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Local Heritage in the Changing Tropics: Innovative Strategies for Natural Resource Management and Control

The Yale School of Forestry Student Chapter of the International Society of Tropical Foresters (ISTF) will be hosting its fourth annual conference February 10-12, 1995, entitled Local Heritage in the Changing Tropics: Innovative strategies for natural resource management and control. The conference will be held at Yale University and will draw participants from around the world.

Tropical ecosystems are burdened by human activity as never before. Natural areas shrink daily in the face of shifting human populations, changing political structures and increasing resource use.

International concern has been mounting about the destruction of cultures and the associated loss of natural resource use at the expanding economic frontier. Local groups have forged new alliances to assert customary resource control. Constructive alternatives are being developed in diverse settings by indigenous people, labor organizations, non-governmental organizations (NGOs), research institutions, governments and others.

The Yale Chapter of ISTF hopes to provide a forum in which to review these strategies and to foster communication in order to chart a new vision of our biological and cultural heritage. Conference speakers and participants will be drawn from all levels of this process.

The conference will address three major themes:

1) Legal structures and local recognition
Focusing on the inclusion of traditional land and resource rights in national law and the transformation of ill-defined groups into legal entities

2) Constructive market participation
Means of exercising local control of natural resources through active market involvement

3) Information technologies
Exploring ways that local people use information and communication technologies for empowerment and the preservation of customary knowledge

This Conference is sponsored by the Yale Tropical Resources Institute, Yale School of Forestry and Environmental Studies, and the Weyerhaeuser Center for Forest Resource Management and Policy Studies.

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Artwork: "The reconciliation through music" by Marina Mendez Cruz of Corazones Valientes, A womens' folk-art cooperative in rural Costa Rica

Harvesting *Geonoma deversa* (Poiteau) Kunth in Southeast Peru: Toward Sustainable Management

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Introduction

Madre de Dios is the main department (political unit) located in the southeast Peruvian Amazon. Although its population is relatively low (0.5 inhabitant/km^2), it is growing faster (2.5%) than the national average (2.0%) (INE 1984). The people in this region depend on agriculture and extractive activities both for subsistence and income (Clark and Elejalde 1990). Among the extracted natural forest products are the leaves of the understory palm *Geonoma deversa*, locally known as palmiche. The braided leaves of *Geonoma* are the dominant roof material for rural houses and also are sold in the city of Puerto Maldonado, where there is an increasing demand for thatched roofing by the low-income, urban population.

Although *Geonoma* stands are harvested periodically every two to three years, local extractors are complaining that they now need to walk farther into the forest to get the material. This perceived scarcity, reflected in farther walking distances, could be the result of inappropriate harvesting methods combined with the higher demand of a fast growing population.

Two methods for harvesting leaves are employed in this area. In one, leaves are cut without damaging the shoot apex; in the second, the palm crown is cut before removing the leaves. Under this second method, the cut ramets eventually die, but this remains the most frequently used method because people find it faster and easier and because they believe the sprouts will regrow faster (Montoya, unpublished data).

In collaboration with the Indigenous (FENAMAD) and Farmer (FADEMAD) Federations of Madre de Dios, I addressed the sustainability of palmiche harvesting. As a first step, I conducted a survey to judge if current leaf extraction is jeopardizing the natural population, resulting in dependence on more remote stands. Secondly, in collaboration with Pampas del Heath National Sanctuary (Santuario Nacional Pampas del Heath), I set up an experiment to evaluate the effect of local harvesting methods on leaf growth and ramet mortality. Additionally, information about production costs was collected whenever possible to attempt a preliminary assessment of the economics of this activity. In this paper, I will only present preliminary results of the leaf extraction survey. Further details of this work will be given in TRI Working Paper #79 (forthcoming).

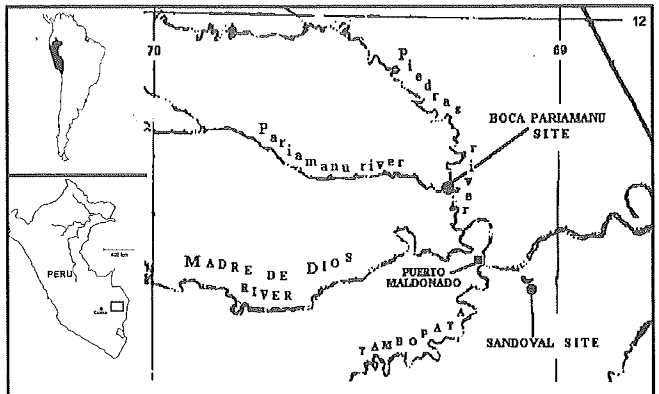


Figure 1. The study sites(right) in relation to South America and Peru

Methods

One site for each extraction method was chosen: Sandoval Lake and Boca Pariamanu, located 13 km and 22 km, respectively, from Puerto Maldonado (Fig. 1). In Sandoval, only leaves are removed during the harvest, whereas in Boca Pariamanu, the palm crown is cut before leaf removal.

Both places are accessible only by river: the Madre de Dios river in the former case and the Piedras river in the latter. According to the Holdridge system, the area is tropical moist forest with a mean temperature between 23-26° C and annual precipitation of 2400 mm (ONERN 1972, Clark and Elejalde 1990). Both sites are located in Late Tertiary deposits, and correspond to the same physiographic unit. Soils are classified by ONERN (1972) as Ultisol. The topography is mostly plane and free of river floods, although some poorly drained areas are present in the Sandoval site.

At each site, 3 plots 0.25 ha in size were established on harvested *Geonoma* stands, and 3 plots of the same size were established on unharvested stands. The unharvested stands were chosen by the local extractors, who used their typical criteria for locating new harvesting sites: the nearest place with the highest plant density. Thus, unharvested places are biased toward the densest spatial distributions of natural populations. The harvested places were chosen among those areas that were ready for a new cut at the time of the survey. The harvested plots had at least 3 previous cuts in Sandoval and at least one cut in Boca Pariamanu. *Geonoma deversa* has a clonal habit, having individuals with 5-12 ramets that can grow up to 2.5 m (Chazdon 1991b).

In each plot I counted the total number of clones. For each clone the following information was recorded:

1) Size distribution of the ramets according to the following categories:

Sprouts: Ramets no more than 20 cm tall.

Juveniles-1: Ramets more than 20 cm tall but less than 1 m.

Juveniles-2: Ramets more than 1 m tall but with no signs of reproductive activity, i.e. no inflorescence, no infructescence and no floral scars.

Adult: Ramets more than 1 m tall with signs of reproductive activity, i.e. flowers, fruits and/or floral scars.

2) The number of ramets with leaves ready for harvest. Local extractors consider good ramets for harvest those taller than 1-1.5 m, with more than 5 adult leaves. Generally, harvestable ramets fall into the size classes of juvenile-2 and adult.

3)The number of floral buds, inflorescences and infructescences in each clone.

Finally, clone recruitment was counted as those single ramet *Geonoma* in the size category of seedling (up to 20 cm), Juvenile-1 (20 cm to 1 m tall) and Juvenile-2 (more than 1 m but no reproductive structures). Criteria for minimum seedling size was the presence of at least one trifoliate (adult like) leaf. Single adult ramets were rare, and they were considered as a clone with one ramet.

Assuming a static approach to population dynamics, I tested the null hypothesis that harvest methods do not affect the following variables: clonal density, clonal size distribution, number of reproductive structures per clone, harvestable individuals and clone recruitment.

ANOVA was employed to test the difference among means. The Tukey test was employed to test the differences among the different harvest regimes and the unharvested plots. Level of significance was 0.05.

Results

The number of clones per plot ranged from 245 to 363 in the unharvested sites (control hereafter). This clonal density was significantly different from Boca Pariamanu (where the crown is cut before leaf removal) but not for Sandoval (where only the leaves are cut) (Fig.2, above). The control plot figures represent a density of 980-1452 clones/ha. These clones have a significantly higher mean number of ramets/clone (8.67) than the harvested places (5.95 in Sandoval, 5.86 in Boca Pariamanu). Additionally, mean number of ramets/clone did not differ between the harvested sites.

The ramet size distribution within clones (Fig.3, above) shows no difference between the two methods of harvest. But size distribution on control clones is significantly different from the harvest methods in most of the cases. There was no significance between control and juvenile-2 size in Sandoval nor with the seedling size in Boca Pariamanu.

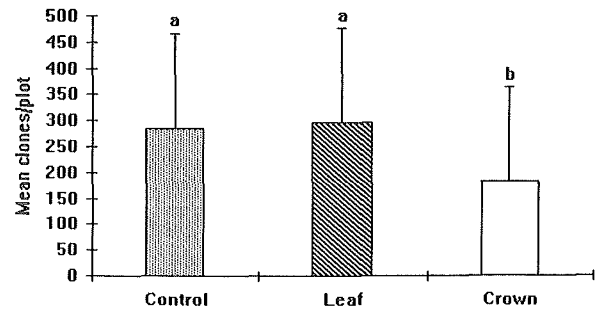


Figure 2. Number of clones/plot for each harvesting method. Control=unharvested, Leaf=only lvs. cut, Crown=crown cut before leaf removal. Same letter indicates no significant differences.

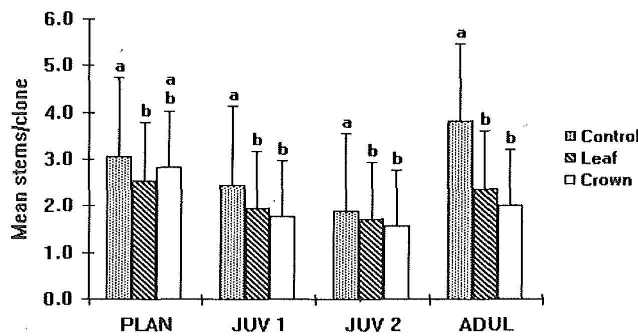


Figure 3. Mean ramets/clone for each size class and harvesting method. Plan=sprouts, Control=unharvested, Leaf=only leaves cut, Crown=crown cut before leaf removal. Same letter indicates no significant differences.

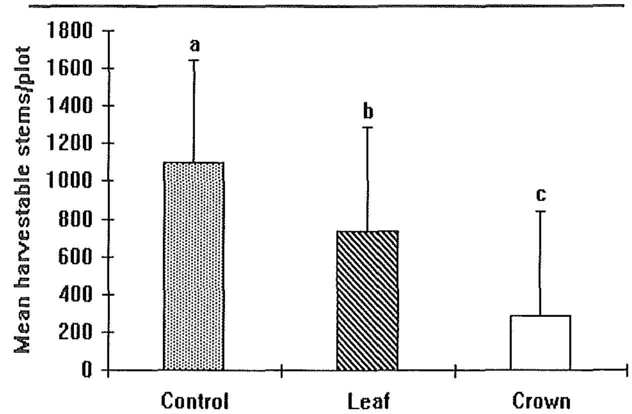
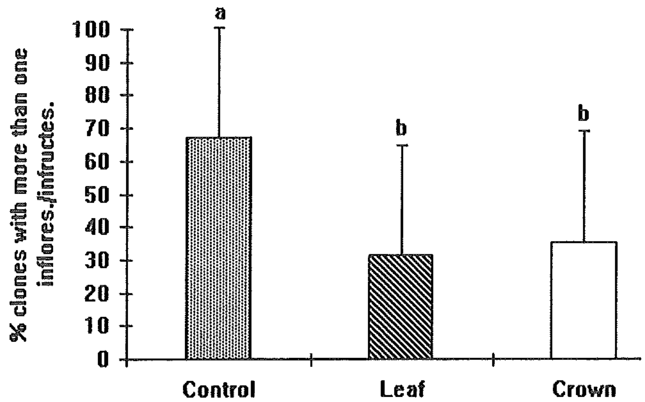


Figure 4. Number of harvestable stems/plot for each harvesting method. Control=unharvested, Leaf=only leaves cut, Crown=crown cut before leaf removal. Same letter indicates no significant differences.

The differences are more remarkable when considering the number of harvestable individuals per plot (Fig. 4, above). The very reduced number of harvestable individuals at Boca Pariamanu could be correlated with the low number of clones in this site. However, the differences are still significant if the mean number of harvestable ramets per clone is considered.

Reproductive structures (flowers and fruits) are pooled per treatment in Fig. 5 (next page). Harvesting regime had a significant effect (arcsin transformation was employed for the test) in the output of reproductive structures. Control plots exhibit twice the percentage of clones bearing more



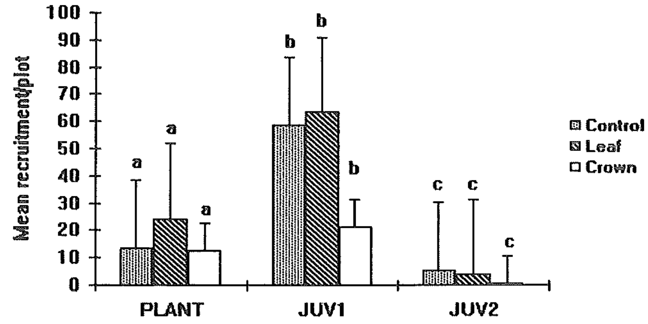


Figure 5 (left). Percentage of clones/plot with at least one inflorescence or infructescence for each harvesting method.
Figure 6 . Clone recruitment/plot for each size class and harvesting method. Size categories for seedlings are consistent with sprout size categories. Control=unharvested, Leaf=only leaves cut, Crown=crown cut before leaf removal, Plant=sprout size, Juv1=juvenile-1, Juv 2=juvenile 2. Same letter indicates no significant differences.

than one inflorescence/infructescence. The difference between the two harvesting methods is not significant.

Although reproductive output is reduced in the harvested places, clone recruitment estimated as single stemmed seedlings, juvenile-1 and juvenile-2 appears not to be affected by the treatments since there was no significant difference among the treatments for each size category (Fig. 6, above).

Discussion

Both harvesting methods may affect not only the natural population stock (clonal density, mean ramet number/clone) and the harvestable portion of the plant, but also the fecundity estimated as the number of inflorescences/infructescences per clone. Moreover, the reduction of ramets per size class in the harvested plots may suggest that vegetative regeneration (sprouting) is also affected by the periodic leaf harvests.

Surprisingly, clone recruitment is comparable between the harvested and unharvested sites. Observed seedlings and juvenile-1 clones most likely have regenerated after the onset of harvesting because plots have been cut for 6-8 years in Sandoval and for 3 years in Boca Pariamanu. (It is likely, however, that the number of harvest years is more than 3 for Boca Pariamanu since the village is 7 years old and the harvested plots are the nearest suitable harvesting stands.) On the other hand, observed juvenile-2 clones may have regenerated prior to any harvesting. The normal levels of seedling recruitment observed in the data could be indicating high resilience for clonal habit to allogenic disturbances. Chazdon (1991a,b) presented evidence that supports this idea. According to her findings, clonal habit of long-lived understory palms such as *Geonoma* may depend more on sprouts than on regeneration in order to overcome debris fall from the canopy.

Alternatively, the lack of difference at the regeneration level in spite of reduced fecundity may be a result of the sampling size. The experiment established in Pampas del Heath National Sanctuary will give us more conclusive results about the harvest tolerance of *Geonoma* stands.

The results presented here support the idea that harvesting methods need improvement. Since most local harvesters cut the crown, thus killing the ramet, a first step would be to shift to a system of cutting only leaves, as employed in Sandoval. Fortunately, local extractors and their directives are very open minded about harvesting methods of this resource. In Boca Pariamanu, most of the villagers are changing the current practice of cutting the crown to cutting only leaves. They showed great interest in seeing the results of this study.

A better understanding of harvesting effects on *Geonoma* will provide useful guidelines for the management of this natural resource. The FENAMAD, FADEMAD, local NGOs and government officials are working to achieve this goal.

Acknowledgments

This project was funded by the Tropical Resources Institute and the Tinker Foundation through Professor William Burch. I would like to thank P. Mark Ashton and Robert Mendelsohn, Barbara Dugelby and Enrique Ortiz, and all the people in Madre de Dios with whom I had the opportunity to interact.

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Social Forestry in China?

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Introduction

Spurred on by the problems social forestry has faced in arranging for local management of forests, I decided to look at a village forest management system in China where villagers own shares in the forest. My experience with social forestry programs and reading in the literature had convinced me that even when social forestry seems to take hold, local leaders often derive most of the benefit, and poor people most of the cost, of these systems (Fortmann 1988). Had the share-holding system in China solved the problem of maintaining equity in the distribution of benefits?

Sanming Prefecture in Fujian Province, China was declared a national experimental reform site for forestry in 1987, based on seven years of experience with a village share-holding management system to promote forest production and protection. The Sanming Municipal Forestry Committee is proud of its reforestation success in Sanming. The forested area is over 30% greater now than in 1981, and the area is still increasing. Production forests on village collective land are managed by village organizations, with villagers owning shares in the standing forests. Village forestry organization comes under the township, county, city and provincial levels of the forestry department.

My interests in looking at the Sanming system were three: to find out to what extent this system is truly managed at the village level; to get a sense of whether the share-holding system, which is fairly sophisticated, is based on historical precedent in this area; and to discover if the system represents a negotiation of policy between local people and the government.

Methods

To answer my questions, I used interviews, archival research and village visits. The interviews were with forestry staff at the prefecture, county and township levels. The most valuable materials were reports and local histories from the prefecture forestry department. I also visited the library of the Forestry College in Nanping and the Provincial Library in Fuzhou.

Forestry department staff arranged for me to visit six villages in three counties. In each county I talked with county and township level forestry staff, and in each village I had discussions with the elected local forestry committee. I was also able to interview, in their homes, three to five households in each village. In all cases these were semi-structured interviews based on a series of questions that I had discussed in advance with my research companions. We would then follow up with questions related to the particular characteristics of the system in each village.

Results

History of Property Rights in Forests

Forested areas have undergone rapid redefinitions of property rights and levels of management since the Chinese Revolution in 1949. Before 1949, forest property in Sanming was divided among landlords, lineages, and the government. In Youxi County, for example, landlords held 30% of the land, lineages held 40%, and the government held the remaining 30%. In landlord/tenant relationships, 60% of the profit from the trees went to the planter and 40% to the landlord.

During land reform in the early 1950s forest areas were redistributed to the government (13.8% of forest area), townships and villages (22.2%), and the remaining 64% to peasant households. Through collectivization (1956) and the establishment of communes (1958), peasants lost the personal use and management of forest land except for plots around the home and land for personal needs, where peasants grew fruit trees and pines. From 1966 to 1976, with the Cultural Revolution, peasants' personal use trees became "tails of capitalism", or evidence of an inappropriate attitude toward property. Even personal use trees became property of the commune, and in angry response to this step, local people cut many trees (*Sanming Linye Zhi*).

In 1979 and 1981, early in the economic reform period, the State Council established policies to protect forests and promote production, with a general principle that whoever planted and protected trees had right to their use. Under this very broad guideline, the Fujian People's Government began to establish property rights in forests. They faced a climate in which peasants feared further changes in property rights and party officials feared further chaos (*Sanming Linye Zhi*).

At that time there were debates nationwide as to whether forest land should be allocated to individual households in the same way as agricultural land. The head of Fujian Province and the head of forestry in Sanming, a close friend of Deng Xiaoping, thought that the nature of forestry, with its long rotation period and long period of risk, was unsuitable for management at the household level (Wang 1994). What evolved was a system of unified management of village collective forest land, with shares in the forest distributed equally to all household members. In 1984 the State Council approved share-holding organizations as a means for managing collectively-owned production forests. At that point Sanming decided to expand the area under collective share-holding management, a system that now covers the whole prefecture (*Sanming Linye Zhi*).

Share-Holding Forest Management

So much of the literature and excitement about Sanming is devoted to the share-holding forestry system that it is surprising how few forest villagers make their living from forestry. The income from forestry supports the share-holding organization, village roads, schools, power lines and so on, all of which, since the production responsibility system was initiated, villages must provide for themselves. In this sense, forestry supports the whole village.

Apart from the collectively-owned land (*jitishan*) managed by the village, individual households are allocated field land (*tian di*) and freehold land (*ziliushan*), based on household population at the time of allocation, for contracts of 15 to 20 years. On the field land, villagers grow rice and a variety of vegetables. Many households interviewed sell vegetables and some also sell grain for part of their income. On freehold land, households plant some combination of bamboo, citrus trees, tong and tea oil trees, tea and tobacco. From the bamboo, households derive income from both the dried bamboo shoots and bamboo culms. Some villagers also rent collective land, on which they may plant bamboo, fruit trees or fir trees. The products of field lands and freehold land can either be used by the household or sold.

Rice on field land (tian di) and bamboo on freehold land (ziliushan), Fujian Province, China

For the collectively-owned production forests, the Sanming Forestry Committee decides the annual cut for the whole prefecture. This cut is then allocated from the county to the township forestry stations, and finally to the share-holding organization in each village. Members assured me that they decide what kind of trees to cut where and how the cut will be made. They also decide what kind of trees to plant where, choosing among *Cunninghamia lanceolata* or *Pinus massoniana*. If they allow natural regrowth, a mixed hardwood forest will regenerate.

When I asked how much villagers receive in dividends at the end of the year, the amount varied from about 20 to 105 *yuan* (one US$ currently = 8.63 *yuan*). There was usually some confusion over the answer, because at the same time of year villagers must pay an education fee, a security fee, a peasant household tax, a fee for families with someone in the military, a fee for road construction, and a tax on agricultural production. It was not clear whether the 20 *yuan* was the household's dividend before or after fees and taxes. In one case villagers mentioned an airport construction fee for a facility they will surely never use. Villagers said taxes were too high, especially taxes for producing trees.

Historical Precedents

Although some village leaders in Sanming claimed there was no forest management before 1949, others I interviewed said that there were share-holding forestry companies in the 1930s and 1940s. Two older foresters mentioned that beginning in this century, there were *mu shan hui:* companies to manage the felling, transportation, and sale of timber. These timber suppliers were share-holding management companies that moved logs from Sanming to Fuzhou by river to be sold to Shanghai, Hong Kong, Taiwan, the Philippines, Malaysia, Singapore and other ports in Southeast Asia (Zhang 1994).

In the Provincial Library in Fuzhou I found management documents from two *mu shan hui* dating from the 1930s. These document the share-holding arrangements between the forest manager and the timber company in the sale of timber.

Analysis

From these interviews and observations, I made the following conclusions regarding my three research questions.

Does the share-holding system represent true village-level management? The answer is mixed. Villages can decide what kind of trees (within a limited range of species) to plant and where. They are locked into a production forestry system, although they can choose — to a certain extent —where to sell their timber. Villages cannot decide, though, to change to an agroforestry system on their collective land. And the amount to cut each year is decided for them. Although in many ways beneficial to villagers, the system is largely designed to meet the production and reforestation goals of the Sanming Forestry Committee.

For historical precedents, the evidence about the *mu shan hui* suggests that local people had experience with share-holding operations related to forestry. Further research is needed to determine how closely the current system is modeled on previous share-holding companies.

Regarding negotiated policies between local people and the government, the *History of Forestry in Sanming*, the gazetteer of the municipality, recounts that in 1983 investigation teams found a share-holding system and a unified contract management system in local villages, and decided to combine these into one system. This story needs further investigation, but close study of the period from 1981 to 1987 would probably reveal a sequence of negotiations between local people and the municipal government, with the State Council approving plans after they were already implemented.

Discussion

In each village it was clear that some households were faring much better than others. Some households lived at a subsistence level whereas others had built new houses, invested in cottage industries, and bought large TV sets and other appliances. My hypothesis is that some households at the time of land allocation in the early 1980s had a more favorable configuration of family members by age and gender. For example, a household with a middle-aged father and two or three sons old enough to plant trees could have taken rapid advantage of freehold land for bamboo, orange trees or other perennials. Quick production and sale of products would have generated funds to invest in other ways, leading to rapid increase in household income. Households with female heads or lacking labor power would not have fared nearly as well.

At a larger scale, it was clear that areas along the railroad and near larger cities in Sanming received the bulk of attention from the forestry department, and were experiencing the most rapid economic development. In these areas new share-holding systems were emerging to link production, purchasing, and resale of timber products. There were also new share-holding companies to rent cars and other vehicles needed by the forestry department. While forestry staff were excited about these developments, and remarked on the flexibility evident in the system, I experienced uneasiness at the growing disparity in incomes between rapidly developing areas of Sanming and those more on the margins. It is unclear to me how this increasing stratification among areas will influence the willingness of villagers to participate in forest protection and production when wealthier areas receive a much greater share of the benefits.

Following my stay in Fujian I spent a week an Nanjing Forestry University, where I was able to read Paul Chandler's dissertation, *Ecological Knowledge in a Traditional Agroforest Management System among Peasants in China* (1992). Chandler looked at indigenous knowledge of *Cunninghamia lanceolata* cultivation among peasants in Fujian Province. Through hundreds of years of practice, these peasants have found conclusively that *C. lanceolata* in monoculture cultivation cannot grow for more than three rotations. In mixed hardwood stands, however, *C. lanceolata* can be grown indefinitely. Chandler points out that forest scientists in China have come up with the same findings. The implications of this limitation for the Sanming system are rather serious, since monoculture *C. lanceolata* forms the backbone of forest production.

Conclusion

The Sanming village forest management system, although it does not solve problems for social forestry worldwide, offers some interesting property arrangements. Where the forest land is collectively owned, and the income from forest production supports the infrastructure of the whole village, villagers certainly have an incentive to manage well both forest protection and production. The increased stratification among villagers resulted from different ability to use and profit from land allocated to the household. From the collective forest, though, the distribution of benefits seemed reasonably equitable.

Acknowledgments

This research was supported by the Tropical Resources Institute, the Yale Program in Agrarian Studies and the Yale Council on East Asian Studies. I am grateful to Nancy Peluso for thoughtful advice on designing this study, to the Sanming Forestry School for hosting my visit and to the Sanming Forestry Committee for arranging for my research.

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Decomposition Rates in Mixed and Monocultural Plantations of Native Species in Costa Rica

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Introduction

Across the globe, government agencies and development organizations have been encouraging tree planting to ensure a continuing timber supply and to reclaim lands degraded by over-grazing or other over-use.

In the Atlantic lowland region of Costa Rica, between 1973 and 1982, land area in cattle pasture and annual crops (mostly banana plantations) doubled at the expense of tropical forest (Montagnini 1994). La Selva Biological Research Station has become a peninsula of forest surrounded on three sides primarily by agricultural land and abandoned farmland.

Sluggish natural forest regeneration on deforested lands can be traced to persistence of unpalatable native grasses and ferns resulting from land degradation and lack of seed sources (Montagnini and Sancho 1992). Poor soils in the area, combined with land degradation, may limit the future of conventional agriculture. These conditions are leading to an increased emphasis on planting trees to yield potential economic gains from timber or fuelwood, as well as conservation benefits which include decreased pressure on natural forests (Evans 1987).

For planting efforts, foresters have often relied on a small number of fast growing exotic tree species whose growth characteristics are well known. Large plantations of exotic species have been encouraged all over the world, and about 85% of plantation forestry in the tropics is dominated by the genera *Pinus, Eucalyptus* and *Tectona* (Evans 1987). In Costa Rica, species most encouraged for forestry have been *Eucalyptus degulpta*, *Gmelina arborea* and *Cordia alliodora*, all of which are non-native species (Montagnini and Sancho 1992).

Researchers have more recently begun focusing on native species with the idea that they may have more beneficial results ecologically and economically than extensive use of exotic species. Native species may be more advantageous than exotic species because they are better adapted to local ecological conditions, seeds and seedlings may be more easily available, and local people are more familiar with their uses and growth habits. In addition, native species are more appropriate for conservation of local biodiversity than exotic species (Montagnini et al. 1993a). The hypothesis that species are better adapted to their native range can be extended to propose that native species may be more productive in native habitats in species mixtures rather than traditional plantation monocultures. In June 1991, workers for the Yale-Mellon grant project at La Selva Biological Station set up an experiment which enables researchers to compare the ecology of trees grown in mixture with trees grown in monoculture. My part of this project was to examine leaf litter decomposition rates in these two growing conditions.

The Project

To see the effects of mixed and pure plantations on land restoration, the experimental plantation was located on recovering abandoned cattle pasture on poor soils. Four native species were planted in mixtures and in monocultures. Controls were plots where no trees were planted. The plots were set up in a random block design replicated four times. Subsequently, two more replicates of this full experiment (Plantation 2 and 3) were planted in November 1991 and November 1992 with different species. The project continues to monitor ecological variables such as biomass accumulation, litter fall, growth rates in height and diameter, survival, and changes in soil fertility, and compares these parameters between the mixed and monospecific plantations.

The Species

The four species, Cedro Maria *(Calophyllum brasiliensis)*, Mayo or chancho *(Vochysia guatamalensis*, also *V. hondurensis)*, vainillo *(Strypnodendron microstachium*, also *S. excelsum)*, and jacaranda *(Jacaranda copaia)*, at Plantation 1 were chosen to fulfill different economic and ecological specifications. *S. microstachium* is a nitrogen fixer, *C. brasiliensis* is a slow growing shade tolerant tree, and *J. copaia*, in contrast, is a very fast grower.

V. guatamalensis is intermediate in growth speed, however, canopy closure occurs fastest under this tree due to its canopy architecture and large leaf size (about 22 cm x 9 cm). This closed canopy, in the monocultural treatment, allows for limited light so that little grows on the thick litter layer beneath it.

In contrast, *J. copaia,* currently the tallest tree, has smaller (about 6 cm x 4 cm leaflets) twice compound lanceolate leaves, allowing a fair amount of light to pass through. Under this monoculture, a vast array of grasses, ferns and other "weeds" flourish, and vines climb up the trees. These trees are so tall that from the ground the leaflets appear to be about half their actual size. In mixture, these trees are not as tall as in monoculture, but in both cases they tower over *V. guatamalensis.*

Unfortunately, at this experimental site, almost all the *S. microstachium,* planted in monoculture, died in early 1994, whereas many of these plants survived in the mixed plots. Therefore, I used *S. microstachium* leaves only for the mixed experiment plots in my study.

The smallest tree, *C. brasiliensis* was planted about 6 months later than the other trees, and is a slow grower. In the monocultures, canopy closure had not yet occurred. Trees in these plots resembled very tall bushes with a grass understory. The leaves of this species are medium sized (about 15 cm x 35 cm), lanceolate, and somewhat rubbery in texture.

Decomposition Rates

I used leaves from these species to study decomposition rates in the experimental plantation. Since the rate of decomposition depends, in part, on nutrient availability to microorganisms, I hypothesized that the mixture of different types of leaves in the mixed plantation might provide the best recipe for quick decay. This might result because the litter from each species provides different percentages of essential nutrients. Similarly, because the activity of decomposers is influenced by abiotic factors such as moisture and temperature, I expected that climate would influence decomposition rates.

Methods

To determine the rate of decomposition, I measured how much weight decomposing leaves lost over a set period of time. To ensure measurement of the same leaves every time, and in an effort to keep the leaves in an environment they would encounter in the field, I collected leaves and put them in fiberglass mesh bags. I put 14 bags of leaves at each of 36 sites in Plantation 1. This design allowed me to collect one bag from each site every two weeks during summer, and for project staff to collect once a month during the rest of the year.

The other aspect of my study was to measure microclimate effects on decomposition rates experienced by the leaves. Although weather data is easily available, decomposing leaves experience different microclimates: the suns heats up exposed leaves in the middle of the day or the shade under the closed canopy cools them. This data is extremely variable, and depends on time of day, amount of time since last rainfall, and cloud cover. Between 11 a.m. and 1 p.m. each day, I measured air temperature and soil temperature at each site. In addition, I measured soil moisture gravimetrically by taking samples at each site and drying them in the lab. This measurement gives some idea of probable moisture conditions at the litter surface.

Preliminary Results and Discussion

When more decomposition data comes in I will be able to determine if it correlates with microclimatic conditions, as expected. Preliminary data, after six weeks of decomposition, showed a slight correlation between decomposition rate and air temperature and a stronger correlation between decomposition rate and soil temperature. However, after 3 months, these relationships weakened. I found no correlation between soil moisture and decomposition rate at any time. My original hypothesis was that microclimate and nutrient composition of leaves are both important in controlling decomposition rates. However, this data may show that in one locality, species have a greater effect on decomposition rates than microclimate.

After three months, the data do not show significant differences between the mixed and monocultural species. Preliminary data indicates the percentages of weight remaining are comparable to those found in a pilot study, using two of the same species (Montagnini et al. 1993b). The literature on leaf decomposition is quick to dispel the notion that tropical climates necessarily induce high decomposition rates (Ander-

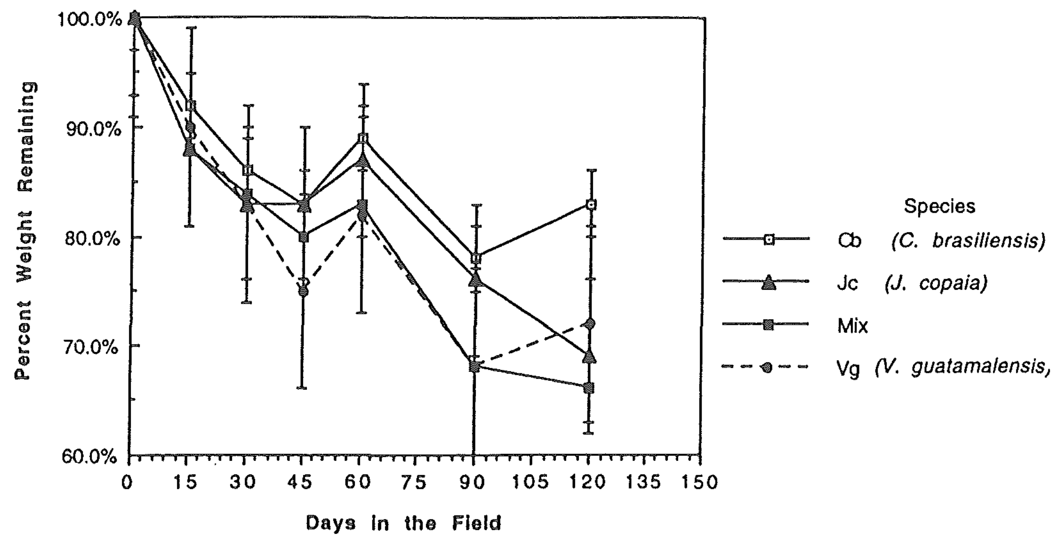

Figure 1. Decomposition of Leaf Litter in the First 3 Months: Litter bags of the three speces in pure plots and the mixed plot were collected after 15, 30, 45, 60, and 120 days. The graph shows percentage weight remaining in bags against amount of time bags were in the field. The only statistically significant difference is the last point on the C. brasiliensis *line, showing that this species is decomposing more slowly than the mixture and* J. copaia.

son et al. 1983). My study supports this contention. Leaves do not disappear overnight (or within a week) in the humid tropical rainforest. After 3 months, average weights were between 65% and 85% of original weights (fig.1, previous page). The only statistically significant difference is that *C. brasiliensis* is decomposing more slowly than *J. copaia* and the mixture at the last collection. This trend might reflect the lack of canopy closure resulting in desiccation of leaf litter in direct sunlight. As the leaves decompose further more significant differences between treatments may appear. I expect the leaves in the mixed plots to decompose faster, due to the mixture of leaf chemistry and a microclimate more similar to natural forest than traditional plantations. If additional data confirms this hypothesis, it will help explain the larger role of nutrient cycling in the process of restoring degraded lands.

Nutrient cycling is an important aspect of restoration, and is a major focus of the larger Yale-Mellon Project. If leaves decompose at a greater rate, this indicates that nutrient cycling is also faster. Scientists hypothesize that nutrient cycling will occur faster in a mixed structural and nutrient environment more similar to natural forest than in a monocultural tree plantation (Montagnini et al. 1993a). A tropical rain forest is an efficient nutrient cycler; soil often lacks available nutrients for plants, and most available nutrients are stored in the vegetation rather than the soil. As soon as a plant dies, its nutrients are recycled into more vegetation. Faster cycling, in theory, should reclaim the land faster by adding decayed organic matter and nutrients to the soil at a greater rate for plant uptake. To measure nutrient cycling, scientists must document the flow of nutrients from soil, into biomass, into leaf litter, and back to soil again. My study on leaf litter decomposition examines just one piece of this system.

Conclusion

When all the data is collected, it will contribute to filling the gap in knowledge on decomposition rates in the tropics, and add to our understanding of nutrient cycling in the context of managed forests and ecosystem restoration. This information may help provide evidence that growing trees in mixture has greater nutrient recycling benefits than monocultural plantations. Since this decomposition study is a small piece of a larger ecological study, this data will help to provide a better understanding of the total ecology of the experimental system.

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Picking Maile (Alyxia oliviformis) *for a Lei, in Ukulele, Maui, by Jonathan Scheuer, TRI Photography Competition Winner, Social Category.* *(see TRI Notes, p. 62)*

Impacts of Native Tree Species Plantations on Soil Structure at La Selva, Costa Rica

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Introduction

Traditional low intensity agricultural systems in the lowland humid tropics relied on a relatively long fallow period to restore soil structure and fertility. With increasing pressure on the land, fallow periods have decreased and use has intensified. Poor management in many cases has led to many kinds of soil degradation including compaction, erosion and nutrient leaching. Physical degradation intensifies nutrient degradation by altering water retention capacity and decreasing nutrient accessibility (Sanchez 1976). Once a site is severely degraded, the normal successional pathway is interrupted, and even extended fallow cannot restore the soil to previous fertility levels (Lovejoy 1985).

Restoration techniques, such as tree plantations, in place of annual crops or pasture, have been proposed as an active measure to counteract soil impoverishment and to increase the rate of soil restoration, given decreased fallow time.

Trees provide organic material, erosion control, shade and temperature moderation, and nutrient and moisture cycling pathways. Below ground, root systems improve soil structure both by physically breaking up compacted soils and by producing exudates which aggregate the smaller particles into granules, thereby increasing porosity and water retention (Sanchez et al. 1985).

My work was conducted on three native species trial plantations established by Drs. Florencia Montagnini and Freddy Sancho at the OTS La Selva Research Station in Puerto Viejo, Heredia, Costa Rica (10° 26' N, 86°59' W at 50 meters above sea level, mean annual rainfall approx. 4000 mm, mean annual temperature 24° C).

The plantations are 1.5-3 years old, and each consists of 4 species arranged in 6 treatments: 4 monoculture plots, one plot with all four species mixed, and one block of natural regeneration. Each plantation consists of one fast growing pioneer species, one nitrogen fixing species, one slow growing species whose wood has an established market, and one intermediate species. There are currently a total of 11 species in the study since the *Stripnodendron microstachyum* in Plantation 1 has suffered a high level of mortality.

Plantations were established on an area that was cleared for pasture in the early 1950s and worked as such until 1984. The soils are examined biannually for changes in pH, and micro- and macro-nutrient availability (Montagnini and Sancho 1990).

This study was designed to answer the questions: Can tree plantations accelerate structural rehabilitation of degraded soils and does species composition affect this process?

Methods

Soil bulk density (Core method)

Two cores (25 cm^3) were taken at each site at surface level (0-5 cm) and sub-surface levels (5-15 cm), dried overnight at 105° C and weighed to determine dry mass (Blake and Hartge 1986). Bulk density was calculated using dry weight and volume. Percent moisture was determined from the same samples.

Compaction

Surface compaction was measured using a hand held 1/4" diameter penetrometer. Measurements were taken in random patterns within each plot with no less than 5 samples per plot.

Root Biomass analysis

Within each treatment plot three samples were taken within 1 meter of a stem with a 10 cm diameter root corer to a depth of 15 cm. After washing, roots were divided into three classes: fine <1 mm dia., medium 1> <2 mm dia. and coarse >2 mm dia. dried and weighed (Montagnini and Sancho 1990).

Results

Bulk Density

Average values found for the top soil layer (0-5 centimeters) were 0.43, 0.46 and 0.44 (g/cc). One way analysis of variance (ANOVA Statgraphics 4.0) showed significant differences among species for Plantations 1 and 2 (see tables 1 and 2). No significant differences were found between species at the 5-15 centimeter depth for any plantation or at any depth for the third plantation. These values are fairly low for the reported results from other areas of La Selva (0.73 to 1.10 MPA) (Sollins and Radulovich 1988, Lal 1987)

Compaction

Compaction was consistently below 1 MPa ranging from 0.08 to 0.31 consistent with the low values for bulk density reported above. Compaction and bulk density showed an inverse correlation when analyzed by linear regression for

Table 1. Average values for top soil layer, bulk density, percent water, compaction and root biomass in Plantation 1.
Numbers in parentheses represent standard deviation. Same letter indicates no significant differences between similar treatments.

Species/Stand	Bulk density	B d (0-5 g/cm³)	%Water (5-15 g/cm³)	Compaction (MPa)	Roots (<1 mm)	Roots (1<>2 mm)	Roots (>2 mm)
Calophyllum brasiliense	0.44(0.3)a	0.55(0.02)a	39.5(0.99)a	0.13(0.02)a	87.89 (10.89)a	18.84 (5.77)a	51.77 (6.82)a
Jacaranda copaia	0.44(0.05)a	0.49(0.01)a	37.09(0.98)a	0.23(0.01)a	83.95 (24.05)a	22.05 (3.01)a	18.71 (6.67)a
Vochysia guatemalensis	0.48(0.04)a	0.51(0.01)a	37.58(0.22)a	0.31(0.07)b	177.72 (51.68)a	38.81 (11.26)b	13.27 (13.27)a
Mixed Forest	0.46(0.05)a	0.53(0.05)a	40.52(1.54)a	0.28(0.07)a	79.73 (73)a	4.29 (2.14)c	22.09 (10.92)a
Regenerating Forest	0.34(0.04)a	0.50(0.03)a	40.52(1.54)a	0.08(0.01)c	99.59 (10.63)a	6.41 (3.66)c	9.71 (9.71)a
Secondary Forest	0.39(0.09)a	0.48(0.06)a	38.14(2.15)a	0.20(0.10)a	221.74 (48.60)b	221.74 (10.60)d	793.26 (16.98)b

both plantations 1 and 2 (Probability level 0.31255 and 0.12976 and R-squared 5.66% and 11.10%, respectively). Previous work suggests that compaction levels of 1.0 MPa are detrimental to root expansion and plant growth. Clearly this is not a factor at this site.

Root Biomass

Root density values were consistently higher in the secondary forest than in any of the treatments, a pattern agreeing with earlier studies (Stijfhoorn 1994). For all treatments except secondary forest there was a fairly consistent pattern; the largest amount of root biomass was found in the fine root class. Linear regression analysis of the relationship between compaction and root density showed significant inverse correlation between the density of medium roots and compaction in both plantation 1 and 2 with the relationship more significant in the second plantation (probability levels 0.59982 and 0.23757 and R-squared values 2.02 and 8.10 percent, respectively).

Discussion

Since the baseline data on physical conditions of the site at the time of establishment are unavailable, it is impossible to assess absolute changes over time. We are instead relying on differential patterns of change to assess relative changes.

From the differences in levels of significance between the first two plantations and the third it is clear that the impact of vegetation on the physical characteristics of the soil increases with age. Although few trends were statistically significant, this is probably attributable to sample size and the age of the trees. The significant relationships between species and differential compaction, percent moisture and root densities as well as the linear correlations discussed above indicate that not only are the plantations effective, but the specific composition of the plantation is a major factor in determining its effectiveness. Species specific effects are more significant with increasing age, as demonstrated by the increasing significance among relationships in Plantations 1 and 2 as compared to Plantation 3. Monitoring of the physical characteristics of these sites will continue.

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Healing Forest and Ailing Economies: Non-Timber Forest Products in Nepal

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Introduction

Hanuman, the mythical monkey god of the Hindu pantheon, knew a good thing when he saw one. As the story goes, Hanuman's knowledge of wild flora and its medicinal properties saved the life of Laxman, the famous warrior of the Indian epic, the Ramayana. Upon learning of Laxman's injury, Hanuman took to the skies and brought down the mountain of Kailasa, with its impressive display of Himalayan biodiversity. His efforts were rewarded: his earthworks included four *samjivini*, or life-giving herbs. Laxman was saved, and Hanuman went down in history as one of the Himalaya's earliest naturopaths. In the thousands of years that followed, subsequent reincarnations of Hanuman searched out new plants with useful properties. This time, however, the motive was profit, not panacea. The trade in Himalayan flora grew into a vast, yet secretive marketing network that continues to flourish today, providing critical economic inputs to forest-dependent peasants in Nepal, India, Bhutan, and Tibet, and fueling multi-million dollar industries in India, China and beyond (Aryal 1993).

This study examines the trade in Himalayan flora in the Annapurna region of Nepal (Fig.1, below). Over a period of eight months, information was gathered on several aspects of harvesting, management, marketing and ecology. The main objectives of the study were to gather baseline data on the social and biological aspects of the trade, and to investigate potential methods of improving rural incomes and biodiversity conservation through better reserve managment and marketing systems. The study was designed to parallel similar studies in eastern and western Nepal in order to develop a replicable methodology with compatible aims and results, and to improve understanding of the non-timber forest products (NTFP) trade in the national context.

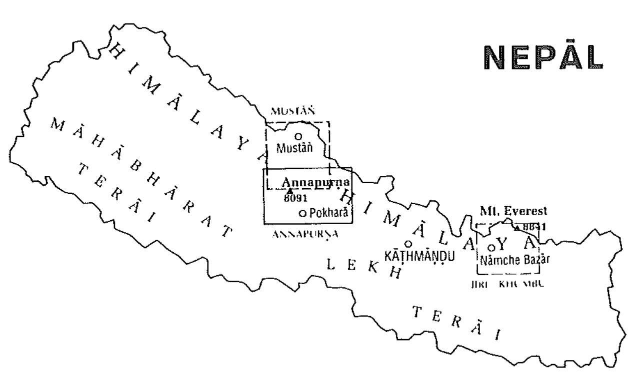

Figure 1. Boxed area (center) shows Annapurna Conservation Area

Background

Each year, from every ecological zone across Nepal, thousands of tons of seeds, bark, fruits, leaves, roots and other plant parts are collected in the wild for the purposes of trade to India. Over one hundred products are involved, used as raw materials for the production of essential oils, resinoids, spices and herbal medicines. Collectively known as *jaributi*, these products reach their destination through informal marketing channels, passing through the hands of numerous middlemen. Recent research indicates that in the rural sector alone over 10 million dollars are generated annually, distributed among a large number of collectors, porters and small traders (Edwards 1993).

Materials and Methods

This study was divided into three main components: literature review and background policy/program research; market survey, including both small intermediary traders and large wholesalers; and field investigations. The difficult terrain, lack of roads and communication, dispersed settlements and collecting areas prompted the development of a research strategy focused on market towns at the end of the road, known as roadheads (Edwards et al. 1993). Such markets act as funnel points that "drain" a relatively discrete area in which plants are collected and traded, similar in concept to a hydrological catchment. Roadhead *bazaars* can be areas of intense trading activity and are a useful point of departure for gaining a regional picture of product availability, quantities, prices, historical trends, marketing pathways, and collecting hotspots.

Data collection relied heavily on rural appraisal (Poffenburger et al. 1992) and ethnobiology (Bellamy 1991) techniques. At the village level, information was gathered from a wide cross-section of people, including women and children, female birth attendants, village headmen and elders, various castes and economic classes, forest management committees and traditional healers. Considerable effort was given to documenting indigenous plant knowledge and collecting voucher specimens.

Study Site

The Annapurna Conservation Area (ACA), gazetted in 1989, is a multiple-use protected area co-managed by numerous village development committees and the ACA Project (ACAP) staff. Founded on the principles of participatory management, ACAP has the dual management objectives of conserving biodiversity and promoting environmentally sound rural development. ACA's 7000 km^2 ranges in altitude from 1000 to 8000 meters, and provides a representative swath of central Himalayan biodiversity containing a variety of ecological zones, from sub-tropical monsoon forest to alpine steppe. It is also a region of remarkable cultural diversity; over 40,000 people comprising at least nine distinct ethnic groups reside here. The Annapurna region not only provided a fertile research site, but involved people who were truly interested in the findings.

Preliminary Results

Products and Volumes

In 1992, at least fourteen products were collected in large quantities (Table 1, below). According to local informants, ten trucks containing approximately 40,000 kg left the Besi Sahar roadhead. Products collected in the greatest volumes included the bark of *Cinnamomum tamala*, a small subtropical tree, and the tubers of *Dioscorea bulbifera*. *C. tamala* is used as the main adulterant of true cinnamon (*C. zeylanicum*); *D. bulbifera* is used for treating gastro-intestinal ailments. Two new products also emerged on the market: the leaves of *Taxus bacchata*, the Himalayan cousin to the Pacific Yew, famous for its anti-cancer properties, and *Saussurea gossypiphora*, an alpine herb whose end-use is unknown but is used locally for medicinal purposes. The value of trade in 1992 at the Besi Sahar roadhead is estimated to be on the order of US $15,000.00.

Table 1. Major Commercial NTFPs Collected in the Annapurna Region, Eastern Portion, 1992

Latin name	Family	Local name	Part used	US$/kg dried**
Sub-tropical/temperate				
Trichosanthes spp.	Cucurbitaceae	indreni ko biu	seed	2.00
Swertia chiretta	Gentianaceae	chiraito/tithe	leaves, stem	2.00
Piper longum	Piperaceae	pipla	fruit	2.00
Valerianna walichii	Valerianaceae	sugundhawala	root	0.70-2.00
Paris polyphylla	Liliaceae	satuwa	root	1.00
Cinnamomum tamala	Lauraceae	dalchini/sincauli	bark	0.50-1.00
Rubia cordifolia	Rubiaceae	majito/cheroot lahar	stem	0.20
Dioscorea bulbifera	Dioscoreaceae	kukur tharul	tuber	0.20
Sub-alpine/alpine				
Delphinium spp.	Ranunculaceae	nirmasi	tuber	2.00
Nardostachys grandiflora	Valerianaceae	jatamansi	rhizomes	1.20
Aconitum spicatum	Ranunculaceae	bikh	tuber	1.00
Rheum emodi	Polygonaceae	padamchal	root	1.00
Picrorhiza kurrooa	Scrophulariaceae	kurtki	rhizome	0.70
Orchis latifolia	Orchidaceae	panchaunle	tuber	4.00

**prices converted to equivalent in US dollars

Edwards (1993) observed that market prices for jaributi correspond to the distance between collection area and roadhead and the degree of difficulty encountered while harvesting. High altitude products tend to fetch higher prices, whereas low altitude products tend to be priced more cheaply. While this is somewhat true for the Annapurna region, the prices appear to be elastic in response to market demand.

Markets and Marketing

Traders at the roadhead and along the main trails are the critical link between jaributi and the market. They receive market information on species and price along with cash advances from large wholesalers near the Indian border, and they are the first major point of transaction for local collectors. There are at least seven permanent traders who double as shopkeepers, lodge operators, and farmers. In addition, a number of opportunistic buyers from large Indian firms periodically visit the region in search of more direct supplies.

Resident traders have their own territories based on kin relations or other historical ties. They are of different ethnicities and have varying levels of business savvy and political influence. At times they may work in collusion, but most operate independently. As such, roadhead prices can be competitive, and a collector is free to sell as he pleases. Contrary to popular notions, the relationship between resident traders and collectors is not necessarily exploitative. Traders can play a very important role in village economies by providing a needed source of credit, cash and marketing assistance. Traders and collectors may also be bound together by a mutually beneficial ritual brotherhood called *mit*. On the other end of the scale, certain powerful traders may force collectors to sell exclusively to them. All these arrangements were observed in the study area.

The jaributi market is volatile and erratic. *Swertia chiretta*, known for its bitter taste and fever reducing qualities, was until recently a low value species fetching only NRs15/kg

(US$0.20). Its alleged use in a new Indian beverage raised the price to over $2.00/kg in today's market, stimulating larger and earlier harvests, cultivation experiments and localized attempts to control the harvest and protect the growing stock.

Tenure and Management

Tenure and management vary widely across the study area, influenced strongly by the level of market information, historical trade links, culture/ethnicity of participants and degree of government intervention. Collection areas fall into two overlapping categories of ownership and control: government land and community land. Due to the shortage of government forestry staff and the rugged terrain, this distinction is often ambiguous. Community land can be divided further into official and customary. Official community land is that which has been sanctioned and demarcated through the government Community Forestry Program; customary land may or may not have official sanction, but local people retain historical access rights. The recent incorporation of the study area into the Annapurna Conservation Area superimposes yet another layer of claims upon the jaributi resource.

Porters transporting Swertia chiretta, *used for reducing fever, to roadhead market*

Management is equally variable, determined to a large extent by feasibility. Government management is limited to the collection of royalties and periodic harvesting and export bans. At the local level, management mainly takes the form of access control, commonly accompanied by a token payment to a community fund. In practice, however, much of the region is unrestricted. Management is also hindered by the lack of market information by those controlling access, thus limiting their ability to make sound management decisions.

Biodiversity Conservation

Across Nepal, the largest concentrations of plants with useful compounds occurs in the subtropical zone (53%), followed by the tropical (49%), temperate (36%), subalpine (18%) and alpine (7%) (IUCN 1991). Over 700 species are known to have therapeutic properties. Herbs may experience a high level of endemism due to the formidable topography and microclimates which inhibit migration and induce speciation. This is relevant to the jaributi trade because large-scale collections could inadvertently cause extinctions.

Depending on the product, collection can have various effects on local plant populations. Collecting herbs, roots and tubers destroys the individual plants, whereas harvesting vines, seeds and fruits causes minimal immediate damage. Recent trends indicate that as prices and markets increase, collection occurs earlier in the season, before the plants have had a chance to seed. Unmanaged harvesting, combined with periodic market booms, appears to have had a significant negative effect on local populations.

Burning, grazing, planting, collecting forest products, and hunting have been a part of the Annapurna landscape for over four hundred years, shaping the mosaic of communities we see today. The anthropogenic nature of this landscape has important considerations for management of jaributi and biodiversity conservation.

Discussion and Conclusions

Widespread poverty, rapid population growth, environmental degradation and lack of employment opportunities characterize life throughout most of Nepal. With per capita GNP at less than US$180/yr, new sources of income must be developed to meet the growing economic needs of Nepal's citizens, yet are compatible with its unique cultural and biophysical characteristics. Improving the jaributi trade may offer one alternative, especially at the primary stages of extraction and exchange. Improvements could take the form of harvesting and marketing cooperatives or village-based processing facilities. Cultivation of threatened species is certainly warranted, although potential benefits will be limited to those with the necessary land, labor, capital and time.

Common property management — instigated by villagers themselves or through government and NGO-sponsored social forestry and protected areas programs — is promising, yet many issues remain problematic. Lack of ecological data precludes the development of silvicultural prescriptions to maintain/increase productivity. The social aspects of the trade are equally formidable. Controlling poachers, establishing reliable markets, gaining access to market information and by-passing Indian hegemony are all important considerations. Given that current trade patterns are the result of regional histories, politics, ecology and culture, site-specific issues need to be incorporated. These include appropriate mechanisms for distributing jaributi benefits and responsibilities among community members and protecting access rights of the poor.

The jaributi trade is an ancient Himalayan enterprise which has expanded dramatically over the past few decades. There is great potential to improve economic benefits and forest management, but it is important to remember that collecting NTFPs for trade is only one of many strategies people employ to manage their needs; it is not a panacea. The Annapurna study describes the trade in one area only and is not generalizable. It does, however, demonstrate the complexity of the issue, potential problems, and prospects for development. The future lies not in the hands of mythical gods like Hanuman, but in those of mere mortals, from illiterate mountain peasants to sophisticated businessmen.

Acknowledgments

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Stories of Protection In a Himalayan Hamlet, India

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Introduction

"Fifty years ago, all these fields and orchards were forests." I was standing at the bottom of the microwatershed in which Supi Bhatelia rests, talking to Sher Singh, an aging farmer who had spent his life in the hamlet. Conversion of forested land to large scale settled agriculture had occurred within his memory. Reservation of forest tracts by the government occurred just beyond it.

Supi Bhatelia, an essentially Rajput community of 30 families, is a hamlet in the Nainital District of the Kumaun Himalaya in India. Past inhabitants of Bhatelia were seasonally transhumant and used the area largely for grazing. Their annual winter migration to forests in the plains ended by mid-1900s. Since then, dominant cropping patterns have changed dramatically from extensive subsistence grain cultivation to more intensive market-oriented crops of potatoes and apples.

In the first quarter of this century, protests against the creation of reserved forests occurred in many areas of the Kumaun (Pant 1922, Guha 1989). Van Panchayats (forest committees) were then formed and charged with creating communal forest tracts under village protection. Today, forest lands in this area are under three main tenurial categories: reserved forests (land under Forest Department control), civil forests (land administered by the state revenue department), and Van Panchayat forests (land under perpetual lease to village forest committees).

Issues at Stake

Sources often report degradation in the Himalayas and then demand immediate action (Myers 1986). In contrast to forest destruction, however, forest protection has been less well documented. Part of the problem is representation: the voices of those close to power are generally recorded and heeded, while subordinate voices are harder to unearth. Recent work in rural natural resource management tenures has looked to narrative analysis and linked stories with discursive strategies (Fortmann 1994). Oral sources may supply clues to past actions and may also help to frame and organize perceptions.

Though they play an important role in defining local power and legitimacy, stories have generally been ignored when studying and framing resource management decisions.

Stories may in fact offer ways of understanding the knotty question of community organization. (Rose 1990, Appadurai 1991). Stories may also allow individuals, who may not have the credentials normally needed, to participate in the body politic. Based on my field work, I outline some narratives of forest protection in a community in the Indian Himalaya. I then use these stories to form a history, articulating the challenges facing community resource management. This is especially important in light of current Joint Forestry Management efforts in India (SPWD 1992).

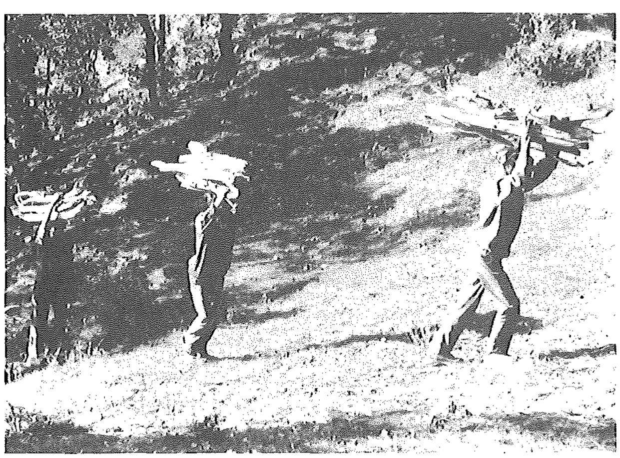
The Mungeru Forest of Supi Bhatelia

Mungeru, a section of Supi Van Panchayat forest, is a 22 ha mixed oak forest, stocked largely in pole and medium diameter sizes. *Quercus floribunda* and *Q. leucotrichophora* are the dominant species on south-facing slopes from 2020m to 2250m. The forest shows signs of historical and contemporary human disturbance. I found traces of past terraced fields, and almost every tree measured showed evidence of lopping.

In recent past, local access to village forests has been similar across tenurial boundaries. Villagers harvest a number of products vital for their agricultural livelihoods. These include fuelwood, timber, slate and stones, forage, medicinal herbs, game, and dry leaf litter. Several informants identified a steady, nearby supply of leaf litter as the most significant return from protecting the Mungeru plot. Litter is collected by women, mixed with cattle dung and composted; this litter is the primary fertilizer.

Methods

After arriving in Supi Bhatelia in June 1993 to study tenurial effects on village forests, I was informed that the Mungeru plot had been under almost total protection for at least two years. These recent actions provided a focal point for examining a local history of protection. With this in mind, I asked my informants who had protected the plot, when and why the protection had occurred. Information was gathered through a series of informal interviews with men from the hamlet. Further informants included Forest Department officials, past and present NGO workers and the Bhatelia women's group. I also carried out forest stand measurements in Mungeru and adjacent plots in reserved and civil forests to compare differing human impacts on forest structure and regeneration (to be reported in TRI Working Paper, #80, forthcoming).



Fuelwood is used primarily for cooking and heating by residents of Supi Bhatelia

Claims About Recent Protection

In 1982, Mungeru was planted with trees by a soil conservation program. Following Forest Department procedures, the plot was surveyed, and a wall was built around it. Local men were contracted to provide labor for wall building and seedling planting. Most of the seedlings died, in part to late planting.

A number of informants identify Chirag, a local NGO, as the institution that controls the protection program. Chirag workers acknowledge their role but also see other local initiatives at work. In 1990, Chirag set up a tree nursery in the hamlet. A local youth ran the nursery and began planting some of the seedlings in the Mungeru forest. He and his family served as community catalysts, interacting with Chirag, hosting meetings, and eventually joining the NGO as extension workers.

In 1991, the women of Supi Bhatelia created a *Mahila Mangal Dal* (women's group) to protect Mungeru. The women chose a female *chowkidar* (guard) to patrol the area daily, a first for villages in the region. More seedlings were planted, in large part to provide an excuse to protect the section. The plot was closed to all forms of use for a year. Then the gathering of leaf-litter by women was permitted, while grazing and cutting of green wood or leaves remained forbidden. In early 1993 a portion of the plot was lopped by the whole community, setting up the beginnings of a rotational lopping regime.

These actions did not take place in a vacuum. In effect, they had usurped the control of the *sarpanch* (head) of the Van Panchayat. This man was summoned to a hamlet meeting and told that they were going to work over his objections. In fine discursive style, the *sarpanch*, when asked when local protection started, said that *he* had made the suggestion to the NGO.

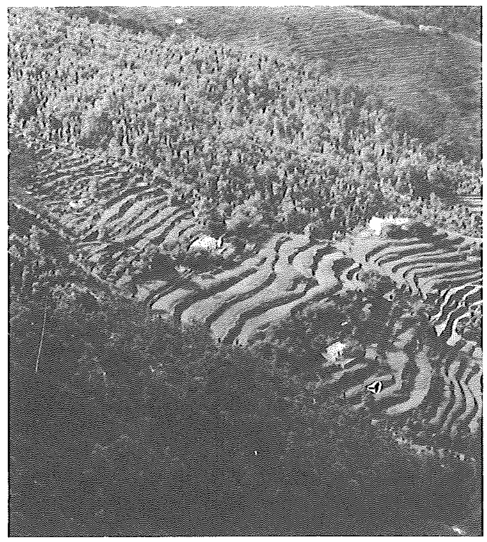
At the onset, there was also within-hamlet disagreement about whether the women would be able to do this work. This was steered towards a consensus by the NGO workers and internal discussions.

Issues of gender remain. The scope of the original committee broadened to include other development projects. With this, men from the hamlet seem to have effectively taken over the forest protection committee. The early development workers and the youth have left for jobs outside the area, and in their absence, men expressed strong reservations about the capability of women. Despite the creation of functioning forest protection, one man told me that "*women are illiterate and ignorant. They should not be given control, as they are like children: they need to be guided in these things. Maybe at some later date they can do it.*" Another man said that the hacking of trees for fodder was attributed to women being ignorant and only interested in expending a bare minimum of labor.

Claims About Long Term Protection

While the last few years saw significant tree protection and use, the underlying question still exists of how the land has remained village-owned. The surrounding villages have a number of cases of encroachment on Van Panchayat lands. Supi village has cases of land encroachment as well. These tend, though, to occur on civil lands (especially those bordering fields) and into the Reserved Forest.

At least twice, the village community has actively discouraged the conversion of Mungeru into fields. In the first, a Nepali claimed he had possessed a deed to the land, but had decided not to use it. *"The forest was in my hand. I could have used it, but did not because villagers would have come and made fields here."* He did build a hut on the land in the early 1970s, toward which the hamlet residents obtained a civil order and tore it down, driving the Nepali off the land. Villagers claim the title was obtained with a bribe to the village land records official.



Houses in Supi Bhatelia surrounded by their fields and bordering forest areas. The forest in the background is the Mungeru plot. The forest in the foreground is part of the government reserve.

The second case was more preemptive. A school teacher claimed to have organized other villagers to give Mungeru protected status in order to keep certain ex-military men from issuance of title deeds.

One of the most hidden claims was made to me in private by a man on behalf of his late father. The man had been active as a Van Panchayat member but also held a deed in secret to a portion of land in Mungeru. The son said his father cared for the forest and did not want to see it used up, but that he was astute enough to get the deed.

In direct contrast to the above cases, a local man lives on and farms about two hectares of what, according to the map, is Van Panchayat land. On questioning, the man showed a deed for the area. He said that his father had cleared the area as a young man. The land was allowed to lay fallow, and was only reterraced fourteen years ago. In the interim, the forest was added to the Van Panchayat and a map drawn up which showed the fallow land within its boundaries.

Discussion

The protection of Mungeru proved a fertile ground for local histories. Two main groups of stories emerged addressing different scales: one set highlighted recent community activities that protected and used the trees, while the other set focussed on tenurial control and prevention of privatization of the commons. Out of these, a fractured history of protection emerged.

Though my informants were largely men, gender relations clearly emerged as a vital part of the user-management dynamic. In most Van Panchayats, women — the primary collectors of forest products — do not have a say in decisions. With the encouragement and empowerment given by the youth and NGO workers, the women literally took control of the area. There has been a gradual shift in committee control to men. Ironically, there is now a tacit use of environmental rhetoric to "keep women in their place".

Many of the stories of prevention of encroachment had a subtext of the membership or non-membership in the community. The Nepali was not tolerated when he tried to build a house in Mungeru. He later married a local woman and now has a certain standing as a member of the community. By contrast, the man farming the bottom part of the land, which his father cleared, did not face action by the local community. A community dialogue regarding forest protection and land tenure exists, and actions taken against encroachers were undertaken by a group rather than individuals.

Current enthusiasm for bottom-up management has led to disappointments when communities have not "behaved" as they should. This is unfortunate, as it can feed the claim that villagers are not interested in maintaining environmental quality, and if they are, these desires are hopelessly enmeshed in local politics. The Mungeru case shows otherwise. The stories hold ambiguity, politics and relations of gender and power as givens, while providing a striking example of successful forest protection. Current resource management initiatives will continue to be appliqued onto a previous terrain of actions.

A stereotype of bureaucratic social forestry schemes has been that *community* is static and pliable and that community members can be called upon to plant trees. Yet the claims and stories around protection of the Mungeru forest are anything but one dimensional. Communities — even those with fairly homogenous caste and social structures — are simply not organized around single issues. Their motivations and actions follow circuitous routes and often intersect in unexpected and hidden ways. Stories help us to see this and, when listened to, may contribute to maintenance of the system as well.

ACKNOWLEDGMENTS

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VALUING SCENIC NATURAL RESOURCES: AN ECONOMIC VALUATION OF THE OKAVANGO DELTA, NORTHERN BOTSWANA

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INTRODUCTION

The Okavango Delta in northern Botswana is the world's largest inland delta. An oasis in the Kalahari Desert, the delta has a precarious existence. Its source, the Okavango River, travels through 1500 km of Angola and Namibia before reaching Botswana, and is subject to hydroelectric power damming, large-scale irrigation and other water development projects in both countries. In Botswana, the demand for water is increasing due to population growth and industrial and agricultural expansion. The mining and livestock industries, heavy water consumers, provide the majority of the country's foreign exchange revenue (Lewis 1993). Additionally, the Government has targeted tourism as a major growth industry (Scudder et al. 1993); the Okavango Delta is Botswana's main tourist destination. Although plans to dam and dredge the Delta were postponed in 1990, no final decision has been made. This research was designed to provide analytical information for future development policy.

Valuing Protected Areas

There are numerous values (or benefits) associated with a scenic and/or recreation natural resource (also frequently referred to as a protected area). Such things as the spiritual importance of the resource to a local community, the subsistence value of plant and animal extraction, the educational value of the area or the heritage associated with the resource are extremely important in analyzing the value of a protected area. These values are not directly associated with markets and therefore, not easily dealt with through economic analysis. Still, there are non-market values associated with a protected area that can be quantified using specific economic techniques.

Although most scenic resources are publicly owned goods which charge nominal fees for utilizing the area, a portion of the resource is usually fully accessible and involves no fee. Because entrance or use fees are often nominal and sometimes absent, they are not an accurate reflection of the **total** economic value of the resource.

A flourishing tourism market may generate employment, capital expenditures and other investments that add strength to the local economy. Tourism revenues, tourist expenditures on goods and services in the region and returns from hunting permits and park entry fees fuel the local (and likely regional) market economies.

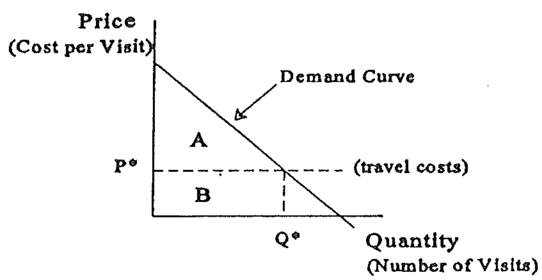
Many countries struggle with questions concerning how to manage available scenic natural resources (Dixon and Sherman 1990). Often, benefits of a project are explicit, while associated costs (or loss of benefits) are more elusive and difficult to quantify. Market costs and benefits are readily quantified, but few policy and planning decisions account for non-market costs and benefits (Dixon and Sherman 1990, Smith 1993). The methods applied in this research attempt to quantify non-market values of a scenic resource by observing people's behavior and applying economic analysis to that behavior.

Methods

Simple Travel Cost Model

The travel cost method for valuing scenic natural resources quantifies a monetary, non-market value for a scenic natural resource, which can then be compared to market-based development alternatives. The simple travel cost model is designed to value an entire site by estimating the demand for trips to the site (Mendelsohn and Markstrom 1988). A site is the entire scenic/recreation natural resource or protected area. This technique values the area as a recreation site and therefore encompasses the value to all consumers of recreation, from Botswana citizens to foreign travellers.

The simple travel cost method values a single site by observing how much people are willing to pay to visit the site (Mendelsohn and Markstrom 1988). As illustrated below, demand for recreation trips works similarly to demand for other goods and services, i.e., the more trips consumed, the lower the value for an additional trip. The first few trips may be worth much more to an individual than the last trip and people will keep purchasing more of a good until their marginal value exactly equals the price of the good (point C). The model assumes that people will make repeated trips to a site until the marginal value of the final trip is worth only the amount they would have to pay to get to the site.



According to this model, the demand for a site should be a normal, downward sloping demand curve. A demand function is an empirical relationship between the price of a good and the quantity purchased:

$$Q = f(P,Z) \text{ or } V/n = f(TC, Z)$$

where Q is quantity (or V/n, quantity of visits per person), P is price (or TC, individual travel costs), and Z represents a number of socioeconomic variables that might influence the demand function, such as age, income and education.

The per user value of the site as measured by this model is the excess value or consumer surplus of the trips (area A) over and above the individual's travel costs. If all trips were worth just the travel cost (area B), the site would have no value (Mendelsohn and Markstrom 1988). If the site no longer existed, people would have the money they would have spent on taking trips (area B), but they would no longer have the additional value of the trips (area A). Since, implicitly, the earlier trips are worth more than the last trip (e.g., experiencing the delta is more exciting the first few times), then they are also worth more than the travel cost. The economic value of the site (the individual consumer surplus-area A) is the integral under the demand function and above the travel cost from a specific region (price line):

$$CS_{individual} = \int_{P_1}^{P_{max}} f(TC, Z)\,dTC$$

This individual CS must be multiplied by the number of visitors (N) from each region of origin:

$$CS_{individual} \bullet N = CS_{total}$$

The total annual value (W) will be the present value (PV) of the sum of all regional CStotals

$$W = \sum CS_{totals}$$

$$PV_{\lim \to \infty} = W/r, \text{ where r is the real interest rate.}$$

This assumes a constant annual value for the site over time, and therefore a constant stream of future (annual) benefits. Demand for a particular site may be subject to change. This research will establish a value for the Okavango Delta in its current condition. Degradation of the resource or the experience obtained at the resource could change the demand and therefore the economic value of the area.

Multiple Destination Site Travel Cost Model

To obtain an accurate measure of value for the Okavango Delta it is important to measure the value of multiple destination trips. The majority of visitors to the Okavango Delta couple their trip with two other destinations, Chobe National Park in Botswana and Victoria Falls in Zimbabwe; therefore these destinations will be combined and analyzed as a single unique site using the method established in Mendelsohn et al. (1992). Consumer surplus for the multi-destination site will be derived as explained under the simple travel cost model.

Contingent Valuation Survey Questions

Water is a scarce resource in most of Botswana. The Government has recently considered damming and dredging portions of the Okavango Delta in order to increase the water supply to mining, livestock, and agricultural areas. This poses a serious threat to the current size and condition of the Delta. If the only way to preserve the present state of the Delta (and its wildlife) was through a per visit fee collected from tourists, would you be willing to pay a visitation fee (separate from Moremi Reserve fees) to visit the Delta region?

If Yes, how much would you contribute per visit? ____________

Wildlife in Africa is frequently in conflict with the needs of humans for land and resources. Larger populations of animals would improve the game viewing opportunities of visitors like yourself. If we could sustainably increase each population of the following species, how much would you be willing to pay for the chance to increase your sightings of each of the following species by 50%?

Species	Total Payment
1 elephant	________
2 lion	________
3 rhinoceros	________
4 leopard	________

The Contingent Valuation Method

Contingent research involves the use of surveys to elicit how people would respond to hypothetical changes in some environmental resource (Smith 1993).

The Contingent Valuation Method (CVM) questions applied in this research presented two hypothetical scenarios to survey respondents. Both questions asked people's willingness to pay or contribute to the scenario questions (see inset, top). The quantitative results from these questions will be compared to the travel cost values, and to estimate the importance of wildlife to the value of the Okavango Delta. Statistical analysis will be applied to the bid measures obtained in each question.

Data Collection

A two-page questionnaire was administered to approximately 700 domestic, regional, and overseas tourists. Questionnaires and collection boxes were placed at the entrances to Moremi Game Reserve and in the majority of safari camps and lodges throughout the delta. Almost 200 respondents self-administered the survey in these locations. Additionally, several mobile safari operators distributed the questionnaire to their clients while on safari. Over 500 visitors faced direct interview at the Maun Airport and Maun area lodges. In general, people were quite willing to participate in the survey.

The sampling was divided three ways: 1) for the first 3 weeks, all willing participants were asked to complete a questionnaire; 2) for the following 6 weeks, only "qualified" data were asked to complete the questionnaire; and 3) for the entire 9 weeks, surveys were self-administered in camps and lodges. Qualified data were people who were travelling primarily to the Okavango Delta or the multi-destination site region. After the first 3 weeks, tourists on trans-African or around-the-world trips were not asked to complete a survey. Approximately 1 in every 10 tourists qualified as data. Non-English speakers were not interviewed. These facts establish bias in the sample, but this bias will create a more conservative estimation.

Preliminary Results

Data analysis is in progress and no quantitative results can be reported before analysis is complete.

Twenty-one countries of origin were represented in the data set. Very few visitors originated in Botswana. The majority of surveys were administered to multi-destination visitors, although a significant proportion of regional visitors make the Okavango Delta their only destination. Consumer surplus will be calculated for the multiple destination site and is anticipated to be a large component of total site value, where total site value is the present value of the sum of benefits from single and multiple destination trips.

Responses to the CVM questions (inset, left) will be quantified for comparison to values established via travel cost models. The majority of the respondents said they would make a monetary contribution to preserve the present state of the Okavango Delta. Most respondents also made bids for increasing the specific wildlife populations. Interestingly, many CVM respondents voiced concern about increasing "already substantial" elephant populations.

Establishing the importance of wildlife to the recreational visitor presents additional contradictions. Most tourists said they came to view big game animals, but most also said they would still visit the Okavango Delta if there were no large game animals.

The economic value of the Okavango Delta will depend upon the shape of the demand curve for the site. Common sites with ready substitutes tend to have relatively flat demand curves, indicating high use from nearby the site. Unique sites, such as the Delta, tend to have steeper demand curves, indicating extensive use from both far from and near to the site. In this case, consumer surplus and therefore economic value tends to be large.

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Understanding Crane Preservation in Tam Nong, Viet Nam

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After years of napalm, Agent Orange, and free-fire zones, the Mekong delta emerged from the Viet Nam War scarred and tired. In an effort to deny the Viet Cong a base in the politically important Plain of Reeds, the American-supported government declared war on a wetlands landscape of dense, native forests and wild grasslands by clearing trees and digging drainage canals. While this policy did facilitate access to the area by Saigon troops, it also left a radically disturbed ecosystem unable to support the wildlife that once inhabited it. Initiatives to revitalize part of this "original" ecosystem must not only confront the destruction of the past, but perhaps more importantly, the progress of the future.

Introduction

Formerly a one million hectare expanse of wetlands, the Plain of Reeds now only boasts one patch that can claim to be relatively undisturbed. Tram Chim National Park is a 7,000 hectare protected area in Tam Nong district of Dong Thap province. This wildlife refuge is the home to a flock of eastern sarus cranes, which breed in Cambodia and return to Tram Chim every winter to feed on wild marsh grass and fish that the park's monospecific melaleuca *(Melaleuca leucadendron)* forests nurture. It is widely believed that the loss of these forests and grassfields will mean not only the disappearance of a previous ecological system, but the eastern sarus crane as well.

When I first visited the park in 1991 the Vietnamese national government had just declared Tram Chim a national reserve to protect the endangered eastern sarus crane and to preserve the rapidly dwindling area of melaleuca forest. Upon returning this past summer, I found that Tram Chim had been upgraded to national park status, conferring greater attention to the park's survival.

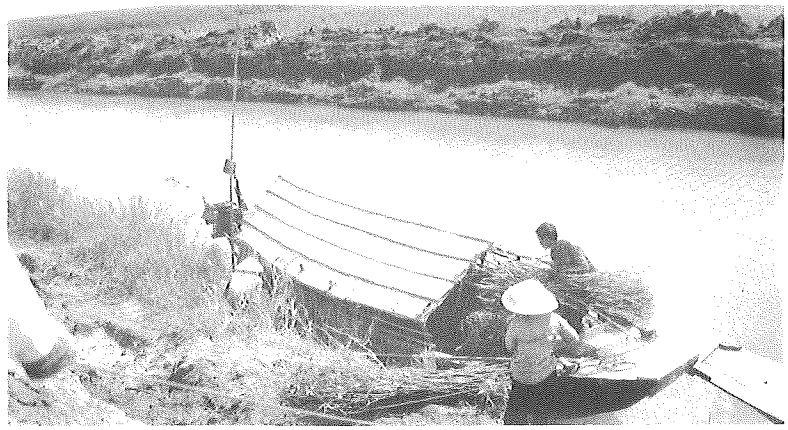
Despite the change in Tram Chim's protection status, park planners report that the cranes and forests are increasingly threatened each year. Information from the International Crane Foundation (ICF) indicates that the number of cranes returning to Tram Chim each winter had plummeted from 981 in 1988 to 365 in 1992. Vietnamese and international consultants attribute this decrease to villagers who "trespass" on the protected area to fish, burn fields to catch rats, collect wood for fuel and construction and occasionally to hunt birds. By looking at land use in Tam Nong district and how it has changed since the area was first settled in 1861, my research, conducted from June to August 1994, aimed at understanding why each year the park is less and less able to fulfill its protection mandate.

The data gathered indicate that in-migration, increasing competition for subsistence resources, tax collection by the local government and the history of land conversion are themes critical to an understanding of villagers' actions.

Research Question

Why has increased attention to Tram Chim as a protected area coincided with a decrease in the park's effectiveness? Tam Nong's cranes have generated interest from governmental and international non-governmental organizations (NGOs), which plan to implement technical projects to regulate water levels and increase acreage under melaleuca forest in and around the park. Coupled with these efforts are educational projects intended to convince the local population of the ecological importance of maintaining a restricted area under melaleuca cover. Though important, these projects overlook the political, economic and social factors causing villagers to fish, burn fields and cut trees in the park.

Methods



Residents of Tam Nong district collect fuelwood from Tram Chim National Park. These people were later caught in the park, and their names were given to local police, after which they were required to go to training in the Park.

My analysis is based upon the assumption that cranes don't return to Tram Chim because of an increasing use of the park by humans. If this is true, an understanding of motivations behind the humans' actions is essential, and my approach draws on history, macro policy and local interviews to explain why the number of cranes continues to decrease in Tram Chim. To understand why people "trespass" on park lands, I interviewed villagers living in the four settlements along the park's edge.

Informants were selected at random, but all obtained their resources locally through farming, fishing, gathering or buying wood and catching rats. Some informants had been caught gathering resources from the park in the past two years by Tram Chim staff, and some were particularly willing and even anxious to talk about how they earn a living in Tam Nong. Almost all knew that Tram Chim had been established to preserve cranes and that it was forbidden to cross into the park.

Interviews were semi-structured and allowed informants to choose what topics to emphasize. To gain a broader scope I asked the same questions to the village-level leaders, who represent villagers' concerns to the district.

Local Interviews

One important concern among informants was the need to produce enough income from their land to pay local taxes, which are set according to the agricultural quality of land. Although the government provides low-interest forestry loans and incentives for planting forest species (Hoe 1992), the implementation of these policies has not yet had a significant impact at the local level. For several reasons, villagers tend to grow highly productive rice crops rather than the melaleuca which government and NGO's encourage them to grow. Those with whom I spoke were reluctant to farm melaleuca, believing their land would be taxed according to its ability to produce rice. Another concern was that growing rice next to melaleuca forests was technically impossible, for the forests harbor rats which feed on rice in adjacent land. In addition, the two crops require different hydrologic regimes. Since a comprehensive system of canals and irrigation ditches has been constructed for intensive agriculture, they find it most cost-effective to plant rice.

Perhaps most importantly, agroforestry for melaleuca fields only generates about half the income as the same acreage planted to rice. Villagers would only plant melaleuca if they did not have enough workers to intensively cultivate their land or irrigation water was not available. As most farmers described an increasing labor glut in Tam Nong due to heavy in-migration and decreasing availability of land, it seems unlikely that labor for rice will be a limiting resource.

Many of those I interviewed had come to Tam Nong from neighboring provinces and districts with scarce land to which they had no access. In native villages surrounding Tam Nong, population increases, rising costs of land and reduced family land were all incentives for villagers to try their luck in Tam Nong, where land was cheap. Those I interviewed had little capital and even less desire to invest in farming melaleuca since, they said, it required up to ten years before they could begin to see any payoff. In addition, informants claimed the increasing population and the ever growing scarcity of uncultivated land continues to stiffen the competition for fish, fuelwood, and other natural resources, thereby underlining the importance of turning a quick and productive harvest which can be traded for other necessities. Seen from this perspective, it is hardly surprising that villagers maximize short-term resource use on their own land and in the park.

Local History

Using the same interview techniques, I gathered information on local history from ten individuals who had lived in or around Tam Nong since the 1940s. Of those ten, all were farmers, and had brought their families to live with them in Tam Nong. Questions centered around when people began to move to the district; when and why canals and roads have been built; how land has been used in the past; how the landscape, vegetation and fauna have changed over time; and how these elders felt about Tram Chim's efforts to preserve the crane and melaleuca forests.

The general picture I gained of Tam Nong's history led me to focus on the construction of infrastructure and incentive programs encouraging migration to this marginal area — both before 1975 and after — as the main reasons why the cranes return to Tram Chim in ever decreasing numbers.

National History

Fitting the crane preservation problem into a national, international and historical context requires a step back from the local scene. Historians' accounts of Vietnamese culture agree on the importance of the Vietnamese people's historic push southward in the creation of modern Viet Nam (Cotter 1968, Dao 1993, Hickey 1964).

Tam Nong is one of the current edges of this southward push. The problem of crane conservation in Tam Nong thus demands an understanding of the settlements which have accompanied this expansion. Since 218 B.C., Vietnam has spread both geographically and culturally (Hickey 1964). Military successes to the south have historically opened up new land to successive waves of migrants from densely populated northern villages. By opening up new land and providing roads and canals, the Vietnamese government was able to culturally and ecologically integrate these newly acquired territories. This process placed villagers familiar with the agricultural practices and social organization of the densely populated northern lowlands in unfamiliar lands, where they created new homes by transforming wild forest into agricultural land. With the consolidation of the nation's borders in 1789, the settlement of marginal areas within national borders that had yet to be brought under cultivation took precedence (Cotter 1968). Landless villagers could raise their standard of living by continuing to occupy new spaces within rather than outside the nation's borders. One consequence of this closing of the frontier was the extension of agriculture into increasingly marginal land.

The historic encouragement of villagers to use intensive agricultural practices was probably neither accident nor simple nostalgia. Jim Scott (1976) believes that precolonial mainland Southeast Asian states formed where irrigated rice provided a taxable economic base for a surplus slated for national distribution or for providing national income to pay for roads, schools and national security. The process of agricultural conversion of marginal areas within Viet Nam thus may have served the economic interests of the nation. Some historians such as Michael Cotter (1968) emphasize the security element. The creation of "defense colonies", he says, allowed for the integration and protection of southern lands.

These two hypotheses indicate that conservation in Tam Nong faces a historical trend of taming wild lands, and this trend may dwarf the technical and educational solutions proposed by national and international conservation programs.

National Policies For Economic Development

According to my interviews, a major land use change affecting resource use in Tam Nong coincided with the end of the Vietnam War in 1975. With the victory of the Viet Cong and the establishment of a stable government, land was viewed in terms of its productive ability. Like many governments in the developing world, the newly established Socialist Republic of Viet Nam saw natural resources as valuable only if transformed by human labor into useable products (Beresford and Fraser 1992). Begun after the end of the war (Huyen 1994), the New Economic Zone (NEZ) program has helped maximize the country's natural resources by relocating landless, rural poor to land-rich areas. Professor Lam Quang Huyen of the National Institute for Social Sciences revealed that surplus harvests have indeed been generated from NEZ areas, and that as long as land remains available, the landless will continue to be encouraged to occupy NEZ areas (Personal communication 1994).

The NEZ program came to Tam Nong in the form of canals for irrigation and roads for transportation. Locals agree that infrastructure development helped boost production and encouraged replacement of one annual crop of floating rice with two crops of chemical fertilizer-enhanced, high yielding varieties. Given the continued emphasis on production, then, it is easy to see why individuals within the national and local government have vested interest in continued infrastructure development in Tam Nong. Rice export has become a major earner of foreign exchange and there are powerful incentives for officials on all levels to struggle for maximal rice productivity. Their efforts have seen success: in 1989 Viet Nam became the world's third largest exporter of rice (Xuan 1992).

The Confluence of District, History and Nation

Given the international context of a nation trying desperately to "catch up" with the booming economies of Southeast Asia and the historical context of migration southward, it is clear that the local resource users in Tam Nong are in a no-win situation. The villagers with whom I spoke were exasperated with the increasing competition for necessary resources and complained of their increasing inability to feed their families. Under these circumstances, can they realistically be expected to respect Tram Chim's borders?

Although migration seems to be decreasing thanks to the overall economic development of the country, Tram Chim seems still to be suffering the residual effects of the NEZ policies which played such an important role in the period immediately after the war. Although there are trends away from the large scale migrations of the past, as long as there is land available and channels of access to Tam Nong, people will continue to take advantage of it and increase the pressure on its resources. Forces emphasizing economic production and national integration have pushed farmers into marginal lands where they can't help but restrict the cranes' habitat. To miss this fact is to doom existing technical solutions to failure.

Implications for the Future

Efforts by organizations interested in crane conservation might best be directed at developing employment opportunities in the most densely populated provinces experiencing out-migration or developing alternatives to expansive irrigation and transportation projects. In lieu of these large-scale, controversial changes, a particularly relevant direction for research is on the development of local property tenure systems and rules of access to regulate resource use. Better understanding of how these systems might develop will contribute to a better understanding of how local resources can be conserved.

Acknowledgements

I would like to thank Ngo Quoc Thang (T.C.), for sponsoring my work at Tram Chim; H.D. Thu Thieng, for helping wade through hours of interviews; and Thân Hoang Dan, for being a great guide.

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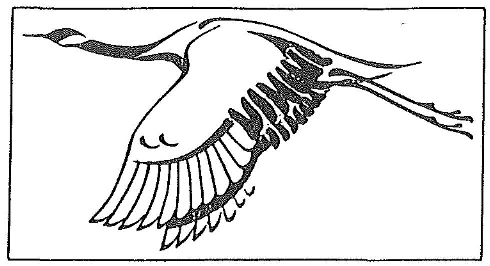

Recent Tropical Literature

Joe Miller, Librarian and Lecturer
Yale School of Forestry and Environmental Studies

General

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TRI Working Papers (1993-94)

TRI Working Papers are available from the TRI office for the prices listed below. If you are interested in ordering one of the working papers below or in seeing a complete Working Paper List, please send payment (in US$ or international money order) and request to TRI Working Papers, 205 Prospect Street, New Haven, CT 06511, USA. Overseas shipping requires an additional US$1.00 per paper.

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#63 A Comparison of Streamflow from Agricultural and Forested Watersheds in the Middle Hills, Nepal. Arjun Heimseth. Tropical Resources Institute, 1993, 67 pp. $7.50.

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#73 The Reproductive Ecology of Philodendron giganteum, Anthurium crenatum, and Anthurium dominicense (Araceae) in a Moist Subtropical Forest in Puerto Rico. Jane Whitehill. Tropical Resources Institute, 1994, 95 pp. $7.50.

#74 Root Biomass and Distribution Under Plantations of Native Tree Species, Grass and Secondary Forest Vegetation in the Atlantic Lowlands of Costa Rica. Eirik Stijfhoorn. Tropical Resources Institute, 1994, 35 pp. $5.00.

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#77 Four Experiments Investigating the Decomposition Rates and the Potential Use as Mulch of Four Indigenous Tree Litters in the Atlantic Lowlands of Costa Rica. Kristin Ramstad. Tropical Resources Institute, 1994, 50 pp. $5.00.

#78 Environmental Conservation in Southern Bahia, Brazil: Designing and Implementing a Sustainable Development Program. Robert Vámos. Tropical Resources Institute, 1994, 73 pp. $7.50.

TRI Notes

Dear Readers,

This fall, the Tropical Resources Institute sponsored a tropical photography contest for students, staff, faculty and alumni of the Yale School of Forestry and Environmental Studies. There were two entry categories, social and landscape, with a combined entry total of 62 photographs. Participants had difficulty choosing a "winner", but we did manage to tally the top ten photographs. First place in the social category went to Jonathan Scheuer (MES Candidate, 1995 and 1994 TRI Intern), while 1993 Intern Robert Vámos (MES Candidate 1994) received first place in the landscape category *(see photographs, pp. 43 & 60)*. The ten chosen photographs will be hung in Sage Hall, marking the School's commitment to tropical research. The cover photograph was also among the contest entries and was taken by 1994 TRI Intern, Lydia Olander (MFS Candidate, 1995). Look for Jonathan's and Lydia's studies in the next issue of *TRI News.*

Each year TRI receives an increasing number of applicants for funding. This year over forty students (over one-third of the 1994 class) sought funding for the summer Internship Program. It is exciting to see the enthusiasm, creativity and thought that our students put into their tropical research, and we hope that our programs will continue to grow and contribute to sustainable management of tropical systems.

In this issue you will find a brief description of our Internship Program (next page). If you are interested in collaborating with a Yale FES Student, please fill out the form and send it in! Also in this issue are recent TRI Working Papers. In addition to the articles you find here, each TRI Intern produces a Working Paper, which presents comprehensive methodology and results. These Papers are available for purchase from the TRI Office *(see p.61)*.

Please also note the upcoming ISTF Conference *(p.34)*, hosted by the Yale Chapter of the International Society of Tropical Foresters, to be held 10-12 February 1995 at Yale University, and the additional workshops and happenings below.

We hope that *TRI News* continues to be of interest and use for your work in the tropics.

Sincerely,

Victoria Derr
Managing Editor

Cooperator's Notes

Smart Wood, the Rainforest Alliance's timber certification program, recently certified two companies, Tropical American Tree Farms of Costa Rica and Highland Trading Company of Vermont. These certifications bring the total of Smart Wood-certified participants to 22.

The Smart Wood program is the oldest and largest forestry certification program in existence. Experts award approval to forest managers and loggers around the world who can prove that they are maintaining or restoring the forest's capacity to regenerate itself, controlling ecological effects and returning benefits to local residents. Certification is also awarded to companies that sell Smart Wood products.

Tropical American Tree Farms, operating on 3,300 acres in Costa Rica, has so far planted more than 350,000 tropical hardwood trees of more than 35 different species on abandoned pasture land.

Highland Trading Company, of Vermont, is a user of Smart Wood-certified lumber rather than a producer. They manufacture racks for audio tapes and compact disks using woods like chakte-kok from a community forest project in Mexico.

For more information on the Smart Wood program, please contact Helena Albuquerque at the Rainforest Alliance, 65 Bleecker Street, New York, NY 10012, USA; phone (212)677-1900.

Nitrogen Fixing Tree Association (NFTA) will be hosting an **International Workshop on Nitrogen Fixing Trees for Fodder** from 20-25 March 1995 in Pune, India. Registration deadline is 10 February 1995, and the fee is US$100. Limited financial assistance is available on a competitive basis. Please address correspondence to: Dr. Joshua N. Daniel; Nitrogen Fixing Tree Association; c/o BAIF, Kamdhenu; Senapati Bapat Road; Pune 411 016; INDIA; TEL 0212-342621; FAX: 91-212-349806.

CAB International has published a new book entitled ***Modelling Forest Growth and Yield: Applications to Mixed Tropical Forests*** (336 pp., ISBN 0 85198 913 6, £40.00 or US$67.50). Written by J.Vanclay of the Royal Veterinary and Agricultural University, Denmark, the book reviews different approaches to modelling mixed forests. Because of their proven utility, it emphasizes empirical-statistical models rather than physiological-process models. Each chapter includes relevant exercises. The book serves as a reference manual for practitioners and as a text for advanced level courses in forest modelling.

Internship Program Expansion

The Tropical Resources Institute (TRI) is currently expanding its Internship Program database in order to increase the number of internship opportunities available to students of the Yale School of Forestry and Environmental Studies.

Each summer approximately 20 students are awarded funding for internships based upon a faculty committee's review of proposals. Among the requirements for funding is that the student have a collaborator with whom the project will be conducted. Only research-oriented proposals are accepted, but collaborations where a student will be contributing to ongoing projects are highly encouraged.

Project proposals are reviewed for funding in January/February of each year by the Tropical Studies Committee; most students therefore establish firm contacts by December for the following summer's work.

The Internship Program is designed to promote research in a broad range of disciplines concerned with the social and ecological aspects of tropical ecosystems. Articles in this journal are the preliminary results of TRI Internship Projects.

If you are interested in the possibility of working with a TRI intern, please detach and complete the form below. Please indicate the types of research opportunities which might exist with your organization or institution.

If you have a specific project that might be appropriate for an internship, TRI will advertise this information in the School's internal newsletter so that interested students may contact you for more details.

Please contact Nuria Muñiz-Miret, Project Coordinator, at the boxed address below if you have any questions.

Internship Program, *Expression of Interest*

Please return this form to:
The Tropical Resources Institute
Yale School of Forestry
& Environmental Studies
205 Prospect Street
New Haven, CT 06511 USA

Contact Name(s)
United States:
Foreign:

Name and address of Institution:

Telephone:
FAX:
e-mail:

Description of institution's work, including site description, scope of project, number of years of project operation and potential for future continuation. Please attach a separate sheet if necessary and enclose any relevant brochures or literature.

Proposed internship project. Please include any preferred qualifications or language requirements.

Provisions (e.g. in-country room/board, air ticket, in-country transportation, etc.) that you/your institution could possibly provide.

Articles

The Tropical Resources Institute sponsors research projects in tropical studies concerning the sustained management, restoration and conservation of tropical ecosystems. TRI News articles are produced by master's and doctoral students of the Yale School of Forestry and Environmental Studies who are working on these projects. Opinions expressed in these papers represent the views of authors only and not those of Yale University or TRI.

For more information about the Tropical Resources Institute contact:
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