# Tropical forests as safety nets? The relative importance of forest product sale as smallholder insurance, Eastern Honduras

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## SUMMARY

Tropical forest resources are known to reduce local residents' vulnerability to income shocks. But what explains differential use of this 'natural insurance' policy among households, and how does it compare with alternative forms of self-insurance? The research described here explores these questions by testing the degree to which earnings from forest product sale are used to cover the cost of idiosyncratic shocks, including crop shortfall, illness, and death. Drawing on a 1998 survey of 116 indigenous households in the Tawahka Asangni Biosphere Reserve of eastern Honduras, this paper finds that commercial forest extraction is neither universal among Tawahka households, nor a primary form of insurance for most (the most common strategy is to solicit loans from kin and neighbors). In addition, results indicate that those most likely to sell forest products in the wake of misfortune are: a) households in the early stages of the life cycle (young and undercapitalized, they cannot liquidate household assets or rely on harvest surpluses), and b) those experiencing forms of calamity—such as children's illness—that do not significantly compromise the scarce household labor needed in extractive activities. Overall, results suggest that the nature and intensity of the misfortune experienced, as well as household attributes such as human capital and land wealth, strongly condition the degree to which forest resources are used to self-insure. Development policies that build on the concept of 'natural insurance' should consider the potential for highly differentiated receptivity within target populations. In turn, conservationists should anticipate that as long as reliable health care and credit provision are lacking in many remote forest regions, the need to self-insure will continue to motivate local peoples' sale of forest resources.

**Keywords:** risk and vulnerability, rain forest products, natural insurance, conservation and development, Tawahka, Honduras, Latin America.

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## THE TROPICAL FOREST AS SAFETY NET

An estimated 11 million people inhabit the world's tropical and sub-tropical forests (Byron and Arnold 1999; Wunder 2001). For many, forest resources serve as 'natural insurance.' That is, wild resources provide famine foods following crop failure, and money earned from the sale of forest products subsidizes agricultural incomes (see Anderson et al. 1991; Arnold and Ruiz Pérez 2001; Byron and Arnold 1999; Chambers and Leach 1989; de Beer and McDermott 1996; Kant 1997; Wunder 2001). This "safety net" function of forest products is particularly important in remote regions where formal insurance mechanisms are rare, but price, health, and environmental risks are high (Pichón 1997; Reardon and Vosti 1995). To date, most of the evidence for the forest's insurance role has been ethnographic, but growing interest in the topic has led to several recent studies that lend critical quantitative support (Godoy, Jacobson et al. 1998; Godoy and Wong 1999; Pattanayak and Sills 2001; Takasaki et al. 2002).

Overall, the 'natural insurance' concept has led to increasing recognition that even small amounts of forest-derived earnings help to bridge income gaps and so play a critical role in livelihood *security*, an area of increasing donor attention (World Bank 2002). As a result, initiatives that seek to lessen smallholder vulnerability are being explicitly linked to conservationists' efforts to promote sustainable resource use among forest communities (Godoy 2001; Hall 2000; Schmidt et al. 1999; Tresierra 1999).

Despite the widening appeal of the forest-as-safety-net concept, however, critical questions remain regarding the motivations, capabilities, and circumstances that inform individuals' or households' decisions to turn to forest resources to mitigate risk or overcome misfortune (CIFOR 2002). Several issues in particular require closer attention if nascent management projects are to become effective on-the-ground programs.

First, the use of forest resources in mitigating risk is often reported as an aggregate trait of the land-poor (e.g., Anderson et al. 1991; Chambers and Leach 1989; Kant 1997). But as researchers increasingly report, there is remarkable diversity within seemingly homogenous rural populations (Agrawal and Gibson 1999; Barham et al. 1999; Byron and Arnold 1999; Perz 2001). The question then arises: do *all* forest peasant households turn equally to forest resources to self-insure?

Second, the literature is unclear about the nature, frequency, and duration of the risks for which forest insurance is summoned. Is forest extraction particularly useful in the face of certain shocks but less for others? Are forest resources more likely to be mobilized in anticipation of shock, or in its wake? Because the former suggests a long-term risk-aversion strategy, and the latter a much more short-term deflection of production activities following particular events, the distinction is critical to understanding long-term impacts of forest product use on forest sustainability.

Finally, researchers have paid little attention to the *relative* importance of forest extraction as self-insurance. Because farmers are known to use a number of other coping strategies to maintain consumption in the face of calamity (Ellis 1998), how does forest-based extraction compare to other risk-reduction strategies?

This paper addresses these questions through analysis of the role of forest-product sale, or 'commercial extraction,' in helping indigenous rain forest farmers in eastern Honduras to meet the costs of recent or impending income shocks. The paper thus explicitly examines how forest products are mobilized to meet financial, rather than subsistence, needs.[i] Scrutiny of the financial role of forest products is warranted because of the rising involvement of even the most remote rural peoples in non-farm or off-farm labor and product markets throughout Latin America (Reardon et al. 2001).

This paper draws from research conducted in 1998 among the five communities of the Tawahka Asangni Biosphere Reserve (TABR, pop. ~1,000). In common with many forest-dwelling peasantries across the neotropics, the Tawahka live within a state-owned forest commons targeted for conservation. By national standards, land and resources are relatively abundant, but credit markets and basic social services are scarce, and environmental, health, and market risks are high (Barham et al. 1999; Godoy 2001; McSweeney 2000). Sites such as these are receiving increased attention from NGOs, governments, and others looking for ways to reconcile economic development with biodiversity conservation. A better grasp of how and why local peoples use the resources around them has been deemed critical to the long-term realization of both objectives (CIFOR 2002).

The paper has four main parts. In the following section, commercial forest extraction is briefly conceptualized as a risk-mitigating form of income diversification, drawing on the agricultural and development economics literatures as well as recent microeconomic studies of forest peasantries. These insights are then applied to the Tawahka case study, which focuses on how, when, and why particular households turn to forest product sale to self-insure, what characteristics are shared by those that do, and how commercial extraction compares with other self-insurance options. In the last sections, results are reviewed in terms of our understanding of forest peasant livelihood security, implications for conservation and development policy, and directions for future research.

## Forest Product Sale as a Form of Income Diversification

Although the defining characteristic of peasant livelihoods is reliance on farming, supplemental income is often earned through a range of non-agricultural activities (Reardon et al. 1992). In tropical forest settings, this 'non-farm' component has attracted considerable attention because of its growing importance in rural production pantropically (Reardon et al. 2001). While some see this trend as symptomatic of a failing agricultural sector, others point out that diversification is associated with lower susceptibility to agricultural risk, and in some cases with enhanced food security, higher incomes, and more mobile investment opportunities (e.g., Ruben and Van den Berg 2001). In tropical forest settings, non-farm activities are prescribed for community-based conservation projects because they are seen to lessen forest peoples' interest in land-based production, thus lowering forest conversion rates (Barraclough and Ghimire 1995; Murphy et al. 1997; Southgate 1998), or, in the case of forest-product sale, to encourage local interest in joint forest management (Hall 2000; Jepma 1995).

What, then, drives an essentially farm-based household to seek income sources off-farm? Households diversify voluntarily (often as a long-term strategy) or involuntarily

(usually as a short-term strategy) for a wide variety of reasons. Among them, diversification allows households to take advantage of greater returns in off-farm sector—that is, to "make money." Alternatively, households may diversify in order to self-finance (Lanjouw 1999; Ruben and Van den Berg 2001).

Most important in terms of livelihood security, however, is the extent to which diversification acts to mitigate risk, in three ways. First, off-farm income can effectively insure against potential failure in agriculture or other economic pursuits (so-called *ex ante* income security). Second, off-farm income can help families to cope *following* failure in the farm sector. This *ex post* insurance function is particularly important after unexpected income shocks and is likely to spur involvement in what might otherwise be low-productivity activities (Godoy, Jacobson et al. 1998; Lanjouw 1999). For some households, farm sector 'failure' may be chronic; those headed by single women, for example, face chronic shortages of farm labor, and so may be particularly resourceful in seeking off-farm opportunities (Salick 1997). Finally, diversification can help families to smooth income fluctuations given the seasonality inherent in agricultural production (Kant et al. 1996; Upton 1996). Forest-based extraction is particularly attractive in this regard, because it can be timed to coincide with lulls in the agricultural calendar (de Beer and McDermott 1996; Wickramasinghe et al. 1996).

The degree to which any of these factors is influential in peasant activity choice varies with differential proximity to markets, access to government or NGO assistance, resource access, and susceptibility to particular environmental risks such as floods or drought. But even within a given area, household production portfolios vary greatly in size and content, because a household's desire and ability to diversify, for any of the above reasons, is conditioned by its own resources, which mediate the choice and degree of involvement in non-farm sectors (Ellis 1998). For example, wealth held in liquidable assets such as livestock can encourage diversification by providing capital and collateral necessary to insure against and/or finance non-agricultural activities (Barham et al. 1999; Godoy et al. 1996). Alternatively, household wealth in land or other assets can itself be used to self-insure or self-finance, rendering non-agricultural diversification unnecessary (Reardon et al. 1992).

## STUDY AREA AND METHODS

### The Tawahka Asangni Biosphere Reserve

The Tawahka live along the middle reaches of the Patuca River within the 2,300 square-km TABR.[ii] To the north are indigenous Miskito communities; to the south and west, an encroaching agricultural frontier of Spanish-speaking, non-indigenous (*ladino*) farmers. In 1998, the Tawahka's five communities varied in size from 64-624 people (referred to as Villages 1-5). Each village was ringed by a patchwork of active and fallowed fields that separates the community from primary rain forest; residents of Village 1 must walk for up to 45 minutes to reach contiguous primary forest. Village 1 was also the closest to the municipal center and Miskito town of Wampusirpi (pop. ~2,000), which is the largest settlement in the Patuca basin.

Tawahka households had about 8 members, and most (67%) were comprised of a nuclear family. Fifteen households (13%) were headed by single women. While the

Tawahka are an unusually young population by rural Honduran standards, their rapid growth rate appears comparable to forest-dwelling indigenous peoples elsewhere in lowland Latin America (McSweeney 2002c).

Social service provision was incomplete and erratic in 1998. Four of the five Tawahka communities had a primary school offering at least three years of basic education, but only Village 1 had a government health clinic. Shortages of staff and medicines meant that residents relied heavily on costly herbal treatments from local healers, especially during the rainy season when illnesses and injury were most common.[iii] Patients who could not be treated locally were sent to Miskito healers down-river, or to a costly mission hospital located about two days' travel to the north.

Tawahka subsistence is based on permanent cultivation of riverbanks, shifting cultivation of uplands, and on the collection of wild goods from rivers and forests. Women were particularly active in fishing, firewood collection, gathering of medicinal and food plants, and in the processing of thatch and bark cloth; they participate about equally with men in agricultural work. Agricultural risks are high. Those cited by the Tawahka included weather, animal herbivory, crop diseases, theft, and seasonal inundation, and losses could be substantial. In 1994 producers reported losing about one-third of their rice and bean crops (Godoy et al. 1997).

At the time of the study, there were no formal constraints on the harvest or sale of forest goods, and all Tawahka had access to unclaimed land and resources in the TABR. In the absence of formal land markets, households accumulated land primarily through claiming and clearing forest. This usufruct system is common among long-settled peasantries—both indigenous and non-indigenous—throughout the neotropics. The system has been shown to most benefit community founders and those with the greatest access to labor, resulting in greater disparities in land wealth than might be expected in such apparently egalitarian societies (Coomes and Burt 2000; Takasaki et al. 2001).

Although cash is often scarce and barter common on the Patuca, the Tawahka participated in local, regional, and national markets in multiple ways. During the study period, they sold cacao, as well as surplus staples such as rice, beans, yuca, and plantains in well-established regional markets. Employment opportunities on the Patuca River included farm work, domestic work, or professional positions in nursing, teaching, or with a regional NGO. Markets for forest products—such as dugout canoes, lumber, handicrafts, bush meat, firewood, medicinal plants, and thatch—were highly informal and largely confined to the mid-Patuca. Forest goods were primarily sold to neighbors and traders. In rare cases mahogany lumber and canoes were exported downriver to coastal Miskito communities. In 1997-98, the groups' aggregate market earnings (i.e., the combined value of cash and barter) were roughly equivalent to U.S.$138/capita.[iv] 18% of this total came from the sale of forest goods, especially dugout canoes (McSweeney 2002a), which comprised 45% of forest-derived earnings in that year.

Nevertheless, only 62% of Tawahka households sold forest products in 1997-98, and fewer appeared to focus their financial strategies around forest-product sale (McSweeney 2002a). Indeed, in the heterogeneity and dynamism of their production activities, Tawahka households appear typical of long-settled forest peasantries throughout the neotropics (Barham et al. 1999; Pinedo-Vasquez et al. 2001).

## Data Collection and Analysis

Between February and May 1998, the author conducted a detailed survey, in Spanish and Miskitu, of 116 Tawahka households, or 88% of the Tawahka population of the TABR, as part of a larger study of Tawahka livelihoods (McSweeney 2000). Every attempt was made to interview male or female households heads alone in a contemplative setting. Nevertheless, family members were frequently present during interviews and their input was often solicited by the respondent. Of the 16 household heads not interviewed, nine were away, two were seriously ill, three were unwilling, and one was incarcerated. The survey comprised two primary types of questions, described below.

### Open-Ended Questions about Cash Needs and Investments

To establish a picture of the importance of commercial forest extraction relative to other forms of self-insurance, household heads were asked two open-ended questions. They were first asked how, hypothetically, they might pay for four types of increasingly large and infrequent cash needs, including the purchase of low-cost, everyday goods (salt, machete), and the cost of two more urgent needs (local medical care, emergency medical evacuation from the village). Field observation and previous research (Godoy and Wong 1999) indicated that these medical needs might be particularly important in motivating households to seek off-farm income. One hundred and three respondents answered the four-part question. Next, the analytical angle was reversed: the heads of those households that had *already* sold a forest product—specifically, the 74 who had sold at least one new dugout canoe between 1996-98[v]—were asked to specify their primary motive for having done so. Dugout canoes were chosen over other forest products because producers were easily able to recall the fate of these relatively 'big ticket' items.

### Questions about Household Production, Wealth, and Shocks

The survey also asked more detailed questions about household composition, production, and wealth. All members' earnings from the sale and barter of goods and services in 1997-98 were recorded in order to gauge a households' relative involvement in forest product sale. Questions about family health and agricultural production offered insights into epidemiological and income shocks experienced at the household level. More fixed household characteristics, such as demographic data, education levels, and asset ownership were designed to elicit differences in households' human, social, and physical capital endowments. From this question set, 2 dependent and 29 independent variables were then selected to develop three predictive models of involvement in forest product sale over the period of one year. This one-year time frame therefore limits the study's quantitative exploration to relatively short-term insurance strategies, despite the fact that longer-term self-insurance responses are likely to be important in tight-knit forest societies where reciprocity is often delayed (Mitchell 1991; Peterson 1993).

The variables used in the models are summarized in Table 1, and the rationale for their inclusion is described below.

**Table 1. Summary statistics of Tawahka household features (n=106)**

| Variables | Description | Mean ±SD | % of obs=1 |
|---|---|---|---|
| ***Dependent Variables*** | | | |
| PART | Sold forest products 1997-98 (no=0; yes=1) | | 62 |
| FSHARE | % total earnings from forest product sale, 1997-98: "reliance" | 17.34 ± 23.09 | |
| ***Independent Variables*** | | | |
| **OILL97** | Cumulative total days lost to illness by non-heads | 8.81 ± 30.8 | |
| FHLOST | # days female head lost to own or other's illness | 12.8 ± 38.23 | |
| DEATHS | # deaths 1996-98 | 0.11 ± 0.31 | |
| KSTUDY97 | # studying away in 1997 (excluding heads) | 0.23 ± 0.55 | |
| BPROD97 | Relative crop shortfall: bean harvest in 1997 (lb) | 787.2 ± 776.14 | |
| RESDUR | Years resident in village, or since household formation | 14.49 ± 10.04 | |
| HAGE | Age of household head (male or female) | 39.25 ± 12.7 | |
| FWORK | # female workers (15-64 years) | 1.68 ± 1.02 | |
| MWORK | # male workers (15-64 years) | 1.67 ± 1.1 | |
| DEPEND | # dependents (0-14 years and ≥65 yrs) | 4.6 ± 2.4 | |
| SINGLE | Headed by single woman (no=0; yes=1) | | 17 |
| FGROWN | # adult children of female head in village | 1.0 ± 1.8 | |
| BROTHER | # adult brothers of male/female head in village | 1.5 ± 1.5 | |
| HEDU | # years formal education of male/female head | 2.99 ± 2.73 | |
| HSTUDY97 | Heads studying away in 1997 | 0.12 ± 0.38 | |
| SPANISH | Male/female head's fluency in Spanish (scale 1-3) | 1.9 ± 0.6 | |
| ESKILL | Oldest male had early extractive experience (no=0; yes=1) | | 63 |
| BSKILL | Business experience through store ownership (no=0; yes=1) | | 20 |
| VEGA98MZ | Total land holdings in floodplain (ha) | 6.45 ± 8.03 | |
| CAC98MZ | Total area planted in cacao (ha) | 0.62 ± 0.86 | |
| QHOUSE | Combined quality rating of all house structures | 2.2 ± 2.0 | |
| COWT96 | # head of cattle owned in 1996 | 0.97 ± 2.27 | |
| ADZE | # of adzes owned in 1998 | 0.23 ± 0.44 | |
| NSEC | # sectors (1-7) in which income earned 1997-98 | 3.66 ± 1.5 | |
| V1 | Resident of Village 1 (no=0; yes=1) | | 63 |
| V2 | Resident of Village 2 (no=0; yes=1) | | 11 |
| V3 | Resident of Village 3 (no=0; yes=1) | | 10 |
| V4 | Resident of Village 4 (no=0; yes=1) | | 9 |
| V5 | Resident of Village 5 (no=0; yes=1) | | 6 |

Source: McSweeney (2000).

### Dependent Variables

Whether a household was among the 62% that sold forest products in 1997-98 is captured by the binomial variable PART. The percentage that forest-product sale contributed to total market earnings in that year—in effect, householders' financial "reliance" on forest-product sale—is the continuous variable FSHARE. Overall, the share of earnings from forest-product sale ranged from 0-93% (median: 6.8%; mean: 17.3%).

### Independent Variables

#### Idiosyncratic shocks

Four forms of income shock were selected to represent different types of calamity that theory suggests might drive a household to self-insure. All tended to occur asynchronously across households, and were common enough to be captured within the sample year. The first, BPROD97, assesses relative agricultural shortfall in terms of total bean production just prior to the study period. Three variables capture health-related misfortunes. Deaths of household members between 1996-98 (DEATHS) incurred funeral costs and, by custom, prevented family members from working for several days. Two different, and continuous, measures of morbidity included the total number of days lost by the head female to her own illness/injury or to the care of sick/injured family members (FHLOST) in 1997-98, and the cumulative number of days that household members other than the male or female head lost to illness/injury (OILL97) in the same period. In both cases, the number of days lost to illness/injury is closely tied to the severity of the condition and the need for costly travel and treatment. A morbidity measure for male heads was excluded due to endogeneity. That is, the male head's illness cannot be used to predict the likelihood of forest product sale because of the difficulty in distinguishing whether failure to sell forest goods arose from the lack of household need, or from the male head's ability to harvest goods due to ill-health. To control for the influence of non-urgent but large cash needs on activity choice, the number of children studying away who were supported by the household are included (KSTUDY97).

#### Demographic attributes

Demographic characteristics and other measures of labor availability were selected. Labor availability is captured through the number of male (MWORK) and female (FWORK) adult workers (15-64 years). Children under 15 and the elderly (over 64 years) are counted (DEPEND) and quantify the economic burden on working adults. Labor is disaggregated to partially control for the effects of gender and age in risk management strategies (Doss 1996), in shaping household activity choice (Katz 1991; Murphy et al. 1997), and in susceptibility to health risks. For the same reason, a dummy variable denotes households headed by single women (SINGLE).

#### Land-based and physical assets

Five types of agricultural and non-agricultural assets were selected to test for the expected influence of wealth on a households' vulnerability to income shocks, and on their ability to self-insure (Table 1). For example, the more land held in active or fallowed floodplain fields (VEGA), or in cacao (an important cash crop), the less susceptible a household is likely to be to crop failure. A variable derived from a

scale of house quality (QHOUSE),[vi] was used to proxy for a financial estimate of physical wealth. House quality was chosen over more liquidable assets (e.g., firearms, buckets, radios) to avoid endogeneity, and because house condition and size is a common way for Tawahka to display and gauge wealth. Also included were the number of head of cattle owned in the year prior to the survey (COW96). Like homes, cattle are an important investment sink; both can be liquidated, and so might dampen interest in forest product sale in times of crisis (Barham et al. 1999; Godoy et al. 1996). On the other hand, ownership of an adze (ADZE), an essential tool in canoe construction, signals a household with the skills and tools to engage in forest-product harvest (Barham et al. 1999).

**Human capital**

Measures of human capital were also included because they influence a household's desire and ability to weather calamity in different ways. For example, early experience in forest-based extraction (ESKILL) is likely to render that sector attractive, while prior entrepreneurial experience (BSKILL) would be expected to favor any form of commercial endeavor (Pattanayak and Sills 2001). RESDUR denotes the years that a household has been in the village (or, the years since household formation), which proxies for local environmental knowledge and the development of social ties, both of which are likely to facilitate forest-product sale. A related but distinct variable is the age of the male or female head (HAGE). Finally, SPANISH measures the household head's competence in the national language. Other studies have shown that this ability can influence indigenous peoples' access to 'outside' information, and to broaden their range of economic opportunities (Hugh-Jones 1992). Two education variables were also included because years of formal schooling has been found to influence Tawahka decisions about agricultural intensification and labor allocation (Godoy, Groff et al. 1998).

**Social capital**

To account for extra-household ties in conditioning economic decisions (Pattanayak and Sills 2001; Reardon et al. 1992), two measures of social capital are included: the number of adult brothers of the male or female household head (BROTHER), and the number of grown children of the female household head (FGROWN). The latter reflects field observation that women experiencing economic setbacks are most likely to be helped by transfers of food, money, and labor from their grown children.

**Other variables**

Finally, to control for other market means to cope with misfortunes, models incorporate the number of market sectors in which households participated in the study year (NSEC). Also, to control for unobserved village fixed effects, the models include dummy variables for each of the five Tawahka communities. Village ascription is expected to influence activity choice because of the differences in size, market opportunities, and environmental endowments across villages (Takasaki et al. 2001). When necessary for statistical analysis, the smallest village, Village Five, was dropped.

Using these variables, then, three statistical analyses were run. First, a Probit regression model was developed to identify characteristics shared by forest-product

sellers compared with non-sellers (distinguished by the binomial PART). As a check on the Probit, Logit and logistic regressions were run, without significantly different results.[vii] Next, to test how the percentage of income earned from forest products changed as households experienced shock, a Tobit regression was run using the continuous variable FSHARE. The Tobit is a censored regression model that can be run without removing the portion of data points that are censored at 0: in this case, the 40 households who had sold no forest products at all. Although confidence in the Tobit model is high, it left much of the variance in Tawahka's reliance on the extractive sector unexplained (pseudo-$R^2$=0.12). Therefore, an ordinary least squares (OLS) model was run on a smaller sample, comprising the 33 households who, among those who sold forest products in 1997-98 (n=65), had earned more than the median value (21%) of their market income from that sector;[viii] other researchers have had success in isolating distinct trends *within* high-reliance groups of forest extractors (Coomes and Burt 2000).

## FINDINGS

### Responses to Open-Ended Questions

Responses to questions about hypothetical cash needs offer a glimpse at how forest product sale compared with other forms of self-insurance (Table 3). Results show that some households (about 8%) looked to forest-product sale to both smooth income (buy salt) and meet sudden cash needs (pay for medical emergency). Interestingly, respondents clearly described how the different types of need were met by selling different types of extractive good sought. For example, fish were cited as a means to buy salt, while lumber was said to pay for medical expenses. In general, however, results show that the majority of households perceived that cash earned from agriculture, and help from family and neighbors, were their primary financial recourse for any given financial need. In contrast, the sale of forest products such as fish, bush meat, bark handicrafts, lumber, and dugout canoes, was cited in less than 10% of answers. And while 12% of households claimed that they would sell forest products to deal with a major medical emergency, many more claimed to rely on their social ties to see them through.

Answers to questions about actual canoe sales confirm and qualify these results (Table 3). For example, almost 20% of canoe sales were indeed sold to pay for treatment of household members' illness/injury. Furthermore, the Tawahka appeared to be using canoe sale in part as an indirect way to self-insure: almost 20% of canoes were sold to cancel cash loans, or were sold as a favor to a relative—that is, to repay financial and social debts. As Table 2 suggests, some of these debts may have been incurred in response to sudden cash need. Nevertheless, Table 3 also underlines the degree to which the majority of canoe sales were *not* motivated by self-insurance concerns. Rather, most represented attempts to smooth consumption (e.g., by covering large, but anticipated, household needs such as holiday expenses), or to finance investment in other sectors, including agriculture and petty trade.

**Table 2. Responses of 103 Tawahka household heads to four questions[a] regarding hypothetical cash needs, listed as percent (%) of total responses**

| | Increasing cost and urgency of financial need → | | | | |
|---|---|---|---|---|---|
| Response[b] | Salt | Machete | Minor medical | Medical emergency | Total |
| Farm sector | 63.1 | 59.2 | 48.0 | 22.3 | 48.0 |
| Forest sector | 6.8 | 5.8 | 8.8 | 11.6 | 8.2 |
| Non-farm/ Non-forest | 16.5 | 20.4 | 10.8 | 11.6 | 9.8 |
| Social capital | 10.7 | 12.6 | 29.4 | 37.8 | 22.6 |
| Cash savings | 0.9 | 0.9 | 0.9 | 3.9 | 1.7 |
| Don't know/ impossible | 1.9 | 0.9 | 2.0 | 12.6 | 9.7 |
| *%* | 100 | 100 | 100 | 100 | 100 |
| *n* | 103 | 103 | 103 | 103 | 412 |

**Notes**

[a] The question was as follows: "Around the time of Holy Week, what would you do to a) buy salt, b) buy a machete, c) cover costs of local medical care, d) pay for emergency medical evacuation from the village?" Holy Week was chosen to ensure constant hypothetical market conditions.

[b] Respondents answers were varied, ranging from selling chickens or fish, to mortgaging rifles or selling cacao orchards, and were grouped into categories. "Farm sector" includes crop and livestock sale and farm employment; the "forest sector" includes the sale of forest products; the "non-farm/non-forest" sector includes earnings from self-employment and non-farm employment; "social capital" accounts for respondents who said they would solicit loans or gifts from family, neighbors, and shopkeepers. As used here, social capital refers to the tangible and non-tangible resources that accrue to an individual or household based on their social ties (Astone et al. 1999).

Source: McSweeney (2000).

**Table 3. Tawahka canoe producers' primary motive[a] for selling a new dugout canoe, 1996-98 (n=74), as % of total responses**

| | |
|---|---|
| To smooth consumption | **40.5** |
| -for food and clothing | 16.2 |
| -holiday expenses | 4.0 |
| -unspecified | 20.3 |
| To self-finance | **21.7** |
| -children's education | 9.5 |
| -acquire tools | 6.7 |
| -finance household move | 1.4 |
| -capital to set up small shop | 2.7 |
| -invest in agriculture | 1.4 |
| To self-insure | **18.9** |
| -pay for medical care | |
| To repay favors, cash loans | **18.9** |

[a] 'Primary motive' defined as the reason the respondent considered to be most important in deciding to sell a canoe

Source: McSweeney (2000).

## Results of Statistical Analyses of Household Data

Tawahka respondents' answers to open-ended questions, then, suggest that commercial forest extraction is neither a universal nor a primary form of insurance for most Tawahka households. The multivariate regressions (Table 4) were therefore used to shed light on *which* Tawahka households were most likely to have sold forest products, and how their involvement in commercial extraction in 1997-98 was linked to their experience of income shock. Below, the significant relationships in all three models are discussed together.

**Table 4. Determinants of household participation in (Probit model), and reliance on (Tobit and OLS models), commercial extraction**

| Variable | Probit | | Tobit | OLS |
|---|---|---|---|---|
| | Coefficient[a] | Probability Ratio[b] | | |
| Intercept | 13.36 ** | | 84.85 ** | 75.76 |
| **Idiosyncratic shocks** | | | | |
| OILL97 days lost to illness by non-heads in 97 | 0.08 ** | 0.12 | 0.1 | 0.01 |
| FHLOST97 days lost by female head in 97 | -0.07 ** | -0.01 | | |
| DEATHS deaths between 1996-98 | -1.61 * | -0.46 | | |
| BPROD97 total bean harvest in 97 | -0.001 | 0 | -0.01 ** | -0.03 ** |
| **Household demographic and labor characteristics** | | | | |
| KSTUDY97 children studying away from home | 1.18 | 1.18 | | |
| RESDUR years in village/since hhld formation | -0.06 | -0.01 | 2.67 * | -0.71 |
| $(RESDUR)^2$ | 0.01 | 0 | -0.07 ** | |
| HAGE age of household head (male or female) | -0.26 *** | -0.04 | -3.52 ** | 1.04 |
| $(HAGE)^2$ | | | 0.03 | -0.02 |
| FWORK no. of female workers | 0.38 | 0.06 | -4.55 | -11.87 |
| MWORK no. of male workers | -0.32 | -0.05 | 5.49 * | 14.63 ** |
| DEPEND no. of dependents (0-14 yrs; >65 yrs) | 0.59 * | 0.09 | 1.37 | 9.4 *** |
| SINGLE household headed by single woman | -1.64 * | -0.43 | 3.21 | -8.4 |
| **Human and Social Capital** | | | | |
| FGROWN no. of grown children of female head | 0.60 | 0.1 | | |
| BROTHER no. of adult brothers | 0.42 * | 0.06 | -1.80 | 0.60 |
| (BROTHER)*(SINGLE) | | | 5.14 | 3.27 |
| HEDU yrs formal education of | 0.02 | 0 | -1.18 | -14.22 ** |

| | | | | | | |
|---|---|---|---|---|---|---|
| male/female head | | | | | | |
| $(HEDU)^2$ | -0.001 | | -0.002 | 0.06 | | 2.10 | ** |
| HSTUDY97 head studying away in 1997 | -1.0 | | -0.15 | | | |
| SPANISH head's fluency in Spanish | -2.77 | *** | -0.42 | -11.88 | * | -12.36 | |
| ESKILL early extractive experience of male head | -1.92 | * | -0.24 | 4.68 | | 4.35 | |
| BSKILL previous store ownership | 4.01 | *** | 0.3 | 18.45 | *** | -9.85 | |
| **Land-based and physical assets** | | | | | | | |
| VEGA98MZ total land held in floodplain in 98 | -0.13 | ** | -0.02 | 2.37 | ** | 2.45 | * |
| $(VEGA98MZ)^2$ | | | | -0.04 | | | |
| CAC98MZ total area planted in cacao | -0.11 | | -0.02 | | | | |
| QHOUSE house quality | -0.69 | *** | -0.11 | -3.80 | ** | 1.69 | |
| COWT96 no. of head of cattle owned in 1996 | -0.13 | | -0.02 | | | | |
| ADZE no. of adzes owned in 1998 | 4.67 | *** | 0.39 | 34.38 | *** | 20.01 | * |
| **Other** | | | | | | | |
| NSEC sectors from which income earned 97-98 | | | | 8.12 | *** | -2.23 | |
| Village 1 (Resident) | 1.02 | | 0.2 | -18.29 | | -5.34 | |
| Village 2 | 3.70 | ** | 0.17 | -27.11 | * | -73.44 | |
| Village 3 | -2.11 | | -0.63 | -24.13 | | -4.30 | |
| Village 4 | -3.55 | * | -1.92 | -65.77 | *** | | |
| | | | | | | | |
| Total observations (n) | 106 | | | 106 | | 33 | |
| Observations at 0 | 40 | | | 40 | | | |
| Observations > 0 | 66 | | | 66 | | 33 | |
| Df | 29 | | | 27 | | 3.59 | |
| Critical $Chi^2$ | 90.79 | | | $Chi^2$ 85.2 | | P(F)≤0.01 | |
| Pseudo $R^2$ | 0.64 | *** | | 0.12 | *** | 0.65 | ** |

[a] A one-unit increase in x increases the probability of PART=1 by this many standard deviations.

[b] Change in the predicted probability of PART=1 for a one-unit change in the independent variable.

Asterisks indicate the confidence level of the result: * P≤0.10, ** P≤0.05, ***P≤0.01.

The Probit shows that health shocks, including death and two measures of morbidity, had significant, but opposing, effects on whether a household sold forest products or not. An increase in the days lost to illness by non-head household members, including children and the elderly (OILL97), appeared to stimulate the sale of forest products by other household members: for every day that person lost to illness, the chance that someone else in the household sold a forest product increased by 12%. In this respect, the aseasonality of forest extraction may render it particularly important during the rainy season, when Tawahka were most often ill, and when income flows from crop sales or farm wage work are thin.

When a household member died, however, or the longer the female household head was ill (FHLOST97), the likelihood of forest product sale *decreased* significantly. This relationship is probably explained by the fact that both calamities strongly affect the productive capabilities of households by constraining adult labor. For example, men are reluctant to leave on long extractive trips when their wife is ill; other adults in the family, who under normal circumstances might absorb his workload during an absence, would be more likely to be covering the workload of the incapacitated woman. In the case of a family death, social custom also dictates that adults observe a time of reflection following the funeral.

Agricultural shocks, however, did appear to drive heightened reliance on forest product sale: according to the Tobit, for every 10 lb (4.5 kg) fewer beans harvested by March 1997, a household's relative earnings from forest-product sale increased by 10% over the subsequent 12 months.

An unexpected finding was the strong positive relationship in the Tobit model between the number of activities from which households earned market income (NSEC), and the share of total earnings from forest-product sale. This finding was initially bewildering because reliance evokes specialization, the opposite of diversification. However, combined with the Tobit result showing a negative relationship between the age of the household head (HAGE) and the share of earnings from commercial extraction, a likely explanation may be that forest-product sale provides the bulk of earnings for households in the early stages of portfolio refinement, who are still sampling from a wide array of income sources, but have not yet had the time or resources that would allow them to focus on any one.

The Probit model also points to links between commercial extraction patterns and household lifecycle: forest-product sellers were most likely to be young, male-headed households supporting more dependents, living in a relatively low-quality house, and holding little prime floodplain land (with every extra quarter-hectare of land owned, a household was 8% less likely to have sold forest products), but who had some access to external male labor (BROTHER).

But while relative land-poverty predicted that a household sell a forest product (Probit), increasing land wealth predicted a rising share of earnings from forest product sale for households *within* the extractor population. That is, both Tobit and OLS models show a significant positive relationship between lowland landholdings and the share of income earned from forest product sale. This relationship likely arises from the fact that among the Tawahka, land can provide a subsistence buffer against the risks of relative financial specialization on forest resources.

Finally, both Probit and Tobit models show that the households that were most likely to be involved in forest product sale were, as predicted, those with a background in business (BSKILL), those least likely to be fluent in Spanish (signifying households that are not headed by *ladino* men, and so have access to the Patuca's indigenous trade network), and those owning extractive technology (ADZE). A surprising finding was that early experience in forest extraction (ESKILL) was either not significant (as in the Tobit and OLS models), or was found to *decrease* a household's chance of selling forest products by 24% (as in the Probit model), all else held equal. The result was unexpected because such experience is typically considered a prerequisite for forest sector involvement (Pattanayak and Sills 2001).

## DISCUSSION: FOREST-PRODUCT SALE AS SELF-INSURANCE

### Findings from the this study offer several insights into the role of commercial extraction in smallholder livelihood security

#### The Nature and Duration of Income Shock

First, this research points to the way in which the sale of forest products, like other types of forest use, can act as an economic recourse to households experiencing misfortune. In 1997-98, Tawahka households who had experienced a poor bean harvest, and those whose members had been sick/injured for lengthy periods, were the ones most likely to sell forest products. These results offer new evidence that just as the *use* of forest resources for subsistence acts as a 'safety net' for forest dwellers, so too can earnings from the *sale* of forest goods also help to offset the (financial) costs of health and agricultural crises at the household level.

This said, however, results clearly show that *who* in the household becomes ill/injured, and how long they require care or are unable to work, very much shapes whether or not household members will turn to forest product sale or not. Among the Tawahka, costs associated with the sickness of adult members, or a death in the family, are unlikely to be paid through the immediate sale of forest products. Rather, answers to open-ended questions suggest that when faced with this type of idiosyncratic shock, Tawahka would rather borrow money from kin, neighbors, or local traders, in common with forest dwellers elsewhere (e.g., Pattanayak and Sills 2001).

These results urge careful consideration of households' differential experience of misfortune in conditioning resource use, and show that idiosyncratic shocks may explain the spatially patchy and "part-time" nature of forest-product sales by smallholders in many parts of the tropics (Arnold and Ruiz Pérez 2001:441).

#### The Role of Household Attributes

Tawahka households not only used forest-product sale to *selectively* insure against particular types of shock, but only particular households took advantage of this function. The evidence shows that for any given level of income shock, households involved in forest product sale were more likely to be headed by young males, to have relatively more dependents at home, to rely on extra-household sources of labor, and to be poorer overall: they held significantly less land than did others, and had a lower-quality home. All these traits point to households in the early stages of the 'agricultural household lifecycle': those with young families who have not accumulated sufficient capital or labor, and so cannot buffer calamities by liquidating assets or falling back on harvest surpluses (Perz 2001). For such households, forest-product sale is likely to be attractive because of its relatively low entry costs.

The study results also show, however, that *among* forest-product sellers, it was the relatively land-wealthy that could afford to specialize in the sector. Presumably, land wealth buffers the riskiness of extraction by allowing farmers to engage in this off-farm pursuit without compromising their food security. They thus engage in forest product sale not to mitigate risk, but rather to take advantage of the potentially greater returns that the forest sector offers. In the case of the Tawahka, land-rich households

were among those able to specialize in the lucrative production of freight canoes for regional markets.

These findings draw attention to the dual role that land wealth can play in risk reduction in forest peasant contexts. On the one hand, the insurance function of land renders the land-wealthy more likely to eschew non-farm pursuits such as forest-product sale. On the other, relative differences in land wealth *within* the population of forest-product sellers can strongly increase the percentage of income that forest goods provide. These findings concur with Takasaki et al. (2000; 2001), Coomes and Burt (2000), and Overman and Demmer (1999) in establishing the complex role of wealth in conditioning resource use. Combined, these studies suggest that while forest product reliance may be an aggregate trait of land-poor populations generally (e.g., Anderson et al. 1991), more fine-grained analysis finds that variations in land wealth *within* those populations can be highly instrumental in shaping individual producers' motives for, and reliance on, commercial extraction.

These findings raise questions about policies that assume that forest-product sale and other forms of non-farm diversification will decrease involvement in forest-converting agriculture (e.g., Tresierra 1999:154), or otherwise compete with the farm sector (e.g., Wunder 2001). Instead, the sectors appear co-dependent, with forest-product sale financing accumulation in agriculture, and land wealth buffering the riskiness of forest-based commercial extraction.

Results of this study also suggest that knowledge about forest resources may be a less universal indicator of the insurance value of forests than Pattanayak and Sills' (2001) study of Brazilian smallholders indicates. Among the Tawahka, it appears that youth and relative undercapitalization are stronger forces pushing households into forest-based activities than experience in forest extraction pulls them into the sector. Indeed, Tawahka elders are more likely to speak of the hardships of forest-based activities than they are to reminisce fondly about the work. There is thus a potential disjuncture between reservoirs of so-called 'indigenous knowledge' (the old, forest-experienced, and long-settled households), and those most likely to need that knowledge to sell forest products to mitigate risk.

### Self-Insurance Alternatives

Theory predicts that *any* form of non-farm income diversification can mitigate the riskiness of remote rural livelihoods (Ellis 1998; Godoy, Jacobson et al. 1998; Godoy and Wong 1999). Certainly, Tawahka households consider a variety of market and non-market mechanisms as a means to cover sudden medical expenses; how they decide among these choices appears to rest as much on their own capabilities as on the nature of the shock itself. As we have seen, shocks that affect a household's dependents (such as a child's illness) are more likely to be paid for through forest-product sale than are those that compromise adult labor.

This said, establishing one-to-one links between shock and response appears artificial. Evidence from this study suggests that the insurance function of forest-product sale may form part of a web of coping mechanisms mobilized by forest peasants in the face of misfortune. For example, only about 12% of respondents mentioned forest-product sale as their *first* response to emergencies, but other evidence suggests that the Tawahka use forest-product sale to *later* repay those social or financial 'loans.' In

short, the Tawahka appear to rely on help from family and neighbors to address immediate security issues, but then may later use forest products to pay off the incurred social debt. Thus the use of forest products may act as an important *ultimate* form of self insurance. Empirical confirmation of this role, however, would require tracing these complex self-insurance strategies over periods longer than the one-year time frame of this study.

## CONCLUSIONS AND RECOMMENDATIONS

This study has explored the forest's role as a financial stop-gap, and appears unusual in offering empirical evidence that the sale of forest resources, as much as their subsistence use, forms a key part of smallholder coping strategies. Below, three specific insights are outlined in terms of their relevance to the practice of conservation and development among the world's rural poor, and areas of future research are briefly reviewed.

1. Currently, the conservation-and-development literature implies that local peoples' reliance on the forest safety net will uniformly motivate interest in sustainable forest management; this belief is reflected in the popularity of programmatic focus at the community level (see Agrawal and Gibson 1999). This study, however, suggests that receptivity to conservation and development programs is likely to be highly uneven within communities. Young households, for example, may be less receptive to long-term initiatives (e.g., agroforestry or reforestation programs) than they might be to opportunities for short-term, quick-return forms of income generation (e.g., fish farming). Practitioners, then, might more effectively target programs at specific cohorts, based on closer attention to micro-level variations in wealth, land ownership, and age. Consideration of the needs of young households becomes particularly important as indigenous lowland groups throughout the neotropics experience unprecedented demographic growth (Kennedy and Perz 2000; McSweeney 2002c).

2. Study results question policies that assume forest-product sale and other forms of non-farm diversification will decrease involvement in forest-converting agriculture (e.g., Tresierra 1999:154), or otherwise compete with the farm sector (e.g., Wunder 2001). Instead, the sectors appear complementary, if not co-dependent, with forest-product sale financing accumulation in agriculture, and land wealth buffering the riskiness of forest-based commercial extraction. Development projects that seek to influence conservation outcomes, and vice-versa, might more fruitfully conceptualize interventions in terms of their effects on livelihood *systems*, rather than assessing specific income-generating activities in isolation from, or opposition to, other sectors.

3. Finally, the study speaks to the broader policy issue of commercial forest exploitation by local peoples. To date, conservationists worried about market-driven overharvest have been widely successful in pushing for clauses in protected-area management plans that prohibit the commercialization of forest resources by local peoples (Scherr et al. 2002). This study suggests that such restrictions are likely to be ineffectual as long as they are not preceded by basic improvements in health care, credit provisioning, and crop insurance programs. Without these institutional fall-backs, needy locals, especially poor, young

families, will have a compelling argument for non-compliance. Or, if restrictions are too aggressively enforced, vulnerable groups will be alienated from a key source of financial succor in moments of household crisis. Already, restrictive policies are forcing forest managers to head off both outcomes through case-by-case regulatory flexibility. In the Tawahka Reserve, for example, a *de jure* ban on commercial forest extraction has been in place since 1999 (Honduras 1999), but resource managers have nevertheless been granting exemptions to households with proven medical needs. Such ad-hoc arrangements are likely to persist as long as conservation agendas are superimposed onto tropical forest communities still lacking basic social services.

## FUTURE RESEARCH

The study also points to at least three directions for future research into the insurance role of commercial extraction. First, replication of the study methodology in other rain forest regions is needed to better elucidate the environmental and market conditions under which forest-product sale can prevail as a risk-reduction or coping strategy. Second, study results join those of Pattanayak and Sills (1999) in offering a first step towards incorporating the insurance value of commercial forest products into ongoing efforts to estimate the financial value of standing forests to local users (Godoy et al. 2002; Goulder and Kennedy 1997). Third, if forest-product sale can be used by smallholders as a means to self-insure against idiosyncratic, household-level misfortune, can this function also prevail in the face of simultaneous (catastrophic) calamities? For example, Morris and colleagues (2002) report that Hurricane Mitch left many rural Hondurans asset-poor. Were the Tawahka, equally hard hit but with unusual access to forest resources, able to more quickly recapitalize than rural households elsewhere? Future attention to these questions holds considerable promise for improving our grasp of the dynamic and complex ways in which forest resources can act to improve the long-term welfare of forest dwellers throughout the tropics.

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[i] This research also assesses the natural insurance concept using a direct measure of forest use. Other studies have used indirect measures, such as forest conversion rates (Godoy, Jacobson et al. 1998; Godoy and Wong 1999), time spent in the forest (Pattanayak and Sills 2001), and household asset composition (Takasaki et al. 2002).

[ii] As encountered by the author on the Patuca River in early 1998, thus reflecting conditions prior to the agricultural reorganization that followed Hurricane Mitch (McSweeney 2002b).

[iii] Based on field observation from 1994-96 and February-May 1998.

[iv] Tawahka market income is comparable to forest peasant incomes elsewhere in Latin America (McSweeney 2000), but appears low for rural Honduras (López and Valdés 2000; Ruben and Van den Berg 2001), probably because of the considerable subsistence component of Tawahka production.

[v] Findings from the author's concomitant investigation of dugout canoe production showed 74 dugout canoes made by Tawahka households that were sold new between 1996-98.

[vi] The house quality scale incorporated attributes such as house size, type of roofing (metal or thatch), and type of exterior walls (bamboo or boards), summed for each dwelling comprising the household.

[vii] All displayed pseudo-$R^2$ values greater than 0.65 and significant at the 1% level. Tests on the coefficients revealed similar significance. Two goodness-of-fit tests (Pearson and Hosmer-Lemeshow) were run on the logistic regression but were not supported by the statistical software for either the Probit or Logit models. The tests gave reason to believe the model is well-fitted. Confidence in the final Probit model was confirmed by its high pseudo-$R^2$ value of 0.64, significant at the 1% level. Assumptions required for a Probit were respected. Tests run to check the robustness of the Probit model also apply to the Tobit and OLS. Assumptions of linear relationships between dependent and independent variables were checked with bivariate plots. Where a clear pattern of curvilinearity arose, power transformations were used to linearize the relationship. A variety of interaction terms were tested in preliminary models, but rejected if they significantly degraded model fit. Multicollinearity was assessed by regressing each independent variable on the remaining independent variables. None showed an adjusted $R^2$ greater than 0.60. Appropriate model specification and the absence of heteroskedacity were assured by examining residual distributions after each model estimation.

[viii] Ramsey RESET tests showed weak evidence of omitted variable bias; Cook-Weisberg tests for heteroskedacity showed little reason to doubt the constant variance assumption for the model.