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Extraction of Non-timber Forest Products in Biligiri Rangan Hills, India: Monitoring a Community-based Project

KAMAL S. BAWA, S. LELE, K. S. MURALI, AND BALACHANDER GANESAN
Department of Biology, University of Massachusetts, Boston; Tata Energy Research Institute, Bangalore, India; Tata Energy Research Institute, Bangalore, India; Biodiversity Conservation Network, Philippines; respectively

INTRODUCTION

Human societies throughout the world derive vast amounts of goods and services from their surrounding natural ecosystems. The livelihoods of millions of people depend upon the continuous stream of materials and other benefits from their immediate surroundings. These livelihoods would not have been sustained for millennia without strategies designed to conserve the resource base. Indeed, most societies that rely on natural resources have evolved cultural and social practices to discourage their overexploitation.

In recent years, however, a number of forces have disrupted these traditional practices. Perhaps the most important of these changes is a shift in economic control of resources from indigenous groups to a loose alliance of outsiders, including traders, large landholders, and government organizations and their bureaucrats. In some cases, this shift started long ago. During the last century in British India, the colonial regime started to expropriate large tracts of forest for reserves that were to be brought under scientific management to meet the needs of the Raj and the empire (Gadgil and Guha 1993). Colonial authorities severely curtailed traditional rights of forest dwellers or relegated them to community forests; these forests, being too small to meet the needs of local communities, were soon degraded.

It is now well recognized that, in much of the developing world, progress toward conservation of biodiversity in natural ecosystems requires returning tenured control over ecosystems to local people. Such a shift in control would have to be accompanied by economic incentives to conserve biodiversity. The Biodiversity Conservation Network (BCN) project is designed to test the idea that economic benefits derived from local biotic resources, combined with control over these resources, can motivate local communities to conserve biodiversity.

Our project centers on extraction of non-timber forest products (NTFPs) by Soliga tribes, who have inhabited the Biligiri Rangan (BR) Hills region of South India for millennia. The Soligas traditionally engaged in shifting agriculture and hunting. Soligas also collected a wide range of NTFPs, initially for their subsistence needs, but later for forest contractors as well. Government has discouraged shifting agriculture since the late nineteenth century, and completely banned shifting agriculture and hunting with the declaration of much of the area as the Biligiri Ranganswamy Temple (BRT) Wildlife Sanctuary in 1974. This legislation allocated the Soligas small pieces of land where they could practice settled agriculture. However, the extraction of NTFPs continued under the aegis of tribal cooperatives, or Large-scale Adivasi (tribal) Multipurpose Societies (LAMPS). The LAMPS serve as vehicles for tribal development, particularly to ensure full return on the collection of NTFPs to which the tribals were given sole rights.

The BRT Wildlife Sanctuary is approximately 540 km^2, and is under the jurisdiction of the Karnataka

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State Forest Department. Approximately 4,500 Soligas live in 25 *podus*, or settlements, scattered throughout and on the fringes of the sanctuary. Soligas practiced settled agriculture on the lands allotted to the households. The average size of the landholding is 0.6 ha (1.5 acres), but approximately 30% of the households lack access to cultivable land. Extraction of NTFPs is the major source of income (Hedge et al. 1996). The existing situation with respect to NTFP harvesting and marketing in BR Hills is shown in Figure 1a. The Soligas harvest NTFPs and sell them to the cooperative marketing society, the LAMPS, which holds the harvesting rights on lease from the Forest Department. The LAMPS then auction the raw NTFPs to the highest bidder.

In terms of amounts extracted and revenue generated, the most significant NTFPs are nelli (*Phyllanthus emblica*), gallnut (*Terminalia chebula*), taarekai (*Terminalia bellirica*), soapnut (*Sapindus emarginatus*), shikekai (*Acacia concinna*), lichens, and wild honey. Our preliminary studies (Hedge et al. 1996; Murali et al. 1996) indicate that the Soligas (1) rely heavily on NTFPs as a source of cash income (they earn more than 50% of total income from NTFPs); (2) derive inadequate returns from the NTFPs due to a lack of value additions at the point of harvest (Uma Shankar et al. 1996); and (3) have little control over harvest with respect to amount, location, and timing of the collection. Preliminary findings also suggest that many species yielding NTFPs are inadequately regenerating, possibly due to overharvesting.

The project described herein is designed to increase the economic stake of the Soligas in conservation of their biotic resources and to increase their capacity to ensure the ecological sustainability of these resources and the larger ecosystem. The project seeks to enhance economic stakes by increasing Soliga income from NTFPs by processing several of the extracted products at the collection site and marketing them directly, in order to capture a greater share of the final value. Sustainability is to be achieved by establishing a community-based biological monitoring and feedback system that will regulate NTFP extraction and ecosystem health and by strengthening the local community's access to and control over biotic resources. Vivekananda Girijana Kalyana Kendra (VGKK), a nongovernmental organization (NGO) in the BR Hills region devoted to Soliga welfare, collaborated in the design of the project.

The central aim of the project is to create an enterprise the Soligas will operate. The Soligas will process some of the NTFPs collected through the LAMPS and sell the processed items in the market to generate profits for the local community, while simultaneously ensuring sustainable NTFP extraction and broad-based development. Thus, the enterprise will ultimately include a processing and marketing unit, a biological unit to ensure sustainable utilization of the biotic resources, and a community outreach unit to ensure broad-based participation of the local communities and an equitable flow of benefits to the community. Figure 1b depicts the desired situation schematically. Specifically, the processing and marketing unit will purchase at least four NTFPs (honey, nelli, soapnut, and shikekai) in raw form from the LAMPS; it will then process and market the products so as to capture the highest possible fraction of the final consumer prices.

The objective of the biological unit of the enterprise is to set up a system of resource monitoring to provide continuous information on the extent to which the NTFPs are being sustainably harvested, and to identify the modifications that might be needed in the harvest and management of forest resources. This involves establishing systems for information collection, analysis, and dissemination at two complementary levels: the community level (necessarily simpler and by rule-of-thumb) and enterprise level (more sophisticated, by scientifically trained staff).

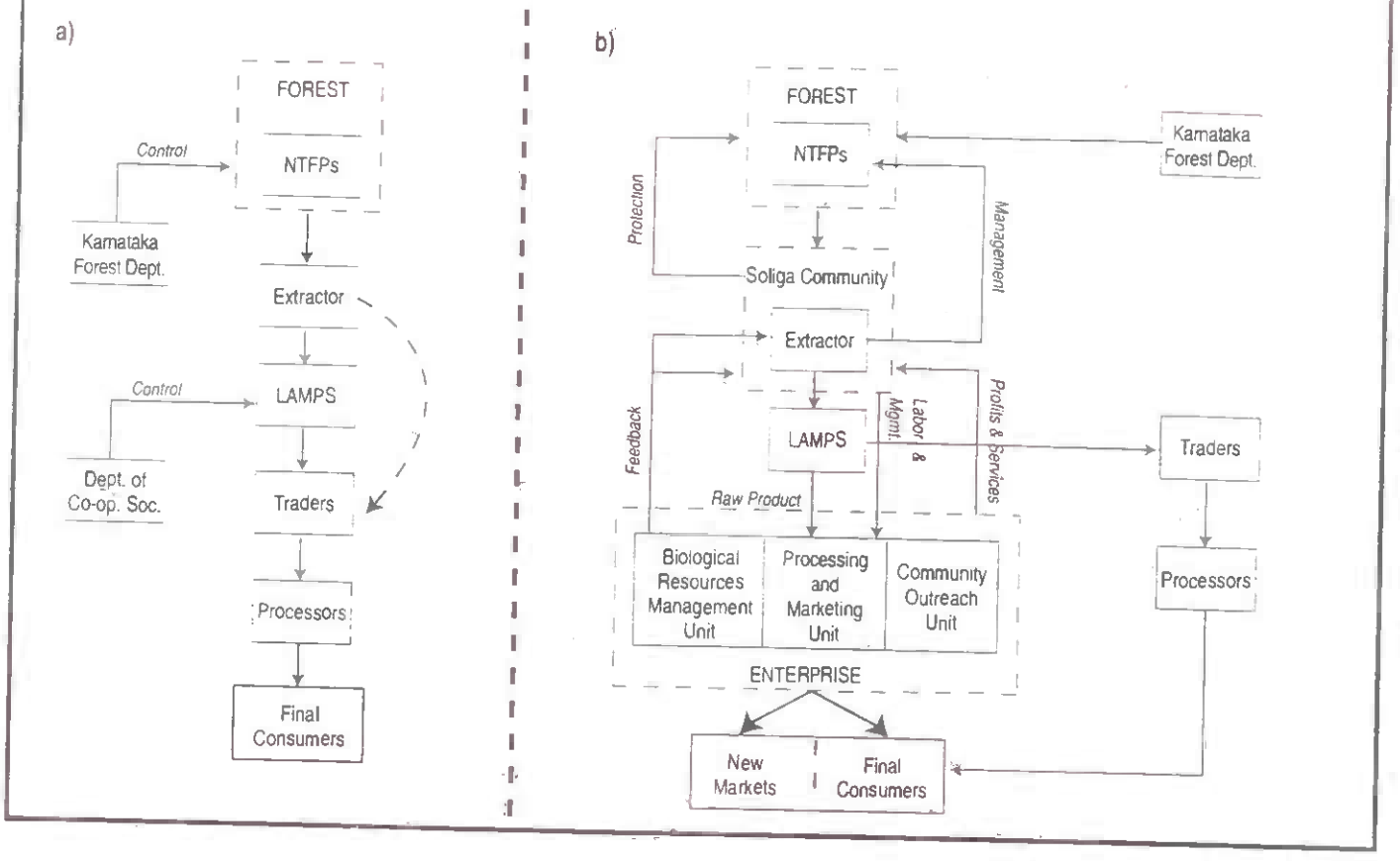
The primary objectives of the community outreach unit of the enterprise are to ensure participation in, training for, and ultimate handover of the food processing unit (FPU) to the Soligas, and to facilitate the establishment of a community-based biological monitoring system. Another objective of this unit is to reform the functioning of the LAMPS, which is critical to making project benefits broad-based and to strengthening community control over forest resources.

In order to achieve these objectives, it was necessary to initiate a monitoring program that would continuously evaluate our success in meeting project goals and would provide ecological and socioeconomic inputs for the project operation, as well as for the conservation of biodiversity.

In the following sections, we first describe the current status of the enterprise and related biological and community outreach units. We then describe the concepts, objectives, and results of the monitoring program. We also indicate how we modified the project activities in response to the findings of the research and monitoring program. We conclude by offering some comments on the concept, methods, and usefulness of monitoring, and constraints in its implementation.

Figure 1

Flow of NTFP and Management Inputs a) Before the Project and b) Envisioned Flow of Goods and Services at the End of the Project



Enterprise-related Action Program

The action program was initiated in March 1995. The progress achieved toward establishing the processing and marketing unit, the biological unit, and the community outreach unit of the enterprise is described below.

Processing and Marketing for Income Generation

The processing and marketing unit is a conglomerate of value-adding activities/units, which are described under four headings: Honey Processing Unit (HPU), Beekeeping Activities (BKA), Food Processing Unit (FPU), and Herbal Medicinal Plant Unit (HMPU). The main features of and physical targets achieved by each value-adding activity/unit are described below, followed by a brief summary of the marketing strategies adopted, the net profits generated, and the level of Soliga staff training achieved.

Honey Processing Unit

The honey processing unit, located in BR Hills, is designed to process honey, currently collected primarily from wild rock bees (*Apis dorsata*). Work on the unit began in 1995, with procurement of equipment. The unit started to function in the beginning of 1996, the second year of the project. It has the capacity to process 30 tons of honey per year. In 1996, the unit processed 8 tons of honey. The total revenue generated in 1996 from honey was 700,000 rupees; the profit margin is approximately 20,000 rupees per ton.

Beekeeping Activities

In 1996, the project initiated beekeeping operations to harvest honey from another species, *Apis cerana*. The project started approximately 34 colonies in two localities. VGKK managed 20 colonies (at a relatively higher altitude), and individual households managed 14. A viral sac brood disease completely decimated the colonies at VGKK; only those located at a relatively low altitude survived. In 1997, the project will establish approximately 150 colonies at various settlements at lower altitudes. The HPU will purchase the honey obtained from beekeeping.

Food Processing Unit

The food processing plant, located in BR Hills, is intended to process pickles, jams, honey, and other food products. The plant processes the fruits of *Phyllanthus emblica* into jams and pickles. In 1996, the plant processed 500 kg of pickles on a trial basis. In 1997, the target was 2,000 kg, with a profit margin of 1,000 rupees per ton.

Herbal Medicine Processing Unit

The HMPU is located at Yellandur (24 km from BR Hills). VGKK originally conceived of and started the unit with funding from the Foundation for the Revitalization of Local Health Traditions (FRLHT). During the planning grant phase of the BCN project, a team from the University of Massachusetts and the Tata Energy Research Institute had confirmed the potential for such an enterprise. When funding for the herbal medicine factory ran out in 1994, VGKK needed funds to procure equipment and machinery, as well as working capital to run the unit. The project invited BCN to take over the unit and to provide inputs on major policy issues, such as management, linkage to conservation of biodiversity, and distribution of profits. During the one year since its inauguration, the Unit has processed and produced more than 10 Ayurvedic drugs. It took much effort and time to forge a marketing arrangement with a major Ayurvedic pharmaceutical company.

Marketing

To facilitate marketing, the project has obtained the necessary regulatory approvals and registered trademarks. In particular, the HPU has obtained "Agmark" certification (a certification of honey quality from the Indian Standards Institution). The FPU has received FPO certification. Both units market their products under the registered trademark "Prakruti" (meaning "nature").

The project has followed a conscious strategy of product and channel diversification in marketing these products. The HPU currently markets honey through the state-owned Khadi and Village Industries Commission, and through wholesale and retail outlets in Bangalore. The FPU will use the same outlets for its products. The project also has opened a retail outlet in BR Hills, which sells all of these products. The HMPU has signed a Memorandum of Understanding with a major Ayurvedic drug company for technical assistance and buy-back. The HMPU is also selling herbal medicines to a Swiss Ayurvedic physician for export markets. However, projected sales upwards of Rs 1 million (over $30,000) in 1996 with a profit margin at 50% have not materialized due to low product quality and staff turnover.

Employment

The HMPU and the FPU provided a source of income to Soliga workers during 1996; Soligas earned Rs 60,000 from the FPU and Rs 12,000 from the HMPU. Skill improvement has been significant on the production side. It is estimated that the Soligas will manage all production activities in the HPU within a few more months. The HMPU has been less successful in providing Soliga employment because the unit is located too far away from the sanctuary. With the viral disease in domesticated beehives still not under control, the beekeeping activities have not yet generated any significant person-days of work for the community.

Enterprise-based Biological Resource Monitoring

Early on in the project, as a result of the BCN-organized Monitoring Workshop, it became clear that monitoring of changes in biological resources or diversity during the three-year life of the project would be unlikely to yield any conclusive results. This is true not only because environmental variability makes it highly unlikely that trends in biodiversity (or for that matter, in incomes) can be spotted within three years, but also because there are typically delays in getting the income-generating activity off the ground. Thus, we saw a clear need to set up a resource monitoring system that would continue beyond the life of the project.*

We visualized enterprise-based biological monitoring at two complementary levels: a simpler, community-based monitoring system and a more scientific system using ecologists employed by the enterprise. The biological research team working on the project currently

* It should be noted that most of the medicinal plant species required by the HMPU are not in the list of NTFPs that the Forest Department permits the LAMPS to harvest. Until collection from the wild is allowed, the HMPU will meet its needs through purchases in the open market and through encouraging cultivation in the *podus* and villages with a buy-back guarantee. (Executed in collaboration with a MacArthur Foundation-funded research project. Ecology, Economics, and Institutions of Forest Use, being carried out by the Institute for Social and Economic Change, Bangalore.)

plays the latter role. Starting in late 1996, one of the ecologists on this team began to work about half-time directly with the enterprise.

Progress toward setting up the community-based resource monitoring system has been slower than expected. The project has trained select Soligas in systematic monitoring of resource extraction and in estimating the availability of NTFPs; the project, however, has not yet generated community participation and interest. Toward the end of 1996, the project conducted a training program on participatory resource mapping. In January 1997, the project initiated a comprehensive program of participatory monitoring of nelli harvest and regeneration, which included preharvest discussions, online monitoring of harvest percentage, surveys of the presence of parasites and seedlings, and postharvest feedback sessions on six harvest days. The response was encouraging; similar efforts were planned for other products during 1997.

Community Involvement, Empowerment, and Benefit Distribution

VGKK has been working for Soliga development for the past 15 years, and most of its staff and board members are Soligas. The enterprise activities have been based physically and operationally at VGKK, which had already initiated a number of vocational training programs and even some small-scale processing activities with the Soligas before our project began. Thus, in one sense, the Soliga community has been aware of and involved in the enterprise from the start. On the other hand, the community outreach unit is still quite far from its goal of true community involvement; i.e., making the enterprise activities entirely owned and controlled by the Soligas. The meetings of the Soliga Managing Committee to oversee the enterprise activities initially evoked little response, but the community outreach program has generated increased interest in the community.

Efforts to reform the functioning of the LAMPS have evoked a somewhat more enthusiastic response from the community. These efforts focused on two levels: reforming the local LAMPS and changing general statewide policies toward LAMPS. The former involved the BR Hills Soliga community, while the latter targeted the Karnataka-wide tribal community. At the local level, reform efforts have generated greater awareness in the community about malpractices occurring in the LAMPS. Soliga members of the LAMPS are demanding revisions in the pricing system, and there have been some attempts to improve the NTFP tendering/auctioning system. At the state level, the project's efforts have generated significant momentum among tribal organizations and tribal development NGOs to push for LAMPS policy reform. This has resulted in the drafting of a detailed action plan that is being finalized and submitted to the government (Lele et al. 1996).

Monitoring Program: Concepts and Methods

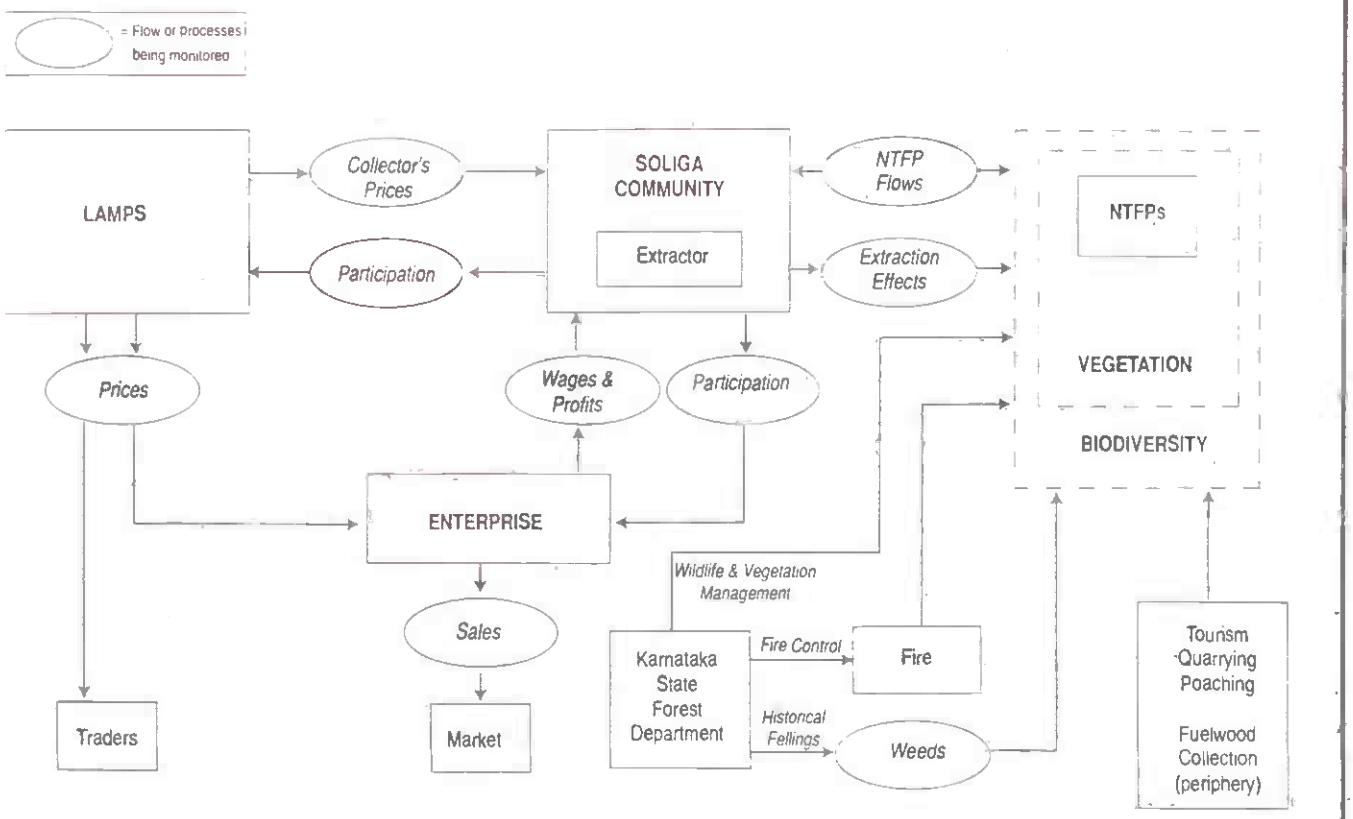
Experience in rural development projects around the world has shown that projects that do not define clear targets and parameters of success and that lack a formal system of monitoring progress toward these targets, often do not succeed in reaching their goals. In projects involving biological resources, the case for systematic monitoring is even stronger due to the difficulty in determining whether a project has made resource use sustainable, enhanced resource productivity, or stemmed the loss biodiversity. Our monitoring program is designed to measure success in establishing the enterprise, as well as success in the support activities that sustain the enterprise.

BCN explicitly tests the hypothesis that enhancement of economic stakes in the biological resources will lead to biodiversity conservation. Hence, BCN also made it mandatory that the project include components that would rigorously monitor changes in biodiversity and economic well-being. Figure 2 depicts the monitoring scheme developed for this project. It involves tracking various parameters of the interactions among the local community, the enterprise, and the biological resources in the sanctuary.

As discussed previously, however, it became clear early on that a three-year period would be too short to yield data to prove or disprove this hypothesis. We responded by making the establishment of a long-term community-based monitoring program a primary objective of the project. Simultaneously, we realized that the term *monitoring* needed to be interpreted in two additional ways. In a literal sense, and in BCN's usage, the term *project monitoring* strongly suggests the use of time-series data to provide midcourse corrections. However, applied research on biological and socioeconomic phenomena, using a combination of historical and cross-sectional data, is also needed to help in project planning, problem solving, and innovation.

For instance, although the biological unit was originally intended to monitor the status of biodiversity con-

Figure 2
Interrelationships among Soligas, Enterprise, and Biodiversity



servation after the initiation of enterprise activities, substantial ecological research was necessary to identify the most important parameters to be monitored. Similarly, the socioeconomic monitoring was originally intended to record the manner of distribution of project benefits. However, an understanding of Soliga community structure and activities was necessary to estimate likely obstacles to community participation in the processing unit and to search for solutions to overcome these obstacles.

Thus, our activities can be better described as an "online project monitoring and research program" that not only helps determine the degree of progress toward project objectives, but also enables the actualization of enterprise objectives through critical feedback from new information, analyses, and ideas. The specific objectives of this broader monitoring program are described below in three parts, along with brief descriptions of the methods used in each case.

Enterprise Unit Monitoring

The monitoring program for the processing units for the first two years aimed to focus on the viability of the enterprise. Specifically, the objectives were to (1) analyze the profit performance of the processing units, (2) evaluate staff performance and training requirements, (3) determine the success of coordination with biological and community outreach activities, (4) evaluate the success in marketing of different products, and (5) undertake a full costing of the products.

Monthly staff meetings monitored the progress of the enterprise unit toward achieving its goals. The staff meetings, in fact, monitored the success of the entire project. In addition to monthly meetings, there were formal and informal discussions among staff members with BCN staff visit teams and management experts. The methods were not formal or systematic. However, as the project progressed, we began to identify clear targets and formal approaches to meet those targets. Progress toward achieving these explicit targets is now reviewed during staff discussions and at monthly meetings.

Biological Research and Monitoring

We designed the biological program to collect basic information about the distribution of resources and the

factors that influence productivity, regeneration, and population growth. Furthermore, the program sought to identify parameters and techniques that the Soliga community could use to monitor and ensure the sustainability of resource utilization. For the first two years, the objectives were to (1) map the distribution and abundance of NTFPs, as well as the distribution of various landscape and vegetation features; (2) determine the effect of harvest, weeds, and fire on regeneration of NTFP species; (3) analyze spatial and temporal variation in productivity and investigate the role of such factors as parasites and diseases on productivity; (4) estimate the levels of extraction and production; (5) explore the potential for beekeeping; and (6) identify parameters and rules-of-thumb for community-based biological monitoring of at least two NTFPs (honey and nelli).

Distribution and Abundance of Species (Landscape Maps)

The project digitized survey of India maps and Forest Survey of India maps, showing vegetation cover, to produce maps that could be updated and used to quantify patterns of change in forest cover and distribution and abundance of species. Moreover, other ecological and socioeconomic information, such as the location of villages, human population density, and patterns of extraction, can be incorporated. The maps also serve as a basis for tracking resource availability and extraction by the community. Ultimately, we expect to have personal computer-based hardware, software, and expertise to update the maps at the field site.

The project undertook a complete survey of NTFPs and other plant species in the entire 540 km^2 of the sanctuary. For this purpose, we divided the sanctuary into 125 equal-sized grids. In each grid (4 km^2 each), a plot 80 × 5 m was laid in the center and all trees greater than or equal to 1 cm diameter at breast height (dbh) were enumerated. Four 1 m^2 quadrants were established in each plot to enumerate herbs, seedlings, and saplings. We are now analyzing these data to ascertain the distribution and relative abundance of various species. The data, once incorporated into the digitized maps, will produce detailed visual images of the distribution and density of various species.

Effect of Harvest on Regeneration and Population Growth

The project is using several approaches to examine the impact of harvest on regeneration and population growth. The first approach consists of establishing transects in areas close to and far from human settlements. Project staff then examine the population structure of NTFPs to compare the distribution of different size classes in the two sets of transects. The second approach consists of harvesting fruits with different levels of intensity (25, 50, and 100%) and then determining the number of seedlings under these focal trees. The third approach examines population dynamics on the basis of recruitment and mortality of various size classes and determines population trends. Thousands of individuals of various size classes in three species, *Phyllanthus emblica*, *Terminalia chebula*, and *T. bellirica*, have been marked and are being monitored for this purpose.

Productivity

Assessing spatial and temporal variation in productivity is critical to determine the levels of harvest that might be sustainable. We are following the phenology of five major NTFP tree species: *Terminalia chebula*, *T. bellirica*, *Phyllanthus emblica*, *Sapindus emarginatus*, and *Acacia sinuata*. We are monitoring the phenology of 50-100 trees of each species, located in different parts of the sanctuary, every month, and estimating crop sizes for each tree.

In order to estimate the productivity of honey from the wild bee *Apis dorsata*, the project established 17 transects along streams throughout the entire sanctuary, as we found that the majority of hives are located around trees close to streams. We also measured the length of these streams. The product of the total length of streams and average number of hives per transect provides an estimate of the total number of hives in the sanctuary. In addition, we have measured the yield of honey from individual hives while the tribal people were collecting honey. The product of total number of hives and the average yield per hive will give us the total production potential of honey across the sanctuary. In addition to transects, we have also collected data on the total number of hives present on rock cliffs within the forest. We have marked 23 rock cliffs, and are periodically observing these cliffs. Project staff visit the transects and cliffs twice a year (June and November).

Levels of Extraction

We are estimating the amount of NTFPs extracted as a percentage of total productivity. Data on extraction patterns is being collected by direct observation in the field, and on the basis of interviews at the household and *podu* levels. Extraction patterns, on the one hand, are being related to ecological features, such as abundance and

tree size, and, on the other hand, to household variables to ascertain biological, as well as socioeconomic, determinants of resource use and harvest.

Parameters for Community-based Biological Monitoring

Our approach to community-based biological monitoring is based on results from ecological, as well as socioeconomic, surveys designed to collect information about traditional Soliga resource management practices. Thus far, we have not encountered much meaningful information from the socioeconomic surveys in relation to the traditional knowledge of resource use. Ecological research indicates that parameters to be monitored are productivity, levels of extraction, density of seedlings, and incidence of parasitism or disease.

Socioeconomic Research and Monitoring

The project redesigned the socioeconomic program to focus broadly on the factors influencing NTFP extraction, overall patterns of economic activity and social relations in the community, and the role of formal and informal institutions in governing the magnitude and distribution of forest-based incomes amongst the Soligas. Specifically, during the first two years, the objectives of this program were to (1) understand the factors influencing quantity, manner, and location of extraction and sale of all commercially harvested NTFPs, with special attention to honey and nelli; (2) analyze factors responsible for LAMPS malfunctioning, identify needed reforms, and carry out advocacy for reforms at the state level; and (3) document community perceptions and knowledge about the conservation and management of the forest.

To achieve these objectives, we initiated: (1) a census and social mapping of all households in all nine *podus* in Yallandur *taluka* (i.e., subdistrict) that are the immediate focus of the project, and also in the nearest three *podus* of Chamrajanagar *taluka*; (2) a rapid assessment of Soliga attitudes, traditional knowledge, and practices of forest use and conservation (including consolidation of existing information on this topic); (3) a household-level monitoring program that covers a stratified random sample of 114 households in 12 *podus* inside the sanctuary and involves biweekly recording of NTFP collection and other income-generating activities by all household members; (4) a similar, but monthly, monitoring of 40 households in two contrasting (one agricultural and one forest-dependent) *podus* in Kollegal *taluka* for understanding the situation in a nonsanctuary region; (5) detailed field-level monitoring of the quantity and manner of extraction and composition of extractor groups for the most lucrative products (*Phyllanthus*, honey, lichen) during their seasons; (6) a study of the functioning and performance of all LAMPS in Karnataka state, followed by lobbying with governmental officials to reform the rules governing LAMPS functioning and tribal access to forests; and (7) a process of continuous consultations with Soliga collectors, *podu*-level and *taluka*-level Soliga political organizations, and key Soliga persons regarding their perceptions about the project, the processing and marketing activities, and their own role in the same.

Preliminary Results from Monitoring and Modification of the Project

Although monitoring has been under way for just over a year and a half, it has yielded interesting insights and resulted in substantial modifications of the project activities, design, and goals. Preliminary findings and their impact on implementation of the program are summarized in Table 1.

Enterprise Unit Monitoring

One of the primary goals of the enterprise is to achieve financial viability and generate profits. We have found it difficult to determine the financial viability of the enterprise for three reasons. First, the enterprise staff have been involved in other activities of the NGO, even though all the salaries were charged to the enterprise. Second, overhead costs were also not proportionally distributed between the enterprise and other NGO activities. Third, enterprise accounts were initially mixed with the accounts of other activities of the NGO. After we identified these problems, it took several months to implement steps to clearly define responsibilities and duties of the staff, maintain separate accounts, and calculate the true cost of the products by taking into account depreciation and appropriate overhead costs.

A major hurdle in the adequate functioning of the enterprise was the lack of skilled staff. While we understood from the beginning that professionals might be required to run the enterprise at the start, we underestimated the need for skilled staff at the entry and intermediate level positions. As a result, training activities at all levels for all aspects of the project, including resource monitoring, became an integral part of the project.

Coordination is one of the keys for success in a project that uses only local resources available in natural

Table 1. Results and Impact of the Monitoring Program

FINDING	RESPONSE
Enterprise	
Enterprise staff are involved in other NGO activities; accounting and bookkeeping of NGO activities are mixed with that of the enterprise.	Develop clearly defined responsibilities and duties; keep separate accounts for enterprise activities.
Labor pool has inadequate skills and little management expertise.	Train staff in procurement, processing, accounting, and management.
Procurement of raw materials, processing, and marketing activities are not well coordinated.	Develop precise schedules for procurement, processing, and marketing of each product.
There is insufficient marketing information about products.	Assign marketing and sales responsibilities to a particular person; create a local retail outlet.
Biologicial	
There is a lack of data on abundance and spatial distribution of NTFP species.	Map the distribution of NTFP species; use spatial information to develop management plans.
Weeds and fire may influence regeneration of NTFP species.	Map the distribution of weeds and fire frequency in the sanctuary, and examine their effects on regeneration.
Parasite loads influence yield of *Phyllanthus emblica* (amla).	Remove parasite while collecting amla.
There is an absence of information about extraction and production levels.	Collect data on extraction and production levels by direct observations; incorporate the information collected into the participatory resource monitoring program.
There is a reduction in thai sac brood disease in *Apis ceranai*.	Develop enterprise plans for box beekeeping.
There is a lack of participatory resource monitoring.	Develop and institute a participatory resource monitoring program.
Socioeconomic	
There is low interest in the enterprise because it directly benefits only few houses through wages.	Make efforts to restructure local LAMPS so as to pass on higher prices to the NFTP collectors.
Community is not well informed about the project and does not feel in control.	Reconstitute the managing committee with elected representatives, including more NTFP collectors; hold open meetings to discuss unity operations, accounts, and handover; identify and work with a team of Soliga "promoters" for creating tribal organization that will eventually own the enterprise.
NGO is ineffective in community organization.	Hire a trained social worker to coordinate community interaction work and to provide intensive inputs for the same.
Benefits are not sufficient.	Explore possibilities for decentralized processing of NTFPs, including re-activation of beekeeping program.
LAMPS functioning constrained by poorly organized Soligas and by bureaucratic control by Department of Cooperative Societies and Forest Department policies, which constrain resource management.	Lobby at state level for policy changes on LAMPs, while initiating local-level awareness-building and reforms.
There is ineffective control over the enterprise.	Create a new, elected board of directors.
There is low interest in the enterprise because it directly benefits only a few harvesters.	Establish new microenterprises that would benefit a large number of harvesters (e.g., beekeeping). Plan for new, decentralized enterprises from profits generated from the centralized enterprise.
LAMPS operate inefficiently under bureaucratic control.	Initiate efforts to restructure LAMPS.
Community members are not well informed about the enterprise.	Hold regular board meetings; arrange visits of community members to the Food Processing Unit and Herbal Medicine Unit.
There are significant differences between gender and households with respect to extraction of NTFPs.	—

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LAMPS functioning constrained by poorly organized Soligas and by bureaucratic control by Department of Cooperative Societies and Forest Department policies, which constrain resource management.	Lobby at state level for policy changes on LAMPs, while initiating local-level awareness-building and reforms.
There is ineffective control over the enterprise.	Create a new, elected board of directors.
There is low interest in the enterprise because it directly benefits only a few harvesters.	Establish new microenterprises that would benefit a large number of harvesters (e.g., beekeeping). Plan for new, decentralized enterprises from profits generated from the centralized enterprise.
LAMPS operate inefficiently under bureaucratic control.	Initiate efforts to restructure LAMPS.
Community members are not well informed about the enterprise.	Hold regular board meetings; arrange visits of community members to the Food Processing Unit and Herbal Medicine Unit.
There are significant differences between gender and households with respect to extraction of NTFPs.	—

populations. These resources are highly seasonal and perishable. Thus, the unprocessed NTFPs must be procured and processed in a timely fashion. Furthermore, procurement, processing, and marketing must be coordinated. In the first year, the enterprise incurred losses due to a lack of planning and coordination. Project staff addressed this problem by developing precise plans and schedules for various operations.

Successful marketing of enterprise products is another primary determinant of the viability of the enterprise unit. Although the project undertook marketing surveys during the planning phase, as well as during the first year of implementation, actual marketing of the products did not begin until 1996, the second year of the project. Initial success in marketing was low, due to the absence of a person fully in charge of marketing and a lack of marketing plans. Marketing improved after assigning clear responsibilities for sales to the general manager of the enterprise, who also opened a local retail outlet, where sales have been increasing.

Finally, staff turnover, particularly at the senior level, had a profound negative impact on the enterprise unit. There were several reasons for the turnover: low salaries, lack of clearly defined responsibilities, parallel lines of authority, and poor coordination. The project has achieved stability in staff, in part, by improving salary structure, developing a well-defined organizational structure, and planning and coordination. Nevertheless, the staff turnover problems at the HMPU persist. We have been slow to address these problems because of the limited role of the BCN project in HMPU operations.

Results of Biological Research and Monitoring

Information about the abundance and distribution of NTFP species is essential for the viability of the enterprise. Our initial monitoring indicated that most of these species were unevenly distributed, and there was a lack of data on the spatial distribution of NTFP species throughout the sanctuary. We are refining our maps by collecting more information at a finer scale, and will use them for a wide variety of ecological studies, as well as for the development of management plans.

Data on the extent and patterns of regeneration are essential to determine whether the collection of NTFPs is having a negative impact on regeneration. Our preliminary studies indicated that overharvesting may have a negative impact on regeneration. However, further field work seems to suggest that weeds and fire may also have an adverse effect on regeneration. We have initiated studies to examine the impact of these factors on recruitment. As a first step, we are mapping the distribution of weeds and determining the fire frequency and location from satellite imagery. We will eventually correlate the distribution of weeds and fire with frequency of regeneration at sites with and without weeds and fires.

Monitoring parameters that influence productivity of NTFPs is one of the main elements of the biological monitoring program. Apart from phenological studies, which seek to document spatial and temporal variation in productivity, we are also investigating the role of parasites and diseases in limiting reproductive output. The nelli trees are often infected with mistletoe vines. Our field studies indicate that the presence of these semiparasitic vines reduces the output of fruits. Our response to this finding has been to recommend that collectors manually remove the semiparasites at the time of fruit collection. Extractors have indeed started to remove the vines.

The sustainable use of natural resources cannot be achieved if the extraction levels are close to production levels. LAMPS records contain information only on extraction levels, and this information is often inaccurate. We estimated the levels of extraction and production by following the extractors into the forest and recording information about these parameters from the areas where they are working. The project is conveying information about extraction levels to the extractors and they are monitoring levels of production and extraction in a participatory resource monitoring program.

The project abandoned one of its initial goals, the management of *Apis cerana* for honey collection, because of the presence of the sac brood disease. In 1996, there were indications that the incidence of disease had been reduced. We invited experts in beekeeping from the Central Bee Research Institute, Pune, to explore the potential of beekeeping involving both *A. cerana* and *A. dorsata*. Based on their observations in the field, the project initiated beekeeping operations in June 1996.

Difficulties in adapting complicated research methods to the community's needs and capabilities slowed efforts to develop techniques for community-based resource monitoring, particularly since information on research methods was scarce and level of community involvement low. In one experiment, we asked key persons in the community to estimate the size of the nelli crop in their traditional manner, and found their estimates to be similar to the estimates we arrived at through more rigorous and systematic methods. However, we found that this information on nelli avail-

ability, particularly its spatial distribution, was not well distributed across the community, resulting in some households or villages going to areas of low nelli production and coming back empty-handed. This emphasized the need for systematic, community-wide assessments, and we are in the process of experimenting with techniques for such assessments.

Results of Socioeconomic Research and Monitoring

A "social mapping" of the entire target community and monitoring of its participation in NTFP collection is essential to understanding the level and distribution of interest in NTFPs in the community and its overall social structure. Participatory Rural Appraisal exercises, censuses, and monitoring of resource extraction showed that the households are differentiated into traditional ("hard-core" or "full-time") NTFP collectors who collect all products (15-25% of all households), marginal or "part-time" collectors who only get involved in the relatively unskilled and lucrative collection of fresh nelli fruits (40-50%), and those who are not involved in commercial NTFP collection at all (35%).

This level of specialization within the community, along with the fact that the processing units were unlikely to generate any significant levels of employment, had significant implications for the enterprise. A processing unit that generates profits by processing products collected by a variable fraction of the community but that channels its economic gains to the entire community (in the form of profits) was unlikely to generate sufficient support among the NTFP collecting households. If the collectors are to be persuaded to monitor and modify their harvest levels and methods, they must see some direct benefits per kg of produce they supply to the processing unit.

However, to pass on some of the enterprise's margins to the collectors in the form of higher prices for the raw products would require a sensitive and transparent functioning of the LAMPS that mediate between the collectors and the processing units (see Figure. 1). This, and the observation that the per capita increment in economic benefits provided by an improvement in the functioning of the LAMPS would be much higher than the (as yet hypothetical) profits from the enterprise, made a strong case for the reform of the LAMPS.

The state-level study of LAMPS (Lele and Rao 1996) was an important contribution to understanding both the overall status of the LAMPS, and also to evolve recommendations for state-level policy changes. The study highlighted the inherent advantage of the BR Hills LAMPS in terms of a richer forest resource and more secure access. It also provided an analytical basis for devising an alternative structure for the LAMPS. Although state-level policy changes would greatly facilitate reforming the local LAMPS, these changes are unlikely to materialize soon. Our local activities are now informed by this analytical basis and the realization of practical constraints for progress. As a first step, we are trying to set up a mechanism to generally reduce the LAMPS' margins and, specifically, ensure that any premium or bonus offered by the processing unit is passed on directly to the NTFP collectors. We are also exploring the role of credit from the unit for tiding over cash-flow problems of the collectors (which may result in injudicious harvests).

Community consultations are necessary not only as a first step toward generating community interest and participation, but also to generate continuous feedback on enterprise activities. Our process of community consultations revealed that the Soliga community was not well informed about the objectives of the project and their role in it. On the whole, we found the local NGO's ability to communicate with, mobilize, and empower the Soligas to be rather limited. Indeed, the NGO was initially reluctant to accept handover of the processing unit to the community, even though it was a goal of the project. Correspondingly, the community did not feel that it could control the unit, as the unit was located in and run by the NGO. Finally, these consultations also reinforced the feeling that a centralized, capital-intensive, and technologically sophisticated approach to processing was not generating sufficient interest among the Soliga community, which is dispersed, seasonally employed, largely illiterate, and constrained by poor infrastructure. The people repeatedly expressed a need for processing activities that could be taken up at the *podu* or even household level.

To overcome the limitations of the local NGO, we hired a trained social worker to coordinate community outreach. To overcome distrust in the community, we had to reconstitute the ad-hoc managing committee of the enterprise to make it more representative, particularly with respect to the hard-core collectors and senior leaders in the community, hold a public meeting to discuss the units' profit-loss and assets-liabilities, and begin work on a detailed procedure and timetable for handover. To make the activities more decentralized and broad-based, we are exploring the potential for other activities including a re-activation of our earlier idea of beekeeping with *Apis cerana*.

A rapid assessment of traditional knowledge and attitudes was necessary to develop a community-based resource monitoring system. The assessment revealed the limitations and uneven distribution of this knowledge, which made it unlikely that the Soligas would, on their own, be able to ensure the sustainability of recently begun or greatly intensified NTFP extraction. It has also become clear that the LAMPS must be an integral part of any plan to manage the resource. Preliminary participatory mapping exercises indicated the depth and detail of ecological knowledge that resides in the community and the significant potential of mapping as a tool for resource management and for social mobilization. We are now implementing a participatory monitoring and mapping exercise for the few key NTFPs, with a focus on participation by key collectors, enterprise managing committee members, and LAMPS directors. We will be monitoring community responses to this exercise.

A detailed study of wild honey extraction showed that the timing of honey extraction significantly affects honey productivity and possibly sustainability (through its impact on larval loss). The nature of tenure over the honey resource clearly affects the timing of extraction: open-access trees and cliffs are harvested earlier than is optimal. Early harvesting may also be related to the access that tenure-holders have to seasonal credit. The establishment of tenure itself is a complex social process in which LAMPS agents — the emerging tribal elite — play key roles. These findings are being incorporated into developing a detailed plan for community-based honey extraction, training, and experimenting during the next honey season.

Conclusions

We confine our concluding remarks to the issue of monitoring. In particular, we describe the various types of monitoring undertaken, the contributions of each group to this project, and insights relevant to other projects. We also offer some overall comments on the need to expand and to redefine the original concept of monitoring as outlined by BCN.

It is necessary to distinguish three types of monitoring relevant to this project. The first type is research monitoring, or monitoring carried out by researchers to observe the distribution and availability of natural resources and the participation of the community in the management and utilization of those resources. The second type of monitoring is project monitoring, carried out on a monthly basis by the entire project (researchers, NGO staff, and enterprise staff), to gauge the progress of the project in meeting its enterprise-related goals. The third type of monitoring, which is still being initiated, is community monitoring; i.e., monitoring of resource use, enterprise operations, and benefit distribution by the community. This type of monitoring must extend beyond the life of the project.

We believe that our research monitoring program has been successful. The biological monitoring has generated data on the distribution and abundance of NTFP species, spatial and temporal variation in productivity, levels of NTFP extraction, the distribution of weeds and their effects on regeneration, and the impacts of parasites and disease on productivity. The monitoring currently under way will yield information on the population dynamics of NTFP species, the impact of harvests and fire on regeneration, and the foraging ecology of honey bees. The contribution of biological research toward understanding the biological link between the enterprise and the forest is thus invaluable.

The socioeconomic research and monitoring effort has similarly generated critical information on community structure, patterns of participation in NTFP extraction and management, LAMPS operation, the importance of tenure, and community perceptions of the project. The research under way will generate a better understanding of the overall tribal economy. These insights and feedback are key to making the enterprise — its commercial, biological, and community outreach activities — better tuned to community needs, capacities, and concerns.

Project monitoring has identified several factors that influenced the realization of basic objectives. These factors include the inability to maintain a distinction between the activities of the NGO and the enterprise, lack of trained staff at all levels, poor coordination, inefficient attention to marketing, and staff turnover. These phenomena are typical of NGOs working in rural development today and are therefore worth remembering in designing future projects. Lack of coordination was not limited to the enterprise staff. Initially, there was also inadequate communication among enterprise, biological, and socioeconomic units. The continuous project monitoring we used is relatively informal and easy to implement. All it requires is a culture of introspection, something that is critical to the day-to-day functioning of any organization, especially a commercial venture.

The enterprise-based approach to conservation projects that involve relatively small community organizations have little chance of success without an acceptance of or receptivity to change. Moreover, strong professional inputs are required at the initial stages of the project. Few organizations have the ability to seek such inputs or to meet their costs. The project sponsors, therefore, have a special responsibility to ensure that such inputs occur. At the same time, professional managers have to be socially sensitive and concerned not only with the outcome but also with the process, as they must show profits, as well as enable the community to take charge. Finally, if the processing activity were not capital and technology intensive, the tenure of professionals could be considerably reduced and transition from a professionally managed to a community-managed enterprise could be eased.

The delay and limited success in our efforts to set up a system of community-based monitoring of resource utilization, enterprise activities, and benefit distribution highlight five factors important to any enterprise-driven, community-based conservation program. First, the enterprise must generate and must be seen to generate early, substantive, and broad-based economic gains for the community. Participatory monitoring has an opportunity cost, and unless tangible benefits offset this cost, community inclination to participate in monitoring will remain weak.

Second, the community must see a clear link between their activities and the sustainability of the resource and of overall biodiversity. In our situation, where the community ceased to be the major actor in the forest landscape and where it has yet to see the effects of its recently intensified extraction activities, the need for monitoring is unclear. "We are hardly affecting the forest" is the constant refrain from the community members. Focused biological research, combined with proper community outreach, can, however, play an important role in dispelling this illusion while highlighting the big picture.

Third, for interest to be sustained the community must see the results of monitoring translated into tangible and meaningful action. For instance, if absence of fire is a major reason for poor regeneration, the community must be positioned to modify fire management in the sanctuary. This, in turn, requires that the community have substantial and secure rights to manage the resource in question; Soligas, in this particular case, have uncertain and inadequate tenure over the resources they extract.

Fourth, traditional rural communities monitor environmental resources through accumulated knowledge passed on orally from generation to generation. Feedback from such monitoring is often subjective and qualitative, which must be combined with objective and quantitative monitoring.

Fifth, participatory monitoring must be cognizant of traditional practices and adaptive to local conditions. Thus, the key task before us is to devise a monitoring plan suited to a particular situation through a process that is itself participatory.

Overall, the forms, methods, and prerequisites of monitoring in such projects are more complex and multilayered than is apparent from BCN's definition. In its attempt to focus attention on monitoring parameters, criteria, sampling strategies and frequencies, etc., BCN has overemphasized the "project monitoring" aspect. Consequently, it has underemphasized the roles of, on the one hand, focused applied research that also uses cross-sectional and historical data, and of informal, often qualitative, but continuous feedback and sincere introspection on the other. It also appears that the three-year project time frame is insufficient for determining its effects on biodiversity and probably for setting up a system of community-based monitoring that is to continue beyond the life of the project.

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