.26			-1.86		
Percent educated adults	-0.014 (1.14)	33.33	-0.32	-0.004 (0.20)	14.33	-0.01
Family size	0.027 (0.11)	4.67	0.09	1.48 (2.27)	5.13	1.79
Percent dependents	0.01 (0.47)	51.26	0.39	-0.04 (1.35)	40.20	-0.43
Income from other vocations	-0.0002* (1.72)	5480.33	-0.76	-0.0005* (2.08)	4956.33	-0.58

Figures in parentheses are calculated t-values; \* indicates significance at  $P < 0.05$  level.

vocations, the probability of a household earning at least minimum income decreases by 0.76% in exterior block and 0.58% in interior block.

#### PRICE APPRECIATION

The price appreciation varies considerably among products as it moves from the extractor, the agent, and from the agent to the LAMPS (Table 6). Marketing channels beyond LAMPS were not investigated. The range in appreciation from the extractor to the agent is from 3.5% for amla to 33.33% for honey. The appreciation between the extractor and the LAMPS ranges from 50% for Magaliberu to 255% for Soapnut.

#### DISCUSSION

The total household income of the Soligas in both blocks is approximately Rs 13000, which is about Rs 2000 above the minimal wage for an individual. Malhotra et al. (1991) report a similar level of cash income for tribal house-

holds in the state of West Bengal (Rs 10257 in 1991 figures, which would be equivalent to Rs 12637 for 1993, with 11% rate of inflation). However, the relative contribution of NTFPs to cash income in the West Bengal was 22%. Malhotra et al. included fodder and fuelwood also under NTFPs. If one were to include income only from NTFPs that are sold for processing through LAMPS, the contribution of NTFPs to cash income declines to less than 2%, compared to 48% and 60% for the exterior and interior blocks. Clearly the Soligas rely heavily on NTFPs as a source of cash income.

Extraction of NTFPs provides approximately more than half of the annual income to the Soligas in the interior of the sanctuary. Away from the interior, where proximity to the outside world allows opportunities for other vocations, the NTFPs provide less income but still amount to a little less than half the annual remuneration. Moreover, in both blocks variance in income

TABLE 6. TRADE OF NTFPS.

Name of the NTFP	Selling price by collector (Rs/kg)	Selling price by LAMPS agent (Rs/kg)	Price difference—collector & LAMPS agent (Rs/kg)	Selling price by LAMPS (Rs/kg)	Price difference—collector & LAMPS (Rs/kg)	Percent appreciation
<i>Acacia sinuata</i> (Soapnut)	2.25	5.00	2.75	8.00	5.75	255.56
<i>Decalepis hamiltonii</i> (Magaliberu)	5.00	6.50	1.50	7.50	2.50	50.00
<i>Phyllanthus emblica</i> (Gooseberry)	1.40	1.45	0.05	2.30	0.90	64.28
<i>Sapindus emarginatus</i> (Soapberry)	2.25	3.25	1.00	6.00	3.75	166.67
<i>Strychnos potatorum</i> (Chilla)	2.50	3.00	0.50	4.00	1.50	60.00
<i>Terminalia chebula</i> (Arale)	2.25	2.50	0.25	3.90	1.65	73.33
Honey	12.00	16.00	4.00	26.00	14.00	166.67
Lichens	15.00	18.00	3.00	30.00	15.00	100.00

from the extraction of NTFPs is much less than that of income from other vocations, indicating that the collection of NTFPs constitutes the most reliable source of income. Clearly the Soligas are almost completely dependent upon the forest products for their livelihood.

The number of people in India who rely on forest products is assumed to be approximately 50 million (Shiva 1993), but there is little information on the extent to which these people derive their annual income from forest resources. In a study of tribal economy in Orissa in eastern India, Fernandes and coworkers (1988) found that 13% of the population is engaged in collection of NTFPs as primary occupation and 34% as secondary occupation. They also found that higher castes are less dependent on NTFPs than lower castes. In the states of West Bengal, adjoining Orissa, Malhotra et al. (1991), however, found no difference among different castes with respect to reliance on NTFPs, though higher castes derived more cash income from NTFPs.

The effect of household and other variables on the degree of reliance on NTFPs follows expected trends. In both blocks income from other vocations is negatively associated with income from the collection of NTFPs, indicating that an increase in income from these vocations would decrease the income from NTFP extraction. The two blocks do not differ much with respect to the degree to which income from other vocations influences income from NTFPs. An increase of 1% in agricultural income corresponds to a decline of 0.55% in income from NTFPs in the interior and of 0.76% in the exterior block.

Clearly in both the blocks NTFP extraction should be the preferred vocation. This is also indicated by the fact that income derived from NTFPs is disproportionate to the time devoted to the collection of NTFPs. Yet the results of the logit analysis indicate preference of vocations other than extraction of NTFPs. There are several possible explanations for the discrepancy. First, extraction is probably physically more demanding than other professional activities. Second, collection of NTFPs entails risks. For example, every year collection of honey from branches of large trees leads to physical injuries, occasionally fatal, for collectors falling from trees. Third, extraction is highly seasonal, and quantities available for extraction may be somewhat unpredictable due to yearly variation in productivity. Fourth, our calculations for the

amount of time devoted to various vocations is in the form of mandays. Mandays involved in the extraction of NTFPs may be longer than those for other professions.

The two blocks differ considerably with respect to education, the percentage of cash income derived from NTFPs, and the relative amount of time devoted to the extraction of NTFPs and other vocations. In the interior block, proximity to forests probably reduces the opportunity cost of collection of NTFPs and decreases the probability of engaging in vocations other than the extraction. Consequently there is greater reliance on NTFPs as a source of income than in the exterior block. The level of education is also lower in the interior block, but whether or not education influences extraction patterns is not known. Certainly, education makes other vocations more likely, but the vocations in which the people in the exterior block are engaged in do not depend upon the acquisition of primary or secondary education. Overall, there is need to examine more closely the household variables that influence the extraction of non-timber forest products in order to integrate extraction and conservation into a coherent policy for management of non-timber forest resources.

Detailed records of marketing channels about the trade of NTFPs are generally lacking in India and elsewhere. It can be noted that the extent by which the prices of NTFPs get appreciated from the point of collection varies from 50% in Magaliberu to as high as 255% in soapnut. Chakravarty and Verma (1991) opined that because the collectors of NTFPs sell them in an unprocessed form the prices they receive are generally low. Low income from NTFPs can lead to overharvesting, and we have some evidence that the current extraction levels are unsustainable (Murali et al. 1995). Income, however, can be increased by value addition at the source and we discuss this possibility for one product, *Payllanthus emblica* in an accompanying paper (Uma Shankar et al. 1996). Increased income through value addition at the source can potentially provide an incentive to decrease extraction levels, provided the local communities realize that it is in their self-interest not to over-harvest the resource which provides much more income than other vocations. Increased income, if correlated with enhanced literacy, can also lead to self-awareness about prudent resource use and open possibilities for other non-subsistence level vo-

cations. Nevertheless, the role of enhanced income from NTFPs in income from NTFPs in sustainable extraction and conservation of biodiversity itself is the subject of empirical study (Godoy and Bawa 1993).

## CONCLUSIONS

Non-timber forest products provide substantial and critical contributions to the cash income of the Soligas. However, the income derived from the products barely matches the minimum wages from other occupations. Thus, the 15 000 Soligas, whose ancestors probably owned all the 540 km<sup>2</sup> of the BRT Sanctuary, merely eke out a subsistence-level livelihood from natural resources. Low incomes from NTFPs is neither conducive to sustainable harvests, nor to conservation. Although the Soligas claim that their extraction patterns do not result in overharvesting, poverty can lead to overexploitation of NTFP resources. One possible way for the Soligas to enhance their income from NTFPs would be to directly process and market the NTFPs (see Murali et al. 1996). In an accompanying paper (Uma Shankar et al. 1996) we describe the processing of one NTFP product. However, direct processing and marketing by themselves will not enhance the conservation potential of the area. It must be accompanied by joint management and monitoring of forest resources, involving Soligas and the forest department.

## ACKNOWLEDGMENTS

This paper forms a part of the MS thesis submitted to University of Agricultural Sciences, Bangalore by R. Hegde and represents contribution number 31 of a research program in Conservation of Biodiversity and the Environment jointly coordinated by the Tata Energy Research Institute and the University of Massachusetts at Boston. The program is supported in part by the MacArthur Foundation. This study was partly funded by Indian Council of Agricultural Research in the form of Junior Fellowship to Ravi Hegde. Work on this manuscript has also been supported, in part, by a grant from the Biodiversity Conservation Network of the Biodiversity Support Program of the World Wildlife Fund. The authors are grateful to Drs. K. S. Murali, Uma Shankar, H. Sudarshan, and Shri Somasundaram for their help at various stages of this study. Our collaboration with the Vivekananda Girijana Kalyana Kendra, BR Hills, greatly facilitated the field work. Many officials of the State Forest Department of Karnataka, especially A. N. Yellappa Reddy, S. N. Rai, S. M. Puttabudhi, and Sanjay Mohan not only provided access to the old forest records, but also shared their views from time to time. The guidance rendered by the two Soliga youths, Basava and Kumbha, during field surveys made this work possible. We also thank numerous forest people for interacting and appraising us of their invaluable knowledge about the forest. Joseph Rose offered comments on the manuscript, and assisted in the compilation of figures and tables.

## LITERATURE CITED

- Chakravarthy, I., and R. Verma.** 1991. Marketing of a minor forest produce in a tribal sub plan area through co-operatives in Rajasthan. *Indian Journal of Agricultural Economics* 71:311–320.
- CSIR (Council of Scientific and Industrial Research).** 1986. The useful plants of India. Publications and Information Directorate, CSIR, Hillside Road, New Delhi 110012.
- Fernandes, W., G. Menon, and P. Viegas.** 1988. Forests, environment and tribal economy. Indian Social Institute, New Delhi.
- Godoy, R., and K. S. Bawa.** 1993. The economic value and sustainable harvest of plants and animals from the tropical rain forest: Assumptions, hypotheses, and methods. *Economic Botany* 47:215–219.
- Gujarathi, D.** 1978. Basic econometrics. McGraw Hill Book Company, New York.
- Malhotra, K. C., D. Deb, M. Dutta, T. S. Vasulu, G. Yadav, and M. Adhikari.** 1991. Role of non-timber forest produce in village economy: A household survey in Jamboni Range, Midnapore District, West Bengal. Unpublished paper, Indian Institute of Biosocial Research and Development.
- Murali, K. S., Uma Shankar, R. Uma Shaanker, K. N. Ganeshaiyah, and K. S. Bawa.** 1996. Extraction of non-timber forest products in the forests of Biligiri Rangan Hills, India. 2. Impact of NTFP extraction on regeneration, population structure, and species composition. *Economic Botany* 50:252–269.
- Nepstad, D. C., I. F. Brown, L. Luz, A. Alechandra, and V. Viana.** 1992. Biotic impoverishment of Amazonian forests by tappers, loggers and cattle ranchers. Pages 1–14 in D. C. Nepstad and S. Schwartzman, eds., *Non-timber products from tropical forests: evaluation of a conservation and development strategy*. Advances in Economic Botany 9. The New York Botanical Garden, Bronx, NY.
- Panayotou, T., and P. Ashton.** 1992. Not by timber alone: The case for multiple use management of tropical forests. Island Press, Covelo, CA.
- Ramesh, B. R.** 1989. Vegetation map of the Biligiri Rangan Hills. French Institute, Pondicherry.
- Uma Shankar, K. S. Murali, R. Uma Shaanker, K. N. Ganeshaiyah, and K. S. Bawa.** 1996. Extraction of non-timber forest products in the forests of Biligiri Rangan Hills, India. 3. Productivity, extraction and prospects of sustainable harvest of *Amla Phyllanthus emblica*, (Euphorbiaceae). *Economic Botany* 50:270–279.
- Shiva, M. P.** 1993. Solutions to overcome impediments in forest development through MFP based management. Paper presented at the International seminar on Minor Forest Products in Forestry, 17–18th April, Dehra Dun.