ELSEVIER

Agricultural Systems 73 (2002) 83–97

AGRICULTURAL SYSTEMS

www.elsevier.com/locate/agsy

Equitable ecology: collaborative learning for local benefit in Amazonia

Patricia Shanley[a,*], Gloria Rodrigues Gaia[b]

[a]*Center for International Forestry Research, CIFOR, Bogor, Indonesia*
[b]*Mulheres da Mata, IMAZON, Belém, Brazil*

Received 5 October 2000; accepted 29 August 2001

Abstract

Rapid growth of timber, mining and ranching industries in forested areas worldwide often offer small holders opportunities to sell forest resources. Rural communities, however, often have little notion of the market value or economic and ecological consequences of forest transformation. Within such scenarios, the learning process needs to be consciously constructed so as to catalyse new ways of thinking about forest management effectively and quickly. This article describes an ecological research project that integrated data and process-oriented approaches to promote collaborative learning. Results indicate that user-centered approaches are needed to ensure that locally relevant information is generated by scientists, and that learning is catalysed not only among information saturated stakeholders such as policy makers and academics, but also among stakeholders who are directly dependent upon forest resources. © 2002 Published by Elsevier Science Ltd.

Keywords: Benefit sharing; Biodiversity; Non-timber forest products; Amazonia; Learning systems

1. Introduction

The largest tract of contiguous tropical forest remaining in the world, the Brazilian Amazon, presents an expansive stage on which to view changing trends in learning methodologies. Historically, the Amazon basin offered a cornucopia of flora and fauna for naturalists to explore; presently, specialists such as ecologists, wildlife biologists, and ornithologists continue to play centre stage by cataloguing, measuring and making predictions about biodiversity. More recently, contemporary

* Corresponding author.
E-mail address: p.shanley@cgiar.org (P. Shanley).

0308-521X/02/$ - see front matter © 2002 Published by Elsevier Science Ltd.
PII: S0308-521X(01)00101-9

actors strive to balance centuries of 'hard' science with participatory, gender-sensitive, and qualitative research, taking into account not only the biological, but also the human resources of the region. For within the forest, the changing composition and abundance of biological resources holds concrete consequences for the nutrition and health care of thousands of rural stakeholders.

Two decades ago, living in extensive tracts of forest unpenetrated by roads, forest residents in many Amazonian regions could gather ample fruit, fibre and game to meet their subsistence needs. In the 1960s in eastern Amazonia, less than 150 km away from many villages, construction of the Belém-Brasilia highway created an artery from which loggers and ranchers penetrated formerly inaccessible forest. The exponential growth of the logging, ranching and mining industries swiftly changed the face of the region. For the first time in their history, small producers had powerful new neighbours eager to buy their timber resources.

Lacking any clear notion of the exact extent of their land holdings or their value; unprepared, illiterate, and in an extremely poor negotiating position, cash-poor villagers daily trade large expanses of forest or trees for meagre sums. After less than a decade of successive timber sales, smallholders accustomed to living in intact primary forest with sufficient game, fruit and fibres, suddenly find themselves in degraded, burnt forests. In these common scenarios of forest impoverishment, survival depends upon developing quick responses to change; former patterns of both thought and forest management require rapid adjustment.

At present, approximately one third of the land area in the Brazilian Amazon is inhabited by smallholder and indigenous communities with rights to manage their own forests (Veríssimo, personal communication) In remote areas of Amazonia where policies often go unheeded, it is forest residents who determine whether forests stand or fall. This makes the need for innovative learning methods about the value of forest resources still more critical (Amaral and Corrêa, 1997).

Yet although most rural Amazonian households rely on both farm and forest resources to meet their livelihood needs, to a large extent only agricultural and timber-directed forestry extension are available to smallholders, as is often the case worldwide. Intermediary organizations with the capacity to transfer forest-related research results to stakeholders often do not exist. When they do, poorly developed forest extension tends to emphasise timber as the only forest resource worth managing. As loggers, ranchers and fire penetrate the Brazilian Amazon, how can smallholders with little knowledge of the potential benefits and detriments of these industries to their livelihoods decide if and how to transform or protect their forests?

This article describes research undertaken at the request of five rural communities in Eastern Amazonia, Brazil to assist them face rapid changes catalysed by the timber and ranching industries. The project was initiated to generate technical information on the ecology and comparative economics of the value of timber and nontimber forest products (NTFPs). During the long-term ecological research, we realized that while technical input was critical, means to present and collaboratively share information to catalyse new ways of thinking were also essential.

To either resist or adapt to the powerful forces changing rural landscapes, rural communities needed to process and incorporate a glut of new information in an

exceedingly short span of time (Laird, 2002). Market prices must be clearly understood, contracts read and signed, the effects of fire post-logging evaluated, and the benefits versus the detriments of logging to game populations and fruit and fibre availability weighed. However, never having witnessed or lived through such change, community members had little basis on which to make informed decisions. In addition, the information needed to make these decisions often does not exist. Scientific research has generally been biased towards timber species of international commercial importance, neglecting locally and regionally important species that are vital to rural health and nutrition.

In this scenario, four significant obstacles exist to catalysing the learning process and conveying needed information. First, locally relevant information to address current change was unavailable; second, forest transformation was so rapid that there was exceedingly little time; third, the population needing the information was largely non-literate; and finally, the populations needing information were remote, lacking in modern transportation, communication and networking infrastructure. Within such scenarios, the learning process needs to be consciously constructed so as to catalyse new ways of thinking about forest management effectively and quickly.

2. Stage 1: working on new insights with forest users

The first stage of the project was research-driven and conducted in a 4000-ha community forest along the Capim River in the Brazilian eastern Amazonian state of Pará where livelihoods are based on swidden agriculture (manioc, bananas, corn, rice) and hunting and gathering of forest products. After repeated timber sales, residents noted a significant decline in game, fruit and fibre, and longer travel time to obtain resources. In an effort to stem the loss of game and locally valued tree species, communities began to search for means other than the sale of trees to gain cash. To answer questions posed by the community, the Rural Workers Union of Paragominas requested assistance from ecologists of the Woods Hole Research Center/EMBRAPA (Brazilian National Agricultural Research Institute). The agricultural union was interested in obtaining technical support to answer questions such as: ''Are there non-timber forest resources we might sell instead of timber?'' and ''Are the resources we lose from logging more valuable to us than the cash we get from selling trees?''

Although easily posed, such questions are less easily answered. Because no prior ethnobotanical or ecological studies had been conducted in the region, determining the comparative economic value of timber and non-timber resources would require:

1. a description of the species composition of forests in the river basin;
2. characterisation of the density, distribution and fruit production of regionally valued fruit trees;
3. assessment of the subsistence value of non-timber forest resources to communities; and
4. conveying the results in an effective manner to semi-literate forest users.

To address the many aspects of the communities' questions, we formed a research team of three women: a wildlife biologist, forester and ethnoecologist. The core team also included community members: five hunters, three mothers and one healer, each of whom possessed deep knowledge of the forest resources. Together with the wider community we selected three regionally important species to study, refined the focus of the study and gathered data.

Community selection of species was an early, crucial step in orienting the study towards generating regionally relevant results. This resulted in a list of native fruit trees (piquiá, *Caryocar villosum*, bacuri, *Platonia insignis*, and uxi, *Endopleura uchi*) that possess a wide geographical distribution in Amazonia but which had not been studied previously, perhaps due to cultural biases and lack of national and international markets. For example, although piquiá and uxi are regionally popular fruits, due to their unique flavour the gritty nature of uxi and oily, non-sweet pulp of piquiá are considered less than pleasing to non-Amazonians. However, both piquiá and uxi contain vitamin A and calories lacking in many Amazonian diets, and bacuri is a delicious pulp used in juice and jam making.

After selecting species with relevance to populations throughout a wide geographic area, we developed research methods. Conventional methods to determine population ecology were required, as well as qualitative methods that drew upon the knowledge of community members. Due to the low literacy levels in the community, data collection methods (i.e. ethnobotanical inventories, fruit production studies, and daily diaries of forest product consumption) needed to be designed so that they could be understood by illiterate people. Thus we developed ecological data sheets with headings showing pictures of piquiá, bacuri and uxi in their mature, immature, and predated states. After counting fruit, community research assistants simply placed numbers beneath the proper picture/heading. Similarly, each page of the daily diaries was headed by pictures of various game animals, fruits and fibres, so that the 30 families involved needed only to check beneath the picture as to whether they had consumed a resource that day (Fig. 1).

Daily diaries shed light on the substantial economic value of freely gathered forest products. With simple calculations based on farm gate or nearby market value,

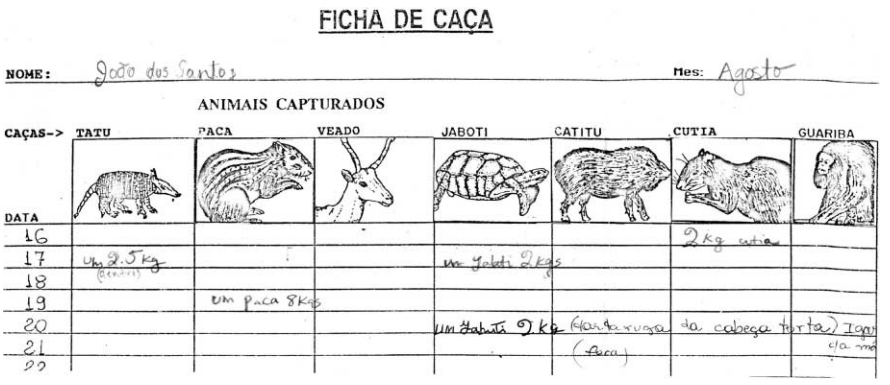

Fig. 1. Sample page of notebook to record game capture.

hunters recognised that in one year they had captured and consumed the equivalent of over US$1000 of game; while other families determined that during the 3-month fruiting season, they had eaten hundreds of dollars worth of forest fruit. Calculating the market value of forest resources offered community members a new way of valuing their resource, values that were often overlooked.

3. The strengths of blending traditional knowledge with modern science

In order to determine how best to employ conventional and innovative research methods, we identified the limits and strengths of traditional knowledge and modern science as applied to the research questions and study site. For example, interviews made clear that Rapid Rural Appraisal was wholly insufficient to determine the numbers of fruit produced by various species as well as their densities and distribution in the forest. While local residents reported that thousands of mature trees of a particular species existed in an area, inventories revealed less than one hundred. Clearly, hunters and other resource collectors favoured forest groves in which fruit and game attracting trees occur in unusually high densities; extrapolating from these exceptional plots did not provide an accurate description of the total forest area. This limitation of local knowledge identified an area in which systematic forest inventories are exceedingly useful.

On the other hand, unstructured interviews with hunters, healers and midwives offered outstanding contributions to ethnobotanical findings. As Ravenborg and Westerman (2000) report, individual interviews were critical to discern differences in forest management practices among villagers that would not be disclosed in public meetings. Community members were also vital in orienting the study to include aspects overlooked by researchers (i.e. game populations); in data collection and analysis; and finally, as end users of the data.

Regarding data analysis, when findings were puzzling to the research team, they were often understood by villagers. For example, data on the most highly valued game-attracting tree demonstrated little or no predation of fruit by wildlife. Villagers explained that it is not the fruit, but the flower of that tree that attracts game. In addition, data revealing that over 3000 uxi fruit were consumed in one month by one small family appeared highly exaggerated. Live demonstration by the family revealed that the pulp of 25 fruit are needed to make one glass of juice; consumed by each family member daily manufacture of the juice required hundreds of individual fruit.

A consistent discrepancy between results and village behaviour revolved around the central research finding that the economic value of non-timber forest products significantly exceeds that of timber. In spite of this finding, many villagers daily traded trees for scant sums. They explained that timber sales could stave off hunger during a poor manioc season; provide funds for the purchase of a needed stove; or offer medical care to a sick child. Results suggest that rural communities have reasons they sell timber, not NTFPs, reasons that are not born out in purely economic or ecological appraisals. This put the numbers in perspective, and highlighted the

fact that tools such as net present value may be wholly inadequate in describing the economics of smallholders (Padoch and Pinedo-Vasquez, 1996).

3.1. Challenges encountered

Ecological issues challenged the research process. The actual low density of the three focus species necessitated a much larger forest area than anticipated (4000 ha), and a greater time and labour commitment to attain a reasonable sample size of trees. In addition, optimistic predictions of fruit production by villagers (probably to satisfy the research team) led us to believe that accurate fruit production data could be gathered in 1–2 years. However, fruit production of the three chosen species is highly erratic; one tree may produce thousands of fruit one year and none during the next four years. Due to the extremely unpredictable nature of fruit production, data were gathered for six years. Furthermore, the warm phase of the southern oscillation cycle (El Niño) occurred in both 1997 and 1998, altering precipitation patterns and possibly fruit production.

Besides substantial ecological hurdles, we also encountered socio-economic and cultural ones. For example, community leaders, although theoretically interested in learning of the non-timber forest benefits, for the practical purposes of gaining cash had signed logging contracts prior to the study without informing the research team. Logging operations during successive years of the study destroyed parts of fruit tree trails and threatened marked trees.

In addition, the objectives and time frame of the community conflicted with the purely scientific objectives. Due to ever-increasing hunger, the community wanted fast, practical solutions to a potentially life-threatening problem while the realisation of scientific goals would require the generation of rigorous data over a long time frame. For example, the length of time required to obtain adequate fruit production data on the chosen species caused a significant time lag until results would acquire meaning for analysis or for conservation and development activities.

3.2. Local relevance of the research findings

Although the results of the fruit production study did not offer immediate solutions to the communities' forest management dilemmas, the data did clarify inaccurate assumptions about fruit availability. The census of fruit trees, for example, revealed that not thousands, but only a few hundred mature trees of piquiá occurred in the community forest and that post-logging, only a handful of mature bacuri trees remained. Secondly, the study demonstrated that community estimations of fruit production were often highly optimistic, exponentially higher than that revealed through direct measurement. The study also identified trees that produce consistently, and those that extend the harvest by producing early and late in the season. Finally, data collection—the daily act of counting thousands of fruits and flowers over the course of 6 years—offered some community members a deeper sense of the relative value of these forest trees for their fruit, as opposed to their wood.

To address the community's question about the potential for fruit sales, results showed that individual fruit production is highly variable and in some cases, heavily predated and, therefore, not conducive to commercialisation. In addition, large distances between trees, wildly inconsistent production, low fecundity and high degree of predation are substantial ecological obstacles to harvesting fruits for sale. Thus, the study demonstrated in stark terms that while fruit is enormously valuable from a subsistence perspective it is far easier for villagers to sell wood than to sell fruit. Even with this variability, experimental sales of fruit indicated that the under-utilized crop of native fruit could be marketed. However, sales also revealed that women were far more effective in bringing home profits to the community than men, who tended to down the earnings in drink.

3.3. Linking learning to changed decision-making and resource management capacity

The perspective of the research team was the following—it is equitable for farmers to have necessary information to make informed land-use decisions. Our role was to try to generate this information and to present it in an accessible and memorable way using learning "triggers" (Fionni and Neto, 2000) within workshops, participatory research, farmer exchanges, and experimental fruit sales. What farmers decided to do based on the new concepts and experience was their choice. In the Capim region, where logging and ranching are well advanced, many smallholders continued to sell timber at low prices after research results were made available. Of the farmers that continued logging, the majority stated regret for their actions. During the research we discovered that after loggers penetrate a forest, a domino effect occurred in which it became extremely difficult for a smallholder to stop the wave of logging. When the logger returned for a third or fourth round, farmers already accustomed to selling timber often sold again.

Although logging continued, we noted that in the four villages in which the research had been conducted, villagers forbid loggers to fell valued fruit trees (Fig. 2). Other households chose to use and manage forests sustainably for the benefit of their families, foregoing timber sales and even creating forest reserves. A dozen households attempted selling fruit to augment their incomes. And in one community, women angered by the loss of medicinals, fruit and game, prohibited their community from engaging in any further timber sales. These instances represented the first time in the history of the communities that any restriction was made on a logger's activity.

Our experience in the Capim basin revealed that in regions in which logging, ranching and mining industries are dominant and advancing, it is exceedingly difficult to promote local change in natural resource management. To impact thinking and promote behavioural changes in forest management, it is strategic to arrive in regions prior to the powerful wave of logging and forest transformation.

3.4. Stage 2: scaling-up the new insights through innovative dissemination

The research and extension work revealed that many communities face similar problems and are in need of like tools and information with which to strengthen their

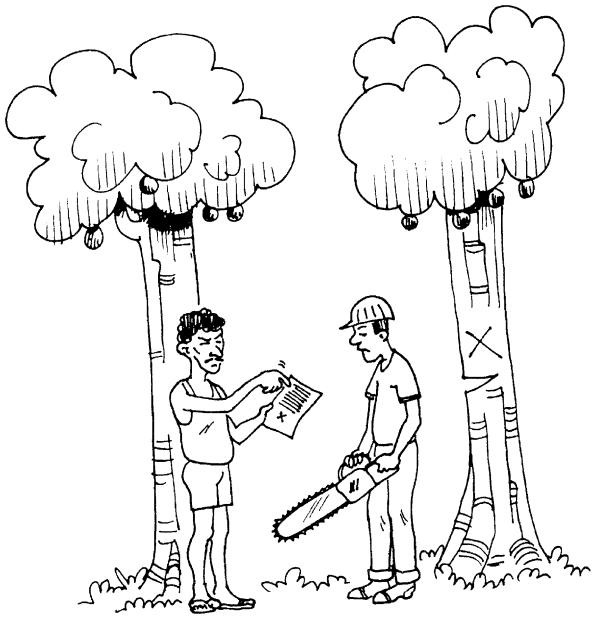

Fig. 2. Smallholder reminding logger that contract excludes extraction of valued fruit trees.

capacity for negotiating better deals and improving forest management. We therefore decided, after generating and sharing findings in the original study region, to disseminate these to a broader geographic area. We augmented our ethnobotanical, economic and ecological findings as we travelled, thus broadening our knowledge base.

This second stage was response-driven and education-oriented, involving new institutional associations. Our primary affiliation in Brazil is the research institute, IMAZON (Instituto de Homen e Meio Ambiente); support throughout the past few years has come from NGOs and foundations such as the International Center for Research on Women (ICRW), IUCN-Netherlands, Rufford Foundation, the Durrell Trust and the Earth Love Fund. The focus of these funders was less pure research than the application of research results to improve rural livelihoods and promote forest conservation.

Villagers from both the original research area and new regions helped to disseminate the findings. They took an active interest in generating and sharing the information with additional communities through Forest Value Workshops (see later). Dissemination was preferentially targeted at communities who requested workshops, and those in the path of the logging industry, who were undergoing, or soon to enter into, negotiations with loggers.

3.5. Forest value workshops

We took the scientific results generated in stage one and turned them into tools to catalyse new thinking about forest resources. The approach consisted of multi-media,

low-tech, low-cost farmer-to-farmer exchange of information presented through interactive workshops. Since scientific information presented in forms such as graphs, tables and written words would be unfamiliar and threatening, we took the economic and ecological research results and wove them into locally familiar forms of communication and entertainment such as skits, posters, songs and dialogue.

For example, the comparative economic value of fruit and timber was demonstrated through role-plays featuring desperate farmers, cunning loggers, and shrewd fruit buyers. Hunters proudly depicted the economic importance of game-attracting fruit trees on posters while healers displayed examples of local bark, root and herbal remedies, comparing their price (free from the forest) to prices of pharmaceutical drugs (costly). During workshop intervals, villagers sang locally popular tunes infused with historic, economic and ecological lyrics on forest value.

By displaying the fruit production data on illustrated posters using simple multiplication, farmers could readily compare the value of the trees if sold for their timber or fruit. Exponentially higher economic values for fruit and medicinal oil as compared to timber alerted landowners to beware of quick deals. Procedures for tapping trees sustainably, tips on processing jam from fruit rind and techniques on how to rapidly inventory non-timber forest products were also shared.

Entertaining yet sobering skits and lyrics infused with solid economic and ecological data extended the knowledge base for communities to make more informed decisions. Open discussions about detrimental logging deals exposed what is frequently concealed while preparing villagers to assess how they would next respond to the pressure of logging. Once villagers were aware that the fruit or oil production of a tree may be worth 25 times that of the value the timber company offers for the entire tree, or that the downstream value of sawn wood is worth 10–20 times that offered locally for crude wood, they re-evaluated the worth of their standing forest.

3.6. The "fruit" book

The large size of the region meant it was impossible to offer workshops to even a small percentage of the remote communities facing forest transformation. Therefore, to reach a wider area, we developed illustrated booklets on the non-timber medicinal, fruit and game attracting trees of local/regional value.

The ecological and economic data presented in workshops were placed on paper in an illustrated form with descriptive text. To make the book (*Fruit Trees of the Forest in the Lives of Amazonians*) culturally appealing to a wide variety of literate and non-literate audiences, data about the ecology and economics of trees are featured alongside illustrated songs, stories and lore (Shanley et al., 1998). Primary data on the economics, density and production of fruit trees are featured next to a section on women's rights, tips for selling fruit, and recipes for shampoo and ice cream. A second booklet (*Recipes without Words: Medicinal Plants of Amazonia*) features illustrations depicting medicinal plant remedies (Shanley et al., 1996).

By providing data on the density, fruit production and economic value of native forest fruit trees, the book offers tools for families to estimate the timber versus the non-timber value of their forest tract. It also gives tips and techniques on planting

and managing fruit trees and on value-added processing of medicinal oils and fruits. Information is designed to be used as a springboard for discussion, experimentation and new thinking about forest management and use of forest resources. The guiding philosophy is stated on the first page: "this is not a book to be read, it is a book to be used in practice".

Additional information from other regions is included so that research findings on the ecology, economics and management of various species could be used throughout a wider geographic range. Readers comment on the rural authenticity of the language, which enhances its accessibility to populations who frequently feel shut out by the formality of written materials.

By returning results in a culturally captivating form to communities, we made the unexpected discovery that information presented in this way was also more accessible to policy analysts, conservation organisations and urban citizens. Requests for books from loggers, scientists, healers, teachers, and government officials attest to this. However, the primary audience remains smallholders, whose livelihoods depend upon having concrete information on forest value with which to make informed land use decisions.

Because the learning materials were specifically designed to reach semi-literate persons they are also understandable by non-Portuguese speaking populations. Requests for the books are being fielded from countries as diverse as Ecuador, Greece, Mexico, Sri Lanka, and Malaysia. Farmers in Indonesia display bemused recognition of the economics of tree sales; healers in Peru recognized recipes of healing plants; and Cameroonians demonstrated curiosity about medicinal tree tapping. Discussions outside of Brazil reveal that the books can serve as templates for how to catalyse new thinking while giving back scientific data to local communities in an accessible form.

4. Impacts of the work in resource management

There have been some clear impacts from the dissemination of the research results, both on local management (e.g. increased use of NTFPs, better local regulation of swidden cultivation) and on the way decisions are made (e.g. greater participation of women, improved negotiations with loggers). Some of this was due to the involvement of communities in the first stage of the research, subsequent workshops and the fact that workshops are led by villagers. In addition, the entertaining manner in which the research is transmitted in the workshops and books lends itself to being passed from farmer to farmer.

Results demonstrated that many species held subsistence and/or market value in excess of the diminutive fees offered by loggers, and that many communities regretted losing such species to the logging industry. When made aware of the lost value of particular species to local health care and nutrition, scores of forest owners in the Capim and Tocantins regions realigned their thinking and forest management choices. For example, after calculating the economic value of fruit produced by one tree ($US 60) as opposed to the meagre price offered for that tree's timber (US$2), many Capimenses chose to protect fruit trees from advancing loggers.

Visits to communities that have implemented ideas generated through the use of the book and workshops have demonstrated positive changes in resource management such as: restoration of degraded areas using economic species in Novo Timboteua; creation of fire barriers in Murutuezinha; implementation of community regulations regarding placement of swidden fields in Quiandeua; increased processing of native fruits into jams and juices in the Tocantins region; sales of fruit instead of timber in three Capim communities; improved negotiations with loggers limiting the area or species extracted in a dozen communities; and the creation of community forest reserves in five communities. Such unexpectedly positive outcomes of data dissemination to communities within and beyond the research area demonstrate that to catalyse improved natural resource management, a new look needs to be taken not only at what methods we use to gather information, but at how we package results, and with whom and how we share them.

5. Key components of the research/learning process

The learning process described here contains methodological and conceptual elements of learning systems employed in other case studies of natural resource management such as a user-centered approach, complementarity of methods, and the need for both technical and process centered approaches (Gonzalez, 2000; Hagmann and Chuma, 2000; Lawrence, 2000; Loevinsohn et al., 2000; Walker and Zhu, 2000). However, one difference is that for practical reasons, the initial phase of long-term participatory research/learning was not extended beyond the study area. This was due to the rapidity of resource change and need for resource management information in a wider area in a short period of time. The situation instead called for rapid transfer of information, tools and concepts to equip small holders to rethink their forest management practices under changing conditions. To promote broad based learning about natural resource management, the following elements were discovered to be useful to trigger new ways of thinking in a wider geographic area.

5.1. Generate timely, relevant information

The key to success in the process of encouraging new thinking and decision-making about forest management was that the information had immediate relevance. With loggers arriving monthly to negotiate timber deals, information and discussion on the downstream value of logged species; the lost value of game post logging and fire; and fruit production per tree as compared to timber value was timely and useful.

5.2. Improve market/regulatory knowledge base

Smallholders are often uniformed during negotiations with industry representatives. Access to basic marketing information can significantly improve a community's ability to weigh the advantages and disadvantages of different natural resource management options. In addition, in areas where land rights are in question, training

in mapping and access to historic maps, or satellite or aerial imagery can help to clarify land disputes.

5.3. Turn information into tools

Presented in challenging ways, information can become a tool to spark changes in thinking and behaviour. Not only content (described earlier) but also methods of presentation are critical; both need to be designed in innovative ways with the objective of catalysing new ideas and behaviour patterns.

5.4. Integrate new and familiar concepts

Lack of familiarity is a barrier to comprehension of new information. Thus if confronted with a barrage of new numbers, charts and data points regarding forest management, community members are likely to shut down. Comprehension can be readily improved by weaving new concepts together with familiar ones. For example, data describing the potential loss of game to hunters after logging events may be best presented not in graph or table form, but couched in a familiar story line through a hunter's words and illustrations.

5.5. Use local units of measurement

To enhance local comprehension units of measurement need to be presented in local settings. For example, while scientists use one hectare as a standard land measurement, rural residents in Amazonia use *alqueire*, equalling 4.8 ha. Likewise, in largely cash-poor communities, monetary values may be meaningless. Economic valuation data may be better understood when related as an equivalent volume of the leading agricultural commodity. For example, the value of game captured by one hunter over the course of one year can be illustrated by depicting the volume and value of cassava flour the hunter would need in order to purchase the game he captured from the forest for free (Fig. 3).

5.6. Use local presenters, language, and lore

Participatory presentations by local residents ensured that language was appropriate to the audience and that the message was authentic. Since language determines who enters a discussion, who is heard, and who is not heard, it was important to eradicate needless technical terms and introduce only select vocabulary to catalyse new ways of thinking. Use of local songs and stories is an effective means to help ensure broad based understanding of technical information.

5.7. Catalyse the learning process with new, useful, challenging concepts

Introduced through maps, discussions and examples, the concepts embedded in 'forest reserve' and 'forest corridor' introduced new ways of thinking about forest

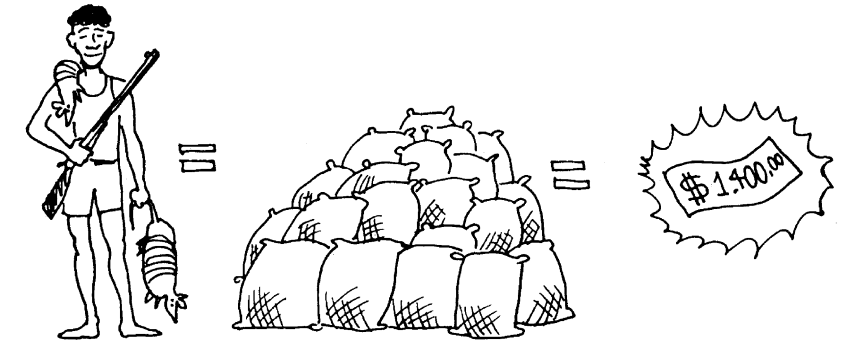

Fig. 3. Using local units of measurement (Shanley et al., 1998, p. 71).

management. After suffering the consequences of forest impoverishment, these concepts acquired immediate relevance, especially for hunters. Tired of tracking game in distant ranches and anxious to lure animals back to their own forests, hunters understood the notions implicitly and began making plans to protect particular areas of forest.

5.8. Encourage participation of women

Traditionally, rural women in eastern Amazonia have little say in logging deals and land sales. The outreach team, however, offered examples of village women participating in the natural resource decision-making process. Once aware of the detrimental consequences of many land use choices, women may begin to attend formerly all-male meetings, become knowledgeable about natural resource issues and make their voices heard.

6. Conclusion: sharing benefits of biodiversity research

Although participatory approaches are highly effective and largely advocated today, our experience suggests that a broad-based approach using innovative, accessible educational materials can also be effective. This is especially true in areas where no active forest extension exists and where the scale and rapidity of forest destruction calls for cost-effective, immediate intervention. Villagers daily make decisions about forest management, frequently with no information on natural resource value from markets, sawmills, radios, newspapers, brochures or extension. In many regions information continues to be a scant commodity, thus access to relevant information can improve the outcome of natural resource decision-making (Uhl et al., 1997).

While participatory collection of primary data by a community in their own landscape can illuminate much about their natural resource use, it is not necessary

for farmers to produce their own data to benefit from it. Notably, the data generated in our research was most readily used not in the region where it was produced, but in other forested regions where it could prepare smallholders for what was to come, and in already deforested regions, as a catalyst to restore degraded areas. One critical aspect of the original research that facilitated this was the selection of species occurring throughout Amazonia and the focus on research questions with local, regional and international significance.

In order to ensure that research results have impact, it is also fundamental to expose the myth promulgated by many research institutes that a multitude of NGOs and intermediary organizations exist which can effectively translate and transmit the results of scientific research to practitioners and stakeholders in need. Although such a network functions for agricultural research, it is wholly lacking in most countries for forest-based research. By recognizing this void, steps can be taken to build capacity in the realm of forestry extension. Steps also need to be taken to encourage scientists to take at least minimal steps necessary to ensure that their results reach not only information saturated stakeholders, such as policy makers and academics, but information impoverished stakeholders, whose lives are often directly dependent upon forest resources.

References

Amaral, P., Corrêa, T., 1997. Extensão e Educação Florestal na Amazônia Oriental: o Caso do Projeto Piloto de Manejo Florestal. In: Padua, S.M., Tabanez, M.F. (Eds.), Educação Ambiental: Caminhos Trilhados no brasil. Brasilia, pp. 119–122.

Fionni, Anorde C., Ferreira Neto, P.S., 2000. Evolving Learning in Designing Agroecological Farming Systems with Small-Scale Farmers in Zona de Mata, Brazil. In Deepening the Basis of Rural Resource Management: Proceedings of a Workshop. ISNAR and RIMISP, The Netherlands. pp. 73–88.

Gonzalez, R., 2000. GIS for joint learning in watershed management: the case of the Ifugaos in the Philippines. In: Guijt, I., Berdegué, J.A., Loevinsohn, M. (Eds.), Deepening the Basis of Rural Resource Management: Proceedings of a Workshop. ISNAR and RIMISP, The Netherlands, pp. 125–137.

Hagmann, J., Chuma, E., 2000. Tying-up loose ends: integrating soft and hard methodologies in NRM research and extension. In: Guijt, I., Berdegué, J.A., Loevinsohn, M. (Eds.), Deepening the Basis of Rural Resource Management: Proceedings of a Workshop. ISNAR and RIMISP, The Netherlands, pp. 109–121.

Laird, S., 2002. Biodiversity and Traditional Knowledge: Equitable Partnerships in Practice. People and Plants Handbook. Earthscan, UK.

Lawrence, A., 2000. Forestry Forest Users and Research: New Ways of Learning. ETFRN, Wageningen, Netherlands.

Loevinsohn, M., Berdegué, J., Guijt, I., 2000. Deepening the basis of rural resource management: issues and outcomes. In: Guijt, I., Berdegué, J.A., Loevinsohn, M. (Eds.), Deepening the Basis of Rural Resource Management: Proceedings of a Workshop. ISNAR and RIMISP, The Netherlands, pp. 3–11.

Padoch, C., Pinedo-Vasquez, M., 1996. Smallholder forest management: looking beyond non-timber forest products. In: Ruiz Pérez, M., Arnold, J.E.M. (Eds.), Current Issues in Non-Timber Forest Products Research. CIFOR, Bogor, Indonesia, pp. 103–118.

Ravnborg, H.M., Westermann, O., 2000. Understanding interdependencies: stakeholder identification and negotiation for collective natural resource management. In: Guijt, I., Berdegué, J.A., Loevinsohn, M. (Eds.), Deepening the Basis of Rural Resource Management: Proceedings of a Workshop. ISNAR and RIMISP, The Netherlands, pp. 189–197.

Shanley, P., Cymerys, M., Galvão, J., 1998. Frutíferas da Mata na Vida Amazônica. Editora Supercores, Belém, Brazil.

Shanley, P., Höhn, I., Valente da Silva, A., 1996. Receitas sem Palavras: Plantas Medicinais da Amazônia. Editora Supercores, Belém, Brazil.

Uhl, C., Barreto, P., Veríssimo, A., Amaral, P., Barros, A.C., Vidal, E., Gerwing, J., Johns, J., Souza Jr., C., 1997. An integrated approach for addressing natural resource management problems in the Brazilian Amazon. Bioscience 47 (3), 160–168.

Walker, D.H., Zhu, X., 2000. Decision support for rural resource management. In: Guijt, I., Berdegué, J.A., Loevinsohn, M. (Eds.), Deepening the Basis of Rural Resource Management: Proceedings of a Workshop. ISNAR and RIMISP, The Netherlands, pp. 23–35.