

Current Issues in Non-Timber Forest Products Research

Edited by M. Ruiz Pérez and J.E.M. Arnold

CIFOR
CENTER FOR INTERNATIONAL FORESTRY RESEARCH

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Proceedings of the Workshop "Research on NTFP"
Hot Springs, Zimbabwe
28 August - 2 September 1995

Editors:
M. Ruiz Pérez and J.E.M. Arnold

with the assistance of Yvonne Byron

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Foreword

Throughout the tropics hundreds of millions of people derive a significant part of their livelihood from a vast range of non-timber products that they harvest from forests. In many cases hunting and gathering practices have their origins rooted deep in the past and are based upon a highly developed understanding of forest systems. Researchers are constantly surprised by the sophistication of the forest management practised by forest-dwelling communities. But the world is going through a period of incredibly rapid change. Economic development and improved communications lead to new opportunities for people hitherto dependent on forests and to both new markets for their products and new competition from cultivated or synthetic substitutes. We know that the extent of dependence on these products is enormous but we have very little basis upon which to predict the likely evolution of the use of non-timber forest products or the future lifestyles of the people who depend upon them.

A prominent feature of the recent concern for forest conservation has been the fact that many of the traditional uses of non-timber forest products are not only important to large numbers of people, they are also to a large extent consistent with the maintenance of the global biodiversity and carbon sequestration values of the forest themselves. Many of the systems meet our criteria for "sustainability", whereas there are countless examples of modern agricultural and forestry systems that have been imposed upon forest lands and are neither sustainable nor meet the needs of the people who depend on the forests.

Decisions to change the use of forest land or intensify the management of forests have often been taken without due regard to the values that people are already deriving from NTFP. Simple economic analysis may suggest that conversion to plantations or agriculture will yield greater utility than retention of the natural forest. But often such calculations ignore the need to provide substitute incomes and employment for forest-dependent people.

CIFOR recognises that there is already a vast body of scientific knowledge on non-timber forest products. A great deal of it is specific to localities, products or groups of people. In its present forms, this knowledge does not allow us to predict future trends, nor does it allow us to elaborate policy to promote sustainability or enhance the welfare of people dependent upon the products. This book presents the main issues that emerge from the existing body of knowledge on NTFP and proposes further research which will help us to

better understand NTFP-based systems and to optimise their future benefits. This book is the product of a workshop held in an area of eastern Zimbabwe where people are heavily dependent upon a large variety of products from the savannah woodlands. It was organised by Dr Bruce Campbell and colleagues from the University of Zimbabwe who actively research this subject. We are very grateful to them and colleagues at the Centro de Investigación de Espacios Protegidos Fernando González Bernáldez, Soto del Real (Madrid), Spain, who hosted a follow-up meeting to examine recommendations arising from the workshop in Zimbabwe and attempt to prioritise these issues as well as suggest ways of implementation. We hope that this book will serve to launch new research efforts on this vitally important subject both by CIFOR and by our collaborators throughout the tropical world.

Jeffrey A. Sayer

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Chapter One

Framing the Issues Relating to Non-Timber Forest Products Research

J.E. Michael Arnold and Manuel Ruiz Pérez

Introduction

Non-Timber Forest Products (NTFP) provide substantial inputs into the livelihoods of very large numbers of people in developing countries, and their production and use can constitute one of the main demands placed upon the forest resource. A complete understanding of the NTFP situation is therefore central to both the task of conserving and managing tropical forests, and of ensuring that these forests continue to contribute appropriately to the welfare of local populations. The Center for International Forestry Research (CIFOR) is conducting research in the field of NTFP.

An initial review of the state-of-knowledge in this area showed that, while much useful research has been carried out, most of this has been situation specific, has had a narrow sectoral focus, and has been restricted to examining a situation at a particular point in time. Differences in objectives, scope and methodology have meant that it is difficult to compare the results of individual studies. Hence it has not proved possible to carry out syntheses that provide the broader framework of information necessary to make sound policy and management decisions. Consequently, policy proposals are being formulated, and development actions are being implemented, without a clear understanding of their impacts and implications.

In order to address these data and analysis weaknesses, CIFOR initiated a process designed to encourage the development of a framework within which individual studies can be pursued in a manner that provides answers to a common set of questions, and that produces information that will be comparable across projects. The present report is one output of a workshop convened by CIFOR as a first step in this process.

The objective of the workshop was to review the state-of-art of research related to NTFP at present and outstanding issues, to recommend hypotheses and research questions for inclusion in the proposed common framework for such research, and to review and recommend appropriate methodologies. In order to provide a basis for these discussions, a number of researchers with considerable experience in the study of particular aspects of the subject, or of researching NTFP use and management in specific regions, were invited to prepare background papers.

The results of the discussions at the workshop and of a smaller follow-up meeting to further analyse and distil its output are reproduced in Annexes I and II, and are commented on towards the end of this introductory chapter. The present volume contains a number of the commissioned background papers that were considered to be of interest to a broader audience. Each is written from a particular perspective and, together, cover many of the main dimensions of the subject. Each seeks to review past research in a subject area and to identify issues that remain outstanding and require additional research in that area.

The present chapter will bring together some of the main issues that emerged, and to draw attention to linkages and common threads across the individual contributions. It also comments on some of the lessons that can be learned about approaches and methodologies for research into the linkages between NTFP and development and conservation, and about possible research priorities.

Framing the Issues

Defining the subject

Historically, interest in the productive capacity of tropical forests has focused on timber and other wood products. The lesser value placed on other material outputs is well reflected in their designation until recently as "*minor* forest products". The availability of information about the latter reflects this lack of interest[1] – being largely concentrated in narrowly focused ethno-botanical or anthropological studies of particular situations, and in studies of an ecological nature.

The increased attention paid to NTFP in recent times stems from a number of factors. One is the much heightened interest in the value of biodiversity, carbon sequestration and other environmental functions provided by tropical forests, and associated concerns with the consequences of the use of these forests in ways which lead to their destruction or degradation. A perception

[1] World-level statistics have been missing since 1972 when they were removed from the FAO Yearbook of Forest Products Statistics. There is a renewed interest in offering such statistics in a more accurate way (Padovani 1995).

that management for NTFP is more compatible with sustainable use of tropical forests than management for timber or shifting agriculture has consequently been one of the more powerful factors in stimulating heightened interest in NTFP (Myers 1986; Fearnside 1989; Peters *et al.* 1989; Bennett 1992; Redford and Padoch 1992).

A second factor has been the growth in awareness that use or sale of NTFP form important parts of the livelihood systems of very large numbers of people, outside as well as inside tropical forests. This has given rise to a thesis that sustainable management of forests for these products should therefore have valuable welfare consequences, as well as being environmentally sound – encouraging the idea that in this way environmental and developmental goals can be pursued jointly (Falconer and Arnold 1989; Falconer 1990; Nepstad and Schwartzman 1992; Panayotou and Ashton 1992).

There has also been heightened commercial demand for many non-timber outputs of tropical forests – rattan, oils, resins, pharmaceutical extracts, etc. – and a realisation that it is likely that there are other species and products of significant industrial value in such a rich and diverse genetic resource. Commercial arguments have therefore been advanced to reinforce the environmental and welfare arguments in favour of conservation (Balick and Mendelsohn 1992; Plotkin and Famolare 1992; Clay and Clement 1993).

Though these different interests in NTFP do coincide to some extent, they also contain inherent basic contradictions. In particular, as is discussed throughout the volume, there are likely to be conflicts between conservation and development. For instance, most harvesting of forest products involves some damage and disturbance to a forest's ecological structure and hence affects biodiversity. Some highly sought species may not be able to withstand pressures, causing drastic reduction in their population or even local extinction (Bodmer *et al.* 1988, Browder 1992; Redford 1992; Peters 1996). Equally, limiting use to low-intensity offtake activities is likely to adversely impact on people's ability to upgrade their livelihood systems, adding to the potential conflict between conservation and development from the forest dweller's perspective (González 1992; Redford and Stearman 1993; Conklin and Graham 1995).

The subject of management of tropical forests for NTFP is thus a complex one, characterised by multiple objectives, multiple products and usually multiple users. Further complications stem from the complex ways in which the component species interact, and the fact that these interactions are usually changing continuously over time. The equally complex patterns of use and change created by human demands on, and interventions in, the forests add a further major complicating element.

The variety of different interests in the subject give rise to different definitions of NTFP. During the workshop discussions the insufficient and negative definition of Non-Timber Forest Products became apparent. However, we decided to keep the name both as a recognition of its wide acceptance and

renewed interest as well as its effects in the current institutional setting and the leverage that it can offer to forest-dependent communities.

A basic definition, and one used in this volume unless stated otherwise, is "any non-timber product that is dependent on a forest environment". However, for some purposes it will be necessary to take account of the substantial quantities of some NTFP that come from tree stocks outside the forest, such as trees retained or grown on farms. Similarly, if the focus is on the relationship between the forest and livelihood systems, it may be necessary to look at all forest products used, including timber. As is pointed out by Padoch and Pinedo-Vasquez in Chapter 6, a focus on forest management may be better pursued by focusing on scale of management rather than products, i.e., distinguishing smallholder from industrial management and use. Another basis for defining the subject could be in terms of institutional responsibility – limiting or expanding the range of products to coincide with the coverage of the mandate of the government department charged with control of forest lands or the forest sector.

Moving towards an analytical framework

Most past research has been narrowly situation specific, and conducted from one or more of the three following perspectives (Ruiz Pérez 1995):

- commodity/income/market;
- people's perceptions/traditional knowledge/household needs; and
- biological properties/sustainable management focus.

These correspond broadly with the disciplinary interests of the economist, the social scientist and the biologist/ecologist/forester. Particular topics that have attracted attention include research into historical patterns and trends in use (Peluso 1992; Coomes 1995; Potter 1996), valuation of non-marketed products and services (Panayotou and Ashton 1992; Lampietti and Dixon 1995), and changes in the productivity and efficiency of production, processing and marketing of particular products (de Silva and Atal 1995).

Attempts to obtain a more global picture have been concentrated on particular types of information. The most comprehensive efforts have been devoted to the important, and still incomplete, task of compiling lists of species and their uses from different parts of the tropics (e.g., Heyne 1927, cited in de Wit 1994; Burkill 1935). A considerable amount of work has also been done on groups of products of particular commercial importance, such as chemical and fibre products, and on their resource base and markets. Amongst others it is worth mentioning the efforts of FAO, the Natural Resources Institute (NRI) in the UK, and the Plant Resources of South East Asia (PROSEA) project, an initiative of a number of South-east Asian countries and Wageningen Agricultural University, the Netherlands.

More recently, exercises have been attempted that draw upon information derived from many local studies, in order to develop more comprehensive comparative assessments, and analyses that relate NTFP use to livelihood systems and other aspects of the socio-cultural and economic frameworks within which their production and use takes place. Some of these take as their starting point hypotheses derived from relevant bodies of theory, and seek to test them. Others have been more exploratory in nature, and designed to formulate hypotheses (Godoy and Bawa 1993; Ros-Tonen *et al.* 1995; Ruiz Pérez 1995).

One approach, that of cultural ecology, based on postulates of evolutionary ecology, has developed a series of adaptationist theories to explain patterns of resource consumption, especially in indigenous communities. Their basic assumption is that people adapt their culture to the constraints of the natural environment. Optimum foraging theory is the most widely known of these (Hames and Vickers 1983). Management theories, on the other hand, emphasise the proactive role of people in shaping the forest to their needs, thus overcoming some of the environmental limitations (Balée 1989).

Another important approach, which is developed and discussed by Homma in Chapter 2, is based on agronomic development theory. It argues that "extractionist" use of NTFP is associated with extensive use of land, low investment, stagnant technology and exploitative use of labour. As commercial demand for a product emerges, output first expands then, as quantities and quality from wild sources decline, prices will rise. Inelasticities in supply of naturally sourced products then lead to development of domesticated sources and synthetic alternatives. According to this theory, production of these products will therefore move from being smallholder extractivist activities to the status of agricultural crops. At the same time, extractivism will cease to provide a viable livelihood system, and will be displaced by agricultural activities that make more intensive use of the land resource.

It has been pointed out that in practice this evolutionary path can be modified in a number of ways, so this outcome is not inevitable. Forest management interventions, for instance, by increasing the productivity of the natural forest, could prove to be an alternative to domestication, or could delay or modify the progression towards domestication. Institutional measures might similarly curb pressures to deplete the natural resource. Extractivist use of a product is often just one component of livelihood systems, practised in conjunction with agriculture and exploitation of other forest products. Decline or collapse in the market for one product therefore need not result in radical change in livelihoods (Almeida 1996; see also Chapter 7).

Development theory is also the basis of the approach that underlies the discussion in Chapter 5 by Wilkie and Godoy. It is argued (Godoy and Bawa 1993) that dependence on NTFP is associated with cultural isolation, lack of technology and capital, and poor access to markets. With increased exposure to trade and markets, per capita incomes rise, imported goods are substituted

for some NTFP and others are exploited primarily for sale. As the opportunity cost of labour rises, use of the forest is increasingly concentrated just on higher-value outputs.

In Chapter 5 this theory is used to develop a heuristic model to explore the implications of such an evolution in patterns of use on the composition of the resource, and hence on biodiversity. Again, as is discussed below, it can be argued that forest management and other interventions could lead in practice to a wider range of outcomes than the model allows for. This is reduced though if, as the authors propose, we can distinguish between ambiguous and unambiguous impacts of change.

Other work has related NTFP use to theories of household livelihood strategies (Falconer and Arnold 1989; Lescure 1995; Townson 1995). Availability of alternative income-earning opportunities, optimal use of labour and other resources, management of exposure to risk, and the balance between subsistence and income objectives, are postulated to be factors accounting for differences in NTFP use. It is hypothesised that a broad distinction can be made between NTFP activities with low thresholds of entry that are largely a response to lack of alternative employment, and which are likely to decline or disappear as other opportunities emerge, and those NTFP activities that are growing in response to growth in demand for their products. But this thesis is still at an early stage in its development.

These general theories, models and hypotheses provide valuable starting points to the process of researching and understanding NTFP use and management. However, at present they are limited in their usefulness. Weaknesses and gaps in the data base, and hence in knowledge about the broader environments within which NTFP use and management take place, at present impose severe constraints on efforts to construct such an analytical framework. In particular, the complexity, variation and patterns of change in the range of forest situations within which NTFP use takes place militate against the likelihood that generalised models based on assumptions of deterministic and uni-directional change will have universal application. Instead, change is likely to follow multiple possible paths that combine causal and random (i.e., unexpected) relationships. Models that assume a single path are therefore likely to be found to be at variance with what is experienced. At the same time, a number of case-study models based on some of the above-mentioned hypotheses have been developed (e.g., Gunatilake 1994; Dufournaud *et al.* 1995; Godoy *et al.* 1995; Wickramasinghe *et al.* 1996).

Analytical Framework

Although the potential for comprehensive modelling is limited at this stage, progress should be possible in exploring more limited sets of relationships, or component parts of the NTFP whole. The papers represented in this volume were originally designed to look at NTFP within the following six-part structure:

- Forest-woodland dynamics
- Non-market and market dynamics
- Technological changes
- Use of labour and the household economy
- People's perceptions, preferences and opportunities
- Policy development

As was discussed during the workshop, these are not mutually exclusive categories. Most of them cut across others to some extent. Households and technology, for example, enter into questions of markets and forest management. It is therefore difficult to separate components that are conceptually equivalent (Neumann 1996).

In the sections that follow the discussion is organised under four broad, and overlapping, headings based on the recommendations of the workshop. The first deals with the structure and ecology of the forest resource and how this is altered by harvesting and other forms of intervention. The second examines the role of NTFP in household livelihood systems, and variations and changes in these relationships within and between households and over time. The third considers the impact of market forces on demand and supply, and on the user populations. The fourth looks at the impact of institutional factors and arrangements at both the community and broader levels.

The forest resource and impacts of forest management and use

Forest ecology and change

One obvious starting point in an examination of the issues surrounding the use and management of NTFP is to seek to understand the pertinent characteristics of the resource from which these products will come. In Chapters 2 and 3 we are provided with such an overview.

In Chapter 2, Peters documents key characteristics of the plant component of tropical forests. The great majority of trees rely on animals for pollination and dispersion, and require viable populations of these animals if they are to be sustained. In Chapter 3, Redford outlines the key features of the dynamics of animal populations in forest habitats.

The interactions between plants and animals and among different plant and animal species are often complex. Removing excessive quantities of seeds or the animals that disperse them can rapidly alter the composition of a forest, and the frequency of occurrence of particular species. Some products can be, but are not necessarily, harvested in ways that do not disturb the forest canopy, kill the parent trees or remove their seeds. But most harvesting is destructive or damaging in some way.

Some species are better able to sustain continuous offtake than others (e.g., those exhibiting abundant and frequent regeneration and rapid growth).

Growing demand will therefore have differential impacts on the extinction, management and domestication of different species.

Defining sustainable management

Much of the discussion of sustainable use and management of tropical forests is focused on ecological sustainability, in particular in terms of conserving biodiversity. The basic concept of management to achieve this objective is to provide a constant flow of information about the ecological response of a species to varying degrees of exploitation. This allows a continual process of adjustment in which any change in seedling establishment or population structure results in a corresponding change in harvest level.

However, there are other dimensions to sustainability that are also highly pertinent; notably that of the capacity of the forest to sustain a flow of benefits relevant to the users. As this will vary over time, as needs and tastes change, this is likely to require changes in the structure and composition of the resource; in contrast to the maintenance of the *status quo* associated with a biodiversity objective.

Much use of forests for NTFP is in forest systems that have already been disturbed by human use to a greater or lesser degree. As is pointed out in the introduction to Chapter 2, the ecology, use and impact of use on the ecology are likely to be considerably different in disturbed or secondary forests than in pristine or near-pristine forests. Harvesting is, in practice, likely to be concentrated in formations that have relatively high densities of valued species, and in forest areas close to users and markets.

It is argued that as demands on the forest increasingly reflect market forces, use shifts to more intensive exploitation of fewer species (see Chapters 3 and 5). Also, that with selective harvesting of only the more valued species, over time the composition of the remaining forest stock shifts to less desired species. But the interventions in the forest that accompany exploitation often extend to more than just harvesting. Use of the forest may be managed in ways to encourage particular species; sometimes to the extent of planting. As is illustrated in the cases of small-scale management in Chapter 6, the value, and even the tree species richness, may on occasion be enhanced rather than reduced.

We also need to recognise the differences between short-term and long-term impacts of forest use and management. As has been shown repeatedly in studies on the impact of timber harvesting, tropical forests can and do recover from even heavy use if allowed the time to do so without further disturbance. But this does not happen if there is repeated harvesting at short intervals (Poore *et al.* 1989).

Indigenous knowledge and forest management

As is discussed in several of the chapters, use and management of the resource is often closely linked to knowledge about the resource, and to the technology

available. In Chapter 10, Grenand and Grenand describe how sustainable use and management in a predominantly subsistence situation has been shaped by a long history of adaptation to the forest environment. They stress the role of cultural identity in the development and transmission of this knowledge. In Chapter 6, Padoch and Pinedo-Vasquez describe and discuss viable small-scale commercial systems that have been developed locally, which also follow harvesting and management practices that are in balance with the resource they are exploiting. They suggest that small-scale, limited mechanisation, ability to respond rapidly to changes in demand, and a focus on managing individual plants, are among the factors accounting for the sustainable nature of the systems described.

More generally, it has been pointed out that extractive production can be seen to be a low-level technology that represents the accumulated knowledge of human societies over millennia of interaction with the forest. This knowledge should be assessed and valued fully in identifying the scope for more intensive use and management of forests – as should the consequences of loss of such knowledge (see Chapter 8 by Falconer).

The nature and impact of introduction of the new technologies and practices that accompany growing commercial demands for NTFP are discussed in the section on Markets, Technology and Market Forces. Here, it should be noted that introduction of new or improved technology can increase the productivity of existing systems without disrupting them, as is evidenced by the adoption of outboard motors to extend the area accessed for gathering and hunting described by Grenand and Grenand. However, it can equally disrupt it; the introduction of chainsaws being an often cited local-level example.

NTFP and household livelihood strategies

Household use of and dependence on NTFP

In different situations NTFP contribute to household self sufficiency, food security, income generation, accumulation of savings and risk minimisation. NTFP-based activities can be important in filling seasonal and other food or income gaps, can provide a buffer in times of hardship or emergency, be an activity of last resort, or can present an opportunity for improving household income and security.

In Chapters 7 and 8, Almeida and Falconer discuss the importance of understanding how these different roles are related to different household strategies, and to differences in household characteristics. In Chapter 10, Grenand and Grenand contrast the "sufficiency" goal of subsistence strategies with the profit maximisation objective of populations functioning within a market economy.

Ogle, in Chapter 12, addresses the issue of intra- and inter-household differences in reliance on NTFP. As is pointed out by Neumann in Chapter 9, there has been a tendency to focus on a concept of an undifferentiated local

population. The reality is one of politically fractured and socially differentiated groups, with pronounced socio-economic stratification resulting in differential capture of benefits. It therefore becomes important to understand who is dependent on NTFP, as distinct from those who have alternative options, and who gains and who loses as a consequence of change.

Changes in the role of NTFP over time

Most contributors stress the importance of understanding the dynamics of change in people's relationships to the forest they draw upon. Many situations can only be understood in the context of what has shaped them in the past, and the factors that bear upon their evolution into the future.

Much change is associated with the growing presence of market forces and opportunities (discussed more fully in the following section). At the household level this transition is likely to be reflected in the impact on the importance and nature of NTFP activities of shifts in the balance between forest-based, agricultural and off-farm opportunities and sources of employment and income, and associated shifts in the availability and allocation of land and household labour (see the Chapters of Almeida and Falconer).

Negative or limiting features associated with particular NTFP activities can also contribute to household decisions to discontinue them. These can include marginal returns, increasing costs and declining returns, poor working conditions, volatile markets, a weak marketing position, exploitative patron/labour relationships, and lack of access to inputs of capital or technology to overcome constraints of labour shortage or work stress.

Community dynamics

In Chapter 9, Neumann discusses cultural and social contexts, emphasising the importance of understanding the sources of intra-community power. For instance, who makes decisions and who has power? What is the capacity of community-level institutions to control and manage? This can be different among different groups, between genders and age classes, etc.

In many communal systems, NTFP production and use is affected by complex, multiple, overlapping rights. These are likely to have been shaped by the historical evolution of their cultural and institutional environments. Recent and current institutional trends, such as the drive to individualisation and titling, threaten further change and tenurial uncertainty. With much NTFP use having traditionally been subject to some form of collective control, the widely observed trends that tend to increase intra-communal conflict, and weaken conflict-resolution mechanisms, are likely to be important factors in many NTFP situations. Insecurity of tenure is believed to favour more certain short-term activities such as destructive harvesting and shifting cultivation. However, there are diverging views about what is the best way to secure tenure.

Markets, technology and impacts of market forces

Identifying market impacts

Most forest-using populations are being progressively incorporated into a market economy. However, as difficulties exist in establishing the real costs and returns from an NTFP activity, because of its joint production nature, its integration with other household activities, its linkage to multiple livelihood objectives, etc., it is difficult to understand, and hence predict, people's interactions with markets.

As has been noted earlier, both Chapters 4 and 5 are based on exercises designed to develop theoretical models to help understand such changes in people/forest relationships. A number of the other chapters look at particular aspects of the relationship, or the relationships that exist in particular circumstances.

In Chapter 10, Grenand and Grenand document a situation in which a population has resisted a move towards a market system, and has retained their predominantly subsistence system. Falconer and Ogle, in Chapter 8 and 12, draw attention to the continuing importance of subsistence demand in a mixed economy, and to some of the interactions between subsistence and commercial uses of a product in such a system (e.g., diversion of supplies from own use to the market). Other authors (Homma, Almeida) comment on the changes in allocation of labour and other household resources that can accompany a shift to greater involvement in the market.

Another interrelationship that is difficult to interpret and predict is that between market values and conservation. Much attention has been directed to the thesis that if a resource has value this will increase the likelihood that those in control of its use will protect it – hence increased commoditisation should strengthen conservation. However, arguments that this is not necessarily the case point to the failure of the market to reflect the values of environmental and other "external" costs and benefits. As Padoch and Pinedo-Vasquez point out in Chapter 6, the limitations in available methods for establishing such values, and errors in their application and in the interpretation of their results, have on occasion resulted in misleading conclusions. Moreover, market demands may lead to short-term over-exploitation and even to local extinction of some plants and animals that provide highly desired products (see Chapters by Peters and Redford).

Exploiting market opportunities

Considerable attention has been paid to the weak bargaining power of many producers of NTFP, in particular in the face of monopsonistic buying, as a factor constraining their capacity to benefit from exposure to the market. However, it has also been pointed out that intermediaries (middlemen) play an essential role in trade in products characterised by perishability, seasonality of demand or supply, dispersed smallholder production and poor transport

infrastructure. In Chapter 11, Hyman argues that there can sometimes be scope for organisation of producers and primary traders, in order to strengthen their positions. But this is often constrained by producers' limited access to credit for use in NTFP activities, except where buyers have been monopsonistic.

Producers' potential to benefit from commoditisation varies widely by product and the type of market. While some NTFP are "inferior goods" that fall out of use as incomes rise, others face strongly growing demand. Some products have large, diversified and stable markets; others face highly volatile, often "boom-and-bust", markets – or demand that is seasonal and subject to sharp price fluctuations. While some therefore provide a strong basis for livelihood systems, others provide at best marginal returns to those engaged in their harvest, and many involve high levels of risk.

Changing market opportunities are often likely to require technological change before they can be exploited. As is documented in Chapter 11, new or improved technology may be required in order to increase returns to the producer, remove bottlenecks (such as preservation of perishable products), increase scale of operation, or control quality. Additional inputs of technology (and capital and skills) in order to process NTFP locally can significantly increase the value added by the producer. Technological advance can mean improving tools and techniques already in use as well as adopting new technology. Such advances can reduce destructive harvesting practices, improve pre-processing, storage and preservation, and improve capacity to meet market quality requirements. But the impact of technology and market forces can also make some NTFP obsolete, e.g., displacing "natural" products by synthetics or plantation-grown supplies. At the same time new opportunities can arise for others, market opportunities for additional products can open up, or uses for previously un-marketed NTFP can emerge. A large number of development initiatives based on NTFP have focused on exploring such opportunities.

However, the original extractive producers may lack access to the knowledge or the capital and skills to exploit these opportunities. Producers can also face policy and other barriers to access to NTFP markets; or price controls and other price distortions in markets. Because they give high priority to conservation objectives, many governments have set in place forest and environmental policies and regulations designed to limit rather than encourage production and sale of NTFP. Restriction of output is often favoured as a means of pursuing conservation because it is seen as easier than addressing the issue of land clearance. Differential controls on markets for different products or in different situations shift supplies to those outlets that are least affected by controls (Dewees and Scherr 1996).

As is discussed in several of the chapters, commoditisation and the shift to market-based NTFP activities can therefore bring about radical changes in the pattern and intensity of exploitation of the resource, and in the contributions of NTFP to household livelihoods and strategies. The role of commodi-

tisation is therefore one that is likely to be central to understanding most NTFP situations, as was discussed during the workshops (see Annex II).

Policy issues

Many of the features and trends noted in the previous discussion have their origins in national policies. Policies that change the extraction-cultivation cycle include land policies that affect title to land and security of tenure, laws that affect labour costs, and infrastructure policy that increases access to markets (and inputs). NTFP activities can also be affected by broader economic, trade and environmental policies. Lack of security of tenure or access, for instance, is likely to stimulate household strategies focusing on activities that generate short term returns, such as destructive harvesting and shifting cultivation. The incentives for households to engage in NTFP activities is also likely to be influenced by policy and other barriers to access to NTFP markets; or by price controls and other price distortions that depress returns.

The ability of community-level institutions to control and manage forest use can be affected by a number of policies. These include policies that assert government control over the forest resource and over the land and rights of usage. Also broader policy measures, such as the drive to titling of land in Africa on the grounds that customary laws and communal ownership are an impediment to agricultural development.

Neumann, in Chapter 9, notes that one result is widely that of ineffective communal control and an environment in which household decision making and market forces fail to generate sustainable use. However, it is often unclear which institutional models might be appropriate at present in situations marked by increasing conflict and less commonality of purpose, and increasingly ineffective conflict-resolution mechanisms. Policy research needs to be based on the realities of fragmented communities and pressures that continue to move towards increasing disaggregation.

Research Priorities and Approaches

As was noted earlier in the chapter, fundamental difficulties arise in trying to develop a conceptual framework that encompasses all of the above, or even the main, factors relating to NTFP. In the exercise reported in Annex I, which sought to arrive at the elements of such a framework, 65 research questions, grouped under six categories, were identified as candidates for inclusion. However, it became clear that this list is far from complete, that the process of identification and selection had not provided a basis for establishing hierarchies or priorities within the whole, and that at present insufficient is known about the context and complex multiple interrelationships involved to be able to establish a satisfactory overall framework for research and analysis.

It is therefore likely that progress in the near future may be more effectively pursued by concentrating on some of the component issues and intermediate approaches. One important approach identified at the meeting summarised in Annex II would be to carry out fuller and more rigorous analyses of the information available in the existing literature. Though past reviews have been useful as a guide to what has been published, they provide little in the way of information about the comparability of the different situations covered, or about the research methods and hence comparability of the research results drawn upon. It is therefore difficult to judge the validity of the conclusions and generalisations reached.

Another advantage of giving priority to understanding more clearly and fully what has already been studied, would be to reduce the amount of duplication of effort evident in some of the on-going research. Too much of it is repeating work that has already been done, apparently because researchers are unaware of what already exists.

The review process could be more effective if it is focused on particular issues that are demonstrably central to much of the NTFP system. It is argued in Annex II that priority in this respect should be given to examining the impacts of commercialisation on smallholder NTFP use. This has important linkages with welfare, management of the forest, structure and function of the forest, and tenure and control. Thus, commercialisation is linked to issues of both social equity and ecological sustainability.

Another area that could contribute to better-focused research would be to give more attention to the issues of scale and the unit of analysis discussed in Chapters 6, 7, 8 and 9. Many questions can be posed at various levels of society, and many need to be in order to address, for instance, different sources of power and different perspectives on distribution of benefits at local and national levels. Also, varied forms of investigation at a number of levels may be needed in order to cover all the key elements of a situation. Thus, research may be needed on international trade as well as on household consumption in order to understand NTFP use. Or correct identification of scale may be important because options for forest management and use may be very different at small and large scales, or in small and large landscapes.

As is stressed by a number of the authors (e.g., Chapters 7, 8, 9 and 10), it is also usually necessary to be able to understand what happened in the past in order to explain the present. Considerable importance therefore attaches to careful analysis of the historical, and dynamic, context of NTFP use. This is also necessary in order to take account of likely future change, e.g., predicting the consequences for NTFP production and use of changes in social structures, increasing integration into the global economy, and loss of local knowledge due to out-migration of young people. This need to be able to set a situation in historical context, and to understand the nature and causes of change in NTFP use and management, further underlines the importance of rigorous

review of existing information, and of being able to compare research results across situations at different stages of development.

At the level of the individual research programme or project, Falconer and Ogle discuss, in Chapters 8 and 12, the importance of accurately identifying the purpose of research, and the use to which the results will be put, in the design and management of the investigation. Who will be the users of the research results, what do they need, in what form and when? This can mean having to respond to needs and interests of several different categories or levels of decision maker concerned with NTFP use and management. In the many instances where the research relies on active involvement of the local NTFP producers and users, care also needs to be taken to consider whether follow-up to help the latter put research results into practice needs to be planned as well. As is pointed out in Chapter 12, failure to do so can easily undermine the whole purpose and value of research.

A final point, touched on in these two chapters and by several other authors, concerns the inter-disciplinary nature of many of the issues that arise in NTFP research. Two particular points emerge. One is the need to be able to deploy researchers from the different relevant disciplines; and to recognise that the ability to work in inter-disciplinary groups can require particular skills and experience. The second is that in researching complex issues, against a background of usually limited experience as to which research methods are most successful, it may often be wise to employ more than one approach or method in addressing a particular issue.

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Chapter Two

Observations on the Sustainable Exploitation of Non-Timber Tropical Forest Products

An Ecologist's Perspective

Charles M. Peters

This chapter presents the observations of a plant ecologist who has spent almost twenty years studying the ecology, use, and management of non-timber tropical forest products[1] or NTFP. In fact, when I first started conducting research on these plant resources they were still referred to as "minor" forest products and no one really paid much attention to them. The situation has changed dramatically in recent years. Non-timber forest products are now big business, and numerous efforts are currently under way to promote the exploitation of these well-publicised and highly desirable tropical resources. Great attention has been focused on the selling process, e.g., on developing markets for different products, on implementing local processing and value-added strategies, and on ensuring an equitable distribution of the income that has been generated. Securing land tenure or usufruct rights for local collector groups has also been an important component of the development of these resources. Clearly, there are good reasons for emphasising these socio-economic factors. If you want to collect forest products, you need access to and some degree of control over the forest. If you want to sell these products, you need markets. If you want to stay in business, you need to capture as large a percentage of the final selling price as possible.

[1] Non-timber tropical forest products are defined in this chapter as biological resources other than timber which are harvested from either natural or managed forests. Examples include fruits, nuts, oil seeds, latexes, resins, gums, medicinal plants, spices, wildlife and wildlife products, dyes, ornamental plants and raw materials such as bamboo and rattan. Crocodiles, butterflies, iguanas, turtles, bird's nests and a variety of other animal resources and products collected from tropical forests are also included in this definition.

It is somewhat surprising, however, that the ecological factors associated with the exploitation of these forest resources have so rarely been addressed. Maintaining a reliable income flow over time requires that the forest resource upon which this flow is based be maintained as well. If this resource is depleted through over-exploitation, destructive harvesting or poor management, no new markets, cottage industry or land tenure system will make very much difference. In the long term, ecology is probably the real bottom line here.

The purpose of this chapter is threefold: (1) to challenge the common assumption that the commercial harvesting of non-timber forest resources has minimal ecological impact on a tropical forest; (2) to propose a series of indicators and procedures for monitoring the ecological sustainability of forest exploitation; and (3) to highlight several problems that might hinder the implementation of such a monitoring system. Given the author's previous experience and interests, the discussion focuses on non-timber *plant* resources, with a particular emphasis on trees. It is important to point out that this chapter is primarily about impact monitoring. It *is not* about the management and rehabilitation of tropical forests that already have been degraded by excessive NTFP exploitation. The basic issue under consideration here is how to avoid resource depletion by ensuring that the harvest of NTFPs is truly sustainable over time.

Ecological Impacts of Forest Use: The Myth

Human cultures have developed a variety of different ways to use forest vegetation. Each form of land use carries with it a particular suite of ecological costs. Perhaps the most intensive and costly way to use a forest is to cut it down, burn it, and plant something else (e.g., timber trees, agricultural crops, pasture grasses) on the site. The ecological impacts of forest conversion are immediate, highly visible and, in most cases, very severe. Current research in tropical forests suggests that the most important of these impacts include:

- the loss of biomass and species diversity;
- the release of CO_2 and other greenhouse gases;
- disruption of nutrient and hydrological cycles;
- soil loss through erosion; and
- increased local temperatures and decreased local rainfall.

To put some of these consequences in perspective, a one hectare tract of primary forest in the Brazilian Amazon may contain more than 200 tree species ($\geq$10 cm in diameter) and present an aboveground living biomass of about 300 tons/ha (Brown *et al*. 1995). Cutting and burning this forest

would eliminate most of the biodiversity and release approximately 150 tons of carbon/hectare in the form of carbon dioxide and other heat-trapping gases (Keller *et al*. 1991). The removal of vegetative cover would increase water movement, soil erosion, and nutrient loss, decrease evapo-transpiration and total ecosystem productivity (Jordan 1987), and potentially modify local climatic regimes because of the increased reflectance of solar radiation (Skukla *et al*. 1990). The site would be characterised by stumps, blackened tree trunks and, depending on the topography, a growing network of eroding gullies. It is obvious to the most casual observer that a major ecological disturbance has occurred here.

Another common use of forests is to selectively cut and remove the boles of desirable timber trees. Although certainly less damaging than total forest conversion, selective logging is also known to produce a number of ecological repercussions. The most conspicuous of these are:

- loss of some plant and animal species;
- damage to residual trees;
- soil loss through erosion;
- loss of nutrients through stem removal; and
- change in forest structure and increase in light levels.

A major problem with selective logging in tropical forests is that the crowns of many large canopy trees are lashed to those of their neighbours by a profusion or vines, lianas or climbers. When the timber trees are felled, other canopy species are also pulled down and the whole woody mass crashes through the lower canopy snapping tree boles, breaking branches, and flattening a considerable proportion of the forest understorey. Harvesting a small number of stems can destroy up to 55% of the residual stand and seriously damage an additional 3% to 6% of the standing trees (Burgess 1971; Johns 1988). Associated impacts include soil compaction, decreased infiltration of water, increased rate of soil loss from erosion, disruption of local animal populations, increased susceptibility to fire (Uhl *et al*. 1988), and nutrient loss from the removal of sawlogs. Commercial tree felling produces a notable impact on a forest ecosystem, and the physical evidence of this disturbance is immediately apparent and persists in the form of logging roads, skid trails and scattered tree stumps for many years.

A final form of forest use that has attracted a lot of attention recently involves the selective harvest of fruits, nuts, latex and other non-timber resources. Although relatively benign when compared with forest clearing and selective logging, this activity also produces a number of ecological impacts including:

- gradual reduction in vigour of harvest plants;
- decrease in rate of seedling establishment of harvest species;

- potential disruption of local animal populations; and
- nutrient loss from harvested material.

At first glance, these impacts seem insignificant. The harvest of non-timber forest resources does not necessarily kill the plant[2] , compact the soil, increase erosion, or cause a notable change in the structure and function of the forest. A forest exploited for fruits and latex, unlike a logged-over forest, maintains the appearance of being undisturbed. It is easy to overlook the subtle impacts of NTFP harvest and to assume *a priori* that this activity is something that can be done repeatedly, year after year, on a sustainable[3] basis. This ubiquitous idea, or some variant of it, has appeared in books, scientific papers, conference proceedings, grant proposals, magazines articles, newspaper stories, on television and radio shows, in the annual reports of private companies, and even on the back of cereal boxes and ice cream cartons. Unfortunately, in the great majority of cases, this assumption is patently incorrect.

Some Facts about Tropical Trees and Forests

Tropical forests exhibit several ecological characteristics which make the sustainable exploitation of non-timber resources a more difficult proposition than it might first appear. One of the most fundamental and well-known features of these forests is their great species richness, or large number of plant species per unit area. To illustrate this point specifically for trees, floristic data collected from small tracts of tropical forest around the world are shown in Table 1. Although there is much variability from site to site, the results from these surveys show that tropical forests are extremely diverse and may contain from one hundred to over three hundred species of trees per hectare. To put these numbers in perspective, a mature northern hardwood forest in the eastern United States contains about ten to fifteen tree species per hectare (Braun 1950).

From a commercial standpoint, the high diversity of tropical forests is a mixed blessing. On the one hand, forests containing a large number of different species usually contain an equally diverse assortment of useful plant resources, i.e., species richness and resource richness are usually correlated.

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[2] The harvest of some NTFP, for example rattan, certain species of palm heart, gaharu wood (*Aquilaria malaccensis*) and most roots and barks, does, in fact, kill the plant.

[3] Within the context of this report, a sustainable system for harvesting non-timber forest resources is defined as one in which commercial quantities of fruits, nuts, latexes and other plant products can be harvested indefinitely from a limited area of forest with negligible impact on the structure and dynamics of the plant populations being exploited (Peters 1994).

Table 1. Number of tree species (≥10 cm diameter) recorded in small tracts of tropical forest.

Location	Sample Area (hectares)	Number of Species (≥10 cm diameter)	Species
Cuyabeno, Ecuador	1.0	207	Valencia *et al*. 1994
Mishana, Peru	1.0	289	Gentry 1988
Lambir, Sarawak	1.6	283	Ashton 1984
Bajo Calima, Colombia	1.0	252	Faber-Langendoen and Gentry 1991
Sungei Menyala, Malaysia	2.0	240	Manokaran and Kochummen 1987
Wanariset, East Indonesia	1.6	239	Kartawinata *et al*. 1981
Gunung Mulu, Sarawak	1.0	225	Proctor *et al*. 1983
Rio Xingu, Brazil	1.0	162	Campbell *et al.* 1986
Barro Colorado, Panama	1.5	142	Lang and Knight 1983
Oveng, Gabon	1.0	123	Reitsma 1988

The great interest in tropical forests as a source of undiscovered pharmaceuticals, for example, is largely in response to the magnitude of the species pool in these ecosystems. Unfortunately, an additional correlate to high species diversity is that the individuals of a given species usually occur at very low densities. There is a limit to the total number of trees that can be packed into a hectare of tropical forest. If you have a large number of species, each species can only be represented by a few individuals.

This tendency of high species diversity coupled with low species density is illustrated in Figure 1 using inventory data collected from small tracts of forest in Brazil and Sarawak. As shown in the histogram, the great majority of the species at each site are represented by only one or two trees; less than 10% of the species exhibited densities greater than four trees/hectare. Although there may be an abundance of resources in tropical forests, most of them are scattered throughout the forests at extremely low

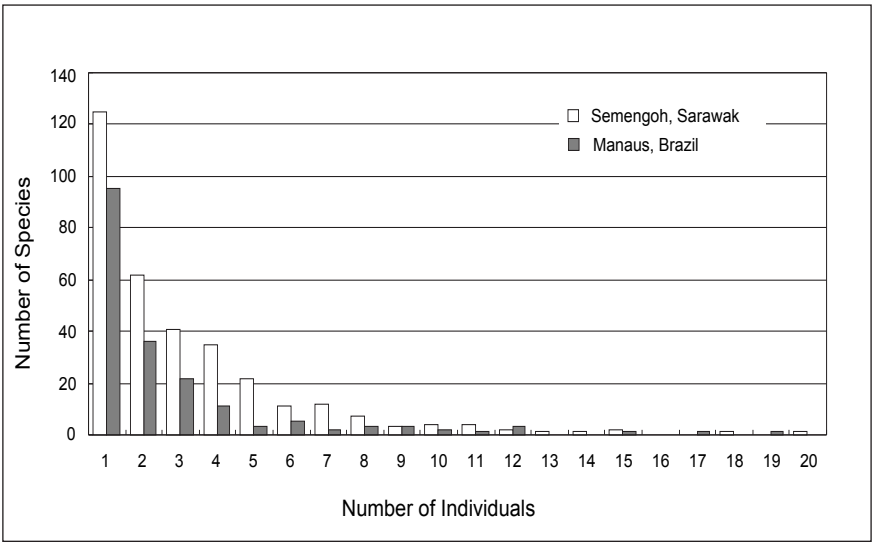


Figure 1. Densities of different tree species within small tracts of tropical forest. Inventory data from Semengoh, Sarawak based on a 4.0 hectare sample plot (Ashton 1984); Manaus data based on a 1.0 hectare sample plot (Prance *et al*. 1976).

densities. Low density resources are difficult for collectors to locate, they require lengthy travel times, produce a low-yield per unit area, and they are extremely susceptible to over-exploitation.

A second characteristic of tropical trees that represents an obstacle to sustainability concerns the way that they move their pollen and disperse their seeds. The low density and scattered distribution of individuals in many tropical tree populations greatly complicates the process of pollination. Given that the distance between conspecific individuals may be greater than 100 metres in some cases, moving pollen from the flowers of one tree to another can be a difficult proposition. Many tropical trees have overcome this problem by co-evolving relationships with a variety of animals, ranging from tiny thrips and midges to bees and large bats, that act as long-distance pollen vectors. These relationships can be quite specific, with one type of insect being solely responsible for pollinating the flowers of a particular species, or even genus, of forest trees (e.g., Wiebes 1979). The use of biotic vectors to transfer pollen is apparently the norm in tropical forests, and studies in Costa Rica (Bawa *et al*. 1985) suggest that over 96% of the local tree species are pollinated exclusively by animals.

Animals also play a very important role in dispersing the seeds produced by tropical trees. Studies conducted in Rio Palenque, Ecuador (Gentry 1982), for example, have shown that 93% of the canopy trees produce fruit adapted for consumption by birds and mammals, while Croat (1978) estimates that

78% of the canopy trees and 87% of the sub-canopy trees at Barro Colorado Island in Panama have animal-dispersed fruits. These animals may either remove fruit and seeds directly from the tree (primary dispersers), or they may forage on fruits that have already fallen to the ground and split open (secondary dispersers).

The important lesson to be gained from these findings is that the production of fruits, seeds and seedlings in tropical forests necessarily involves the collaboration of animals. Although it is very easy to overlook this fact, or to view forest animals solely as pests that damage or consume large quantities of fruit, sustainable resource use in tropical forests ultimately depends on the continual availability of pollinators and seed dispersers. In simple terms, no pollination means no fruits, no fruits and/or no dispersers mean no established seedlings, and no established seedlings means no next generation, no products, no profits – and no sustainability.

A final characteristic of many tropical tree species is that they have a very difficult time recruiting new seedlings into their populations. Even given abundant pollination, fruit set, and dispersal, there is still a very, very small probability that a seedling will become successfully established in the forest. The seed must avoid being eaten, it must encounter the appropriate light, soil moisture and nutrient conditions for germination, and it must be able to germinate and grow faster than the seeds of other species that are competing to establish themselves on that micro-site. The young seedling must stay free of pathogens, be able to recuperate from the damage caused by herbivores, avoid falling branches and other hazards, and continue to photosynthesise and push its way upward into the forest canopy. Not surprisingly, mortality during the early stages of the life cycle of a tropical plant is extremely high.

A graphic example of the seedling mortality experienced by tropical trees is provided by the four survivorship curves shown in Figure 2. *Brosimum alicastrum* is a widely distributed canopy tree from the neotropics (Peters 1990a) *Shorea curtisii* and *Shorea multiflora* are dominant tree species in Southeast Asia (Turner 1990), and *Grias peruviana* is an abundant lower canopy tree in western Amazonia (Peters 1990b). As is illustrated in these histograms, seedling mortality for these four species during the first twelve months following seedfall ranges from a high of 22% for *S. curtisii* to a low of 3% for *B. alicastrum*. Half-lives, or the time required to kill off 50% of the initial cohort, vary from two to five months. Taking into account seed predation and germination failure, less than 0.1% of the seeds produced by *B. alicastrum* become established seedlings. Only a very small fraction of these (approximately 1 in 1.5 million) will ever make it to the canopy and start producing fruit . Data such as these, which are by no means atypical for tropical trees, provide perhaps the most convincing demonstration of how difficult it is for a species to maintain itself in the forest – even in the absence of any type of resource harvest.

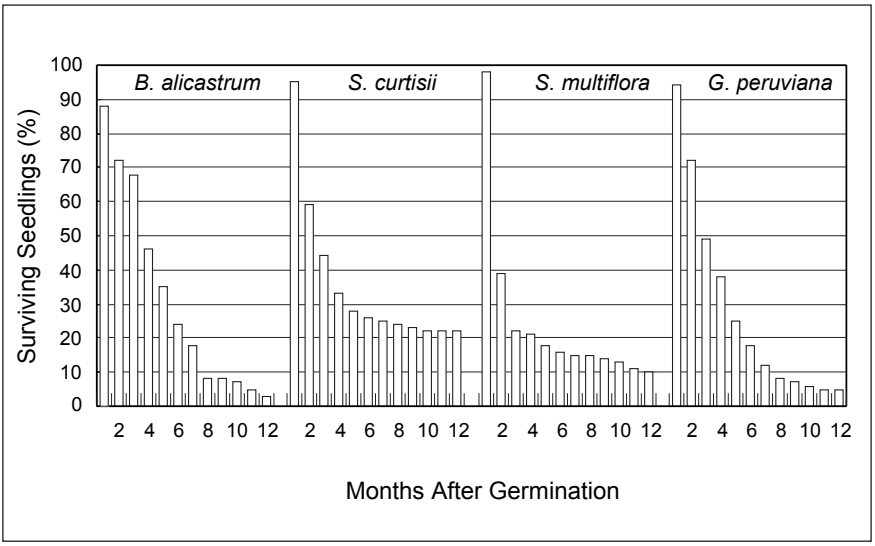


Figure 2. Seedling survivorship curves for *Brosimum alicastrum*, *Shorea curtisii*, *Shorea multiflora* and *Grias peruviana*. Histograms show the percentage of seedlings surviving during the first year following germination. Data for *B. alicastrum* were collected in Veracruz, Mexico (Peters 1990a), *S. curtisii* and *S. multiflora* were studied in Peninsular Malaysia (Turner 1990), and *G. peruviana* data were collected in Peruvian Amazonia (Peters 1990b).

The Reality of NTFP Harvest

Given the low density of tropical forest species, their reliance on animals for reproduction, and the difficulty experienced in establishing their seedlings, the harvest of any type of plant tissue will necessarily have an effect on the species involved. The delicate ecological balance maintained in a tropical forest is easily disrupted by human intervention, and extractive activities that at first glance appear very benign can later have a severe impact on the structure and dynamics of forest tree populations. This impact may not be immediately visible to the untrained eye – but it is definitely occurring.

In general, the ecological impact of NTFP utilisation depends on the nature and intensity of harvesting and the particular species and type of resource under exploitation. Sporadic collection of a few fruits or the periodic harvesting of leaves for cordage may have little impact on the long-term stability of a tree population. Intensive, annual harvesting of a valuable market fruit or oil seed, on the other hand, can gradually eliminate a species from the forest. The felling of large adult trees can produce a similar ecological result in a much shorter time period.

Although the fact is seldom mentioned in much of the literature on the subject, a large number of non-timber forest resources are actually harvested destructively. Uncontrolled felling for fruit collection has virtually eliminated the valuable aguaje palm (*Mauritia flexuosa*) from many parts of the Peruvian lowlands (Vazquez and Gentry 1989). Destructive harvesting has also seriously reduced the local abundance of the ungurahui palm (*Jessenia bataua*), the babassu palm (*Orbignya phalerata*), and a wide variety of other important Amazonian fruit trees such as *Parahancornia peruviana*, *Couma macrocarpa* and *Genipa americana* (Peters *et al*. 1989). Gaharu trees (*Aquilaria malaccensis*) in Southeast Asia are routinely cut to harvest the resinous heartwood (Jessup and Peluso 1986), and the collection of "damar" from *Dipterocarpus* trees in Peninsular Malaysia involves hacking a large box in the trunk of the harvest tree and then building a fire inside this cavity to stimulate the flow of oleo-resin (Gianno 1990). There are numerous examples of species that are killed are fatally wounded by the harvest of non-timber, vegetative tissues such as rattan, palm heart, *Lonchocarpus* roots[4] , thatch, and an assortment of barks, stems and leaves that are used medicinally.

Even in the absence of destructive harvesting, the collection of commercial quantities of fruit and seeds can still have a significant ecological impact. In terms of simple demographics, if a tree population produces 1,000 seeds and 95% of the new seedlings produced from these seeds die during the first year, the population has still recruited 50 new individuals. If, on the other hand, commercial harvesting removes all but 100 of these seeds from the site prior to germination, the maximum number of seedlings that can be recruited into the population is reduced to only five. This ten-fold shortfall in recruitment can cause a notable change in the structure of the population.

In reality, this example is probably overly optimistic. First, it is assumed that all of the seeds left in the forest are positioned in precisely the right spot for germination and early growth. Second, there is always the possibility that the fruits and seeds left in the forest will experience a rate of mortality that is higher than 95%. Commercial collectors, in effect, are competitors with forest frugivores, and their activities reduce the total supply of food resources available. In response to the reduced abundance of fruits and seeds, frugivores might be forced to increase their foraging to obtain sufficient food. The net result would be an increase in the total percentage of seeds destroyed.

All of these factors interact in a synergistic fashion to inhibit the recruitment of new individuals into a plant population. Over time, this lack of

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[4] The roots of this leguminous plant contain rotenone, an extremely potent natural insecticide (Acevedo-Rodriguez 1990). In the 1930s a significant export trade for this plant was developed in many parts of Amazonia (Padoch 1987).

recruitment will alter the size-class distribution of the population being harvested. If commercial collection continues uncontrolled, the harvest species can be gradually eliminated from the forest. This process of gradual population disintegration is illustrated in Figure 3 using demographic data for *Grias peruviana* and the stepwise results from computer simulations using a transition matrix model (Peters 1990b). Size classes 1 to 4 are based on height measurements, while classes 5 through 12 reflect a 5.0 cm DBH interval. For the purpose of the simulation, the intensity of harvest was set at 85% of the total annual fruit production; each time interval represents 20 years.

As is shown at TIME 0, the *G. peruviana* population initially displays an inverse J-shaped, or negative exponential[5] , size-class distribution of a shade tolerant canopy tree with abundant reproduction. After two decades of fruit collection, however, the structure of the population has been notably changed. The infrequency of seedling establishment has caused a reduction in the smaller size classes; the greater number of stems in the intermediate size classes reflects the growth of saplings that were established prior to exploitation. By TIME 2, the population has been even further degraded by the chronic lack of regeneration. There are intermediate size classes that contain no individuals at all, and it appears that the existing level of saplings and poles is insufficient to stock these classes. Finally, the size-class histogram shown for TIME 3 represents the culmination of a long process of over-exploitation. The population consists of only large, old adult trees, none of which are regenerating. In the absence of remedial action, it is only a matter of time before *G. peruviana* becomes locally extinct.

The important point to be gained from this simulation is that at no point during the process of over-exploitation is there any dramatic visual evidence (e.g., dead or dying trees) that something is going wrong. Even during the latter stages, the forest still contains a considerable number of *G. peruviana* trees that are producing fruit. Harvesting would undoubtedly continue unabated until these adult trees began to senesce, at which point collectors would be forced to move into a new area of forest in search of *Grias* fruits.

The example shown in Figure 3 represents an extreme case of uncontrolled over-exploitation and does not necessarily imply that every level of NTFP harvest leads directly to species extinction. The simulation is very useful, however, because it shows that even though the ecological impacts of this type of resource use are relatively subtle, very gradual and essentially invisible, in the long run they can be as devastating as logging in causing the disruption of local populations and species extinctions.

[5] Several authors (e.g. Meyer 1952; Leak 1965) have reported that diameter distributions conforming to a negative exponential are characteristic of stable, self-maintaining plant populations.

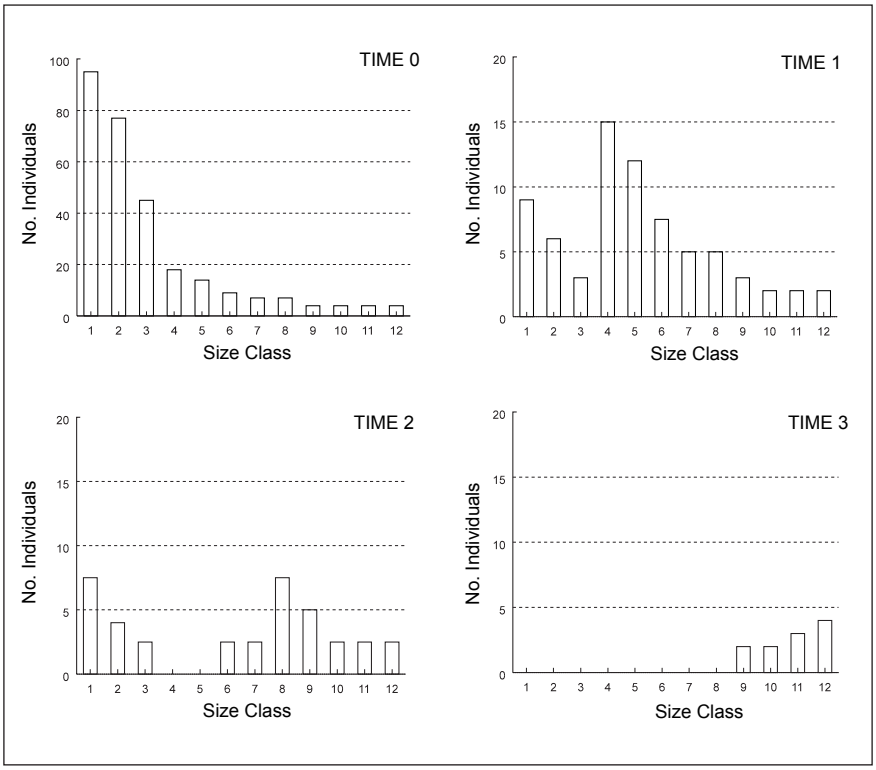


Figure 3. Simulated change in the population structure of *Grias peruviana* in response to excessive fruit collection. Results based on stepwise analyses using a transition matrix model and demographic data reported in Peters (1990b). Harvest intensity set at 85% of the total annual fruit production. Note change in scale in the latter three time periods to account for progressive decrease in population size.

Finally, in addition to its impact on seedling establishment and population structure, the collection of non-timber forest products can also affect the genetic composition of the plant population being exploited (Peters 1990c). A population of forest fruit trees, for example, will usually contain several individuals that produce large succulent fruits, a great number of individuals that produce fruits of intermediate size or quality, and a few individuals that produce fruits that, from a commercial standpoint, are inferior because of small size, bitter taste, or poor appearance[6] . If this

[6] Similar examples could be included for almost any other type of non-timber forest product. It is always the best damar-producing trees that are tapped the most intensively, the longest and strongest rattan canes that are the first to be harvested, and the plants producing the seeds with the highest oil content that experience the highest intensity of exploitation.

population is subjected to intensive fruit collection, the "inferior" trees will be the ones whose fruits and seeds are left in the forest to regenerate. Over time, the selective removal of only the best fruit types will result in a population dominated by trees of marginal economic value. This process, although more subtle and occurring over a longer period of time, is identical to the "high-grading" or "creaming" of the best tropical timbers that occurs in many logging operations.

Monitoring to Minimise Ecological Impact

Given the "boom and bust" dynamic that has historically characterised the exploitation of non-timber forest products, it seems unlikely that leaving markets, commercial collectors and tropical forest species to their own devices will automatically lead to a sustainable form of resource use. Achieving this objective will require more than blind faith in the productive capacity of tropical trees, an unwavering trust in a free market system, and the unquestioned assumption that local collector groups instinctively hold the goals of forest conservation above any desire for personal economic gain. Sustainable use of tropical forests will require a concerted management effort by all of the parties involved. It will require careful selection of species, resources and sites. It will require controlled harvesting and periodic monitoring of the regeneration and growth of the species being exploited. More than anything, however, it requires a greater appreciation of the fact that ecology and forest management are the cornerstones of sustainability.

From an ecological standpoint, one of the most essential ingredients required to achieve a sustainable level of resource use is information – information about the density and distribution of resources within the forest, information about the population structure and productivity of these resources, and information about the ecological impact of differing harvest levels. An overall strategy for collecting this information, and for applying it in such a way as to guarantee that the plant populations being exploited will maintain themselves in the forest over time, is presented as a flow chart in Figure 4. The overall concept and sequence of operations outlined is adapted from Peters (1994). The different procedures are sufficiently general that they can be applied to any class of NTFP activities, at any scale, and in forests that have already been heavily exploited as well as in more pristine, undisturbed environments.

Taken together, the six operations accomplish three fundamental management tasks. The species or resources to be exploited are first selected. Baseline data about the current density and productivity of these resources are then collected. Finally, the impact of harvesting is monitored and harvest levels are adjusted as necessary to minimise this impact.

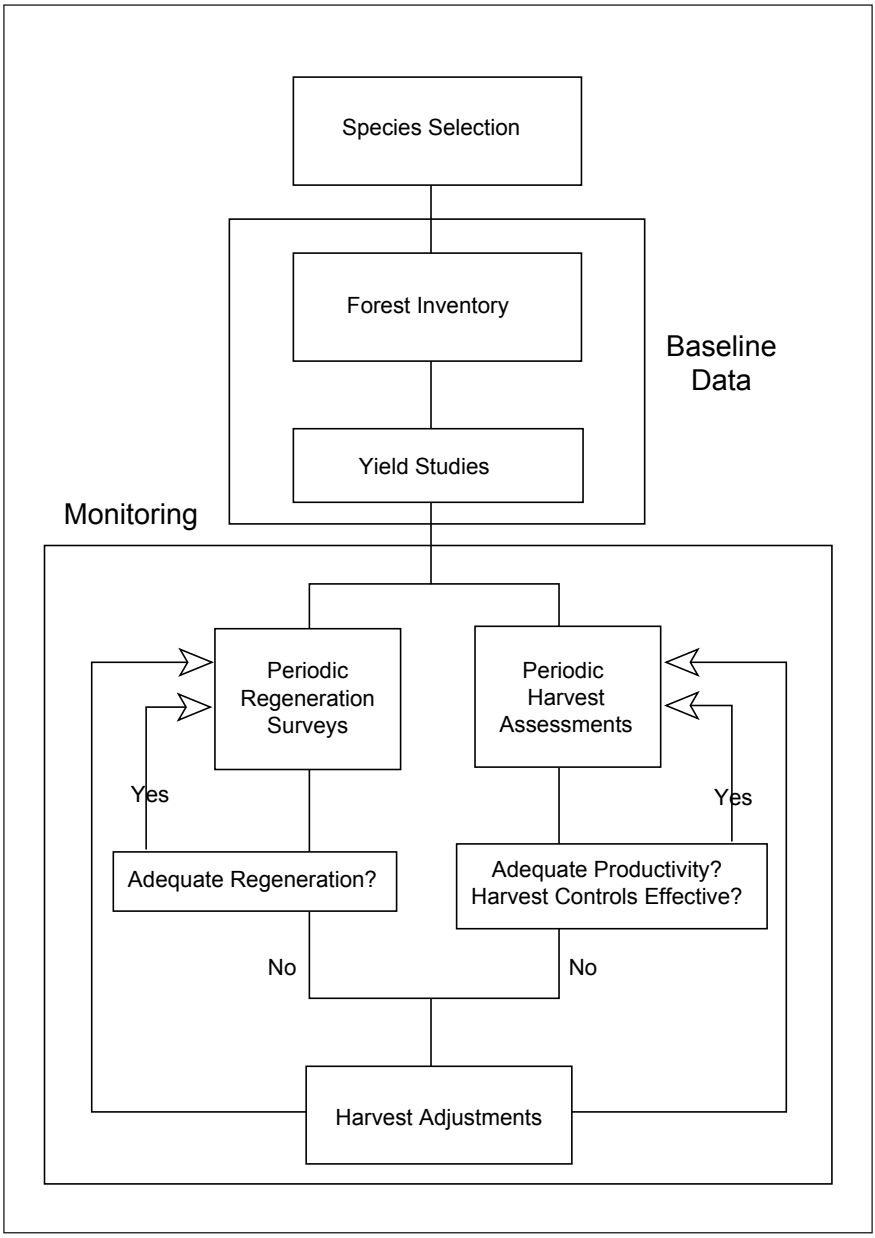


Figure 4. Flow chart of basic strategy for exploiting non-timber tropical forest plant resources on a sustained-yield basis. Complete process is composed on six steps: (1) Species Selection; (2) Forest Inventory; (3) Yield Studies; (4) Regeneration Surveys; (5) Harvest Adjustments; and (6) Serial Harvest Adjustments.

The basic concept here is to provide a constant flow of diagnostic information about the ecological response of the species to varying degrees of exploitation. Sustainability is achieved through a continual process of reciprocal feedback, i.e., the demographic reaction of the target species must result in a corresponding adjustment in harvest levels. The exact nature of this "fine-tuning" process will depend on the site, the judgement of the resource manager, the precision of the diagnostic data collected, the effectiveness of harvest controls and, perhaps most importantly, the ecological behaviour of the plant population selected for management.

Species selection

The decision of which plant resources to harvest will be based largely on economic concerns. Those resources possessing the highest current market price or the greatest potential for future market expansion will usually be chosen first. Social factors can also come into play here. Some forest resources may have a long history of extraction or traditional use in the region, and local people may have a strong cultural preference towards continuing to exploit these resources. Other resources (e.g., medicinals or plants of ceremonial importance) may be subject to certain taboos that prohibit commercial exploitation.

In addition to economic and social factors, a third set of criteria that should also be considered is the overall potential of the resource to be managed on a sustained-yield basis. Although the fact is frequently overlooked, some species are inherently better able to withstand the continual perturbations caused by resource extraction than others. Important ecological factors to consider include the life cycle characteristics of the species (e.g., phenology of flowering and fruiting, pollination, and seed dispersal), the type of resource produced (e.g., fruits, stems, barks, etc.), the abundance of the species in the forest, and the size-class distribution of natural populations. Given a group of resources with similar economic profiles, why not select those that are the easiest to manage and have the highest potential for sustainable exploitation?

In terms of life-cycle characteristics, for example, species that flower and fruit at unpredictable intervals or depend on specialised animal vectors for pollination and seed dispersal will be harder to manage than species that fruit every year and are pollinated by wind or common, "generalist" animal vectors such as bees. The type of resource being exploited can also greatly affect the potential for sustainability. Species that produce valuable roots, barks or stem tissues (e.g., rattan) are more problematic because harvesting invariably kills the plant. Latex, fruits, oil seeds and leaf tissues, on the other hand, can be harvested year after year from the same individual if proper controls are followed. Finally, abundant species whose populations exhibit a large number of seedlings, saplings and poles are considerably more resilient to perturbation than low-density, scattered

populations. A detailed listing of the overall management potential of different non-timber forest resources based on their botanical characteristics, life-cycle strategy, productivity and population structure is presented in Peters (1994).

Forest inventory

Density and size-class structure data are the most fundamental pieces of information required for management. Just as foresters need to know how many cubic metres of timber occur in a particular forest, the management of non-timber resources also relies on estimates of the distribution and abundance of different species. These estimates can only be obtained through a quantitative forest inventory. Inventories also provide the baseline data necessary to monitor the impact of harvesting. Without some knowledge of initial density and size-class structure, the population could slowly become extinct with each successive harvest and never be noticed.

Forest inventories are time-consuming, somewhat costly, and extremely tedious to conduct. It is strongly recommended, therefore, that a professional forester or inventory specialist be involved in the planning and execution of this fieldwork. In general, the inventory should be designed to provide the following types of information:

- The inventory should provide a reasonably precise estimate of the total number of harvestable trees per hectare (i.e., the resource density) in different forest types. For fruit and oil seed species, this means the total number of adult trees. For latex-producing species, medicinal plants and rattans, some juvenile trees may also need to be included.

- The inventory should provide data on the current population structure or size-class distribution of adult trees. Collecting these data requires that the diameter (cm DBH) of all stems be measured. Height measurements can be substituted in the case of herbaceous plants, small understorey palms or woody shrubs.

- The inventory should provide a preliminary assessment of the regeneration status of the species. Does the species appear to be maintaining itself in the forest? Are there a sufficient number of small trees to replace the inevitable death of adult trees? To begin answering these questions, smaller, non-productive individuals must also be counted and measured in the inventory.

Yield studies

Given an understanding of the density and size-class distribution of a forest species, the next question that needs to be addressed is "How much of the desired resource is produced by natural populations of the species?" Suppose

250 kilograms of fruit are harvested from the forest. Is this level of harvest sustainable? The answer depends on a number of factors. How much fruit does the population produce? Is this only 10% of the total population seed production, or were 95% of all fruits removed? Clearly, it makes a difference. Just as foresters (theoretically) use growth data to avoid cutting timber faster than it is produced in the forest, the sustained-yield management of non-timber resources also requires information about the productive capacity of the species being exploited. This information is obtained through yield studies.

The basic objective here is to obtain a reasonable estimate of the total quantity of resource produced by a species in different habitats or forest types. In view of the fact that larger plants are invariably more productive than smaller plants, of particular interest is the relationship between plant size and productivity. Probably the easiest way to obtain these data is to train local collectors to weigh, count or measure the quantity of resource produced by different sample trees during their normal harvest operations. These studies should be repeated every few years using the same group of sample plants to monitor the variation in yield over time.

Regeneration surveys

The baseline data collected in the forest inventory and yield studies provide an estimate of the total harvestable yield from the forest. Based on the discussion in the preceding section, however, it is clear that not all of this material can be harvested from the forest for very long. What we really want to know is the *sustainable* harvest from the forest. How much of the resource can we harvest from the forest without damaging the long-term stability of the plant populations being exploited? Answering this question requires information about the ecological impact of differing harvest levels.

The first signal that a plant population is being subjected to an overly intensive level of harvest is usually manifested in the size-class distribution of that population. For most species and resources, the effects of over-harvesting are most clearly visible in the seedlings and small sapling stage. Harvesting may kill a large number of adult plants (e.g., rattan, gaharu or palm hearts), may lower individual tree vigour to the point that flower and fruit production is affected (e.g., leaf or bark harvest, or the tapping of plant exudates), or may remove an excessive number of seeds from the forest. From a population standpoint, the net result of these activities is the same – all reduce the rate at which new seedlings are established in the population. This impact can be detected, and hopefully avoided, by periodically monitoring the density of seedlings and saplings in the populations being exploited. In essence, the seedling and sapling densities in each population are a demographic "yardstick" with which to measure the actual long-term impact of harvesting. To use a medical analogy, these data are the vital signs by which to assess the health or infirmity of the population.

Harvest assessments

Harvest assessments are an additional type of monitoring activity used to gauge the ecological impact of the resource harvest. These are primarily visual appraisals of the behaviour and condition of adult trees that are conducted concurrently with harvest operations. In many cases, these quick assessments can detect a problem with reproduction or growth before it becomes serious enough to actually reduce the rate of seedling establishment. The sample plants selected and marked for the yield studies are perfect subjects for these observations. Examples of the type of information to be recorded during these assessments include: overall vigour of the plant, wounding caused by harvesting, trampling of seedlings by collectors, evidence of insect pests or fungal pathogens, and abundance of fallen flowers and immature fruits under the crown.[7]

Harvest adjustments

The monitoring operations are used to appraise the sustainability of current harvest levels (see Figure 4). The seedling and sapling densities recorded in the original regeneration survey represent the *threshold values* by which sustainability is measured. As long as densities remain above this threshold value – and no major problems are detected in the harvest assessments – there is a high probability that the current level of exploitation can be sustained. If, however, seedling and sapling densities are found to drop below this value, immediate steps should be taken to reduce the intensity of harvest. The effectiveness of this harvest reduction will be verified during the next regeneration survey. Further reductions in harvest levels may be warranted if seedling and sapling densities fail to stabilise, or drop even lower, during the five-year period.

In actual practice, achieving a sustainable yield in this manner will invariably involve a considerable number of harvest adjustments. There is frequently a lag time in a population's response to disturbance and, after several cycles of apparently stable results from the regeneration surveys, the population may exhibit a drastic fluctuation in seedling and sapling densities. The important thing is that these fluctuations do not go unnoticed. By gradually lowering, or even raising in some cases, the intensity of resource extraction, the level of seedling establishment should eventually approximate the threshold value established for the population.

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[7] In many cases, these fallen flowers will be aborted or unpollinated reproductive structures. A drastic increase in the quantity of fallen flowers beneath a tree could indicate a lack of pollinators or resource limitations.

Some Hard Questions about Sustainability

In a perfect world, baseline data about the size-class structure and yield characteristic of different NTFPs would always be collected, regeneration surveys would be routinely conducted, and harvest levels would be adjusted periodically as necessary to ensure the long-term sustainability of resource exploitation. The sordid history of forest exploitation in the tropics, however, suggests that this has rarely, if ever, been the case. From a technical standpoint, there is no reason that non-timber tropical forest resources cannot be managed on a sustained-yield basis. Why then, given all of the recent interest in the conservation, social, and financial benefits of non-timber forest products, has so little attention been focused on actually monitoring the sustainability of the resource base from which all of these benefits accrue? In closing, I would like to pose three questions, the answers to which will probably go a long way in explaining the total lack of sustainability which currently characterises the modern world of NTFPs.

Who is responsible for doing the monitoring?
It seems to me that this question has never been clearly defined. If local communities are to be given the responsibility of stewarding their own forests (an alternative that I decidedly favour), why haven't I witnessed a surge of collaborative programmes designed to train forest collectors to inventory, monitor and manage their resource base to sustain commercial levels of exploitation? There are literally hundreds of projects currently under way throughout the tropics that are focused on the development, marketing, and sustainable exploitation of non-timber forest products. Many of these involve the creation of a management plan. Most of these plans are developed by expatriate development workers, university foresters or extension agents from the provincial capital. I wonder whether these plans are actually being developed with the enthusiastic participation of local community groups. I also wonder whether ecological considerations are given equal emphasis with the economic, social and political (i.e., tenurial) aspects of the enterprise. Will the monitoring and management activities be continued once the outside technical assistance has been withdrawn?

Who is paying for it?
Forest inventories, yield studies, and the periodic survey of regeneration plots are expensive activities. Even given the local expertise to collect these data, where will the money come from to continue this field work once the development project or research programme has finished? If we are really interested in maintaining the long-term sustainability of forest exploitation, these activities must be viewed as a fixed cost. Are any provisions being made to ensure that these costs will be covered continually from the profits generated by the sale of forest products?

How do you stop it if it's not sustainable?
Much of the current interest in NTFPs stems from the potential conservation benefits afforded by this type of land use. The forest can be used and conserved at the same time, ecosystem structure and function is preserved essentially intact, and local populations experience a welcome improvement in their monetary situation and standard of living. At least that is how it is supposed to work. As an ecologist, however, I am always bothered by a disturbing variation on this scenario. Let's assume for the moment that everything works. New markets are created for a certain NTFP, all the baseline data has been collected and the monitoring systems are in place, a local cottage industry has been set up, and sales are increasing every year. The revenues from the enterprise make a significant contribution to the well-being of the community. During the third survey of the regeneration plots it becomes obvious that the current rates of harvest are not sustainable and that the resource is being progressively over-exploited. The appropriate management prescription is that harvest levels should be reduced by 20% which will cause an immediate and notable drop in the profits from the enterprise. Where does the incentive come from to follow the path towards sustainability?

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Chapter Three

Not Seeing the Animals for the Trees

The Many Values of Wild Animals in Forest Ecosystems

Kent H. Redford

Introduction

For most of the evolutionary history of humans timber has had little or no value. Instead, forests have been valued for the myriad of non-timber forest products they produced for humans. It is ironic that Western culture has only belatedly recognised the value of these non-timber forest products at the same time that the forests themselves are rapidly disappearing. Nowhere is this irony more pronounced than in the human use of forest animals.

Forest-dwelling animals are of both indirect and direct importance to humans. Of direct importance are the values wild animals have and have had in religious customs, mythology and folklore. These symbolic or socio-cultural values of wildlife remain important today in nearly all communities world-wide. A second class of direct usage includes products such as skins and hides, materials for handicrafts or ceremonial use, oils and medicines, the live-animal trade, sport (hunting or tourism), stock sources for domestication or improvement of domestic breeds, and perhaps most importantly, food (Redford *et al*. 1995).

Forest animals also provide indirect benefits to humanity in creating and maintaining the forest environment, allowing it to provide the ecological services on which human livelihood depends. The ecological roles animals play include pollination, decomposition, seed dispersal, seed predation, herbivory and predation. Through these roles, animals influence such forest characteristics as composition and structure of vegetation. They also influence the reproductive success of plants, contribute to soil fertility and serve as regulators of pest populations.

Wild animals are vital components of the forest ecosystem, and they are also indispensable elements of subsistence and non-subsistence economies. The fact that they have been poorly studied and their importance has remained poorly appreciated is a result of several factors, including:

- divisions between disciplines;
- distaste in many Western cultures, particularly on the part of "conservation" organisations, for the aesthetics of hunting;
- the fact that hunting has been declared illegal in many countries;
- over-emphasis on agriculture;
- a conviction that what is not marketed is not important; and
- the common developed-world conviction that subsistence hunting is evidence of "under-development".

Until very recently, none of these various uses of forest animals has been included in calculations of "forest value", nor have they featured in lists of benefits from the forest, or even been considered as non-timber forest products (e.g., Peters *et al*. 1989). As Falconer (1993) has stated:

> Bushmeat is an important NTFP and should be in NTFP studies for a number of critical reasons, notably the high value people place on bushmeat, the considerable size of the trade, the significant changes in consumption patterns and the resource base.

Wild Animals and the Forest Ecosystem

In addition to bushmeat and other direct benefits to forest-dwelling humans, wild animals provide a set of indispensable indirect benefits through their contributions to the continued functioning of the forest ecosystem. These include their role in pollination, nutrient cycling and pest control, amongst many others.

The greatest ecological values of wildlife are provided by a largely intact, healthy ecosystem – one that is capable of supporting significant populations of wild animals, and particularly large vertebrates. As Kiss (1990) describes:

> The intact ecosystems which harbour wildlife also often provide essential environmental services for surrounding communities, such as a wide range of forest products, water catchment, moderating seasonal flooding, and serving as resource reserves for times of drought or other climatic stress. Local communities often are not aware of the full range of these environmental services nor the direct negative effects that losing them would have on their livelihood.

Direct use is linked to indirect use through the impact that the harvesting of target species has on non-target species. Naiman (1988) asserts that:

> ... although less widespread and ecologically influential than in the past, within our remaining natural systems animals continue to play significant ecological roles that go far beyond their immediate requirements for food or habitat. In many cases they are responsible for bio-geo-chemical, successional, and landscape alterations that may persist for centuries.

Although many ecologists have documented the important roles played by large animals in seed dispersal, seed predation, herbivory, pollination and predation, few until recently have considered what would happen if these animals were removed from the system. There is a growing body of work which suggests that in tropical forest ecosystems, large vertebrates perform very important ecological roles, and that their removal might result in a changed forest (See Redford 1992 for more detailed references).

The concentration on large animals is by no means meant to dismiss the role of small animals in structuring ecological communities. Work on termites, earthworms and other insects, to mention a few, has shown the critical role that these small species play in such parameters as nutrient cycling and decomposition (Wilson 1987). Yet the emphasis on large wild species has several explanations: 1) the obvious vegetation structuring role they play in ecosystems; 2) they are frequently the major targets of human interest; 3) there has been more work done on their ecological roles in this habitat; and 4) the possible ecological effects of their absence are better understood.

Vegetation structure

The importance of large animals in structuring forests has been discussed for deer, tapir and peccary (Dirzo and Miranda 1990), for rhinos in Nepal (Dinerstein and Wemmer 1988), and for elephants in the Ivory Coast and Uganda (Alexandre 1978; Chapman *et al*. 1992). In more open vegetation formations of Africa, for example, elephants can transform woodlands into open grassland, accelerating the release of nutrients (Owen-Smith 1988).

Seed dispersal

Many authors have documented the important role played by large birds and terrestrial mammals in the dispersal of the seeds of tropical plants. Based on his work in Panama, Howe (1984) stated that "animal mediated dispersal is certain to be critical for the demographic recruitment of many or most tropical forest species". Large birds, particularly the cracids, hornbills and turaco, are among the most important seed dispersers. Many of the species of cracids, particularly the curassows, are the species whose local populations are most rapidly depleted by hunting. Because of the cracids' importance as seed dispersers and their susceptibility to hunting,

Silva and Strahl (1991) have suggested that "human impact on the *Cracidae* may have irreversible long term effects on the biology of neotropical forest ecosystems". Similar arguments have been made for other large birds in Africa, Asia and Australia.

One of the other groups of important large seed dispersers is the primates, including chimpanzees, spider monkeys, orangutans and woolly monkeys. Like large birds, large primates are highly prized game animals and very rapidly hunted out of a forest (cf. Peres 1990). In the absence of these and other large primates, many species of plants may experience severely altered seed dispersal patterns, and at least some trees would become locally extinct.

Predation

The role played by predators in structuring communities has been well studied in marine and inter-tidal systems. This work has shown that predators can increase the overall species diversity in a community by decreasing the abundance of smaller predators and competing herbivores, and by reducing dominance of prey species. Research of this sort has not been conducted in tropical forests, but biologists working in various locations have observed that a decrease in abundance of large predatory mammals is correlated with an increase in abundance of medium sized terrestrial mammals. Absence of large predators such as tigers, jaguars, leopards and ocelots also seems to result in dramatic differences in densities of prey species which are found in more regular numbers in the presence of these predators (cf. Emmons 1987).

These large animals provide what Terborgh (1988) has referred to as a "stabilizing function". Animals like black caiman, jaguars and harpy eagles maintain the remarkable diversity of tropical forests through "indirect effects", a term referring to "the propagation of perturbations through one or more trophic levels in an ecosystem, so that consequences are felt in organisms that may seem far removed, both ecologically and taxonomically, from the subjects of the perturbation" (Terborgh 1988).

In many tropical habitats, large animals are no longer present in numbers which even approach their past density. They may not be completely extirpated but they are only present in the area in very low densities. Even if elephants, bearded pigs, rhinoceros, mandrills or jaguars have not become extinct in the wild, their populations may have been reduced to such an extent that they no longer perform their "ecological functions". In such habitats the animals are, in all probability, ecologically extinct. "Ecological extinction" is defined as "the reduction of a species to such low abundance that although it is still present in the community it no longer interacts significantly with other species" (Estes *et al.* 1989).

The animals that are the most popular game species, the ones most heavily affected by human activity, and the ones whose populations have

most likely become ecologically extinct include the most important predators and the large seed dispersers and seed predators in tropical forests.

Direct Benefits to Humans

Social uses of wild animals

Wild animals play important social roles in the lives of forest-dwelling people filling a myriad of functions in the belief systems of human societies. Both archaeological and ethnographic records show that nature, and especially wild animals, are central to the religious practices, mythology and folklore of many societies.

The various symbolic and religious roles of wildlife exist side by side with the practical uses of animals. Practical uses in turn are determined by certain cultural beliefs which were originally derived from accumulated collective experience. Certain foods, for example, are "taboo" or forbidden in specific societies. Taboos are the social restrictions placed by a group on the consumption or use of certain species. For example, among the Pedi of South Africa, of 37 species of wild mammals found in the area, 12 species can only be eaten by men or boys (de Vos 1977). Sometimes certain animals, such as rodents, are thought to be "impure" and are avoided, especially by pregnant or menstruating women or by girls at puberty. For this reason, women from some groups in Senegal do not eat bush rats during pregnancy.

Tradition not only prohibits the consumption of some animals, it also defines situations in which the use of certain animals is necessary or even indispensable. At a birth, death, marriage, coming-of-age ceremony or other highly significant moment in the social life of a community, the flesh, blood, skin, teeth, bones or other parts of animals may be required for the correct fulfilment of a ritual. The animals or body parts used in such ceremonies may be collected by family members, bought or traded. For example, distribution of game at the time of a girl's first menstruation is vital among the Etolo of New Guinea (Dwyer 1974), while sloths, not normally hunted otherwise, are essential for the "ceremony of the singing souls" among the Matses of Colombia (Romanoff 1984).

Hunting is fundamental to many cultures as it contributes significantly to a community's self-definition. The social role of hunting as a cohesive agent, especially among men but also between men and women, may be of equal or greater importance to the actual food returned to the village. The process of distributing game can be essential to maintaining social cohesion through its affirmation of kinship and friendship bonds (Stearman 1992). Successful hunters accrue prestige. Several indigenous groups in the Beni region of Bolivia (Stearman 1992) choose to describe themselves as hunters even though hunted game is not their most important source of food. A similar situation is found among the Dayak of Borneo (Caldecott 1988).

Another important socio-cultural category is the use of animals or their products in traditional medicines. Traditional trade in medicines employing wildlife is still practised on many different levels, from local markets to commercial networks of great magnitude. The Southeast Asian market in black rhinoceros horn is very lucrative, for example, due both to its popularity as a curative and as a presumed aphrodisiac, and to the scarcity of the horn. Such varied items as bear gall-bladders, ground tiger tails, deer antlers and elephant appendixes can be found among the pharmacopoeia in many shops.

Women in rural societies interact with wildlife in other important ways. Studies of traditional gender roles with respect to forest utilisation have yielded information on women as gatherers of forest products, usually non-animal products, and men as the hunters of wild animal species. Although men are the primary hunters of large game, women are frequently involved in the catching, butchering and transporting of animals, as well as in the cooking and preservation of their meat. In some African settings the sale of bushmeat may be urban women's only source of employment (Steel 1994).

Wild animals as food

Food is perhaps the single most important contribution wild animals make to humans. This "subsidy from nature" in the form of wildlife remains vital to the survival of many rural dwellers and indigenous people. For example, various indigenous hunting groups sharply distinguish being "hungry" from being "meat hungry". Wildlife provides a major part of the animal protein in the diets of rural people in a great many developing countries.

Game and fish contribute 20% or more of the animal protein in the average human diet in over sixty countries (Prescott-Allen 1982), and that percentage is much higher among rural and poorer parts of these countries' populations. Detailed studies are few, but Asibey (1974) estimated that 75% of sub-Saharan Africa depends largely on traditional wildlife sources of protein. In Botswana, in spite of very large-scale cattle production, people still obtain about 80% of their meat from wild game sources (von Richter 1979). In Zaire, 75% of the protein comes from wild sources (Sale 1981). Bushmeat represented three-quarters of the estimated meat production in Liberia and amounted to an estimated 105,500 tonnes per year (Anstey 1991). Estimated off-takes of game meat range from 24 kg/km^2 (Fa *et al.* 1995) to 350 kg/km^2 (Fitzgibbon *et al*. 1995). Substantial numbers of inhabitants in Latin America also depend on wild caught animal protein. Fish and game comprise 85% of the animal protein consumed by people in the Ucayali region of eastern Peru (de Vos 1977).

The nutritional advantages of wildlife

There is an important consideration that is frequently neglected by those studying the nutritional relevance of animal protein: the regularity of the

supply of protein is probably more important than overall average consumption. In other words, eating a small amount of animal protein each day may be better for nutrition than eating a great deal once every twenty days. In this regard, the use of non-domesticated animals, particularly wild animal species, assumes considerable importance for two reasons (Dwyer 1985).

First, many wild animal species are small, particularly if invertebrates and small fish are included. These animals may be eaten frequently by children: Chavunduka credits insect consumption with preventing many potential cases of kwashiorkor among the young in remote rural areas of Zimbabwe (cited in DeFoliart 1989). Because small animals are frequently eaten as snack food or caught and prepared away from the main kitchen, their consumption has been vastly under-estimated by researchers. These small animals are consumed much more frequently than larger game animals and certainly more frequently than the meat from domestic animals.

The second reason why meat from wild animals is frequently more important to nutrition than that of domestic species is their lesser market value. Only certain species of wild animals have a market value, while all species of domestic animals have such value. As a result, domestic animals are frequently not consumed by their owners, but are reserved to be sold at market when cash is needed.

The result is that both domestic animals and larger game animals are rarely eaten by subsistence farmers or hunters and their families because of their market value. Instead, smaller wild species with little market value, particularly insects, often overlooked by researchers, may supply a very important source of nutrition (Falconer 1993; Campbell *et al*. 1995).

Invertebrate wealth

Invertebrates play a major role in the diets of many tropical people and are important NTFPs. Entomophagy (the eating of insects) has not received adequate attention by researchers for a number of reasons. Many investigators are concerned with consumption of highly visible, measurable vertebrate prey and dismiss the importance of invertebrate consumption, especially insects. Over 500 species of insects have been recorded worldwide as human food, which includes all major insect orders (DeFoliart 1990). These are frequently eaten in the field as they are encountered, and almost never quantified. These food items are generally overlooked or are merely reported as "grasshoppers" or "locusts" on food item lists, rarely identified to species (DeFoliart 1989). Sometimes, researcher disgust and bias against entomophagy as a "primitive" practice may cause informants to hide certain food resources (Posey 1987).

Edible insect food resources are incredibly varied. A study by Ruddle (1973) revealed at least 25 insect species in the diet of the Colombian Yukpa. Dufour (1987) reported 20 species for the Tukanoans of southern Colombia. In Southern Zaire, a study restricted to caterpillars found at

least 35 species were consumed (Malaisse and Parent 1980). Mexico has diverse groups which eat insects, and more than 200 species are consumed there (DeFoliart 1990). Honey is an important food item in many cultures and is collected from both wild and domestic sources. It is frequently consumed together with bee larvae, which provides additional benefits from protein and fat.

Wild animals as sources of income

Wild animals can provide important direct benefits to forest dwelling people by providing sources of income. Wild animal products have great value compared to most agricultural goods and are more easily sold, thus they are worth transporting over long distances. In addition to the sale of animals for food (discussed below) wild animals have significant value sold as skins, as worked handicrafts, for medicinal and ceremonial purposes, in the live pet or curio trade, and finally as the target of tourists and hunters (Redford *et al*. 1995). Markets for these products range from restricted local ones (e.g., some medicinal and ceremonial uses) to global (e.g., ivory and the live pet trade in parrots). Though these markets can potentially provide significant sources of income to forest dwellers, in most cases, it is the others in the market chain who obtain most of the profits. In addition, many of the animals with the most valuable products are rare or slow-breeding, making significant, sustainable harvest difficult.

Wildlife Harvesting Patterns

Traditional societies have developed complex, integrated wildlife resource use and management strategies. These are the culmination of long processes of cultural development founded on observation, experience and experimentation. There has been some work done describing these traditional patterns of wildlife harvesting. The most highly sought after species are usually large-bodied prey, generally mammals (Redford 1993). These give the greatest return for time invested in hunting. Mammals are universally sought and most-consumed, followed by birds, reptiles, and then amphibians. However, significant numbers of smaller (non-game) animals are also consumed, including large amounts of invertebrates. This is partially driven by the fact that prey density is very important in determining potential hunting success and in general, smaller species are more common and reliable than larger species (e.g., Fitzgibbon *et al*. 1995).

Effects of market involvement

Traditionally, indigenous groups relocated to another area as hunting returns and garden production diminished, but most of these groups today are no longer able to move. The increasing encroachments on hunting areas used by traditional societies have restricted their freedom of movement and, as a

result, they have become increasingly sedentary. This is often encouraged or imposed by national government policies, social policies of non-government or missionary groups, and development agencies, as well as by changes in land tenure systems. This increased sedentariness leads to intensification of local resource depletion and eventually a dependence on agriculture and domestic stock. New technologies further accelerate this process. These technologies are not confined to manufactured tools, as in the example noted in Yost and Kelley (1983), where the recent introduction of dogs among Waorani tribesmen has allowed them to hunt species previously ignored or rarely hunted. Not only are new technologies frequently more efficient but they are often highly unselective, enabling hunters to capture a much wider range of species (Steel 1994). This is particularly true of the use of snares made from steel cable or nylon rope (Caldecott 1988; Lahm 1993).

The range of traditional patterns of hunting wild animals appear to narrow with acculturation and articulation with western society and cash markets. This trend has been noted anecdotally but rarely quantified. A comparison of forest colonists (in closer contact with the "outside world") and Indians in South America shows these differences in their hunting patterns. Indians hunted mammals, birds (and probably reptiles) at a higher rate and in a wider variety than colonists, with colonists hunting a small subset of the diverse group taken by the Indians. Some overlaps occurred with certain favoured species commonly hunted by both groups (Redford and Robinson 1987).

The effects of market involvement on local wildlife populations and the humans who depend on them are varied and complex. The trade of wild animals generates income and employment, for example, and it has the potential to help manage and regulate herd size and wildlife populations. These are useful by-products of wildlife marketing. On the other hand, poor management and over harvesting are two typical examples of the problems which can be exacerbated by market forces in wildlife trade.

Subsistence hunters, like most other subsistence producers, are being drawn into the market economy, integrating into their livelihoods many consumer goods which can only be obtained with cash or cash substitutes (barter). They enter into a system based on manufactured items, and they swap their game yields for trade goods. Active local markets develop with the growth of rural populations, and the wild animals sold by the hunters become consumer goods for urban populations as well. Non-hunters consume a broad range of wildlife products, most important of which are wild animal meats, which they often prefer to livestock meats. Some types of wild animals are also commodities in international markets, such as those which supply fur, or those in demand as pets or collectors' items (such as butterflies). The combined local, urban and international demands produce market pressures which can, in cases of localised poor management of harvesting, accelerate the problem of wildlife depletion (Lahm 1993).

In general, wildlife marketing helps to fuel the local economy and raise the incomes and living standards of subsistence hunters and rural communities. Hunters generally find ready markets, driven by urban demand. Hunting is not only the domain of traditional or subsistence hunters; settled farmers also very often hunt and sell game for supplemental income. Several levels of middlemen, processors and transporters as well are involved in the wildlife marketing chain. Hence where wildlife meat markets are firmly established, the production and sales provide work and income for a large group of people (e.g., Lahm 1993).

It is important to recognise, however, that market hunting has often had detrimental consequences on local wildlife populations, primarily because this type of hunting can cause the harvest of certain animals at unsustainable levels (e.g., Bodmer *et al*. 1988; Bodmer 1994; Robinson and Redford 1994; Fa *et al*. 1995). Besides the problem of species depletion, the sale of wild meat often carries other less evident costs. Where incentives to generate cash are powerful, the nutritional status of hunter communities may be compromised by the sale of needed game meat for the purchase of non-edible goods or low-protein foods.

Urban populations in developing nations have shown rapid rates of increase over the last few decades. In addition to high birth-rates, a major factor in this expansion has been migration from rural areas. This recent transition from rural life partly accounts for the fact that urban consumption of wild animal products in developing countries usually far exceeds that in industrialised countries, where city dwellers consume wildlife products less frequently. The newly urban population which has been recently removed from a rural setting often retains a preference for forest products, including wild meat, which it is no longer in a position to obtain for itself. Bushmeat can be very important to these urban consumers. For example, in Equatorial Guinea half of all protein in urban areas comes from bushmeat (Fa *et al*. 1995). Estimates of the costs of replacing this bushmeat with a comparable protein such as beef has ranged from US$40 million a year in Gabon (Steel 1994) to US$100 million a year in Liberia (Anstey 1991). Urban demand can quickly grow to levels that outstrip the ability of the surrounding environment to maintain the desired species, and alternative harvesting and management methods need to be developed to avoid provoking the extinction of these species.

The Management of Wild Animals: Soft Management

Increasingly, researchers are beginning to realise that the distinction between wild and domestic species (of animals or plants) is not as clear-cut as once thought. Humans have been manipulating wild species for millennia and careful research has shown many cases in which indigenous people engage in “partial domestication”, also referred to as “soft management”.

Most of the literature documenting this type of practice is concerned with plants. Alcorn (1981) points out that "agriculture is only one type of plant management, and domestication is only one of the processes to which people submit plants". Soft management practices for plants include slashing, neglecting, sparing, protecting, transplanting or planting. The result of these activities is such that what may appear to the uninitiated observer as undisturbed forest can in fact be a vegetation formation in which species composition and distribution are largely a product of human action. Balée (1989) refers to these types of plant communities as "cultural artefacts".

It is becoming increasingly clear that animal communities have also been affected by humans in ways that have not traditionally been thought of as management. Though often even less clear-cut than in the case of plants, such practices are evident throughout the world. Perhaps the most obvious method is the use of fire by humans to increase hunting success by either making hunting easier through clearing, attracting game animals to the areas of regrowth, or increasing the carrying capacity of the environment for certain game species. Deliberate burning practices of this type have been documented in Australia, New Guinea, southern Africa and Central and South America.

There are many other examples of soft management of wild animal species. Amazonian Indians refrain from cutting wild fruit-bearing trees in gardens in order to increase populations of game animals. Farmers have been known to deliberately plant more crops than are needed in order to provide food for game animals. Other soft management practices include rotation of hunting zones, restraint from killing females, taboos and seasonal movements by hunters.

It should be noted here that since cause and effect for many of these practices have not been quantified, it may turn out that some of the techniques simply make animals easier to kill, rather than actually influencing breeding patterns or increasing production rates. This is a critical question that must be answered before promoting models based on the theory of garden hunting.

The traditional practice of leaving fruiting trees in gardens in order to attract game animals was used by Redford and others together with the Yuquí Indians as a basis for the development of an agroforestry project which incorporated wild animals (Redford *et al.* 1992; Stearman and Redford 1994). In the case of the Yuquí, the major factor responsible for decreases in game yields appeared to have been an unwillingness on the part of hunters and their families to hunt in areas away from the settlement. The result of this unwillingness was a dramatic decrease in hunting success in an area within about a 10 km radius of the settlement. The objective of the project was to help the Yuquí find a better way to "manage the forest" in order to increase the harvest of game animals and, secondarily, of fruit from wild trees.

The forest management strategy adopted proposed the creation of satellite encampments to be scattered throughout the Yuquí territory. Camps were designed to attract game by planting fruit trees while at the same time providing agreeable camping spots for the hunters and their families. The satellite camps or villages were based on agroforestry plantings and incorporated wild and domestic fruit trees. These trees provided fruit directly to the Yuquí and also served to attract and increase the population of important game species, many of which are fruit-eating.

Wild Animal Use in the Modern World

The tremendous expansion of human populations during the last 200 years has brought great changes in the ways people use wildlife. New technologies have dramatically altered traditional practices. Firearms are the most obvious example of such change, but even technologies such as use of outboard motors, flashlights and headlamps have expanded spatial and temporal constraints, allowing exploitation of riverine and nocturnal animals which previously were rarely harvested. Consequently, wild animals are becoming rare in many areas inhabited by forest-dwelling peoples, affecting not only the animals, but the ability of the people to live in the forest. The gradual degradation of the forest through harvesting is a problem in and of itself. However, even more worrisome is the possibility of permanent and dramatic loss of ecosystem function. As Holling (1994) has pointed out "although natural systems are resilient they are not infinitely so, and in exploitative systems that resilience shrinks". Humans rely on being able to adapt to linear, slowly changing situations. It is possible that abrupt, non-linear changes, caused by loss of animals may pose particularly difficult problems to forest-dwelling people.

The global expansion of human activities during the 20th century has taken an enormous toll on the wildlife populations upon which forest dwellers, rural farming communities and some indigenous groups depend. Major habitat alterations due to logging, mining, agriculture, pasture development, road construction and urbanisation have steadily reduced the area suitable for many of the favoured animal species. These changes in land use and tenure have also affected and diminished the territorial holdings under traditional tenure systems.

Colonisation schemes in some tropical countries increase pressure on wildlife populations by increasing the number of hunters. The new immigrants rarely observe local hunting customs regarding food or species taboos, hunting seasons or protected areas, most of which are aimed at managing wildlife resources sustainably. As deforestation progresses, even less habitat is available for wildlife as well as for humans.

Conclusions

All around the world there has been a gradually developing awareness of the existence of this intricate, interdependent association between forests and the wildlife they harbour, and between these and human populations. The activities of wildlife are often an integral part of ensuring that the forest in its entirety continues to function and thrive. Rural communities depend on nature to varying degrees for food, fuelwood, raw materials for many uses, and medicine to satisfy subsistence needs. Wild animals remain central to meeting these needs in many parts of the world. Though usually valued positively, some animals have negative values, such as the locust swarms of Africa and Asia. Sometimes the value placed on a certain animal species varies according to context, as in the case of the highly valued elephants of East Africa which become dangerous threats when crop raiding.

Since earliest times animals have been providing humans with products vital for subsistence, such as clothing, tools, medicine and material for handicrafts and art. Many of these animal products have also acquired commercial value in local, national and international markets. Some animal products, like elephant ivory, musk from musk deer and rhino horn, have been so valuable that their quest has shaped human history. But, animals are most frequently valued by humans for their meat. Caldecott (1988) reminds us: "Where game stocks remain adequate, monetary poverty need not be associated with dietary poverty". Wild animal species have other values that are non consumptive in nature. These include religious and spiritual values, values due to the willingness of tourists to pay to see them, biotic function values, and what can be termed "emergent ecological values".

Wild animals have had values for humans throughout the course of human evolution. They have been critical actors in the ecological subsistence dramas acted in by millions of tropical forest dwellers. Over the last century as new value systems have gradually replaced old ones, the important values represented by wild animals have been perverted. The value that timber from tropical forests has to outside economies has eclipsed the values of all but a few animal products (e.g., ivory). The rise of interest in non-timber forest products reflects the attempt to "re-value" the importance of forest products other than timber. This re-valuation process must not forget the vital benefits that animals provide to humans throughout the forested world.

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Chapter Four

Modernisation and Technological Dualism in the Extractive Economy in Amazonia

Alfredo K.O. Homma

Introduction

The economic importance of extractive products has fluctuated throughout the course of history. This is the case for several products which have been significant in the economic, social and political development of Amazonia. The "drogas do sertão" and cocoa (*Theobroma cacao*) of the colonial period, and rubber (*Hevea brasiliensis*), Brazil nut (*Bertholletia excelsa*), rosewood (*Aniba rosaeodora*), palm heart and fruit of açaí palm (*Euterpe oleracea*) and the timber extraction of today are good examples. The extractive economy is influenced by many variables, including technological progress, changing economic alternatives, population growth, resource depletion, wage levels and relative prices. In general extractive activities are initiated, pass through a "boom" phase and later disappear, in both time and space, when economic advantage is lost and the product becomes less important (Homma 1992, 1993).

If the extractive economy is to be considered a viable option for Amazonian development all aspects must be closely examined. First, the characteristic dynamics of the extractive economy are not clearly understood and a large part of the rural population depends more on agricultural activities than extraction of forest products. Secondly, the real economic value of these products is not known and future technological change and population growth could lead to results which are contrary to the aims of adopting the extractive option. Most families rely to some degree on extractive activities for income and stability, whether they are predominantly agricultural or extractive households.

Measures can be taken to permit more balanced extraction of products which have large natural stocks, such as the fruit and palm heart of açaí, timber, Brazil nut and even rubber. However, the continuation of this system must not restrain technological advance or the creation of employment through domestication of a product. For almost all extractive products, family labour is required only seasonally and must be complemented by other activities such as agriculture, fishing and temporary wage labour. For areas which have not yet adopted extractive activities, the question arises whether their incorporation could support the colonisation process. As people are more concerned with their own welfare than with issues of biodiversity, the gradual decline in the value of extractive products and the creation of new alternatives will inevitably expand agricultural frontiers. While there are definite risks and products can be replaced by new economic alternatives, extractive activities may be a limited solution for traditional development in certain areas.

It must be recognised that extractive activities are not independent nor operate in a closed economy. There are links with local, regional, national and even international markets and each of these is also affected by development in the others. Extractive forest products for export are used in many different sectors of the economy and extractors depend on these same sectors. For instance, the açaí palm fruit collector in the Amazon estuary depends almost entirely on purchased staple foods from other areas. In most cases, the crops come from areas of shifting cultivation, where the majority of rural people earn their livelihoods. The positive environmental image that extractivists have achieved, mainly through favourable media coverage, hides those inter-relationships with other sectors of the economy which may deplete natural resources, both directly and indirectly. In addition, the extractors also develop local agriculture to supply some staple foods and to graze animals, based on relative prices of agricultural and extractive products. This occurs, for example, in the extractive rubber sector.

The dependence of the extractive economy on the overall economic system must always be considered. During the last century, rubber extraction boomed because it was directly linked to demand in the foreign market. Various extractive products have been dependent on the market at a local, national and even international level. Consequently, the expansion, stagnation and decline of demand for products can be related to these economic/market forces in which the extractive system operates. Brazil nut extraction in the Marabá region is an example where economic, social and political changes caused the decline of the activity. Another aspect is the transformation of the extractive economy itself, as in the case of the babaçu palm (*Orbygnia phalerata*). Originally, production was only for subsistence. It became a commercial product during a second phase between the First World War and the 1950s, followed later by industrial exploitation. Since the 1970s, despite great initial stocks, the babaçu forests have been transformed into agriculture in the State of Maranhão (Amaral Filho 1990).

Plant Extractivism as an Economic Cycle

Four phases typically characterise the evolution of the extraction of plant resources in the Amazon region (Figure 1). The first phase is that of significant growth in extraction, favoured by the existence of substantial reserves or by a monopolistic position in the market for the given resource. The extraction of lumber, açaí fruit or palm hearts are examples.

The stabilisation phase represents a balance between supply and demand, at a point close to the maximum extraction capacity. In this phase, extractors attempt to maintain levels of production, even though this may imply increasing unit costs in order to fulfil commitments. Prices start to rise after this phase, as the sector is unable to increase extraction to meet growing demand. Policies to encourage more efficient extraction, with minimal waste, or to protect extractivism could be adopted. An effort has been made to promote plantations and, paradoxically, attempt to delay the disappearance of extractivism. The Brazil nut may currently be reaching the stabilisation phase.

The decline phase, brought about by reduced resources and increased costs of extraction, leads to a gradual decrease in extraction. Depletion affects the quantity and quality of the resource supplied and reduces the volume of extraction. Hence, for the same input, unit costs increase. The situation of rosewood extraction is an example of this phase.

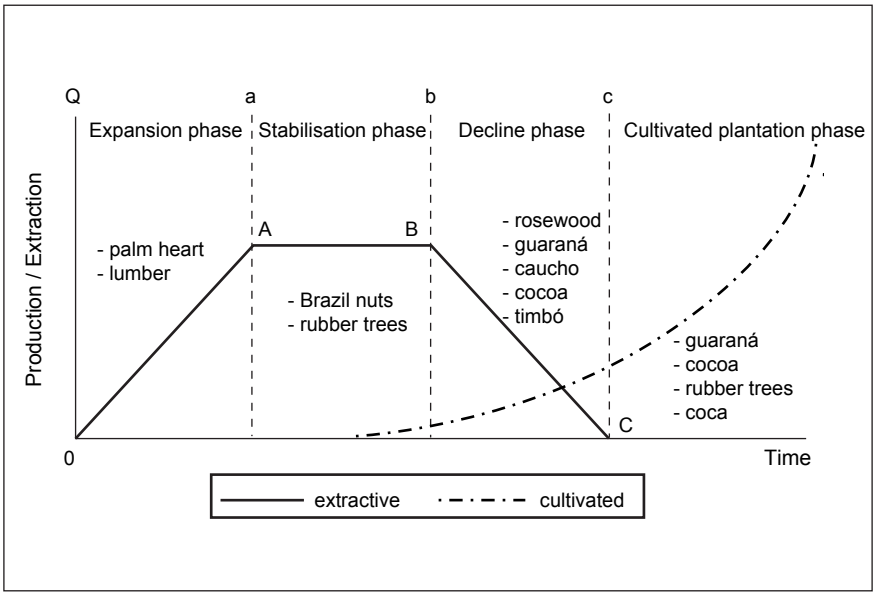


Figure 1. The historical cycle of forest production in Amazonia.

The cultivated plantation phase begins during the stabilisation phase, when the conditions for cultivation are defined by the availability of technology, the lack of substitutes (natural or synthetics) and the existence of favourable prices. The permanence of extractive activities will depend on its profitability in relation to the alternatives.

The length of the entire extractivism cycle is not only determined by the availability of stocks of extractive resources. It is also closely related to development policies, and is affected by economic and social variables, scientific and technological developments, migration trends, labour markets and, more recently, environmental policies. The viability of extractivism through these different phases along a historical process depends on the balance between these agronomic, ecological, economic and social factors. Thus defined, sustainability requires that activities remain profitable over time, and provide social improvements for those who participate in them, in addition to the capacity to maintain an adequate agronomic and ecological balance (Homma 1994).

Therefore, extractive activities have intrinsic characteristics making agronomic and ecological adaptation possible over a period of time. A change in one variable affects the other. However, the balance of these four components is relatively fragile, with the economic component being the main "Achilles heel" or weakest point.

The broad support being currently enjoyed by the extractivist economy, for example in terms of creation of extractive reserves, may lead to a change in the balance between factors and so change the shape of this cycle. A positive effect would be to freeze the expansion of agricultural frontiers, but this would not guarantee economic sustainability or forest conservation since deforestation also depends on the economic situation of the extractors (May 1989). Four theoretical possibilities are shown in Figure 2. The normal course, described in Figure 1, is represented by the letter A. Extending the overall length of the cycle will increase the duration of all its phases (B). The decline phase could be prolonged (C). The fourth alternative (D) represents the establishment of extractive reserves which change private property to communal areas. With the creation of new economic alternatives the extractive activity may become unattractive, thereby shortening its economic cycle. This could occur in areas with heavy migration, high population density, the existence of economic alternatives and other variables that lead to the natural disappearance of extractive activities. Inevitably, in any of the four alternatives, the final scenario would be the disappearance of these activities.

The interaction of conditions that lead to the situation described in Figure 1, may show successive dislocations from this cycle over time based on geographic location or macro-economic factors. This repeatedly occurred in the Amazon with the "*drogas do sertão*", extraction of cacao, rubber, Brazil nut, and rosewood. The timber sector, which has always been

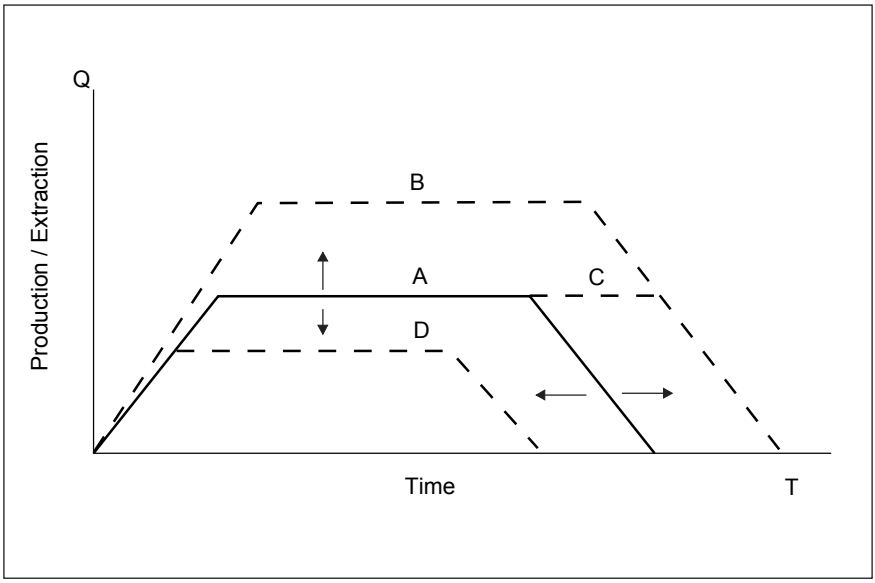


Figure 2. Possibilities of change in the plant extraction cycle due to the implementation of government policies

considered in aggregate terms, does in fact involve dozens of tree species. In general, timber extraction begins with the logging of species considered "noble" or of great commercial value, such as mahogany (*Swietenia macrophylla*). With the exhaustion of these stocks, species of lesser value are logged. The present areas of extraction for palm heart and açaí fruit in the Amazon reflect the economic viability of this activity and the existence of stocks of açaí palms as a result of the transformation of economic activity over time. The commercial extraction of palm heart began in 1968 in Barcarena, Pará, as a result of the exhaustion of *Euterpe edulis* stocks in south-central Brazil, a palm which does not re-grow after cutting. Transformation in the Amazon estuary has been continuous since the seventeenth century, and this example illustrates the role of the dynamics of extractive economies in the changing Amazon landscape. In the past, the extraction of ucuuba (*Virola surinamensis, Myristica sebifera*), andiroba (*Carapa guianensis*), resins, pitch, patauá (*Jessenia bataua*), cacao, murumuru (*Astrocaryum murumuru*), pracaxi (*Pentaclethra filamentosa*), jutaicica, and maçaranduba (*Manilkara huberi*) lactic products all were more important than the present fruit and palm heart extraction from the açaí palm. Rubber extraction also caused transformations in the beginning or boom stage of this product and during the Second World War. Timber and palm heart extraction tend to favour the formation of more homogeneous stands.

Classification of Extractive Activities and the Market Evolution Process

Extractive processes in the Amazon may be classified into two major categories, based on the way extraction is carried out:

Predatory or annihilation extractivism: entails the destruction of the source, or the rate of regeneration is slower than the rate of extraction (e.g., lumber, palm hearts, rosewood, and indiscriminate hunting and fishing). The natural consequence of such practices is increasing scarcity, until it becomes uneconomic to continue with the activity. Generally, when this level is reached, the damage caused to the species threatens its survival and may lead to its local disappearance and even extinction.

Gathering or non-predatory extractivism: is based on gathering products and maintaining the integrity of the mother-plant that produces the resource. An example is the extraction of rubber or Brazil nuts, where the rate of regeneration exceeds the rate of extraction. Theoretically, this ensures the possibility of extraction *ad infinitum*.

In both these situations the economic theory of David Ricardo theoretically prevails, in which initially the best resources are extracted for a given area with a short-term horizon. However, this approach is not always adopted, given the availability of extractive plant resources in the Amazon forest. Great distances and problems of market supply, worker conditions and a real lack of knowledge of resource potential lead to better-quality stocks either not being used, or being used in a predatory fashion. The present process of expansion of the agricultural frontier and population movement towards the upland areas of dense forest, also have implications for the destruction of these more promising zones.

For some species, extraction may be of two forms, and involve both destruction for one purpose and gathering for another. A typical case is that of the açaí palm tree, from which hearts of palm are obtained by destruction of the individual palm and juice obtained by gathering the fruit. Even during the gathering process, resources may be destroyed – if they are not subject to responsible extraction – by depredation aimed at an immediate increase in productivity or by substitution of other more competitive activities, regardless of profitability.

The beginning of extractive exploitation

The "untouchability" of natural resources may be explained by the cost of extraction of a potential supply exceeding the potential return for a given product or a low economic importance of the product. At this stage, supply (S) is greater than demand (D), as if it were a free commodity such as air

(Figure 3a). The supply and demand curves do not intersect; the resource is for direct consumption by the extractors themselves.

As a natural resource is transformed into a useful or economic utility, extraction becomes a viable option. The opening of markets, improvement of infrastructural conditions, technological progress, the appearance of a new industry and population growth are all factors which may influence the decision to commence extraction.

With the growth of the market, the demand curve (D, D_1, D_2, D_3, D_4) gradually moves to the right (Figure 3b), generating a price sufficient to guarantee supply of the product. Since a characteristic of extractive resources is that their availability is established by nature, the potential to increase supply in response to price rises is limited. Beyond a certain level, quantity supplied cannot be expanded. The careful management of some extractive resources may increase the capacity for supply of the product slightly.

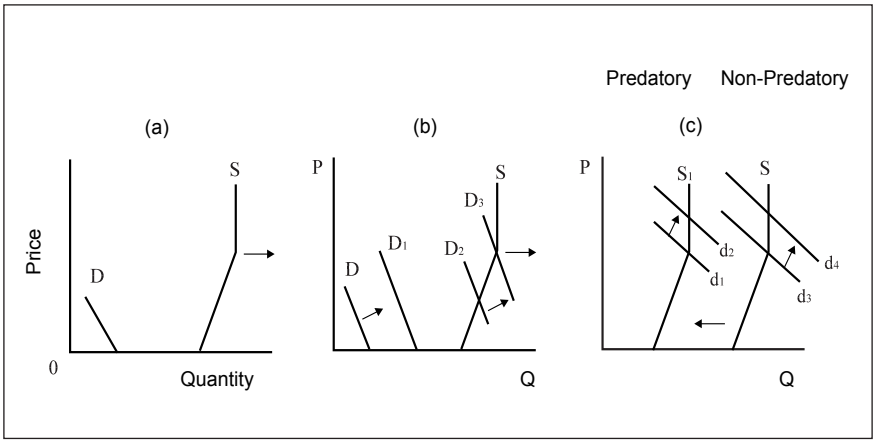


Figure 3. The process of market evolution for extractive products

The end of extractive process

The final phase of extractivism is the exhaustion of the natural resource, or fixed supply. In the case of extractivism by destruction (Figure 3c), the supply source is reduced and the supply curve (S_1) moves towards the left. This leads to an increasing long-term equilibrium price as demand increases (D_1, D_2) and supply is fixed.

In the case of extraction by gathering (non-predatory), the equilibrium point is reached when the supply curve becomes inelastic (Figure 3c), and when prices are so high that growth of demand (D_3, D_4) leads to domestication or the discovery of synthetic substitutes. Extractive species are then abandoned.

The extractive economy exists within a much wider context than is traditionally considered. Extractivism is initially prompted by the discovery of a natural resource which presents an economic possibility or that could be useful to people. In general, the growth of markets and technological progress bring about domestication of the product (Figure 4). This has taken place in the case of thousands of extractive products that are presently cultivated all over the world. Later, synthetic substitutes are developed as demand grows and technology advances. Very often one of the phases is omitted, as in the case of rosewood, which moved directly from extractivism to the synthetic substitute, or timbó (*Derris nicou* and *D. urucu*). With progress in biotechnology and genetic engineering there are more possibilities for the direct domestication or synthesis of natural resources that are useful to people, without passing through the extractive phase. Consequently there is little chance that the extractive economy can be given a major stimulus from the discovery of new extractive resources, such as drugs. This, however, may be possible initially or if the stock of the new extractive resource was very large or very readily accessible.

Extractive resources have increasingly been replaced by synthetic substitutes for three main reasons: increases in the cost of the natural resource because of depletion of stocks; reduction in the cost of production of the substitute due to technological improvements; and the extractive sector's inability to meet growing demand for a given product.

In this way, various extractive products have been replaced by industrial products. The discovery of aniline in the nineteenth century ended extraction of Brazil wood (*Caesalpinia echinata,* dye), which had begun following its discovery by Europeans in 1500. The discovery of DDT in 1939 reduced the importance of natural insecticides, affecting export of

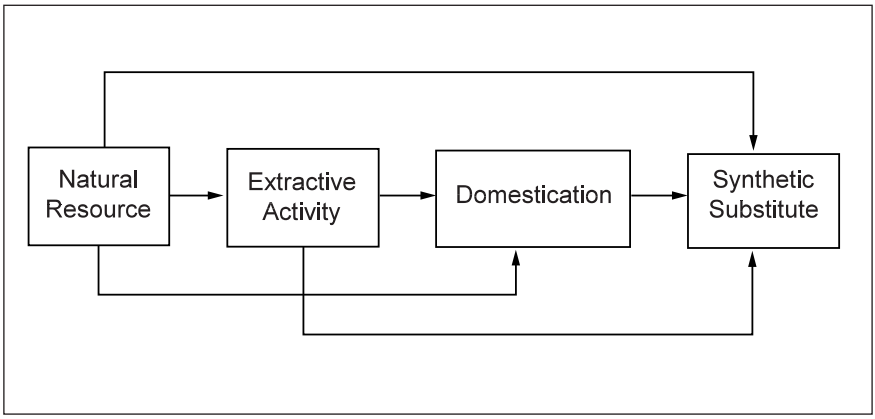


Figure 4. Possible ways of using a natural resource following its transformations into an economic resource

extractive timbó from the Amazon. Synthetic rubber is another example of the substitution process. At present three-quarters of the world's consumption of elastic gums is based on synthetics. The discovery of synthetic linalol affected the market for the extraction of rosewood. Other examples of substitutes having an impact on extractive activities are synthetic waxes, coumarin, non-elastic gums (balata [*Manilkara bidentata*], sorva [*Couma* spp]) and quinine.

Substitution by synthetic products is never perfect. The initial stages of the substitution are very intense, overtaking the markets of the natural product. The process stabilises based on the degree of substitution. Once this limit is reached, any increase in consumption of the synthetic is accompanied by a complementary increase in demand for the natural resource. This tends to promote domesticated cultivation and a chain reaction in plant extraction.

The discovery of synthetic substitutes represents the end of the "evolutionary process" of the extractive resource. Synthetic production is independent of restrictions of an ecological nature, providing an increase in the capacity to provide supplies at lower costs than those of the natural resource, producing the effect known as "backstop technology". In the case of extractive food resources, domestication would seem to be the path to be followed.

Other aspects to be considered in the extractive economy included low price and income elasticities of demand for the majority of products. The transformation of some products of an extractive origin into "ecological symbols" or establishment of artificial barriers (e.g., green products, industrialisation or souvenirs) may attribute a short-term novelty value. Even so, if the market indicates a significant growth potential, inducements to domesticate the product will be inevitable. In addition, such a solution for extractive products is of limited value, affecting only a small portion of the population in specific areas.

From the theoretical perspective, it is probable that a significant short-term response of extractive supply will not be accompanied by a proportional change in demand. A drop in the price level, *vis-à-vis* demand inelasticity, may lead to a drop in profits for extractors.

The relationships between product and factor prices in the various sectors of the economy also affect the extractive economy, independently of the standpoint of the extractor. The present trend towards agriculture by rubber tappers, for instance, is very closely related to the agricultural product/extractive product price relationship.

If the price of the agricultural product rises proportionally more than that of the extractive product (P_1), the extractor will tend to concentrate on agricultural activities (C on the transformation curve in Figure 5). On the other hand, if the prices of extractive products rise proportionally more than agricultural products (P_0), the extractor will tend to devote more time

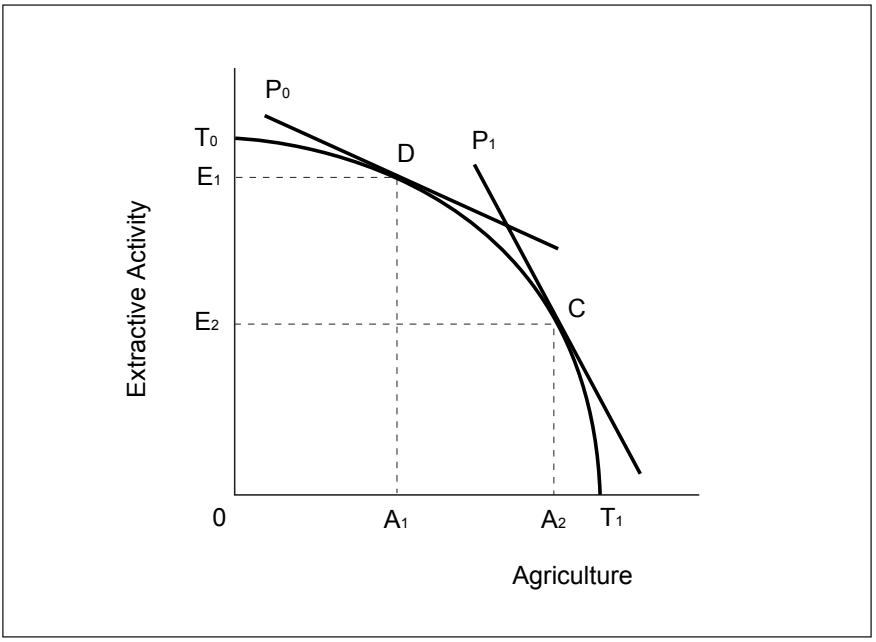


Figure 5. Effects of changes in the agriculture/extractive price relationship on the entire activities of an extractor

to extractive activities (D). Policies aimed at facilitating plant extractivism, such as the emphasis currently being given to extractive reserves with the creation of captive markets and investment in social infrastructure, may give the price advantage to extractive products in the short-term. In the medium and long-term, it is doubtful whether the advantages provided by these policies can be maintained, when added to market limitations.

Markets control the existence (and disappearance) of extractive economies. The transformation of a natural resource into a useful or economic product is the first step towards an extractive economy. However, as the market expands, the forces which lead to its decline also increase. The limited supply capacity for an extractive product brings about the need to cultivate domestic plantations or to discover synthetic or other natural substitutes.

The Importance of Domesticating Extractive Resources

The domestication of extractive resources began 10,000 years ago in Neolithic times. Since then, some 3,000 species found in nature have been progressively selected, adapted and cultivated (Heiser 1973). Of these, barely 100 species of plants are cultivated on a wide scale but these support

rural production and innumerable associated activities. In the Amazon region and other tropical areas, the domestication process is an ongoing phenomenon. It is important to recognise this process because, for the majority of cultivated plants, this information has been lost over time. Each type of product follows a distinctive domestication process.

Extractive products with great economic importance
For such products, the inevitable result is domestication or the discovery of synthetic substitutes as scarcity develops with growth in demand and relative inelasticity of supply. Those extractive products with a more elastic demand or control of markets are more likely to be domesticated, as there is the possibility of appropriating any producer surplus. The domestication of jaborandi (*Pilocarpus microphyllus*) and the beginning of the domestication process for fava danta (*Dimorphandra gardeniana* and *D. mollis*) by Merck are examples of this type. Thousands of plants and animals domesticated by humans in the last ten thousand years also fall into this category.

Extractive products without the possibility (need) for immediate domestication
Many extractive products are unlikely to be domesticated in spite of their economic importance because of the length of time and high costs required for their reproduction. This is the case for babaçu and tucum (*Bactris setosa*, Mart.) or hardwood species. As markets expand beyond the capacity to supply from natural stocks, domestication becomes a possibility. If domestication proves to be too expensive, these products are likely to be substituted or abandoned. For those extractive products such as timber, açaí palm, Brazil nut and rubber tree, with great stocks readily accessible at relatively low costs, it may be a long time before domestication is even considered.

Extractive products without a specific economic importance
In the Amazon region, only a few of the hundreds of wild fruits which exist will undergo domestication based on their economic potential, while demand remains low and extraction costs are high. As stocks remain available or can compensate for the workforce required to harvest the fruit, the extractive activity may continue at least until some external force affects this balance.

Conspicuous extractive products
The importance of the extractive product in this case results from some indirect use for pleasure, well-being, environmental awareness, etc. “Green” products fall into this category, but it is quite probable that with continued growth in markets, pressures for their domestication will come into effect.

In the same way as the demand for "Giffen goods" declines with lower prices indicating inferiority, the demand for "Veblen goods" is derived from their scarcity and very high prices which are perceived to indicate quality.

The domestication process is not uniform for all extractive products. The most important reason for domestication is the lower cost of production and increased return to land and labour. In addition to practical advantages, these factors make it possible to overcome the inflexibility imposed by the extractive sector's low elasticity of supply which, in addition to the limitation imposed by stocks, depends significantly on the movement of manpower to increase extraction. Thus it is infeasible to respond to the growth of demand on a long-term basis. Domestication leads to the production of an near-identical commodity of better quality than the extractive product. A given quantity of a domesticated plant species can be produced in a much smaller area. Thus domestication of extractive resources in the Amazon region, principally those related to the destruction of the rain forest, can have positive effects on the preservation and conservation of forest resources. This would avoid the situation which exists in the case of extraction of jaborandi for the shampoo industry. However, with domestication, extractive resources are less valuable, and this may lead to more lucrative economic alternatives to be established on the land, thereby intensifying the destruction of natural resources.

The visible result of domestication is its capacity to increase supply, in contrast to the static or declining nature of extractivism. This lowers the price of the product, and induces a reorganisation of production factors, to the stage where plant extractivism becomes an unprofitable activity.

Any analysis of the effects of domestication of plant extractive resources should include the effects on distribution. As the changes are slow, two distinct groups have developed: one operating solely in the extractive sector and the other cultivating the extractive product in a rational way, using available technologies for domestication. Figure 6 illustrates the two systems of supply. This is an adaptation of the Evenson (1983) model to analyse the benefits of disseminating agricultural technology between two regions.

Curve S_1 represents the supply of the extractive product, and is perfectly inelastic. S_1+S_2 is the combined supply curve for the extractive and domesticated products, with a predominance of the latter. DD is the demand for the product. At equilibrium price P_0, the extractors supply Q_1 and domesticated production provides the remaining quantity of Q_2.

While the technology used in cultivation remains unchanged, in a short and medium-term situation, the supply curve of extractivism tends to remain inelastic and move towards the left. Depredation and exhaustion of reserves lead to a declining participation of extractivism in the market. With increasing technological skills of cultivators, greater quantities will be offered from plantations. The joint supply curve moves to $S_1+S'_2$, and the

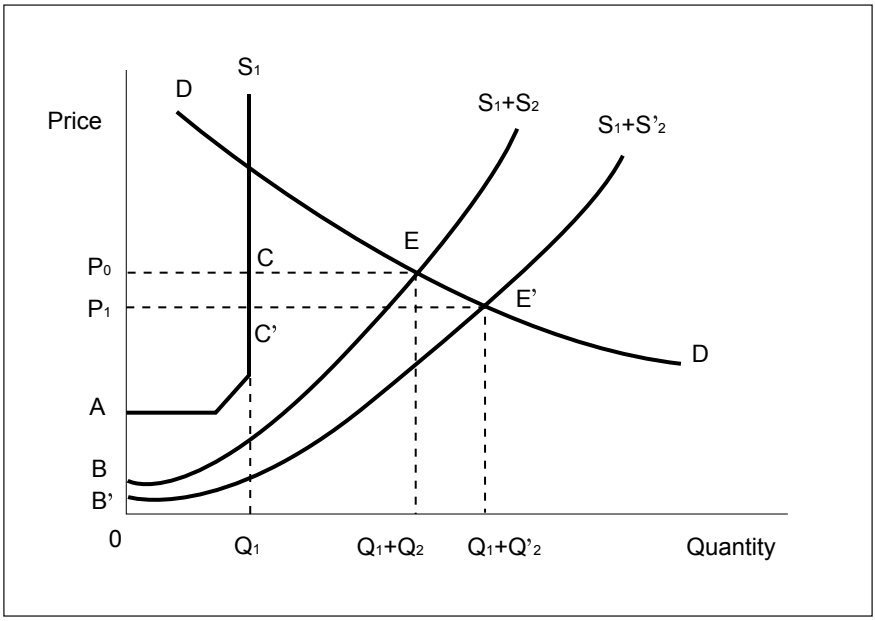


Figure 6. Model of the disequilibrium that is established between combined supply of a forest product (from extraction plus cultivation) and demand (adapted from Evenson 1983)

price falls to P_1, however the quantities supplied by the extractors remains static at Q_1.

For many extractive products, the domestication process is already complete, but in the Amazon the phenomenon is still under way. Even here, a large number have already been domesticated and become important agricultural products in their new sites (rubber, cacao, chinchona [*Chinchona calisaya* and *C. ledgeriana*] quinine, etc.). Others are cultivated in their own region (guaraná [*Paullinia cupana*, Brazilian soft drink]), urucu (*Bixa orellana*, dye), coca (*Erythroxylum coca*, cocaine), jambu (*Wulffia stenoglossa*) and malva (*Urena lobata*). Still others are in an advanced stage of domestication, for example, native fruits such as cupuaçu (*Theobroma grandiflorum*), peach palm (*Bactris gasipaes*, an edible fruit), açaí, bacuri (*Platonia insignis*, an edible fruit), tucumã (*Astrocaryum tucuma*, fruit) and camu camu (*Myrciaria dubia*); toxic plants such as the timbó; aromatic plants, such as rosewood, cumaru (*Dypterix odorata*); medicinal plants, copaíba (*Copaifera duckei*), andiroba, ipecacuanha (*Cephaelis ipecacuanha*), jaborandi (*Pilocarpus microphyllus*); and other native forest species used for lumber.

For domesticated cultivation to expand, certain conditions must exist, such as the availability of technology, a strong demand, the unavailability

of substitutes (synthetic or natural), and the isolation from extractive stocks. The presence of large stocks of extractive products very often leads to domestication taking place in regions outside the domain of extractivism or being carried out by farmers who do not favour extractivism. Paradoxically in the final phase, the presence of domesticated crops in the extractive areas may help to maintain plant extractivism in the short term. In the State of Paraná, whether most erva-mate (*Ilex paraguariensis*) is supplied from extraction or plantations, is related to available stocks, profitability and competition from other alternatives. The extraction of this herb is in a disintegration phase. In the past its extraction was destined for export, but since 1931 it has been exploited for national markets. Its present sustainability depends on the production of food crops and domestic animals and because of the absence of any other activity to occupy this economic space (Yu 1988).

With funding from the British Government, the Goeldi Museum of Pará State has been developing the domestication process of pepper (*Piper hispidinervium*). This plant is native to the State of Acre and is characterised by the presence of safrol in its leaves, an oil used in the perfume industry and for organic insecticides. With the decline in the extraction of sassafrás (*Ocotea pretiosa*) in Santa Catarina and Paraná, and cutting prohibited since 1991, interest has been rekindled in a substitute plant which contains safrol. In its natural state, the density of *Piper hispidinervium* is very low, which makes its extraction unprofitable on commercial terms. The domestication process is passing through an extractive phase. This also indicates that not all natural resources are appropriate for an extractive economy.

Jaborandi, a plant which produces an active ingredient called pilocarpine for which there is no synthetic substitute, is also undergoing domestication. The jaborandi market has been a monopoly of Merck, which has been developing a plantation of 300 ha (7 millions plants) in Barra do Corda, Maranhão State. Merck has experienced problems with extractive harvesting of this product because of competition generated by the use of jaborandi in shampoo. Recent publications discuss the domestication of ipecacuanha, found in Rondônia State, for extraction of ementine from the roots. This plant is being trialled in Darjeeling, India (Franz 1993), indicating that the Amazon is not merely a repository for genetic resources. On the contrary, it is more probable that many plants will follow the same route as chinchone, tomato, potato, rubber, cacao and guaraná, spreading from their native region to be introduced around the world.

For this to take place, increased efforts must be made to domesticate present and potential extractive resources. Only in this way will it be possible to meet the demands of market growth, offer products with improved quality at lower costs, and increase the productivity of land and labour. It is through domestication that it will be possible to create real

market opportunities for those people who derive their livelihoods from extractive activities. For some products, there is complete indifference to domestication because of abundant stocks or the long time periods required to begin production. This is the case of the oil palm, babaçu, that has been replaced by other vegetable oils, other synthetic detergents and suffered from labour competition for other activities. The protection of these resources demands the creation of economic alternatives for this segment of the population.

Management of Extractive Resources

For many extractive resources, both those where sources are destroyed or products collected, extraction should not exceed the carrying capacity. It must be remembered that rational management doesn't guarantee existence "*ad infinitum*" since this is determined by the inter-relationships between the many sectors of the economy. In general, for extractive resources which are found in large quantities such as wood, Brazil nut, babaçu and açaí palms, efforts to guarantee managed extraction must be made. This will ensure that the extraction will continue for a long period, as well as promote the conservation of natural resources. For some extractive resources, such as the açaí palm in the State of Pará, managed extraction for the gathering of fruit has resulted in a more homogeneous forest, and consequently increased the productivity of land and labour. As this is far from the general rule, extraction of other products may lead to their disappearance and a loss of genetic resource.

Extraction of latex from the native rubber trees, despite the efforts of environmental movements, has declined (Table 1). In 1990, for the first time, production from rubber plantations was greater than extractive production. The low productivity of land and labour in relation to the present minimum wage, is more responsible for the stagnation of rubber extraction than the expansion of domestic plantations. This has induced the cultivation of annual crops. Even though only one-seventh of the rubber stocks in the extractive areas is effectively under exploitation (FUNTAC 1990), it is unlikely that a sevenfold increase can be achieved. Limitations of family labour and increased population density make extraction unprofitable. Relatively low productivity, due to the prevailing level of technology, is still a major limitation in terms of economic viability for cultivation of rubber trees.

For açaí palm, that is harvested in two ways (fruit and palm heart extraction), growth of the fruit market is encouraging homogenisation of açaí palm stocks in the Amazon estuary in areas near Belém, and reducing palm heart extraction. The consequences of this process needs better evaluation. With the increased value of açaí fruit over the last ten years, there has been a tendency to increase the density of this species. An indirect consequence

Table 1. Natural production of rubber in Brazil from native stands and plantations 1978-95

Year	Native stands		Rubber plantations	Total
	ton	%	ton	ton
1978	20.357	85,87	3.350	23.708
1979	21.118	84,61	3.840	24.959
1980	23.200	83,45	4.600	27.800
1981	24.300	80,20	6.000	30.300
1982	26.300	80,18	6.500	32.800
1983	28.200	80,11	7.000	35.200
1984	28.500	79,17	7.500	36.000
1985	32.813	81,28	7.558	40.371
1986	23.518	72,04	9.127	32.646
1987	14.412	54,11	12.225	26.638
1988	18.096	54,97	14.821	32.917
1989	16.901	55,13	13.756	30.657
1990	14.188	46,03	16.639	30.827
1991	13.568	45,93	15.975	29.543
1992	6.326	21,00	24.386	30.712
1993	7.438	18,29	33.225	40.663
1994	5.367	11,90	39.726	45.093
1995	4.500	10,59	38.000	42.500

Source: SUDHEVEA/IBAMA; Martin and Arruda (1993)

has been the destruction of male trees of buriti (*Mauritia flexuosa* Lin.) judged to be unnecessary. In reality, this extractive area suffers daily flooding and hence the pressure for agricultural uses was lower, thereby allowing the açaí palm stocks to regenerate.

In Figure 7, the extractor is faced with the opportunity to gather fruit or palm heart, depending on the relative price of the two products and the labour cost. In the areas closest to markets and with good transport facilities, fruit extraction is more profitable and advantageous. The falling price of palm hearts relative to açaí fruit has become the principal variable promoting the conservation of açaí palm stocks, by encouraging management for fruit extraction to satisfy the growing market of Belém. Formerly these areas had been used for predatory extraction of palm hearts and attempts to force conservation by environmental restrictive laws have not been successful.

The management of some extractive resources by improving infrastructure can eliminate constraints and increase technical and allocative

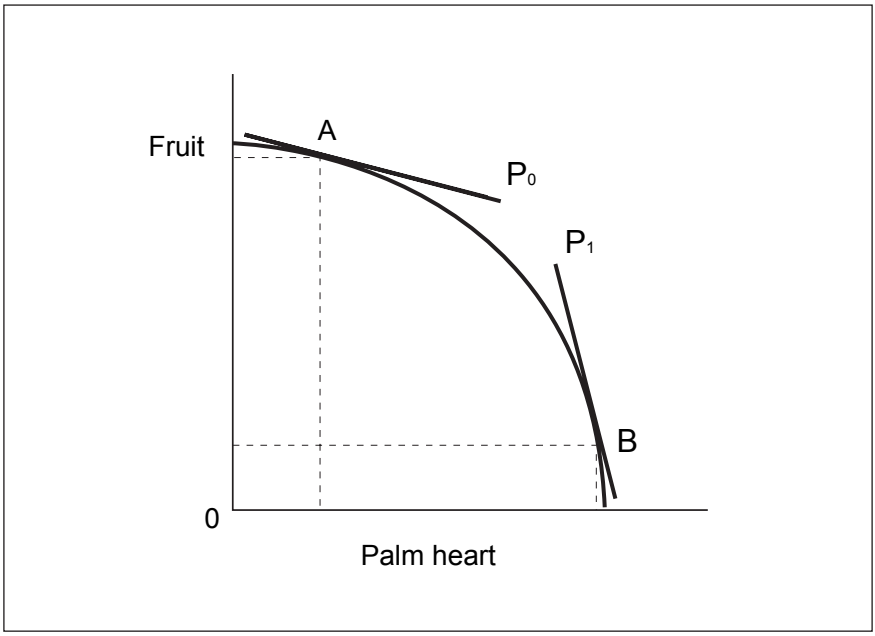


Figure 7. Effects of changes in the price relationship extractive products on the entire activities of an extractor.

efficiency, thereby changing the production possibility frontier curves at the limits. In Figure 8, point D displays both technical and allocative inefficiency; C displays allocative efficiency but technical inefficiency; B displays technical efficiency but allocative inefficiency; while A defines the points of economic efficiency, given the same price relationships (Ellis 1993).

In areas distant from markets and with transport problems, palm heart extraction becomes more advantageous. In the face of an abundance of açaí palm stocks that could be enlarged by management, it is probable that the growing fruit market will not lead to domestication at present. One possible future scenario for the domestication of açaí palm is related to the growing market for palm hearts harvested from the plantations developed in south-central Brazil. Even in the case of products with large stocks, domesticated plantations may develop to meet the needs of specific markets that have comparative advantages.

The extractive "colonisation" of resources which have not yet been incorporated into the extractive process or which show economic potential (e.g., patuá, buriti, timber) must be treated with care. The environmental damage, although less than that caused by agricultural activities, may be similar over the long term. Economic viability of extraction may also be uncertain.

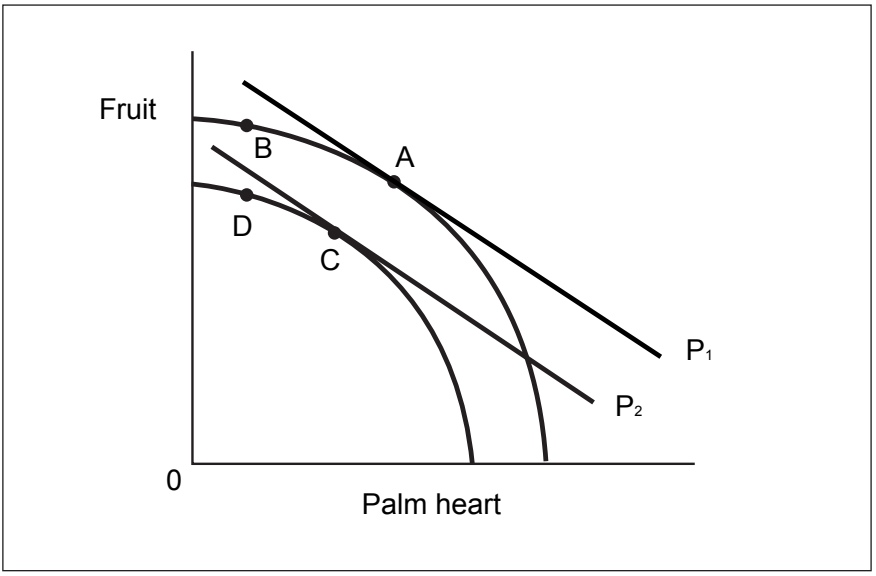


Figure 8. Possibilities for managing extractive resources to increase their frontiers of productivity and efficiency

The management of açaí palm requires labour, maintenance and judicious gathering of the fruit. It has become usual to extract palm heart initially to clear the area and provide capital for management. The amount of labour necessary requires the hire of temporary workers, with the appropriation of the economic surplus by açaí palm owners. Communal administration of açaí palm stocks through extractive reserves, or some other associated form without defined land tenure, will be attractive only if there is a pressure for land appropriation, transport and processing has been developed, and if there are no labour shortages or leadership problems. At the moment, the theft of açaí fruit by neighbouring and unemployed people dwelling in the villages has become routine in the main extractive areas. With the gradual growth in the açaí market for fruit, it is probable that large areas of the Amazon estuary will be transformed into homogeneous stocks of açaí palm along the river. Besides the other anthropogenic transformations undergone in the last two and half centuries (e.g., wood extraction, channel opening, extraction of other extractive products), the process of promoting the growth of homogeneous stands of açaí palm, and its effects on biodiversity, should be studied more closely (Raffles 1995). This activity does, however, cause less environmental damage in areas where agricultural pressure is low and where natural resource constraints occur in upland areas. It has been a mistake to only analyse the extractive economy from a static and isolated perspective, forgetting the dynamics, transformations and interrelations over time and between sectors.

Conclusions

An analysis of the different extractive products domesticated in Brazil, and in particular in the Amazon, suggests that when markets are small, the conditions exist for extractive activities to survive. However, as the markets grow, supply from the extractive sector becomes inadequate, and in view of available technology and favourable prices, the domestication process begins, which then results in the collapse of the extractive economy. This process of domestication has tended to be validated in those areas and for those people who are not dependent on extraction, and who are cannot influence the stocks of these resources.

The emphasis on plant extraction has been one-sided in giving attention only to the sector itself, neglecting the importance of domesticating these resources as a means to protect biodiversity and secure new economic alternatives, employment and growth in demand. As the domestication of extractive resources is at odds with the continuation of plant extraction, policies to retard domestication must be avoided, even if this causes losses to the extractive economy, but provides benefits for the consumers. As a majority of the resources for agricultural research in tropical countries comes from international organisations and the developed countries, policies that attempt to favour extractive activities alone, without giving attention to technological modifications, may cause considerable harm to the society.

For those extractive resources which have large stocks, such as timber, açaí palm, Brazil nut and in part even the areas for rubber extraction, management is important to allow their extraction for longer periods and to increase supply potential, with the least possible wastage. Environmental proposals, in creating captive markets for extractive products, impede the domestication process as well as cause losses to the consumers. These may have detrimental effects on the conservation and preservation of natural resources in the medium and long term.

Domestication, for many extractive products, may mean improved conservation of the natural resources by reducing pressure on stocks. This is happening at present with jaborandi. In other situations, such as beans, the domesticated genetic resources show a greater range of variations.

The extractive economy is subject to transformations which arise from the extractive economy itself and from other economic activities, in a co-evolutionary process. Technological transformations and the global economy also affect the extractive economy, with the result that in some situations during the final phase, this sector survives to support other sectors such as agriculture (Paiva 1975).

A large part of the Amazonian population involved in extraction of plant resources, is also involved in agricultural activities. The allocation of time to extractive activities depends on the products to be collected, the accessibility of the resources, their compatibility with the agricultural calendar

and the price relationship between agricultural and extractive products. In the Amazon, the prohibition of forest clearance and burning has resulted in a relative increase in prices for annual, mainly food, crops. This has given many people involved in extractive activities better possibilities in the production of food. Extractive activities in this case are no guarantee against deforestation, as this depends on the economic situation of the producer. *Even the end of extractive activities does not necessarily mean an end to the forest*. Therefore it becomes important to provide incentives for agricultural systems which involve annual and perennial crops and livestock in areas where extractive activities dominate. In this way their spatial and temporal permanence can be protected, levels of deforestation in primary forest reduced, incomes increased and the supply of basic foods guaranteed.

The characteristics of low productivity of land and labour in the extractive economy, and the dispersion of resources, mean that the process of domestication is inevitable if the market shows prospects for growth over the long term. In the same way, considering extractive activities as an option for uncleared areas is invalid because a great majority of the rural population does not wish to rely exclusively on the extractive economy for survival.

Many extractive products deteriorate due to the need for processing, the degree of perishability (mainly food products) and industrialisation. There is also some waste associated with collection and processing, and a need to use by-products generated during extraction, processing and industrialisation. Distance from the market and the absence of an adequate technology limit greater use of the açaí fruit, in spite of the large stocks available. The incorporation of these resources into the extractive economy without adequate market expansion, could depress prices and, in turn, reduce income for the extractor. Extractive resources can be characterised by the great variety and low quantities per product, or by few products and great quantity per product, depending on the economic viability of extraction and commercialisation. Each extractive product has specific characteristics, which makes it unwise to generalise (Lescure 1994).

It is mistakenly believed that extractive reserves are an important way to avoid deforestation in the Amazon (Allegretti 1992). The act of forest clearance is closely related to the economic situation of the extractor. The fall in rubber prices, for example, in relation to agricultural products, led to a recent process of "agriculturalisation" in the areas of rubber extraction. If the economic situation improves it is quite probable that the rubber tappers and other extractors will begin to raise cattle, which is a tendency among smallholder farmers.

Deforestation occurs as a process of occupying the land and from the beginning is linked to the family life cycle. Even though deforestation can continue throughout this cycle, it is more intense in the first few years. This procedure ensures title to the land and allows a considerable stock of secondary vegetation to develop as support for a migrant farmer, and also

minimises the long-term costs of slash and burn activities in preparing the planting area. Cultivation in areas cleared from primary forest has greater agricultural productivity, almost no land costs, reduces the costs of weeding, and provides opportunities for the sale of timber. However, as these areas are located in frontier regions, there are disadvantages in relation to product prices, transport, costs and availability of labour, etc. On the other hand, costs of slash and burn can be halved if cultivation takes places in secondary forest areas which have greater access to transport, as they are normally located in older frontier areas, demand higher prices for products, and have greater availability of labour. Among the disadvantages are decreased agricultural productivity, higher costs of weeding, higher land costs and inadequate periods of fallow as demographic density increases. Shorter fallow periods can lead to a situation were the use of the land for agricultural activities may be unprofitable if no technological advances are introduced.

As many of the extractors also clear the primary forest to use for agricultural activities, a component of any research is related to the use of secondary vegetation. Processes which accelerate its regeneration, and enrichment with tropical wood and other species, are important to reduce the incorporation of primary forests into the productive process. On a global scale, if the objective is to reduce deforestation and burning of the Amazon's primary forest, there is a need to analyse broader public policies that favour the use of secondary forest areas of the region. It is important to encourage the development of technology that will increase the productivity of pastures as well as annual and perennial crops, thereby helping to reduce the incorporation of new areas of primary forest into agriculture and stabilising agriculture already established in cleared areas (Homma *et al.* 1993). The viability of extractive activities also depends on the returns to agriculture practised by the extractors and the impact of other sectors.

Labour laws and improved social benefits have affected the availability of rural labour in Brazil, principally in the Amazon, where there are two costs. For those hiring labour it has become more expensive as employers are obliged to pay a minimum salary, and to those who receive this salary it is very little. Those who voluntarily depend on extractive activities have to accept incomes below the minimum salary, which justifies the maintenance of these activities, for the simple fact that other economic alternatives do not exist. The gradual disappearance of rosewood extraction, apart from the exhaustion of favoured stocks close to waterways, took place mainly due to a lack of interest (on the part of those extracting the product and their employers). Labour laws have given many legal advantages to the workers which has made extractive activities quite risky for the employer in relation to payment of salaries (including overtime hours, occupational hazards, etc.). This has meant that the number of rosewood extraction plants, despite the abundance of reserves in headwater regions of the rivers, have declined from about fifty in the seventies to only five today.

With the exception of the logging sector, the extraction of forest products can be characterised as being labour intensive, and so survival depends on the existence of marginal or low-cost labour. Labour-intensive activities that do not evolve technologically, either increasing the productivity of land and labour or processing of the product, have difficulty surviving when labour costs increase in real terms. This phenomenon is not exclusive to extractive activities, but to agriculture generally, as with the disappearance of jute (*Corchorus capsularis*) and malva cultivation in the Amazon.

Competition with other sectors of the economy is another variable that affects the extractive economy. Public policies for the extractive sector must involve government investments in social infrastructure such as education, transport and roads to improve the quality of life in these areas. In this manner, one cannot discard the hypothesis that improvements in educational opportunities, the creation of new economic alternatives, population growth, increases in land values due to the restrictions in supply resulting from the support to extractive activities and improvements in social infrastructure, may terminate provoking the disintegration of the extractive economy over the medium and long term. Thus, while in the past plant extractivism drained manpower from agriculture, today it is the reverse, and it is agriculture that is draining manpower from extractivism. The importance of extractive products depends on the specific circumstances in which they are found in relation to the economic viability of extraction and can vary with economic, social and technological changes in the society.

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Chapter Five

Trade, Indigenous Rain Forest Economies and Biological Diversity

Model Predictions and Directions for Research

David S. Wilkie and Ricardo A. Godoy

Introduction

Since 1937 the gross value of global trade has increased from $US25 billion to over $US3400 billion annually. Even remote regions increasingly are being exposed to commerce, as the tendrils of regional and world markets contact and progressively absorb once isolated indigenous communities.

Economists tout trade as one engine of economic development, and perceive markets and commerce as helping raise household income and standards of living. Commerce does have its negative aspects (OECD 1994), and much has been written on the economic consequences of trade and fluctuating commodity prices on single-product exporting nations (Coote 1992; Barratt Brown 1993). These discussions focus on the economic impacts of trade at the national level. Rarely do researchers deal with the impact of trade on the economies of small indigenous rain forest communities and the conservation of biological resources.

Tropical forests cover a mere 7% of the world's landscape, yet contain over half of global biological diversity. Indigenous communities throughout the tropics are the primary users and guardians of the forest's ecosystem, species and genetic diversity (Clay 1988; Juma 1989; Anderson 1990; Poffenberger 1990). If policy makers are to develop practical approaches to conserve biodiversity they must evaluate the likely impacts of increasing trade on indigenous economies, and assess how these changes will affect rain forest biodiversity.

Biologists, anthropologists and development practitioners concerned with the conservation of rain forests and with improving the livelihood

security of forest-dwelling people are exploring the links between trade and indigenous communities – often as advocates for the development of markets for rain forest products (Juma 1989; Anderson 1990; Shaw 1991; Counsell and Rice 1992; Panayotou and Ashton 1992; Plotkin and Famolare 1992; Redford and Padoch 1992; Godoy and Bawa 1993; Reid *et al*. 1993; Stiles 1994). Many argue that by extracting and selling forest resources, indigenous communities can raise their income, and, as a result, will become more aware of the value of their ecologically diverse and productive forest. Thus, local users of forests will be encouraged to conserve the forest as a source of sustained income, rather than as a source of wealth for investment in quick pay-off ventures such as cattle ranching.

There is certainly much evidence that extraction of NTFPs contributes to local economies, livelihood security and dietary risk minimisation (de Beer and McDermott 1989; Falconer and Arnold 1989; Falconer 1990; Panayotou and Ashton 1992; Redford and Padoch 1992; Godoy *et al.* 1995). Whether households within extractive economies are ever likely to be wealthy is, however, doubtful (Fearnside 1989; Browder 1992). Considerable research has documented patterns of resource use in different areas under different conditions (Asibey and Eyeson 1975; Martin 1983; Dainzinga and Yambo 1992; Falconer 1992; Plotkin and Famolare 1992; Wilkie *et al*. 1992; Chardonnet *et al.* 1995). Yet, we still know little about the factors that determine the form and intensity of resource exploitation by local communities, and how and why resource extraction changes over time. Despite the importance of forest-based commodities in the economies of rural households, studies have focused more on the economic valuation of the forest (Peters et al. 1989; Ruitenbeek 1990; Balick and Mendelsohn 1992; Godoy and Bawa 1993; Grimes *et al*. 1994). There has been little empirical work examining how extraction of NTFP for sale affects household consumption of forest and non-forest based goods, and changes in household investments in labour, capital and land affect forest species composition and abundance (Nepstad and Schwartzman 1992).

Padoch (1988; 1992) has shown that, although locally or regionally marketed goods can account for the bulk of forest species extracted and sold by indigenous communities, little is known about how these markets function (Scott 1985). Local markets often follow boom-bust cycles with supply and demand oscillating wildly. Aguaje (*Mauritia flexuosa*) prices in local markets in the Iquitos region of Peru showed a 6-fold price increase in a week that spurred a massive increase in supply (associated with destructive harvesting methods) causing a subsequent crash in the price to, or below, the pre-boom value (Padoch 1992).

As with local markets, few attempts have been made to evaluate, theoretically and empirically, how integration of indigenous communities into regional and world markets is likely to affect household income, investments, sales and consumption and the effect of these decisions on indigenous people's

use of forest resources (Ros-Tonen *et al*. 1995). Without understanding the impact of trade on indigenous household economies it is difficult to: a) predict how integration into extra-local markets will alter indigenous communities' use of forest resources, or b) evaluate the likely consequence of trade liberalisation on the conservation of biological diversity.

Model

In this paper we present an heuristic model to demonstrate the likely effects of extra-local trade on indigenous household economies and the conservation of biological diversity. The model builds on micro-economic and trade theory, and the ethno-historical and ethnographic literature. Through the model we show how changes in household income, investments, sales, and consumption at different stages of integration into regional and world trade affect the exploitation of forest resources and highlight the management and policy implications for the conservation of biodiversity.

The stages presented in the model are not meant to represent the only possible sequence of events resulting from the progressive integration of an indigenous community into trade. Rather, they offer a plausible heuristic device to examine the ramifications of the advent of export opportunities for indigenous community economies and their use of forest resources.

The model starts on day zero with a small community of forager-farmers living in a village isolated from the outside world and its markets. The model assumes that the individuals and households within the community have long experience exchanging goods amongst one another, but have not had the opportunity to trade with the outside world. We chose forager-farmers as the baseline rather than pure foragers because few, if any, autarkean communities at present use foraging as their only means of subsistence (Headland and Bailey 1991). The model ends with a community fully integrated into regional and world trade. In the model we assume:

1) that the community is small relative to the extra-local market. Demand for the goods produced by the community is unlimited relative to the capacity of the community to supply them; thus goods exported by the community will affect neither demand nor price. This assumption does not hold for locally traded goods that often suffer from boom and bust cycles associated with over-supply and fickle demand (Padoch 1992);
2) that farmland belongs to the household that cleared it from old growth forest. All other old growth forest is owned by the community;
3) households have normal, "well-behaved" utility curves;
4) households which buy or sell with the rest of the world spend all their income at the end of a day, and do not incur debts, nor set aside cash as savings;

5) the forest contains a mixture of tradable and non-tradable goods. Tradable goods are either exportable or substitutable (i.e., goods that a household can either export or can replace with imports). Non-tradable goods are those produced and consumed solely within the household. Non-tradable goods can be either normal (superior) in that their consumption rises with household income, or inferior in that their consumption declines with rising household income;
6) the capacity of the forest to supply goods depends on their abundance and replacement rate;
7) households are economically rational, and seek higher standards of living.

Day_0 - Autarky or the Ethnographic Present

A community of forager-farmers is living in an isolated rain forest in the tropics. Our depiction of the community draws from ethnographies of forest dwellers and refers to the time just before first contact with outsiders. Though households exchange goods among themselves they have few trading relations with outsiders and few goods are either imported from, or exported beyond, the community (Morris 1982). Households invest in many types of foraging and farming activities. On average each household allocates 50% of its time and labour to produce food, 10% to produce durable goods (e.g., shelter, tools, etc.), 10% to maintenance (food preparation, washing, child care, etc.) and the balance (30%) to leisure (Hayden 1981; Bailey 1991).

Time allocation to food production is such that, although the amount of foraged food items varies and agricultural crops constitute a living larder, on average, households have just enough food to live but no surplus. Each household obtains most of its protein from hunting and fishing, and its carbohydrates from farming. Households gain implicit ownership of land by clearing old growth forest. Though the community lays claim to the surrounding forest, low demand for forest resources makes it unnecessary to regulate exploitation of forest resources by "mutual coercion, mutually agreed upon" (Hardin 1968).

Day_1 - Contact

Traders arrive in the community for the first time on day_1. They talk with the community to explain that they have a variety of goods to trade, and are interested in buying goods from the community. As ethnographic and ethno-historical accounts suggest, traders are most likely to want to obtain locally produced items with the highest price to transport cost ratio (Rich

1960; Jablow 1994). Given the geographic isolation of the community, and the absence of a well-established infrastructure linking the outside world to the community, traders focus their attention on compact, high-value goods. In world markets, protein usually commands higher prices than starches, and fresh plants and fungi tend to contain a high percentage of water and thus may have a low value to weight ratio. We might expect, therefore, that traders will rank indigenous goods as follows: animal products (including skins) > nuts and seeds (including most spices) > fruits and tubers > leaves and stems.

When the value of a forest and an agricultural good is the same, and the capacity to increase production of both goods is equivalent, households should opt for producing a surplus of forest goods to trade, because part of the costs of extracting goods from the forest commons is borne by the community (Scott 1954), whereas all the costs of producing agricultural goods are borne by the household. We hypothesise that the initial impetus of trade will be to focus household attention on goods with two traits: a) light, high-value goods, and b) goods that tend to come from open-access areas.

To autarkean communities the offer of trade is irresistible even without coercion (Rich 1960; Bishop 1972; Parker 1972; Gross *et al*. 1979; Jablow 1994; Black 1995; Hudson 1995). Households see the opportunity to replace native goods (e.g., stone axes) that are costly to produce (in terms of labour), and often short lived (e.g., bark clothing, wicker baskets), with superior and cheaper industrial goods such as cotton clothes, steel axes, aluminium pots and plastic buckets. Given the priorities of traders and indigenous households, the goods for which households will quickly generate a saleable surplus are likely to be foraged animal-based goods (e.g., game-meat, fish, and skins). The traders offer to buy as much of these goods as households can produce, and promise to return on day_3 with the goods that households have expressed interest in obtaining through trade

Day_2 - Investment Reallocation

In order to generate a surplus of forest-based goods to trade, households must allocate more time to foraging. By the end of day_2, households show a reallocation of their investments in activities such that production of export goods has absorbed the time once spent in leisure. The first impact of opening up to trade is reallocation of time from leisure to activities that produce goods for the outside world. Labour investment in production of exportable goods increases both relative to other activities and in absolute terms. As a result, the relative intensity of production of exportable goods increases, as does the total quantity of exportable goods produced or extracted. At this stage we do not expect reduction in the production of any good because labour to increase production of goods for export was taken

solely from leisure and not from other productive activities (Brush 1977). Marginalised communities eking out a living from a degraded resource base may not have leisure time to reallocate (Barrett and Browne 1993; Mwaka 1993), and thus may reduce labour investments in subsistence activities to generate income from market activities.

Day_3 - Imports

The traders return on day_3 and each household trades its surplus of exportable goods produced on day_2, for goods brought from the outside world by the traders.

Impact on the household economy

To the household, the value of forest goods exported increases in relative and in absolute terms. The opportunity cost of labour rises in concert with the rise in the value of goods exported by the household. Household income increases with sales of goods to the traders. The value of land increases if it produces exportable goods and particularly if it is owned by the household.

Households substitute cheaper and more durable goods from the outside world for goods produced locally (Bennett 1987). Rain-forest households, with access to trade, routinely replace bark cloth, clay pots and stone tools with woven cloth, metal and plastic pots and steel tools. Trade, therefore, reduces household consumption of substitutable goods (i.e., goods that have import substitutes) and increases consumption of exportable goods. Increased income and access to cheap substitutes suggests that the total range of goods consumed will also rise. The impact of trade on household consumption of non-tradable goods is, however, ambiguous. Rising opportunity costs of labour and capital should reduce production and consumption of non-tradable goods that are labour or capital intensive, but may have little impact on consumption of other non-tradable goods. Rising household incomes should increase consumption of normal non-tradable goods, while reducing consumption of inferior goods.

Impact on the diversity of forest resources exploited

Biodiversity is defined in terms of the genetic diversity within a population of inter-breeding individuals (a species), the species diversity within a community, and the ecosystem diversity within a landscape. Measures of diversity attempt to account for both the richness (e.g., the number of different forms of a gene know as alleles) and evenness (e.g., the relative abundance of each allele, species or ecosystem). This paper will focus primarily on impacts of trade on species diversity, and will only highlight relevant impacts of trade on genetic and ecosystem diversity.

Assuming that forests contain a mix of exportable, substitutable and non-tradable goods (i.e., not all forest goods have a market), we would expect to see the diversity of species extracted by households, as measured by evenness, to decline. That is, a smaller number of forest goods will receive a greater share of household labour investment, and will contribute a greater share to household production and income. We also expect that the genetic diversity of some species extracted by households, as measured by evenness, will also decline as foragers focus their harvesting efforts on prime specimens (i.e., those with the biggest horns, densest fur, largest seeds, etc.).

Trade will, however, have an ambiguous effect on the diversity of forest goods extracted as measured by genetic and species richness. Though households are investing more in fewer goods, trade theory predicts only that investment in substitutable and inferior non-tradable goods will decline, not that investment will, necessarily, cease. Thus, although the relative intensity of extraction of forest goods may change, the absolute number or variety of forest goods extracted may not change.

Impact on the sustainability of forest resource exploitation

Forest animals, because of their expected high value to transport cost ratio, and the externalisation of production costs, are likely to be one of the primary exportable goods extracted from the forest once indigenous households start trading with the outside world (Rich 1960; Hart 1978; Jablow 1994). Advent of a market for meat and skins will raise the relative investment in hunting by households, concomitantly increasing hunting pressure in absolute terms, and resulting in a decline in numbers and biomass of all hunted species. Although we assume that meat is an homogenous good, not all animal species or individuals within a species will be affected equally by increased hunting pressure, particularly when animals are hunted primarily for their pelts, tusks or horns.

Some animals are not hunted because the opportunity costs associated with doing so are too high. Optimal foraging theory (Charnov 1976) predicts which animals will be included in the hunting set, and which will not. We assume that all animals are distributed randomly in space, and that hunters search patterns and encounters with animals are random. If all animal species in the forest are ranked according to their average ratio of value to capture cost (labour and capital inputs required to capture the animal once it is detected), and we know the encounter rate or density of species, then species are added to the hunting set until the rate of return of capturing an individual of the next ranked species is less than the average rate of return for all individuals in all species of higher rank (Stephens and Krebs 1986). Species are added to the hunting set according to their value to capture cost ratio, regardless of their abundance. In this way, hunters do not invest time

capturing a low-ranked species and miss the opportunity to capture an individual of a higher-ranked species. Assuming that the value to capture cost ratio of a species never changes (i.e., market value and technology remain constant) species are added or dropped from the hunting set as the density of species of higher rank within the hunting set changes.

Hunters pursue species that have a high value-to-capture cost ratio. These species will decline in numbers and biomass with hunting, but hunters will not stop exploiting them even if they are rare. Their high value-to-capture cost ratio induces hunters to attempt to take them every time they are encountered, regardless of how infrequently. As a result, increased trade is almost sure to result in the depletion or local extinction of high value-to-capture cost ratio species by indigenous hunters (Fragoso 1991; Silva and Strahl 1991; Wilkie *et al*. 1992; Lahm 1994; Bodmer 1995; Chestin and Poyarkov 1995).

As the numbers of high value-to-capture cost ratio species declines the average rate of return for the hunting set will drop, and lower-ranked species that were ignored by hunters prior to contact with traders will begin to be pursued (Conelly 1985; Evans 1986; Geist 1988). The same argument holds for prime animals within a species. Hunters will first exploit those with the most desirable characteristics, only adding lower-ranked individuals to the hunting set once the density of high-ranked individuals declines (e.g., sport elephant hunters will take the big tuskers before resorting to smaller-tusked individuals).

Not all animal species hunted by indigenous households are equally susceptible to over-exploitation. Animals such as elephants, tapirs and primates exhibit K-selected traits – slow growth, often large body size, long life, delayed reproduction, many lifetime reproductive events producing few highly dependent offspring. At the other end of the continuum, r-selected animals are short lived, with rapid growth, early reproduction, often small body size, and one or a few lifetime reproductive events producing many self supporting, independent offspring. K-selected species animals tend to be rare because the habitat can only support a few large-bodied individuals, and they also tend to be slow to replace themselves. An increase in hunting pressure in response to trade is likely to result in reduced densities and possible local extinction of K-selected animals (Ludwig *et al*. 1993; Bodmer *et al*. 1994; Bodmer 1995; Chestin and Poyarkov 1995; Fa *et al.* 1995). Even subsistence-level hunting purely for household consumption can extirpate large-bodied, slow-reproducing animals (Redford and Robinson 1991; Alvard 1993; Fitzgibbon *et al*. 1995). Intensification of hunting is only likely to be sustainable for small-bodied, abundant, r-selected species (Geist 1988; Shaw 1991; Fitzgibbon *et al*. 1995). Small r-selected species often have low value to capture cost ratios relative to K-selected species, and thus they may not be preferred by hunters, at least not initially (Alvard 1993).

The impact of trade on harvesting of entire plants is similar. Primary forest tree species, prized for their fine-grained and durable wood, exhibit many traits of K-selected organisms. In undisturbed forest, primary species often have higher densities of exploitable adults than do early pioneer or late secondary species. Their extraordinarily slow growth and replacement rate make over-exploitation almost a certainty once they start to be exported. Peters (1994) emphasises that only by exploiting parts that do not result in the death, declining productivity, or reduced replacement of the plant is market exploitation likely to be sustainable. Further only those plants that produce many fruits regularly, and that use abiotic mechanisms for pollination and seed dispersal, are likely to sustain exploitation for export. He notes also that as tropical tree species show high genetic diversity, intensive collection of fruits from individuals that exhibit desirable characteristics will result in regeneration stemming primarily from the fruits and seeds of inferior plants. Thus, the export of seeds with desired characteristics is the non-timber forest products equivalent of "high grading" in the logging industry or trophy hunting, and will result, eventually, in a species population dominated by plants with undesirable genetic characteristics, and of low economic value.

Day_4 - Specialisation

As households' incomes rise they are able to substitute cheaper and more durable imports for local goods and no longer need to invest time and labour in producing these goods. Households can reallocate time from producing substitutable goods (i.e., that have import substitutes) to producing exportable goods (Behrens 1992). Imports of goods from the rest of the world can save the household time by making many tasks (e.g., cooking, carrying water) more efficient. Consequently, household labour investments will be further reallocated toward the production of export goods, away from the manufacture of local durable goods and maintenance activities.

Rising income of households is likely to increase demand for leisure time. As leisure time was initially reallocated to production of exportable goods, demand for leisure with increasing wealth is likely to further reduce labour allocations to production of substitutable and inferior non-tradable goods.

As households become more integrated into the world market, the criteria used by indigenous hunters for ranking animals changes. Before and shortly after contact, the chief criteria for ranking animals was the dietary value-to-capture cost ratio. As prices enter indigenous economies, villagers begin to use the expected value or monetary benefit of a good relative to the costs (measured chiefly in labour terms). Although the value-to-capture cost ratio concept remains the same before and after trade, the currency changes. Animals are now prized for their monetary value relative to the monetary costs of extraction. The new currency could either reinforce or counteract

previous trends. If the animals with the highest expected benefits happen to be small but with valuable skins, pressure may mount on r-selected rather than K-selected species. As trade changes the currency for valuing animal species from a dietary to a monetary measure, the ranking of species may change. If the relative rank of species changes with trade, the number and composition of species within the hunting set will change, as will the absolute abundance of species – those within the hunting set will decline, those excluded will not.

Impact on the diversity of forest resources exploited

With progressive integration into the market, households reduce investment in substitutable and inferior non-tradable goods, and continue to reallocate their labour to production of exportable goods. Increasing specialisation with trade results in a reduction in the evenness of diversity of forest goods extracted by households. Household investment will focus on a declining number of forest goods that will contribute an increasing share to household income.

Only essential, non-substitutable goods (e.g., culturally or spiritually significant goods) cannot be dropped from the suite of forest-based goods exploited by indigenous households. Given the intensification of exploitation of a narrowing set of normal exports, it becomes more likely but not assured that households will cease extracting some perfectly substitutable or inferior non-tradable goods. Although substitutable goods might drop out of household production, the household may start to extract or produce new goods for export. The composition of species extracted from the forest will change as trade continues but the impact of trade on the number of forest resources (species richness) exploited will remain ambiguous.

Access to technology complicates the expected impact of trade on the extraction of forest goods. If we assume that households invest in technology that increases the efficiency of production of exportable goods, but are neutral with respect to the production of substitutable or inferior non-tradable goods, then technology merely accentuates the ongoing impacts of trade on forest resource exploitation. Technology has, however, the potential to convert previously non-exportable forest resources into export goods.

Impact on the sustainability of forest resource exploitation

With increasing trade, exploitation of forest-based exportable and superior non-tradable goods will intensify and their abundance will decline. Large, slow-growing, slow-reproducing species will be more prone to local extinction than small, fast-growing, rapidly reproducing species. High market value and efficient technology have the potential, however, of causing the local extinction of any forest-based exportable good (Conelly 1985; de Beer and McDermott 1989; Redford and Padoch 1992; Pollack *et al*. 1995; Ros-Tonen *et al*. 1995).

As a forest-based good becomes progressively rare with over-exploitation for export, the market for this good may change as consumers find cheaper, more-abundant substitutes (Homma 1992). Cayman hunting for the market exhibits an approximately 50-year cycle of over-exploitation, market collapse, population recovery and resumed hunting (Jason Clay, pers. comm.). Though market collapse may allow over-exploited species to recover, if the number of surviving individuals has declined below the minimum viable population size, rapid local extinction is likely (Berger 1990). Market hunting induced extinction of the little auk, Stellar's sea cow, passenger pigeon and Long Island heath hen attests, however, that scarcity does not always result in market collapse (Trefethen 1975). If markets do not collapse as a normal good becomes scarce, households will attempt to secure access to resources through the development of property rights (i.e., privatisation of resources), and may attempt to enhance production levels by *in situ* management and/or domestication (Homma 1992; Arnold 1995; Lawrence *et al*. 1995). Domestication of cinchona species for the production of Quinine did not prevent, however, the local extinction of these trees in parts of Amazonia in the 19th century (Ros-Tonen *et al*. 1995).

Trade encourages households to specialise in the production of those local goods that can be exported. We might expect that trade will enhance the conservation of substitutable and inferior non-tradable forest goods, because households reduce or cease their exploitation. Reduced household demand for substitutable and inferior non-tradable forest goods only will result in their increased abundance and enhanced conservation status if: 1) over-exploitation of exportable forest goods does not have an adverse effect on substitutable or inferior non-tradable good productivity, and reproductive success (i.e., the exportable good is not an essential resource for the substitutable or inferior good); and 2) existence of the substitutable or inferior good does not limit production of exportable goods (i.e., monkeys that are no longer hunted for food do not consume forest fruits now harvested for export, or the trees once used for boat building grow on soils too infertile to be converted to cattle pasture). If households perceive high opportunity costs for retaining substitutable or inferior non-tradable goods within the environment they may attempt to eradicate them as 'pests' or convert the land upon which they reside to other uses.

Implications

Increasing integration into trade produces predictable outcomes on indigenous rain forest household economies and on the conservation of biodiversity. Table 1 contains a summary of our predictions, which are discussed below.

Table 1. Expected impacts of trade on household economy and on biodiversity conservation

Impact of trade on household economies	OUTCOME
Investment in exportable goods	↑
Investment in substitutable goods	↓
Investment in nontradable goods	↕
Investment in leisure	↕
Income	↑
Wage	↑
Consumption of imported goods	↑
Consumption of forest-based goods	↓
Exploitation of forest-based goods	↑
Privatization of resources	↑
Impact of trade on biodiversity	
Evenness diversity of resource exploitation	↓
Richness diversity of resource exploitation	↓?
Sustainable exploitation of exportable goods	↓
Sustainable exploitation of substitutable goods	↑?
Sustainable exploitation of nontradable goods	↕
Domestication of wild resources	↑

As indigenous communities and households become more involved in extra-local trade we predict the following outcomes :

Effects on household economy:

1(a) the diversity of species extracted from the forest by a household, as measured by species evenness, should decline, because households will reallocate their time (i.e., labour invested in extraction) among forest goods toward those that have greater potential for export.

1(b) trade will have an ambiguous impact on the diversity (species richness) of goods extracted from the forest by households. Though households may reallocate more time toward a subset of (chiefly export) forest goods, they may nonetheless continue to forage for the same number of species they did before contact.

2(a) the number of species that contribute significantly to the cash income households obtain from the sale of forest goods will decline.

2(b) investment of labour in forest extraction will focus on fewer forest goods.

2(c) the impact of rising income and market integration on the relative contribution of the forest to household income will remain ambiguous, because it will depend on a) the markets for forest goods, b) the value

of forest-based market goods, and c) the productive capacity of forest-based market goods.

Effects on biodiversity

3(a) the sustainability of exploitation of normal, export goods will decline.

3(b) export goods that exhibit K-selected traits and whose extraction results in their declining productivity, or reduced replacement, are likely to be exploited to local extinction.

3(c) as the numbers of an export good decline or approach zero two things may happen:

i) households attempt to maintain production by *in situ* management/enrichment or domestication (Lawrence *et al*. 1995), thus reducing the probability but not eliminating the possibility of local extinction, or

ii) the market for the good collapses as consumers switch to cheaper more abundant substitutes, and exploitation stops until populations recover. Population recovery is, however, predicated on whether the number of surviving individuals is greater than the minimum viable population size.

3(d) as household investment in production of substitutable forest goods facing cheaper industrial substitutes and inferior non-tradable goods declines, conservation status of these species will:

improve

i) if there is no opportunity cost to the household associated with retaining the species within the environment, or

worsen

ii) if there is an opportunity cost to the household associated with retaining the species within the environment, or

ii) if decline in abundance or local extinction of an exportable good adversely affects the productivity or replacement rate of the other good.

3(e) selection of prime individuals for the market is likely to result in changes in the genetic composition of species, such that a population becomes dominated by individuals with undesirable (from a market perspective) genetic characteristics, and of low economic value (assuming that no enrichment management is occurring).

Conclusions

Examination of Table 1 shows that the advent of regional and world trade within indigenous rain-forest communities results in generally unambiguous impacts on household economies. Trade is expected to result in increased

household income, wages and access to import goods, and an initial decline in leisure time. From a development perspective the outcomes of trade on household economies appear largely desirable. Only a decline in leisure time could be considered to reduce an indigenous household's standard of living, at least until incomes rise sufficiently to increase demand for, and relative value of, leisure to the household.

From a biological diversity perspective the impact of trade is ambiguous. Trade will result in the declining abundance of goods that are exploited for export to outside markets. Market value, exploitation technology and the life history characteristics of the exportable good together will determine whether a species is exploited to local extinction or not. Empirical evidence suggests that few wild resources can sustain commercial exploitation (Trefethen 1975; de Beer and McDermott 1989; Redford and Robinson 1991; Panayotou and Ashton 1992; Eves 1995; Fa *et al*. 1995; Noss 1995; Pollack *et al*. 1995; Ros-Tonen *et al*. 1995), and that trade will result in either the local extinction or the domestication of species of exportable goods (Homma 1992).

Trade may or may not enhance the conservation status of substitutable or inferior non-tradable goods. On the surface trade would appear to benefit all species considered substitutable or inferior goods, because household exploitation of these goods should decline. As discussed above, the actual outcome may be different for such goods. Survival of species that are substitutable or inferior non-tradable goods will depend on whether their existence constitutes an opportunity cost to households. If so, then the abundance of these species will decline as they are removed or converted to alternative uses. Similarly, substitutable or inferior non-tradable goods species that depend on products or services generated by exportable goods may decline in abundance as exploitation of exportable goods increases. Unencumbered trade of exportable goods will result in declining species evenness and may result in declining species richness.

The basic biological data necessary for determining sustainable levels of exploitation for trade (e.g., population levels, changes and cycles, reproductive and growth rates, natural mortality and trade or bycatch mortality, etc.), are usually unknown (Ludwig *et al*. 1993; Peters 1994), and the economic impact of trade on indigenous economies is largely untested (Browder 1992; Padoch 1992). Thus, before conservation and development organisations rush too far into the promotion of NTFP production and marketing it is critical to determine under what conditions is commoditisation of NTFP likely to a) enhance livelihood security and social/economic equity of forest resource-dependent communities, and b) enhance conservation of forest-based biodiversity. Implicit in answering these questions is examining how local, world and 'green' markets differentially affect household economies and forest resource exploitation and conservation. Consequently, as indigenous communities become more involved in world

markets empirical studies must be undertaken to: a) at the household level, examine how income livelihood security, consumption patterns and investments of labour, land and capital change; b) at the community level, establish how, property rights and social/income equity change; and c) determine the impact of market integration on the genetic diversity, biomass, population structure and yield of exportable and substitutable/inferior non-tradable goods (Peters 1994). Furthermore, it is crucial to establish under what conditions is marketing of NTFP likely to result in i) the conservation of an exportable good, ii) the local extinction of an exportable good and/or iii) the domestication of an exportable good.

Lastly, as the harvesting and sale of NTFP is likely to have adverse impacts on some forest species, the existence and viability of alternative markets (e.g., "charity" leasing of conservation easements from indigenous communities) that do not require harvesting of forest resources but provide local communities with income should be investigated.

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Chapter Six

Smallholder Forest Management: Looking Beyond Non-Timber Forest Products

Christine Padoch and Miguel Pinedo-Vasquez

Introduction

In this chapter we make three points about how smallholders manage forests and how scholars have studied and discussed forest management. First, we suggest that the commonly employed categorisation of forest management by product type, i.e., timber and non-timber, is not appropriate since this dichotomy does not reflect the reality of how most forests are managed in the tropics and it restricts rather than aids the formulation of a useful research agenda. We suggest instead that the scale of forestry operations and their degree of industrialisation are more realistic and useful parameters. Smallholder forest management differs from large-scale industrial operations in important ways whether timber or non-timber products are the main outputs. By re-focusing the discussion, away from products and on scales and inputs, we believe it is possible to predict more accurately how management is or should be carried out and to better plan what and how research needs to be done.

Secondly, we propose that both the techniques and effects of smallholder, non-industrial methods of forest management have been understudied. Many tropical forest dwellers use sophisticated and complex forest management techniques and methods to increase the market value of their forests while also maintaining other values such as high plant biodiversity, a multiplicity of outputs and uses, and flexibility of production. While the precise methods and techniques that are employed vary greatly throughout the world, there appear to be a few general principles that characterise smallholder operations and that urgently need to be investigated.

We also suggest that many recent studies of the value of forests and forest products very poorly predict the behaviour of smallholder forest managers because they ignore or misunderstand villagers' actual needs, priorities and interactions with markets. The use of such inappropriate measures may confuse important issues of why forest smallholders manage their resources as they do and what might be done to inhibit or promote other uses.

We draw examples to illustrate our points primarily from our own research in Borneo and Amazonia. Based on these arguments we then make a few suggestions concerning priorities for research on forest management in the tropics.

Non-timber as a Non-category

Many recent studies on ethno-botany, traditional resource management and community-based conservation in the tropics have identified and quantified the number of valuable species that people collect, plant, or manage in their forests (Boom 1987; de Beer and McDermott 1989; Plotkin and Famolare 1992; and many others). These product-oriented books and articles present smallholder forest use and management in the tropics as essentially, if not exclusively, oriented toward non-timber products.

Fruits, fibres, medicinals and other non-timber goods are indeed important to many tropical dwellers. Our (and other) studies in areas as far apart as Amazonia and Borneo, however, show that timber is also an important output of forests managed for multiple outputs by smallholders (Peluso 1993; Pinedo-Vasquez and Padoch 1996). The products that are gathered or produced in the forests and communities that we have studied include many items consumed by villagers as well as important market commodities. The latter include rattan, Brazil nuts, heart of palm, ironwood, tropical cedar and other valuable examples of both non-timber and timber species all from forests owned, used and managed by smallholders.

The categorisation of forest management as either directed toward timber or non-timber production suggests that product-orientation largely determines the way management is carried out. This assumes, for instance, that forest management for timber in the tropics is similar to management in most temperate areas, i.e., that it is a specialised activity mainly carried out by timber companies or other commercial enterprises (Uhl and Buschbacher 1985; Fearnside 1989; Anderson and Ioris 1992). Although there are instances of timber companies managing natural tropical forests, many smallholders also manage forests for timber (Pinedo-Vasquez and Padoch 1996). In the Amazon estuary area near the city of Macapá local sawmills are mainly supplied with timber from properties managed by small-scale farmers and forest managers. In March, April and May of 1994 we monitored the processing of logs at the eight sawmills located along the lower Mazagão river in the Brazilian state of Amapá. During this time

each mill processed an average of 320 logs (22 cm x 3 m minimum and 72 cm x 3 m maximum) per week. All of that production was supplied by the approximately fifty smallholder families that live in the rather heavily settled river area; most of the logs came from managed forests. Similarly, floodplain forests intensively managed by villagers in the Peruvian Amazon are gradually becoming the main source of supply of logs used in the plywood factories of Iquitos (Pinedo-Vasquez 1995).

Non-timber forest products, on the other hand, do not come only from the forests of peasants or other traditional folk. Significant areas of forests are managed by large concerns for the industrial production of non-timber products such as heart of palm and rattan (Fearnside 1989; Peluso 1992). Near the city of Manaus a landowner manages approximately 193 ha of forest for the production of Brazil nuts (*Bertholettia excelsa*) (Mori and Prance 1987). A company based in Iquitos is managing açaí do Pará (*Euterpe oleraceae*) in a forest area of approximately 250 ha for heart of palm that is canned and exported to Europe and the United States. Industrial management of Southeast Asian woodlands for the production of rattan is also common in Indonesia, Malaysia and Thailand (Peluso 1992).

The lack of attention given to timber management by smallholders and to production of non-timber products by industrial concerns, has led to considerable misinterpretation and over-generalisation about forests and peoples and in turn to the formulation of inappropriate policies. Several authors have suggested that forest management for the production of non-timber plant products is ecologically sustainable, while forest management for timber production is not sustainable in the tropics (Fearnside 1989; Anderson and Ioris 1992). Many analysts have promoted the production of non-timber forest products in managed forests as an alternative to timber production for sustainable use of the tropical forests (May 1990; Anderson and Ioris 1992). Based on such generalisations, several countries are using the timber and non-timber categories to implement policies and regulations for conservation and forest management (IBGE 1984; Allegretti 1990; Plan maestro, Pacaya-Samiria 1992). For instance, extraction of non-timber products by rubber tappers is promoted in Brazilian extractive reserves, while extraction of timber is prohibited (Allegretti 1990). This and other kinds of regulation emerged because of an assumption that production and extraction of non-timber forest products do not affect the ecosystem while timber production and extraction necessarily damage ecosystem functions (Fearnside 1989; May 1994). A number of scientists have recently pointed out that non-timber extraction is often neither sustainable nor environmentally benign (Godoy *et al*. 1993; Peters 1994).[1]

[1] We certainly do not make any claims for the sustainability of all smallholder management either. The determination of environmental effects must be made for any specific case.

We suggest that scale of production and degree of industrialisation are often better indicators for categorising research programmes and distinguishing types of management. There is great variation in the size of forest areas under industrial management as there is among areas managed by smallholders or communities; smallholders' operations – as indeed the very term indicates – tend to be limited in size.[2]

Whether for timber or heart of palm, industrial management in the tropics tends to involve significant capital investment. Smallholders also often make notable investments in their managed forests, but these are largely in the form of labour. Industrial concerns, on the other hand, often invest in land purchases, roads and other infrastructure, machinery, chemical inputs, processing facilities, and recruiting and maintaining a labour force from outside the region.

Industrial management of forests is also mainly oriented toward the intensive production of one or a very few highly valued products. Despite their much heralded use of many products, some smallholder managers also run specialised operations, concentrating on the production of just one or a few species. Among smallholders such specialisation does not, however, tend to result in quite the same single-species stands and single-purpose utilisation that characterises many industrial enterprises. Even the most timber-oriented of village specialists in the Peruvian Amazon, for instance, uses his or her managed forests for hunting, fishing, honey production, and the collection of medicinal plants, ornamentals, fruits and firewood.

Differences in levels of investment and degrees of specialisation, we believe, are essential in determining the flexibility of forest production and management. Many smallholder forest managers, particularly in Amazonia, are famed for the rapidity with which they respond to fluctuating market prices, opportunities and problems (Padoch 1988; Padoch and de Jong 1992). Large, highly capitalised and specialised industrial concerns are frequently far less capable of quick switches in production objectives and management patterns.

Smallholder Specialists, Generalists and Agro-foresters

Much of the product-oriented literature mentioned above assumes or suggests that tropical NTFP are collected from unmanaged woodlands. Awareness that many tropical smallholders manage forests is growing, but there is still little technical information on just how they manipulate forest stands to increase production of economic products (Wiersum 1996). Our

[2] Based on our experience smallholder families or communities rarely actively manage more than 150 ha, although they often own or claim much larger territories. Industrial concerns usually manage far more than 150 ha.

experience indicates that a great variety of management methods, techniques and models used by smallholders have yet to be described.

While little has been written about any techniques of smallholder forest management, what has been written tends to emphasise the manipulation of swidden fallows by traditional populations (e.g., Padoch *et al*. 1985; Posey 1985; Denevan and Padoch 1988; Dufour 1990; de Foresta and Michon 1993; Wiersum 1996). This kind of smallholder management is commonly practised in Amazonia and other tropical regions. In most rural communities, swiddening households usually manipulate the vegetation in their fallows although there is often considerable variation in just how the management is carried out and which species are promoted (Padoch and de Jong 1989). Most descriptions emphasise swidden-fallow management for a large array of NTFP. We, however, have frequently observed that people managed these kinds of forests for the production of timber species, including highly valued tropical hardwoods.

Most existing descriptions of swidden-fallow agroforestry emphasise management practices carried out in the first few years following intensive agriculture, and most research has been done on relatively short-fallow, very diverse systems. Our field experience suggests that some smallholders manage plots over very long periods of time, changing management techniques as forests age. Active and complex management continues as former fallows become mature forests.

There is a particular lack of information on "specialised" smallholder management, i.e., how peasants and other rural folk manage mature forest stands to increase their production of one or a few highly valued products (although see Anderson 1990; Anderson and Ioris 1992). Such management is specialised in two senses. It focuses on a few market products or species and, we have also observed, it tends to be performed by specialists, i.e., by particular communities, groups, associations or families that have non-generalised knowledge or distinctive management traditions. Because of their use by a limited group of particularly skilled people, such patterns are often overlooked by researchers. In Amazonia we have observed peasants employ specialised management not only for enhancing non-timber product harvests but also for the production of timber.

One smallholder expert specialist we have encountered, for instance, is M. H. of the community of Sapo Playa near Iquitos in the Peruvian Amazon. While he is a farmer, hunter, fisherman, etc., M. H. specialises in managing stands of ojé (*Ficus inspida*) for its medicinal resin, which he sells in quantity in Iquitos. Management of ojé involves a complex series of treatments to control termite and other insect populations, as well as to curb competing plants. A few of his neighbours also manage this product, but M. H. is the acknowledged expert and largest producer.

Another smallholder specialist is B. A. of the community of Foz de Mazagão near the mouth of the Amazon in Brazil. He is the accepted

expert in managing floodplain forests for timber, especially for *Calycophyllum spruceanum* which he sells to sawmills of the area. Both specialists work intensively and produce largely for the market, with only a small proportion reserved for household consumption. Many communities we observed have one or more such local specialists and experts.

The Complexity of Smallholder Forest Management

The two examples of forest management by smallholders in the Peruvian Amazon and Indonesian Borneo we describe briefly below highlight the diversity, complexity, and efficacy of techniques smallholders use in managing forests. While these examples describe radically different systems, they show some striking similarities as well.

Among the most remarkable of similarities between the different systems is their use of techniques of managing individual plants rather than all members of a species or type as an indiscriminate group. This strategy results in enhancement of economic value as well as maintenance or even an increase in species diversity.

Managing Amazonian floodplain forests

Over a three-year period we observed and evaluated smallholder management of one area of floodplain forest in the Peruvian Amazon. The floodplain (**varzea**) studied lies at the confluence of the Napo and Amazon Rivers. Of the several types of forests managed in the area, capinurales, that is forests dominated by the tree known locally as capinuri (*Maquira coriaceae*), are among the most economically important.[3] Residents of the Napo-Amazon floodplain extract a variety of products from capinurales for both domestic use and sale in regional markets. These include wood for plywood and other construction materials, as well as resins, medicinal substances, and fruits. Capinuri responds well to natural and human disturbances, but dense capinuri stands are formed through a complex process of management. This process begins with management of capinuri in agricultural fields, and extends through swidden-fallow and mature forest stages.

Amazonians leave individuals of capinuri and other valuable species standing when they clear their fields and subsequently weed selectively to protect seedlings while they are growing their crops. When agricultural fields have become fallows, local people manage the juveniles of capinuri and other valuable species by periodically thinning, pruning and selectively weeding the stands. Each of these phases and activities involves complex, multi-stage,

[3] Here we will present only a brief summary of this research; this study is described in greater detail and data on the results of forest management are presented in their entirety elsewhere (Pinedo-Vasquez 1995).

sophisticated and named management techniques (Pinedo-Vasquez and Padoch 1996). We will focus this description, however, on the management of capinuri and other valuable species in the mature capinural forest, since it is this stage that has received the least attention from researchers.

In mature capinural stands, two management techniques are commonly used: **desangrado** and **anillado**. **Anillado** is used to kill selected stems of competitor species. The technique comprises five activities: selection, marking, removal of understorey vegetation (principally vines), girdling and burning. The last involves burning a small area of the trunk from which the bark was removed until the sapwood is affected. The **anillado** technique usually causes the tree to die rapidly and avoids re-sprouting from the roots or stem.

Desangrado is another management technique and is one of the most commonly used in the Napo-Amazon **varzea**. It consists of two operations: selection, in which individuals of vine and other species that are climbing or strangling the trunk and/or covering the canopy of valuable species are selected for removal, and girdling which involves the removal of bark, cambium and sapwood in a ring extending around the selected individual near the bottom of its trunk. The sap, resins and water that are lost from the ring fissure attract ants, termites and other insects. The infestation of insects in turn limits the sprouting of vines and helps kill them.

The two techniques are often used together, with **desangrado** usually employed to remove large trees and **anillado** to kill woody vines. These and other traditional management techniques augment the value of capinural forests to local villagers. The changes their application produce in capinural forests were determined by comparing plots that had been managed as capinurales for varying periods with control areas that had not been managed.

Management neither increased nor decreased the number of trees (greater than 10 cm DBH) per area found in capinural forests. It did, however, result in an increase in the commercial volume per hectare of timber in capinurales. The mean commercial volume of managed capinurales was 81 m^3/ha for areas that had been managed as mature capinural forests for 8 years, 89 m^3/ha for those managed for 16 years and 85 m^3/ha for those managed for 24 years. All these values were significantly higher than the estimated mean of 54 m^3/ha for the unmanaged capinural.

The application of traditional management techniques also resulted in a significant increase in the number of species. The mean number of species in managed sites were 32/ha (8 yr), 30/ha (16 yr) and 36/ha (24 yr) while in the unmanaged sites it was 22/ha.[4] The increase in the number of species in managed capinurales was largely due to persistence of several pioneer

[4] These figures may seem low when compared to those from other lowland humid tropical sites. Amazonian floodplain forests generally have lower species diversity than their upland counterparts (Campbell *et al*. 1986; Peters *et al*. 1989a).

species in the gaps that were opened by the removal of some trees from the canopy. Some of these pioneers are economically important.

Managing forest gardens in Kalimantan

Over the last five years, we have also been studying the resource management practices, including the manipulation of forests and forest gardens, of the Tara'n Dayaks of West Kalimantan (Borneo) in Indonesia.[5] Despite their vastly different social and physical environments, the Tara'n and Amazonian ribereños manage forests in some similar ways and with some similar effects.

The Tara'n live north of the Kapuas River in the Balai sub-district of the Sanggau District. The sub-district comprises an area of 396 km^2 with a population density of 54 people/km^2, high for rural Kalimantan. Tae, a village comprising five hamlets, their fields and forests, is our main study site. It covers a total area of almost 16 km^2, and sustains about 88 people/km^2.

Mature forests in Balai sub-district are limited to small fragments and are largely restricted to hilltops. Much of the area, however, is wooded. Swidden cultivation of hill rice and a few other crops, although still practised, is waning, while intensive wet rice farming is assuming ever greater importance. As Tara'n farmers rely less on swiddens and extend their permanent fields, the hillsides are converted increasingly to managed forests or forest gardens.

The Tara'n of Balai make and manipulate many kinds of managed forests. The various types can be distinguished by their different origins, management techniques and priorities, and rights of access and inheritance (Padoch 1993; Peluso and Padoch, 1996). The most interesting are those known as **mawa'n** in Tara'n or **tembawang** in the Indonesian language.

In their earliest stages future **mawa'n** are house gardens, planted to a variety of fruits and herbs and tended intensively. Such areas become **mawa'n** when a house is moved or a field hut abandoned. Productive fruit trees that once surrounded the house are rarely cut. The long history of occupation of Balai by the Tara'n has resulted in a landscape that is dotted with fruit groves marking the location of dwellings many decades or even a century ago. Some individual mature **mawa'n** are ten hectares or more in size; in total they cover hundreds of hectares in Tae village territory.

In their manner of creation, therefore, **mawa'n** differ greatly from Amazonian capinurales. Many of the trees that form an early **mawa'n** are planted. As they mature, however, **mawa'n** come to more closely resemble

[5] The environment and forest gardens of the Tara'n have been described in greater detail in Padoch and Peters (1993).

forests. The Tara'n not only tolerate but actively encourage the establishment of spontaneous vegetation. All desirable plants, whether planted or not are protected and managed in more mature **mawa'n**.

Management techniques used in **mawa'n** vary widely, but the suite of activities invariably includes cleaning of undergrowth, including selective weeding and harvesting of products, including the making of paths and, usually, continued planting of desirable species. The timing and intensity of clearing varies with the species that make up the plot, as well as with the plans and desires of the individual manager.

Some **mawa'n** managers, for instance, plant rubber among the fruit trees. Where rubber is tapped, cleaning around each tree is done quite frequently to maintain easy access. Such weeding, although not done expressly to manipulate the species composition or structure of the plot, has that effect on the stand.

Most **mawa'n** include a variety of the familiar domesticated fruits of Southeast Asia: durian, rambutan, langsat, mangosteen, and others. But **mawa'n** are also managed for diversity. One transect through a **mawa'n** 10 m x 200 m in size, revealed that among 224 individual trees or stands of bamboo 5 cm and above in DBH, there were 44 species. Since unmanaged forests are extremely rare in this region, no direct comparisons between managed and unmanaged forests in Tara'n territory were done.

Of the 44 species found in the 0.2 ha transect, 30 had edible fruits or shoots. Many were semi domesticated or wild relatives of the well known market species, especially common were relatives of mango and rambutan. Tara'n forest managers claim to plant, at least occasionally, 74 different fruit species and they identify more than 100 species of fruit in the managed forests of Tae.

Indonesian forest gardens are an example of a widely generalised technology, while the management of capinurales is a far more specialised activity. Both, however, are complex, involving multi-stage, multi-technique management. Both are maintained by people who know their forests well and who monitor them continually, eliminating individuals that are competing with desirable species. Although worlds apart and noticeably different, they are strikingly similar in contrast with industrial systems.

Industrial management of non-timber and timber species is based on species exclusion; while forest management conducted by smallholders in Amazonia and Borneo depends largely on individual exclusion. By managing individuals rather than species or life forms smallholders often maintain high plant diversity in their managed forests. Because of the richness of species composition, the structure of forests managed by smallholders is often very similar to that of natural forests. We believe that research programmes would do well to focus on identifying and understanding patterns common to diverse smallholder systems and experimenting with further development of these kinds of management patterns.

Valuing Smallholders' Values

Many shortcomings of recent NTFP valuation studies, especially the difficulty of making comparisons among them, have been pointed out by several researchers (e.g., Godoy *et al*. 1993). As these articles indicate much of the problem stems from inadequate and inconsistent methods of data collection and analysis. We believe, however, that some difficulties with recent forest product valuation studies have yet to be adequately discussed.

The problems of assigning monetary values to forest products, especially to those that are not offered for sale has been stressed. While monetary values are difficult to determine, it must also be kept in mind that even knowing the market price of a product that is regularly sold by smallholders can be of little help in understanding the value of the product to the smallholder who decides how to manage forest resources and what to sell. Many attempts to economically value forests (Peters *et al*. 1989b; Mendelsohn and Balick 1995) use a future benefit analysis approach. Although future benefit and net present value analysis are widely used by foresters to value forests, rural realities often contradict assumptions implicit in future benefit and net present value analyses (Pinedo-Vasquez *et al*. 1992).

The decisions of Amazonian smallholders who manage forests are rarely guided and are poorly explained by calculations of perpetually accruing net revenues. Predictions of future benefits that are made by smallholders do not rely only on estimates of future commodity prices and market opportunities, but also on access to multiple benefits including an array of subsistence products.

Several authors have used a fixed market price for subsistence products such as medicinals and fruits in order to come up with the value of particular managed or unmanaged forest plots in the tropics (Mendelsohn and Balick 1995). Such assumptions have produced high and economically attractive values for a hectare of managed or unmanaged tropical forests. By using such calculations and approaches, the suggestion has been made that extracting non-timber products is an economically viable alternative for tropical smallholders (Peters *et al*. 1989). Such conclusions contrast dramatically with the reality faced by farmers and forest managers.

In many forest-rich areas markets are easily glutted with any forest product, prices are highly volatile, transport is unreliable, communications difficult, storage facilities inadequate, credit expensive or absent. In one Peruvian community, for example, we found that peasants succeeded in selling less than 5 per cent of what were calculated as the marketable products of managed forests (Padoch and de Jong 1989). Under such circumstances smallholders often value qualities such as price stability and the non-perishability and subsistence value of products far more than an occasional high price. Decisions, of course, vary greatly within and between populations; some smallholders perceive and avoid risk far more than others.

Some of the discrepancy between assumed high prices and rural realities result from government policies. Most tropical countries emphasise agriculture as the most suitable land and resource use. Prices of agricultural products are relatively stable or at least relatively predictable, while those of the majority of forest products including non-timber and timber are not. In this situation, forest management and the production of forest products become marginal activities for the majority of tropical countries despite the great knowledge and experience smallholders may have in managing forests for generations.

Tenure issues also intrude on economic valuation. In many tropical countries most smallholders and rural communities lack secure land and resource tenure. As a result there is little incentive to pursue options of land use with immediate returns lower than those available from agriculture, regardless of potentially realisable future benefits (Pinedo-Vasquez *et al*. 1992).

As long as valuation studies largely ignore local needs, priorities, market and subsistence realities, they will not allow for adequate prediction of smallholders' behaviour or formulation of policies that reflect local realities and work toward smallholders' benefit. In valuing forest areas managed by smallholders it is necessary to use informed economic analyses of alternative land and resource uses that reflect the context of the choices facing forest populations.

Research on and for Smallholder Forest Managers

To help put the resources of inter-disciplinary science in the service of smallholder forest managers, several changes must be made in research agendas. Among these might be the following:

1. Research, training, extension and other programmes should not be organised around a timber/non-timber dichotomy. Questions of scale, and levels of inputs and outputs, should be given priority. Research on small-scale, low input, multiple-output forest management, including both timber and non-timber products, should be a priority.

2. Many scholars writing about the need to design sustainable small-scale management systems have given scant acknowledgement to the multitude of management methods, techniques and models that already exist (see, for instance, Gentry and Vasquez 1988). Study of existing techniques and their effects should be a priority. Description of the diversity of site-specific techniques needs to be complemented with a search for common principles and effects.

   The results of our studies suggest that some traditional management techniques might indeed be useful in designing and implementing large,

medium or small programmes of forest management at the industrial level. More detailed experimental studies are required however, to measure the ecological sustainability and the economic viability of the practices used by smallholders. Further experimentation and development of management methods incorporating the knowledge of smallholders should be a priority.

3. Many recent studies appear to assume that all Amazonian Indians are expert forest managers or all Bornean Dayaks are equally competent extractors. There are experts and incompetents in these as in all other communities. Local experts should be identified and incorporated into programmes for developing and improving existing systems.

4. If valuation studies are to serve smallholders in forest areas and to help policy makers design adequate policies for them, those studies need to pay more attention to the realities of household and regional economies. Valuing managed forests that contain high biodiversity and large numbers of valuable species, however, cannot be done by making a list of products and assigning prices to each. Such approaches lead to fictitious values that confuse rather than facilitate understanding of how forest management is conducted in the tropics. Valuation studies need to account for the actual behaviour of smallholders who rarely, if ever, receive the value that was computed by a study of available volume of forest products and their sometime market prices. Socio-economic constraints on use of forests and marketing opportunities need to be understood and clarified. Future valuation of forests in the tropics should consider realistic economic analyses of alternative uses of land and resources rather than the assumptions implicit in future benefit and net present value.

5. Flexibility in response to both problems and opportunities is an important and rarely discussed feature of smallholder forest use and management. This omission is largely the result of a common disregard of the history of forest product trade in many areas. Studies need to add an historical dimension and subsequent plans need to incorporate this understanding.

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Chapter Seven

Household Extractive Economies

Mauro W.B. Almeida

Old and New Extractivist Paradigms

During the last decade, extractivism has been widely acclaimed as a conservation and development strategy to benefit populations living in resource-rich areas. This is a paradox. The concept of "extractivism" applied to backward economies has long been associated with the impoverishment of natural resources, economic stagnation and harsh treatment of native or migrant workers (Bunker 1985; Sweet 1982). The characteristic features of this "old extractivism" syndrome are open-access areas that are over-exploited and depleted by coerced, under-paid and unqualified workers to supply external and volatile markets using out-dated technology. The rubber extractive economies of South America and Africa (Putumayo and Belgian Congo) are classic examples of this syndrome (Hardenburg 1912; Furtado 1963; Pinto 1984; Taussig 1987). The Brazilian economist Alfredo Homma has elaborated a compelling neo-classical version of this story (Homma 1980, 1982, 1983, 1986, 1989a, 1989b).

In contrast to this "bad extractivism" syndrome, we have witnessed the emergence of a "good extractivism" paradigm over the past decade (Fearnside 1989a, 1989b; Allegretti 1989, 1990; Schwartzman 1989; Anderson *et al*. 1991; Ayres 1991; Ruiz Pérez *et al*. 1993; Diegues 1994).

In the new paradigm, extractive economies preserve the natural resources while achieving a reasonable income helped by "nature's subsidy"; when supported by co-operatives and democratic associations, these economies may be equitable. Furthermore, emergent green markets hold the promise of future development through biotechnology. The "good extractivism"

paradigm assumes that its sustainable features are based on traditional management systems oriented to the well-being of people and to the conservation of nature.

Of course the "good extractivism" paradigm does not promise immediate delivery. Several studies have contributed to the new extractivist paradigm with data on the actual or potential economic efficiency of forest economies (Dubois 1989; Peters 1989; Peters *et al.* 1989; LaFleur 1992; Vantomme 1990; Anderson *et al*. 1991; Afsah 1992; Anderson and Ioris 1992; Hecht 1992; Nations 1992). Others have emphasised changes in the cultural and social systems of forest populations (Schwartzman n.d.; Butler 1989; Campbell 1990; Almeida 1993a; May 1992; Schmink *et al*. 1992; Silberling 1992; Franco 1995). Conservation biologists have explored the possibilities for improved wildlife management by traditional populations (Bodmer *et al*. 1988a, 1988b; Redford 1992), while several researchers have shown that "extraction" (synonymous with gathering for a market) is only part of complex management systems fulfilling different functions and making use of a variety of sub-systems in rich environments (Denevan 1984; Seul 1988; Anderson and Posey 1989; Anderson 1991; Lima-Ayres 1992; Whitesell 1992). All these studies have identified problems requiring research and solutions.

However, the "good" extractivism paradigm has not dispelled more general doubts about the "bad" extractivism syndrome.[1] Extractivism continues to be criticised as inadequate as a conservation strategy, an economic policy and as social reform. Some argue that the existence of human populations (particularly poor ones) is inevitably harmful to wildlife, and rubber tappers are depicted as having a strong impact on forest animals (Oliveira 1991; Redford 1992). Traditional forest management, at least in one form, was also questioned by Parker (1992, 1993; cf. Posey 1992). Others see extractive economies as inherently inefficient (Homma 1989a, 1989b) or failing to supply food and generate employment in underdeveloped areas (Torres and Martine 1991; Romanoff 1992). Critics concerned with equity find that the amount of land required per family for sustainable use is too large (Anderson 1991; Torres and Martine 1991), or that patron-client relationships are still pervasive in extractive areas (Browder 1992; Romanoff 1992). These authors argue for policies that would set

[1] I witnessed a dialogue which illustrates the conflict of views. Rubber tappers' trade-unionists visiting Brazil's federal capital in 1986 met the Brazilian scholar and former Minister of Economy, Celso Furtado. They were lectured on the phases of human evolution, starting with "extractivism", progressing to pastoralism and agriculture, and arriving at industry. "Are you, rubber tappers seriously considering to stay at the extractive phase of humankind's history?", asked Furtado to the standing guests. He could have added that he had described in a classic book (Furtado 1963; cf. Pinto 1984) "extractivism" as the worst possible way of life for humankind.

aside areas for conservation, increase productivity by means of agroforestry research and reduce the area needed per family. This is tantamount to placing extractivism as, at best, a transitional phase towards agriculture (Sawyer 1991; see Browder 1992 for a summary of all three arguments).

Any attempt to settle these issues, either by choosing among the conflicting paradigms or by means of a new synthesis, would be premature at present. There is indeed a widely accepted model which supports the "bad extractivism" viewpoint: Homma's model. The several empirical studies arguing for the "good extractivism" paradigm do not directly address the predictions of the model. Therefore, there is a real need for empirical research on the validity of the model, and for theoretical research to expand the model itself or to propose alternatives (Ruiz Pérez 1995). On the theoretical level, there is a lack of a detailed information on how households make decisions on both market and non-market use of factors to increase domestic welfare (i.e., "forest home economics").[2] On the empirical side, as Browder (1992: 175) has stated, "a major impediment to the development of a replicable model of extractive systems is a lack of a single role model of extraction among rural Amazonian households". Therefore, theoretical modelling of households as domestic economies is required, as well as better empirical research guided by adequate typologies which include the temporal dimension.

Problems and Hypotheses

Some contributions to the debate on extractivism may be classed into three groups: economic models (Homma 1982-1986), product-oriented case studies (Peters *et al*. various dates), and property-regime models (May 1992; Silberling 1992). Other works focus on the household, including comparative studies of household income, with or without a time dimension (Anderson 1991; Hecht 1992), and economic models of the household economy (Mäler *et al*. 1994).

In summary, Homma's model proposes that, given the essential scarcity of the resource base, there is a chronic market disequilibrium that pushes up prices. This encourages the substitution of domesticated species for the wild resource, leading to a fall in prices. With uncertainty about the future value of resources (the assumption being that rising prices will stimulate investment in non-extractive processes to replace the extractive activity), decision-makers (risk-averse households or firms with rational expectations, maximising income streams over a highly discounted, uncertain future) see the extraction of renewable resources as the economic equiva-

[2] See Almeida, M.W.B. (1995). Comments on Homma's Theory of Extractivism. Manuscript.

lent of optimal rate of depletion, not as a problem of finding an optimal sustainable output over time. Thus, renewable resources are economically treated as if they were non-renewable resources. Open-access situations aggravate this effect, by increasing risk and thus reducing the horizon of "optimal depletion".

The micro-foundations of this model (i.e., the assumptions about household behaviour) are neither explicit nor tested. The force of the argument is that a record of past sustainable practices is no guarantee of the same in the future, if prices and markets change and factors (land, labour) have alternative uses.

If autonomous, decentralised decisions by households fail to meet the conservation agenda, then the comparison between micro-actors (households), collective bodies (such as local peoples' associations) and the state becomes relevant for the conservation of resources and biodiversity. Thus, instead of "tradition", institution building and adequate economic policies may be part of the solution to the inability of current markets to generate ecologically efficient resource use.

Models and Data

Existing empirical studies lack a time dimension for prices and techniques, and a regional specification. Thus, Anderson's data covers the early eighties to the mid-nineties (for the Amazon estuary), the Hecht models do not consider changes in relative prices, and estimates made by Peters and collaborators include the time dimension in the form of discount rates. These evaluations should be assessed against actual price series data.

As an example, the strategy of the Combu Islanders studied by Anderson was presented as a generalisable model of successful extractive practices. It would be useful to be able to test Homma's model with the data. Rubber prices (paid to Amazonian tappers for 1 kg rubber) have fallen from US$1.80 in 1982 to US$0.40 in 1993, and are now around US$0.70. In the same period, the households studied by Anderson (1991) have abandoned rubber extraction. There is no information on whether the existing trails were depleted in the process. Households shifted to gathering açaí palm (*Euterpe oleracea*). At the regional level, however, there are signs that açaí palm stands are being depleted as the market for palm heart expands, with the side effect of food scarcity because açaí palm fruit is an important part of their diet (Aramburu 1992). This may not have happened at Combu Island because of the presence of private landowners. Does the shift from rubber to açaí palm heart support Homma's scenario of short-lived high prices, substitution and depletion of open-access resources? Does it support a model of a self-sustaining, diversified, market-sensitive but resilient household economy? I will come back to these issues later in discussing data from my own research.

Problems of Collective Action

The theoretical issue of the open-access status of extractive areas and the associated behaviour of individual extractors leading to a forest "tragedy of the commons" is worth consideration. Although other authors argue that it is privatisation that leads to tragedies of natural resource use in the Amazon (May 1991) and that "social movements" may help to prevent the "tragedy of the commons" scenario (Silberling 1992), there is a need for additional empirical evidence. After an Extractive Reserve was created in the upper Juruá river area and old patrons were expropriated, for a while trails became an open-access resource, since tappers ceased the payment for trails but individual titles were not issued (Almeida 1993a). As a consequence, there was a perceptible shift toward unsustainable techniques in the context of a rubber price decline – the same situation that led Combu Islanders to quit rubber extraction.

Two hunters living at some distance from each other exploit the same hunting area in the forest. They have discovered (perhaps aided by biologists) that deer have been over-exploited in the past and soon will be extinct. They know also that under a two-year ban on hunting, and a hunting quota thereafter, the population of deer will recover and afford a sustainable and sufficient supply of the game for the future. Each forest dweller has two options: to adhere to the ban and quota, or to continue unlimited hunting.

Under these conditions, what will each household do? There is no consensus on the answer, but it is reasonable to believe that each household will have an incentive to breach the agreement if attempting to protect itself from the worst outcome, i.e., to co-operate while the other defects (playing the "sucker"). As a result, both households would defect and the outcome would be worse than that if they had co-operated (Dasgupta and Heal 1979).

The relationship between the behaviour of households and collective interests is not a simple one. Each isolated household may be trapped in such a "hunter's dilemma" by high communication and transportation costs that prevent collective action and the establishment of efficient institutions. Thus, households may individually become indebted to a single patron to obtain transportation and credit, instead of sharing a boat and getting better bank loans, because they cannot meet the organisational costs involved in setting up a co-operative. Or, if a co-operative is set up, it may be victim of "free riders" (Olson 1965). In other words, forest households face the dilemmas of collective action in a particularly acute way.

Besides households, individuals, gender/age groups, neighbourhoods/kinship groups and associations can be units. Patron-client networks and public agencies are examples of structures which mediate between local-level organisation and larger national institutions.

Individual choices are aggregated in the household head's decisions, but this process conceals conflicts of interests. Wives may disagree on the

consumption budget, or may be deprived when abandoned by husbands. They manage crops and raise cattle, but seldom are considered as eligible for project management.

Neighbourhoods and kinship groups link households, often under the informal authority of elderly or economically influential members. There are voluntary and formalised associations, such as co-operatives, based on individual membership. Networks based on neighbourhood, kinship and patronage may aim to control co-operatives. Rival networks may coalesce into factions and conflicts may degenerate into feuds.

Issues which go beyond the competence of households include resource use (e.g. zoning and ceilings to agricultural activity), trade (e.g. bans on timber and game trade in extractive reserves) and property (e.g. inheritance, membership and exclusion rules). Facing such issues, householders make decisions by "negotiation, disagreement, conflict, and bargaining" over decisions.

Social and Equity Issues

Labour relationships and trade systems, together with land-property arrangements, encompass the issues of class, clientelism and exploitation. Extractive territories in Amazonia have fractal trade systems for the distribution of goods to widely dispersed consumers along rivers and forest-paths (Romanoff 1992; Almeida 1993b). These pervasive structures may prove very resilient and not easily replaced by co-operatives that abolish credit. The longer it takes for a co-operative to rotate capital, the longer it can await payment (extended credits), but the more it will have to charge in order to pay interest and other costs that increase with time. For some tappers, being in debt was a guarantee of a standing relationship between patron and client that assured continued supply of goods in return for produce (Schwarz 1993; Franco 1994). Local politicians are an additional factor in creating standing relationships of patronage, when votes are traded for offices, services or goods as in many rural areas.

Rural and forest households may hire hands and lease land; they may engage in petty trade; they may accumulate cattle, vehicles, money or other wealth and establish local patron-client networks. Often the "co-operative managers" chosen by a local community (which may be a kin-related set of inhabitants of a single stream) is the old-time local boss and petty patron.

Peasant Households and Extractive Households

Households are usually defined as a set of persons most of whom are linked by kinship and marriage, acting as a joint consumption/residential unit having a single budget; operationally the group (whose core is a "family")

eats from the same pot and lives under the same roof (Netting *et al*. 1984; Netting 1993; Almeida 1986).

Peasant households may be defined as rural households that also organise production. Under a household head, they act as corporate units holding rights on "family" labour, with the consequence that labour has an internal structure by gender and age which changes as the household passes through a developmental cycle (Fortes 1958). The household's developmental phase (new, mature, old) may explain much of the economic variability found in surveys, affecting the ratio between consumers and labourers (Durrenberger 1984). Where land is abundant, these issues may be particularly appropriate since more domestic labourers may be employed in more resources (Almeida 1986; Costa 1989). Households may also manipulate numbers by means of adopted kin, step kin and in-laws, and domestic hirelings.

Another feature of peasant households is that they use reproducible or inexpensive equipment. The implication is that there are no capital barriers to households initiating productive activities; and they that rely on "traditional" knowledge which means that information and processes often are accessible to everyone by learning and experience.

Finally, peasant households rely heavily on renewable resources. These resources are subject to various property regimes, such as open-access resources, "collective-corporate" property, "household" property and individual appropriation. They often have a moral identity as a "house" associated to a "family name"(Almeida 1993a).

The peasant household produces goods for a market but is, at most, marginally integrated into factor markets for labour, land or management: wage labour, rented land and administrative personnel are typically not part of the household budget. Instead, it uses domestic labour, collective/communal/domestic resources and traditional handed-down expertise. Even equipment is partly produced within the household. The broad category of peasant households ranges from fishermen to agriculturists to forest extractivists. One may speak of forest peasants, or forest households, or extractive households as almost synonymous (Almeida 1993a).

Households, Firms and the State

Households are the main corporate unit, not only for holding labour, equipment, knowledge and resources (receiving and consuming income from their use), but also for organising production (cf. Mäler *et al*. 1994). As productive units, they compete with firms, state-agencies and associations (although they may co-exist with them). One important policy issue is to compare the relative efficiency of these different organisations for management purposes.

The following tables aim to isolate some of the dimensions involved in such comparisons. One result is that there is no simple way to classify all

"extractive situations" in a unique manner. Instead of trying to do so, it may be best to look at the trajectories that extractive situations follow across distinct phases (cells in the tables). Instead of static situations, we thus obtain dynamic paths.

Table 1 suggests that development scenarios may move from peasantries (often linked to land-owners or trade patrons) to either to firms (agribusiness, ranch) or to "forest management" by autonomous households. Presumably, such forest managers (or forest farmers) would conserve natural resources under adequate market conditions (valuation of forest) and appropriate economic policies (prices, taxes, quotas).

Table 1. Institutional systems

	large	small
traditional; subsistence orientation	latifundia; rubber estates	peasants; extractive households
modern; market integration	agribusiness; ranches	farmer; forest manager

Table 2 suggests that there are dynamic institutional paths, involving representation, property and management issues.

Table 2. Property systems

property	open	collective	private	state
customary	frontier land; game; fish	village-forests	haciendas; seringais	
legal	oceans; stratosphere	condominia; extractive reserves	homesteads; private plots	parks; reserves

The combination of different property regimes may be necessary to accommodate the wide range of forest dwellers' use of resources. Public property, as proposed by the Brazilian rubber tappers' organisation (Almeida 1994a), guarantees long-term management policies and blocks a "non-

commons tragedy" (May 1992) caused by land markets. Associative property by means of long-term concessions empowers local populations to manage common areas and to enforce zoning (thus blocking a "tragedy of the commons"). Finally, use licenses for households are an incentive to long-term investment.

Technology and Choices in Extractive Economies

An initial approach to identify extractivist situations could begin with the technology in use. This is suggested by Table 3. Household extractive economies combine technologies of extraction, agriculture and ranching and would take all the second row in the table. According to the "new extractivism" paradigm, this diffuse technology may be better than a focused technology such as in the first and third rows.

Table 3. Technology and institutions

	extraction	agriculture	ranching
Latifundia	rubber estates	plantation	
Households	fishermen; rubber tappers	agricultural peasants	herdsmen
Firms	fishing; timber companies	agribusiness	ranches

Another, more operational, definition of "extractive (peasant) households" is that they derive most of their cash income from the marketing of collected products. This reinforces the concept that "extraction" is not just a technical feature, but rather a mode of integration into the market. Thus, extractivist activities by tappers are not to be confused with hunting-gathering activities by Indians. This also means that the boundary between "extractivists" and "agriculturalists" is unclear when forest households engage in multiple activities, all of which may be marketed. Under the main-income definition, the same forest peasantry (or parts of it) may move from one box to another because of price changes, along different paths.

A survey taken at a single point in time may generate the artificial distinction of two separate sub-economies, one being "extractive" and the other being "agricultural", thus failing to capture the dynamic, malleable structure of the forest household economy for which extraction and agriculture are part of a single system. Another problem of a static analysis of

households is to record differences due to the household's position in the development cycle as being evidence for permanent stratification (young male workers may prefer extractive labour while older workers and widows concentrate on agriculture).

According to the influential model of Ester Boserup (1972; see also Lipton 1990; McNicoll 1990), the so-called "extractivist communities" of Amazonia could be classified as forest fallow agriculturists. Under this view, fallow systems comprise a wide range from very long (forest), long and short systems; a concept with incorporates at one extreme the Acre headwater forest peasants (rubber tappers with densities around 1 person/km^2), and at the other extreme the lower Amazon oligarchic forest dwellers (*Euterpe oleracea* gatherers with densities up to 40 persons/km^2). A particularly relevant feature of Boserup's theory is that carrying capacity is not determined by a fixed ("backward") technology in a given ecosystem. Instead, forest households may chose among several alternative land-use systems, and also profit from a diversity of micro-ecosystems. As a result, several different carrying capacities may obtain.

Systems associated with different carrying capacities will differ in their demands on the intensity and type of labour, and also in their respective "subsidies from the forest". Short-fallow agriculture will require sometimes year-round, frequent weeding with a hoe, while long-fallow agriculture will require short periods of tree-felling followed by abundant harvests with little weeding in the first year.

Very long fallow systems may allow for several uses of fallow areas of rich forest in successive stages, and for use of mature forests (over 50 years) to hunt and to collect wood, fibres, vegetables, poisons, medicine and resins. Commercial extraction is then one such use of long-fallow forest. Is there an inevitable dynamic path towards demographic intensification and shorter fallow systems (i.e. agroforestry, then agriculture)? Or there are stable situations under low demographic intensities and long fallow systems, maintaining the side-benefits associated with rich and varied natural resources?

For each level of carrying capacity, the stability of the economy will depend on institutions which stabilise the number of householders. Given the forest area needed by a household under a certain management system, the succession to the position of household head must be regulated by rules of inheritance, or others that will exclude otherwise eligible candidates (Netting *et al*. 1984). One hypothesis says that there is a definite trend, as numbers increase and demands from excluded heirs mount for collective areas to retreat in favour of household-held areas, an "association between density of population, competition for land, agricultural intensification, and individual or family ownership of land" (Netting *et al*. 1984). Such dynamic issues have not been explicitly addressed in the existing Extractive Reserves.

Forest in fallow may be locally accepted as collective territory assigned to recognised community members, while forest trails and forest undergoing active management, as well as other resource areas, may be defined as household domains. Whenever such systems are not institutionalised, conflicts arise because the state allocates these seemingly empty areas to enterprises or to settlement projects (Boserup 1972).

Comparative analysis should be combined with path analysis to test general models. Information could be organised in two-dimensional tables (as suggested in Tables 4 and 5), and these tables should then be replicated for several points in time, giving a three-dimensional representation. There are comparable data for the Upper Juruá area for the period 1991-1995.

Table 4. Features of agricultural systems.

	long fallow	medium fallow	short fallow
agriculture	slash-and-burn <5%	variable	continuous >95%
hunting	high		zero
gathering/extraction	high	medium	low
biodiversity	high	medium	low
densities	<1 person/km^2		>40 persons/km^2

How Do Forest Households Act? The Cultural Approach

Approaches modelled on indigenous societies where management practices are said to be embedded in cosmological beliefs (Descola 1986), or on the model of closed and corporate peasant communities (Scott 1976), tend to raise doubts about the sustainability of traditional management systems when these systems enter a market economy (Smith 1994).

Under such approaches, household decisions are considered the outcome of a traditional culture of people adapted to the forest but fragile in a modern world. The concept of "cultural conservationists" may or may not be a fictional concept (Carneiro da Cunha 1995). However, it tends to generate scepticism about the future stability of extractive economies, when compared to actual household behaviour in observed situations (Nicanor 1992; Redford and Stearman 1991, 1993). Not all traditional societies are conservationist, and even those that are might change when entering the market sphere (Carneiro da Cunha 1995). It is uncertain whether rubber tappers can be classed as "traditional peoples".

Table 5. Examples of forest uses in Amazonia.

	Combu Island[1]	Upper Juruá [2]	Northern Bolivia[3]
Time Period	**1984-1988**	**1982-1983**	**1981**
forest	floodplain forest	open tropical forest	tropical forest
deforestation	less than 5%	less than 1%	?
biodiversity	oligarchic forest	very high	?very high
size	15 km^2	5,000 km^2	
density	43 persons/km^2	1.2 persons/km^2	
average landholding	15.3 ha/house	500 ha/house	
classes	23% of dwellers pay rent to landowner	payment of rent; debt-relations	patrons/client relationships
extraction as main source of income	92%	90% in 'terra firme'	?
shifting agriculture	0%	90%	yes
hunting		yes	yes
extractive income	$3,171.56	$1,260.00	
total			$2,360.00

Notes: (1)Anderson and Ioris 1992; (2) Almeida 1993a; (3) Romanoff 1992

Aristotle contrasted good household management ("oikonomia") and profit-seeking trade ("chrematistic"), condemning the latter on ethical grounds. This conflict between householding and marketing may be ingrained in the cultural background of rural populations (Gudeman and Rivera 1990), and was also invoked by Marxists who saw an ideological conflict between a "gift economy" and market fetishism in rural and forest peripheries (Chevalier 1982; Taussig 1987; Almeida 1993b).

Another perspective on the role of culture in households is to note that households behave according to plans and blueprints expressed as maps, calendars, gender-based labour schedules, food preferences and taboos. A household may be seen as a "form" (an emic concept) to be reproduced by its members, including ideal views of persons, values associated to territory, patterns of consumption and goals. To identify such models of a "good life" is part of the knowledge to be obtained from qualitative research.

These cultural models, however, do not exclude choices and strategies. I have never met a rubber tapper who did not believe in the reality of the panema phenomena (e.g., the causal relation between permanent bad luck in hunting and the physical contact of animal meat with pregnant women). The custom of the "neighbouring" game (i.e., sending fixed proportions of every kill to specified neighbours), and the exclusion of selling or bartering, is never questioned by households. However, near towns it is likely that a market for game meat will generate commercial hunting which would not break the cultural rules applied to neighbours.

Rational Forest Households

Forest householders are not intrinsically conservationists, nor are they necessarily forest managers concerned with sustainability at all costs. It would be equally simplistic to assume that forest peasants are predators of the forest or maximises of short-term benefits regardless of long-term concerns with their resources. If forest peasants act rationally (Popkin 1986), households become a source of variation and change. Different models of rationality for peasant household behaviour have been proposed (Ellis 1988). I now consider some of these models.

The model of "maximising peasants" assumes that, although poor, peasants may be efficient in the sense of adjusting household sectors in response to relative prices to maintain the house and also save. The model anticipates that declining market prices for extractive products will lead to the abandonment of extraction in favour of more agricultural/pastoral techniques. Policy recommendations would include the exogenous introduction of processes for a higher yield per unit of labour and more value per product.

The model of "risk-averse peasants" aims to explain apparently "irrational" choices that do not seem oriented towards income maximisation as expected under the maximising peasant model. If the household head is unsure about future prices of new agroforestry products, he or she may not want to divest labour from extraction and hunting (having almost immediate returns) or from manioc agriculture (a risk-free crop) to agroforestry with a doubtful outcome. The model also anticipates that households will have little motivation to invest in the conservation of natural capital for future use.

A maximising firm concentrates on rates of physical output (or of money value) per unit of input (land or labour or dollar invested), but households may not maximise any single goal; it is not possible to maximise both the monetary value for work and well-being derived from leisure time. Therefore, households will make trade-offs guided by "satisfycing" strategies rather than maximising. Another way to describe this situation is that households maximise total utility by a mixture of money income and leisure.

The "drudgery-averse peasant" model proposes that households try to maintain food supply using as little effort as possible. It anticipates that households will reduce work per labourer when the number or workers rise (maturing households) or as prices go up. More complete models of household behaviour would also include wages and money income in the household "production function".

Some Research Data

A survey of sixty-nine households in the same rubber estate and environment (Riozinho, now part of the Upper Juruá Extractive Reserve) provided budget data on work and income over the period 1982-1993. Household results were then plotted within a production possibilities space based on the level of manioc production, rubber production and hunting. The results suggested the following classification of households:

(a) Maximisers of money and durable goods. These employed most of their labour time to produce rubber with average productivity above one ton/year (per household), accumulating wealth which sometimes was invested in petty trade.

(b) Food producers. These households cultivated big manioc and maize areas, and accumulated social influence by expending food surpluses. Their average productivity ranged from 400 to 700 kg rubber/year.

(c) Labour minimisers. These "lazy" households applied themselves mostly to hunting and fishing and kept purchases to a bare minimum, producing between 200 and 400 kg rubber/year. They often ran out of manioc meal.

In 1982 the average household employed 1.2 mature workers (aged 14 or more) on 2.2 trails (i.e., 1.8 trails per rubber tapper). Considering that a single adult can cover three trails (a six-day week, two days per trail), households were applying only 60% of their labour to rubber making. Only 69% of trails available were being used. At the time, the rubber price was US$1.80 per kg which, in Riozinho, meant US$18.00 per day for a tapper on a standard trail of 120 trees. This was a much higher return to labour than the national minimum wage of US$78.70 a month. However, even "maximisers" were unwilling to quit food production or hunting. In this group, higher productivity per household was a result of more workers (developmental phase

hypothesis), not of more labour per worker (which in fact could decrease). Households persisted in growing manioc (a time-consuming and intensive task) when rubber gave much higher returns to labour. One reason was that nobody wanted to specialise in making manioc meal to sell, since this (at the current low prices) paid less for a day's labour, but prices were kept low because everyone produced manioc. The dispersive strategy (followed by everyone, and preventing specialisation) buffered the households against the risk associated with price changes, at the cost of maximising money income (Almeida 1993b). Declining prices for rubber in the decade from 1982-1992 had the effect of pushing forest dwellers off extractive areas.

Table 6. Market and forest uses: a case study of Riozinho (Alto Juruá Extractive Reserve).

Year	1982	1991	1993
Price of rubber (US$)	1.8	0.7	0.4
Households	68	49	40
Settlements	27	21	20
Persons/km^2	1.39	1.00	0.81
Ha/household	397	551	675
Houses/settl.	2.5	2.3	2.0

The households that remained fared well if they belonged to the groups that favoured food production and hunting over maximisation of rubber production (cf. Almeida 1984 on the period between 1914 and 1945). With social density reduced, from 2.5 to 2.0 houses per settlement, and fewer settlements (with a greater average distance between them), there was less conflict among neighbours caused by the invasion of crops by pigs and cattle. As a consequence, houses could expand manioc gardens and pasture-land. The population density fell from 1.4 to 0.8 persons/km^2. The area, which was known as a "river of hunger" in 1982 because of the scarcity of game, became a better place to obtain food from the forest. Population density decreased (from 1.7 to 1.1) and social density measured by households per settlement was reduced (from 2.7 to 1.9). Over 70% of the households that left Riozinho moved to other forest areas along the Juruá river, and only about 30% moved to town.

The overall result of the fall in rubber prices was therefore not a mass exodus but a new equilibrium of the total population distributed among the distinct environments of the region. At 1995 prices (US$0.60/kg or US$6.00

per labour day in the terra firme), rubber tappers are unwilling to continue extraction, but they still set a floor of US$10.00 per labour day, still well above the official minimum wage of US$100/month (1995) and above the rural wages paid at riverbank ranches at US$3-4.00 per work day. This suggests that forest labour retains a high opportunity cost under low-density conditions of forest use (Almeida 1994b). There are data for the Juruá river that seem to contradict these conclusions (Parfit 1989; Whitesell 1988) but, in fact, this is not so. Such data refer to the middle Juruá course under the influence of nearby towns, a gas company and ranches, while my data are refer to the uppermost headwaters of the Juruá tributaries in Brazilian territory. This highlights the need to carefully consider context for meaningful comparisons.

Issues in the Study of Households

The literature poses a number of questions. How do households make production plans using the whole range of resources and labour, alone and jointly with neighbours? How do these production plans respond to price movements? How do they reflect preferences and attitudes relative to use of time and the natural environment? For instance, "the hypothesis that increasing the value of a forest resource makes it more feasible to protect that resource" must be tested (Romanoff 1992), instead of taken for granted.

Empirical answers to such questions must be given within a context of time and place together with other factors exogenous to the household. A typology should include market location (proximity to roads and towns); environment (oligarchic/diversified forest); presence/absence of land/trade monopolies; the availability of non-extractive resources (or non-renewable ones, such as mining resources). Typologies should be cross-cut by criteria endogenous to the household: the size and structure of the domestic group, education and migration record of household members (and in particular of the head), ownership of equipment and affiliation to organisations; preferences and goals.

The preferable measures include productivity (yield per land, labour, per invested dollar), stability (does the productivity remain constant in the face of environmental or socio-economic disturbances?), sustainability (the agro-ecosystem's ability to maintain productivity), and equability (the degree to which agricultural products are shared amongst members of a household, village or region).

The problems include the issues of how to guarantee families continued access to the resource during future years (Nations 1992: 216) by means of adequate institutions; how to solve problems of transportation, marketing, and access to services (Schmink 1992: 290); and how to overcome the dependence of extractivists on single extractive products subject to substitution and loss of value.

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Chapter Eight

Developing Research Frames for Non-Timber Forest Products

Experience from Ghana[1]

Julia Falconer

Introduction: The Varied Concerns for NTFP

Interest in non-timber forest products (NTFP) has grown with the increasing awareness of tropical forest problems and destruction. NTFP have been heralded by some as a means of slowing forest destruction by increasing the overall worth of the forest and by shifting the emphasis of forest exploitation from trees to products whose harvest is believed to be less ecologically destructive (Balick 1987; Fearnside 1989; Ruitenbeck 1989; Anderson 1990a 1990b; Clay 1990; Plotkin and Famolare 1992;). Others have highlighted their existing importance in world trade (Sale 1978; de Beer and McDermott 1989; Wickens *et al.* 1989; Prance 1990; Poulsen 1990; May 1991).

The increased concern for NTFP has come largely from the conservation movement rather than from foresters, development specialists or aid planners.

[1] This discussion is based on research into NTFP exploitation and management in Ghana supported by the UK Overseas Development Administration and the Ghana Forestry Department. The research was initiated in 1989 with a study on the use and trade of NTFP. Building from that research, the Forestry Department developed a 'collaborative forest management programme' (CFMP) with the aim of exploring how to improve forest management, notably for NTFP, and to redress problems with forestry and sector policy with regard to NTFP exploitation. The CFMP touches upon all of the main aspects of the NTFP situation. However, this discussion focuses on the social dimensions of NTFP use and particularly on the demand for NTFP, whether for market or subsistence. The discussion on research frames is presented from a practitioner's perspective (of someone who is trying to develop NTFP management) and focuses on what have proved to be the most critical issues in terms of informing policy makers on NTFP exploitation and management.

Over the past few years numerous studies have been conducted to find new products or markets and to better estimate the value of forests and thus enhance the arguments for their conservation. Programmes and projects have been launched to exploit and market a vast range of goods from birds nests to gums and fruits (Balick 1987; Wickens 1991; Clay 1992).

It has been shown over and over again that the most important facet of NTFP exploitation is the role they play in rural livelihoods. In many parts of the world, these resources are critical, especially for the rural poor and women, in helping to satisfy everyday subsistence needs. Of particular note is the importance of these resources in times of hardship; in emergencies when quick cash is required or when usual food stores run out. Thus one of the most critical functions of the forest has been shown to be as an economic buffer in hard times (Falconer and Arnold 1989; Falconer 1990).

The surge of interest in NTFP was predicated upon a few assumptions which, with the benefit of experience and research, have proved hard to justify. Common assumptions on the importance of NTFP include that:

- commercial exploitation of NTFP is less ecologically destructive than timber harvesting and therefore has greater potential for sustainable forest management (this has led to the promotion of green products);
- local forest users (and particularly forest dwellers) exploit forest resources wisely and sustainably;
- commercial exploitation of NTFP will more directly benefit people living near the forest compared to timber harvesting; and
- NTFP are mainly found in undisturbed forests and are destroyed with timber exploitation (and thus they have commonly been billed as 'alternative' products to timber rather than as complementary products adding to the benefits derived from a forest managed for multiple uses).

There are examples where NTFP may prove some of these assumptions true, but there are also those which can be found to challenge them (Browder 1992; Richards 1993). While NTFP are important to a large number of rural people, the starting point of many studies and programmes is the **product** – rubber, rattans, monkeys, etc. (Plotkin and Famolare 1992; Richards 1992; Rioja 1992). But NTFP programmes should begin with the **people** who use the forest, examining different needs and the **functions** forests serve for them.

The increased interest in NTFP has led to a huge increase in studies and programmes and our understanding about this category of forest goods has increased substantially compared to ten years ago. The central role these products often play in people's daily lives has become better understood. However, from the perspective of the forest manager, NTFP generally still remain marginal goods when compared to the higher-value timber products. This may be partly a result of the inherent complexity of managing a forest for NTFP; they are used by a wide group of people for different and some-

times conflicting ends. In many places where NTFP have a high commercial value their natural populations are becoming scarce (Robinson and Redford 1991; Plotkin 1992; Falconer 1993). In other cases, some products have under-developed markets or marketing structures which constrain their potential (this may be particularly true in the case of medicines and forest foods). The studies conducted over the past few years are many and disparate and many have commented on the difficulties of finding common threads in recent research (e.g., Ruiz Pérez 1995).

The stated goal of developing common research frames is to better inform policy and management decisions in order to improve integration of NTFP production and use into management practices (Ruiz Pérez 1995). As a starting point one needs to ask **why** we want to better integrate NTFP production into forest management and forest conservation. It is evident that there are different overall aims of NTFP policy initiatives. For example:

- to maintain and sustain the resource and its uses (and presumably users);
- to develop and promote NTFP through new markets, support to processing, etc. and presumably contribute to development;
- to conserve forests and biodiversity; and
- to promote "non-traditional" enterprise to improve local economies and diversify the economic base of the rural poor.

The aim of NTFP policy will necessarily shape what decision makers need to understand. For this reason, it is difficult to develop a generalised research frame or model. Furthermore, policy decisions regarding NTFP use, development and management are made at different levels, notably forest (community), national and international. At each level, decision makers have different information needs. It is clear that, despite this, there are some issues of common concern where all decision makers require greater understanding; namely:

- people's subsistence needs for NTFP over time;
- broad context of NTFP use and use patterns;
- livelihood strategies and how NTFP contribute to these;
- economic buffering functions of NTFP; and
- development potential of particular products or groups of products.

Key Research Questions

Generalised or over-arching research frames should concentrate on common concerns such as those suggested here since whatever the focus of a programme or policy, the particular product, forest system or forest user will need to be

understood in the ever-changing **broad** context of how NTFP are used and valued. Research questions which place NTFP use and value in a wider socio-economic setting as well as addressing the dynamics of changing use and value will prove most helpful for forest policy makers. For example:

- What are the broad economic, social and cultural contexts of NTFP use and value? How is NTFP use related to agricultural systems and cycles (inputs, labour demands, market demand, as sources of NTFP)? How has NTFP use responded to changes in the local economy (e.g., increasing commercialisation)?
- What are the overall patterns and extent of NTFP use in livelihood strategies (disaggregated to different social groups)? How have these changed? (This should focus on functions and not specific products per se.)
- What are the important sources of NTFP? Have these changed? Why?
- How do existing forest (and land) management practices and policies affect people's uses of and value for NTFP?
- How can we predict change in use/demand over time to decide where and whether intervention might make a difference, either positively or negatively?

These issues are explored in more detail below in light of the research on NTFP carried out by the Forestry Department in Ghana. This research illustrates the kind of information policy makers require to improve the management of forests for NTFP and local benefit. More information on this work can be found in Forestry Department papers and publications (Falconer 1992, 1993; Forestry Department 1995a, 1995b).

Overview of NTFP Use and Trade in Ghana

Throughout West Africa forests form an integral part of the rural economy, providing subsistence goods and services as well as items of trade (Falconer 1990). NTFP exclude, as the name suggests, commercially exploited timber; all other products garnered from forests, whether for commercial or subsistence purposes, are categorised as NTFP, and so include such diverse products as animals, building materials and sponge fibres. NTFP are of particular importance among the rural poor, who have access to few resources beyond the common forests.

In Ghana, as in other countries in the West African sub-region, the government realised that as pressures on forest resources increased they needed a better understanding of the uses and users of the forest. As the CCF (head of the Forestry Department) concluded in 1994:

> it is only when the forests have real value to local people will we be able to gain their cooperation and energy for forest protection and management. Without that cooperation the future of the forest cannot be guaranteed except at the prohibitive cost of a vast army of forest guards. (Forestry Department 1995a)

The Forestry Department recognised that some forest values were being neglected in their forest management efforts, especially the provision of NTFP. While the original forest reservation policies (from the 1920s) embodied elements of participatory forestry, notably by encouraging local people to manage their forests under locally administered by-laws, over time forest management has emphasised the sustained supply of timber for the wood industry. NTFP do not appear in forest management planning and NTFP harvesting is regulated through a system of expensive short-term permits which does not encourage stewardship amongst NTFP gatherers. The revenue earned from the permits is not re-invested in NTFP management. As the CCF observed in 1990:

> Somewhere down the course of history, timber and timber products assumed such major importance in human affairs that they appeared to be the only significant output of the forests. They dominated the national and international trade statistics, were promoted rigorously in all sorts of media, adapted readily to the changing tastes of urban consumption and generally basked in an exaggerated measure of self-importance.
>
> For most rural populations however, this prominence is ill-founded. For those who come face to face, without relief, with the harrowing experiences of ill-health, hunger and other forms of deprivation, the reality is the enormous contribution NTFP, in all their varied forms, make to all aspects of their lives. (Falconer 1992)

The NTFP study described here helped the Forestry Department to better understand the value of forests and paved the way for a NTFP management programme. It looked at ways of incorporating NTFP into forest management planning by examining the demand for them and their supply in Forest Reserves. The study was a first step in developing a NTFP management system and improving the Forestry Department's understanding of the value of forests for rural communities and traders. The Department built from this new understanding by establishing a Unit to further the aims of improving its forest management. Thus the development of management options has involved a three-staged process entailing different kinds of research into NTFP use and values.

Stage 1: Understanding the broad context of NTFP use.

Stage 2: Developing management approaches which ensure that people have better access to the State-managed NTFP resources while at the same time providing a framework through which local users take a more active part in sustaining the resource.

Stage 3: Implementing NTFP management at the field level.

The NTFP study examined household uses in a series of village studies, and trade through market studies in two regions and at rural and urban markets. These are described in detail with reference to southern Ghana in Falconer (1993).

The village studies (8 villages in different eco-zones) give a broad picture of the way people use and value forests and fallow. The study of trade provides an overview of the range of NTFP sold as well as a more thorough understanding of the trade in five NTFP. These detailed studies examined all aspects of the trade; tracing the products from the urban centre through supply channels to rural gatherers.

Household uses of NTFP

Forests contribute to all aspects of rural life; providing food, fodder, fuel, medicines, building materials, and materials for all sorts of household items, as well as many more intangible benefits such as cultural symbols, ritual artefacts and locales. There is, however, **great variation** in the extent to which forest products are used from area to area and even between households within a community. Because of this variation, it is difficult to abstract generalisations about NTFP use. Indeed, this variation reflects the extent to which NTFP are an integral part of rural livelihoods.

In many instances NTFP are collected from bush fallow rather than forest. While bush fallow may sometimes be quite complex secondary forest, generally there is very little "forest" outside the government-managed forest reserves in southern Ghana. People only exploit resources from the forest when they cannot be found on nearby fallow lands, or when they are collecting for trade and better supplies are available in the forest.

Forest foods continue to contribute significantly to the diet of many rural households. While a great variety of goods are gathered from forest and fallow lands, the forests commonly supply tubers, mushrooms and snails. Many different fruits and seeds are eaten as snacks on the farm or in the bush, especially by children. Foods gathered from fallow and forest areas are added to sauces as flavouring, as medicines, as substitutes for staple food during periods of scarcity and especially for their healing properties. Collectively these foods add diversity and flavour to the diet as well as providing protein, energy, vitamins and minerals. Forest foods are perhaps most important for children, especially during the "hungry" season, as snack foods play a more significant role in their diets at this time.

Wild animals, known as "bushmeat", are among the most-valued products of the forest. They are an important source of meat in both urban and rural diets, although generally consumed in small quantities. In some villages, snails and rats are eaten regularly, while in other places bushmeat consumption is very rare. Forests also provide stream habitat for freshwater fish and crabs which are widely consumed and very popular. The importance of bushmeat in the diet varies greatly depending on supply. Throughout the region, the consumption and value of bushmeat is changing rapidly as a result of increasing urban demand and dwindling supplies of wild animals. In many areas bushmeat has become a luxury item and its consumption is declining overall. However, its popularity is not; in general people would prefer to eat bushmeat. While most people believe that the forest is the most critical habitat for wild game, the most commonly consumed species may not actually depend on forest habitat, e.g., grasscutter, bushbuck, porcupine. Most of these animals are caught on farm and fallow lands, not in the forest.

Diets are changing throughout the region. Forest decline and increasing commercialisation of the rural economy are contributing to these changes. For example, forest foods are now rarely eaten during emergencies. Instead people rely on markets during food-scarce periods. Nonetheless, some forest foods are still widely consumed, especially those of cultural significance.

Forests supply **medicines** for the vast majority of urban and rural people and medicines are consistently ranked as one of the most-valued forest products by local people. **All** people in the study villages use plant medicines, and the majority of them rely on wild plants as their main source. Even amongst urban households plant medicines are widely used, especially as first aid. Although there are many different healing practices and beliefs, common to most is the use of plants, sometimes in conjunction with mystical and ritual practices.

Knowledge is not confined to specialist healers; common plant treatments are known and used by the majority of people. Women play a critical role in this regard as it is usually they who administer first aid to their children. Plant medicines are used for both curative and preventative treatments, and many are added to foods. Knowledge of common medicines is passed on through families and this knowledge continues to evolve as the environment changes.

Most common medicines used regularly as first aid are found in the village periphery or in bush fallow rather than in the forest. However, for a particular ailment, or at the request of a healer, people will travel great distances into the forest to find specific medicinal plants. There is also a strong urban market for some forest medicines; rural people migrating to town centres want the traditional treatments they are accustomed to.

All rural households rely on **fuelwood** to meet all their energy needs. But, most fuelwood is collected from farms and bush fallow, rather than the forest. The supply of fuelwood is not a problem in any of the study villages. Although in some cases, where the fuelwood is used in a processing enter-

prise such as palm oil production or preparation of cooked foods for sale, fuelwood collection may be difficult.

Building materials such as cement and aluminium roofing sheets are available, but the majority of rural households cannot afford these, relying instead on the forest for their building materials. In the study villages, the majority of houses are mud and wattle, utilising sapling-size trees as standing poles and raphia or bamboo to produce a lattice. While specific species are sought after for particular needs, a great variety of different materials are used, even within one community. In one village, for example, more than 43 plant species were used in building. In some communities access to forest reserves for building materials is a major concern. Food storage barns, livestock pens and other farm buildings are invariably made from a variety of forest trees, raphia and oil palms, or bamboo.

NTFP also feature commonly in the **material culture**, providing household, agricultural and marketing equipment. The pestle (used for pounding the staple food) was ranked by villagers as the most important above all other forest products. Other essential household items include mortars, furniture and sleeping mats, wood for hoe and other tool handles, poles for crop storage containers and crop dryers, canes for baskets, crop drying mats, fish traps and other fishing equipment. Most items are made within the household rather than being purchased.

NTFP trade

For many households the gathering, trade and processing of forest products provide one source of supplemental income (for additional information see Falconer 1993 and Townson 1995). These activities are generally undertaken at times when there is little demand for farm work, or when the need for cash is acute. In some cases, however, these activities provide the basic means of livelihood. In several study villages, NTFP provide the main source of income for the majority of households. In one village Marantaceae leaf gathering is the main livelihood for most of the village women; in another many women rely on sponge making, while the majority of men are full-time cane basket weavers. Numerous urban traders are also wholly dependent on the forest product trade.

The returns from gathering, processing and trading NTFP vary enormously from product to product and location to location. While there are some NTFP-based activities which compare favourably with cash cropping, the returns from others are extremely low.

In contrast to the pattern of subsistence exploitation, forests are the main source of traded NTFP. In many areas fallows formerly provided important supplies of traded NTFP but, for much of the area, agriculture and bushfires have depleted these resources to un-merchantable levels.

The NTFP trade involves a great number of people: gatherers, producers, wholesale and retail traders often working along complex trading channels.

These people sell a vast array of products, from sleeping mats to snails. In one urban central market, for example, there are approximately 700 people involved in the forest product trade on a full-time basis; at all the weekly markets visited in towns throughout the region NTFP are sold. Trading is an important economic activity in even the remotest villages of southern Ghana.

In order to better understand the complexities of trading patterns this study focused on five products: bushmeat, chewsticks, plant medicines, food wrapping leaves and cane products. For all five products, there are thousands of people, especially women, involved in collection and trade and for many it provides their main source of income. In Kumasi's central market, for example, more than 90 per cent of the NTFP traders are women.

There is a strong market for all five study products, especially in urban centres, and there are no signs of declining demand. NTFP prices can fluctuate considerably by season. This seasonal price fluctuation may reflect increased supply at times when more people enter the trade or according to the production cycle of some other sector. For example, the urban demand for cane baskets increases during the fishing season, while in rural areas there is more demand for cane baskets during cocoa harvest periods. For some products the demand may soon outstrip the supply: the desired Garcinia species for chewsticks (*G. epunctata*), for example, appears to be getting scarce even in remote forest regions. Not surprisingly, trade patterns are influenced largely by access to markets and access to trade networks. Despite this general principle, those NTFP with a high market value are exploited for trade from relatively inaccessible locations.

Supply of NTFP: the resource base

While certain regions of the country are known for their rich supply of particular NTFP, very little is known about the condition of the NTFP resource or the levels of exploitation. In 1990 the Forestry Department incorporated a few NTFP (selected according to presumed scarcity and widespread popularity of traded goods based on interviews with users) into their national inventory to gain a general picture of their distribution and relative abundance across different ecological zones. While the results of this survey have yet to be analysed, what is clear is that many of these NTFP are widely distributed across the forest zone, but their abundance varies significantly resulting in very patchy distribution.

The NTFP study suggested that farms and fallows are important sources of NTFP. Even where people live near a forest they prefer to collect from farm or fallow where the goods are available. People will only go to the forest if they cannot conveniently find what they need on fallow land, or if they are collecting for trade and need better quality or more abundant sources. A great deal more research needs to be done on the sources of NTFP supply and how to counter the evident degradation of the fallow which used to provide for most people.

Key Lessons from the NTFP Study

Returning to the research questions defined above, what are key lessons from this NTFP study.

1. What is the broad economic, social and cultural contexts of NTFP use and value? How is NTFP use related to agricultural systems and cycles (inputs, labour demands, market demand, as sources of NTFP)? How has NTFP use responded to changes in the local economy (e.g., increasing commercialisation)?

2. What are the overall patterns and extent of NTFP use in livelihood strategies (disaggregated to different social groups)? How have these changed?

Perhaps the most important function which forests serve for those living nearby is as an environmental and economic buffer. They provide subsistence products and opportunities for earning cash, especially at times when other means of earning income fail. The subsistence value of NTFP should not be under-estimated, nor should the level of exploitation for subsistence use. While many foresters see subsistence exploitation as harmless and commercial exploitation as destructive, it is evident that the forests and fallows are intensively and extensively used to meet domestic needs.

The subsistence functions of forests may at times be critical, especially for household food security; providing foods during lean periods (especially seasonally) and supplementing diets with essential variety, protein and vitamins. In Ghana, bushfoods contribute important supplements to the diet during the hungry season at a time when there are few alternatives.

These subsistence uses are only sometimes replaced by more modern alternatives when they become available. The most common reason cited for decline in subsistence use was scarcity of the resource. Where the NTFP serves a critical function, e.g., providing food in the hunger season, scarcity may reduce the options of poorer households during a difficult period. There are a few products, notably bushmeat, which have higher value, use or demand in urban centres. In these cases this may result in a decline in subsistence consumption.

Changes in patterns of NTFP exploitation for income may be driven by availability of the resource, the need for cash or changes in market demand. In particular more people became involved in the trade and processing of certain NTFP when other sources of income declined, e.g., agricultural production failed, or when they need cash (for fees, medical bills, funerals, etc.). Involvement in trade and processing of NTFP also responded to demand with people entering and leaving the activity according to shifts in demand; this was particularly true for goods tied to agricultural cycles, such as cane baskets. Some people enter trade only when the resource is scarce and concentrate their efforts when there is less market competition and hence higher prices.

The extent to which households engage in NTFP-based income-earning activities is a function of the availability of the resource, access to markets, the existence of established trade networks, availability of other income earning activities and, in the case of processing, acquired skills.

3. What are the important sources of NTFP? Have these changed? Why?

In many areas where people formerly collected NTFP from fallow lands, they are now forced to collect from the forest reserves because of degradation of the fallow. In the northern reaches of the forest zone these changes were brought about by drought and a series of bushfires, in the wetter parts of the zone fallow area declined as the cocoa frontier expanded. These changes have caused a decline in accessible NTFP resources. Thus, where accessible, forests increasingly provide goods which were previously gathered from farm fallow. Even in the forest reserves, many sought-after NTFP, such as chewsticks and canes, are becoming increasingly scarce commodities.

4. How do existing forest (and land) management practices and policies affect people's uses of and value for NTFP?

While the subsistence value of NTFP had long been recognised, these resources did not feature in forest management planning. However NTFP, as the main link between communities living near forestry reserves and the Forestry Department, provide a means for collaboration. NTFP management systems which sustain and develop the value of forests for people living near them can help to assure people's interest in the forest's long-term management. In the past there was little pressure on the reserves for NTFP and as such perhaps little need for active management. Now, however, an ever-increasing population is forced to rely on the reserves for their subsistence NTFP needs and in many cases it is clear that some locally valued products are disappearing. As the reserves will face increasing pressure from those who would rather see them put to other land uses, ensuring that people's subsistence needs for NTFP are met from the Reserves should be a management objective.

NTFP cannot be grouped into one management category; different NTFP resources call for different management approaches. In some cases, more intensive management is required to sustain the resource and the industry which it supports. In other instances the buffer function of the forest or particular NTFP is paramount. Thus flexible management systems are required which are geared to the particular NTFP resource, the local economy and the needs of the people living near the forest. While foresters generally limit their management objectives and plans to the actual forest resource for which they are responsible, it is clear that what happens outside the forest reserves will influence what happens inside the reserves. Thus political and envi-

ronmental changes which bring change in land-use practices outside the forest reserves may have direct impact on how people use and view the forest itself. The key to forest conservation and management is supporting and developing the local value of the forest as forest rather than as farm.

Developing NTFP Management Options

The study described above provided enough information to forestry decision makers to put NTFP management onto their policy agenda. It provided a general idea of some of the key contributions these resources make to the local and national economy and to rural livelihoods and pointed to several fundamental policy disincentives which prevent people from better managing the NTFP resource. It suggested that the current NTFP exploitation pattern had changed significantly in some parts of the country as a result of degradation of farm land and declines in agricultural production. This experience encouraged the Forestry Department to further explore how to improve NTFP management (Forestry Department 1995a).

One of the tasks of the newly formed Collaborative Forest Management Unit (CFMU) was to develop management approaches which ensured that local people had better access to the State-managed NTFP resources while at the same time providing a framework through which forest users could take a more active part in sustaining the resource. Building upon the NTFP study the Unit embarked on a survey to examine NTFP exploitation patterns and problems faced by villagers and the Forestry Department in managing them (or not!) across a wide area of the country. This was designed to examine the variation across the entire forest zone since the study described above was confined to eight villages (Forestry Department 1995b).

The Unit also embarked on a number of pilot initiatives with communities to explore the extent to which people are prepared to work with the Forestry Department in NTFP management. The Unit is developing approaches to manage exploitation for subsistence as well as commercial purposes. This programme has highlighted the need for a better understanding of the NTFP resource itself, the dynamics of land use and identifying sound strategies to identify NTFP with potential for market development (Boafo and Falconer 1996).

Another aspect of the Unit's work has focused on implementing NTFP management at the field level. The Unit has started a series of initiatives with communities who want to improve NTFP management in particular forests. In some instances this has led to community management of their forests and in other cases to management of particular NTFP in government-managed forest reserves. In both instances, the communities have identified very particular information needs at the resource level. They have a very clear understanding of the dynamics of subsistence use. However, they have investigated who and to what extent people from their area are involved in exploitation for

trade. There are two critical areas of interest to them for which the Forestry Department is ill-equipped to assist.

- How to improve or restore the resource base of particularly important NTFP in the forest.
- Information on market potential of various NTFP and ways of identifying new marketing networks.

This example from Ghana shows that information requirements vary depending on the aim of the programme and who is implementing it, and this will invariably be reflected in research programmes which are geared to addressing the needs of their intended beneficiaries. The information needs of a group of villagers who want to manage particular NTFP in their forest, or in the farm fallows, differ from those of the Forestry Department that is responsible for instituting programmes to manage the vast biodiversity of different forests for different groups of end-users. These vary also from information which policy makers use to send appropriate signals to encourage wise use of the forest, and to ensure that those most dependent on the forest do not suffer from government-sponsored management programmes.

Holistic Multi-Disciplinary Approach to NTFP Studies: Proposed Research Circles

This Ghana case study provides a practical example of NTFP research which has led directly to policy changes at the national and forest level and to the development of programmes to improve the management of the NTFP resource, as well as to improve local people's livelihoods and benefits derived directly from managed forests. What lessons can be drawn from this experience in Ghana to guide the development of relevant research frameworks? Many models and research efforts attempt to simplify NTFP use/conditions/values in order to better understand the dynamic dimensions of NTFP exploitation or value. While such models may provide some insight into a particular aspect of NTFP use, they fail to assist the policy makers, foresters or local resource users with what is most critical when developing and managing NTFP. What is needed is a framework(s) which helps understanding of the **linkages** between various aspects of NTFP use, functions and values and the broader contexts which shape these uses, functions and values.

We have found that in order to inform national policies and management practices one must understand the broad context and the local variations in NTFP use and values. Thus there are four distinct and important areas of study which need to be combined to provide a broad picture:

- an understanding of the resource base itself and especially the sources of exploited NTFP and changes in condition and supply;

- "primary" resource use (by users who directly extract and consume) in the context of rural livelihood strategies and the dynamics between subsistence and income-generating functions of NTFP use;
- "secondary" resource use or the trade and processing of NTFP goods, including the dynamics of local and national markets and marketing patterns; and
- the wider policy, economic, social and cultural contexts under which NTFP exploitation and management operate.

In constructing research frames it would be useful to consider how these different sets of issues inter-relate. Figure 1 depicts these as inter-connected research circles. This is an attempt to move away from linear portrayals of issues and dynamics and to focus on the linkages instead of pathways. What is important in this diagram are the arrows indicating linkages. Dynamics or change over time should be explored within each of the related sets of issues and also between them. For example, change in resource conditions relates to change in primary and secondary use as well as to changes in the wider policy and economic contexts.

A Word on Methodologies

In order to carry out research which looks at so many different aspects of NTFP resource use, it is advisable to form an inter-disciplinary team (and one involving both practitioners and researchers) and to employ different research methods to explore one issue.

The Ghana study described here was carried out by an inter-disciplinary team of foresters, nutritionist, social scientist, geographer and wildlife ecologist, joined by community members as well. This approach proved very useful as each person brought a different perspective to the research experience and as a result the combined picture was probably more detailed than it would have been had the researchers come from similar perspectives. The study also employed numerous different field methods from formal consumer surveys to informal focus group discussions, to "participatory" trips to the forest and farms. A wide range of qualitative and quantitative information was collected.

While "participatory" research tools were used in the study, they can lead to serious misunderstanding between forest users and villagers and the Forestry Department if no follow-up action or programme is anticipated in the research area. These methods only seem appropriate where the research is being undertaken as part of a programme to develop or manage NTFP or NTFP enterprises, i.e., "action research". In other places perhaps more conventional RRA methods are more appropriate.

The one aspect where the Ghana study is probably weakest is looking at the dynamics of exploitation patterns – how they may change in the future.

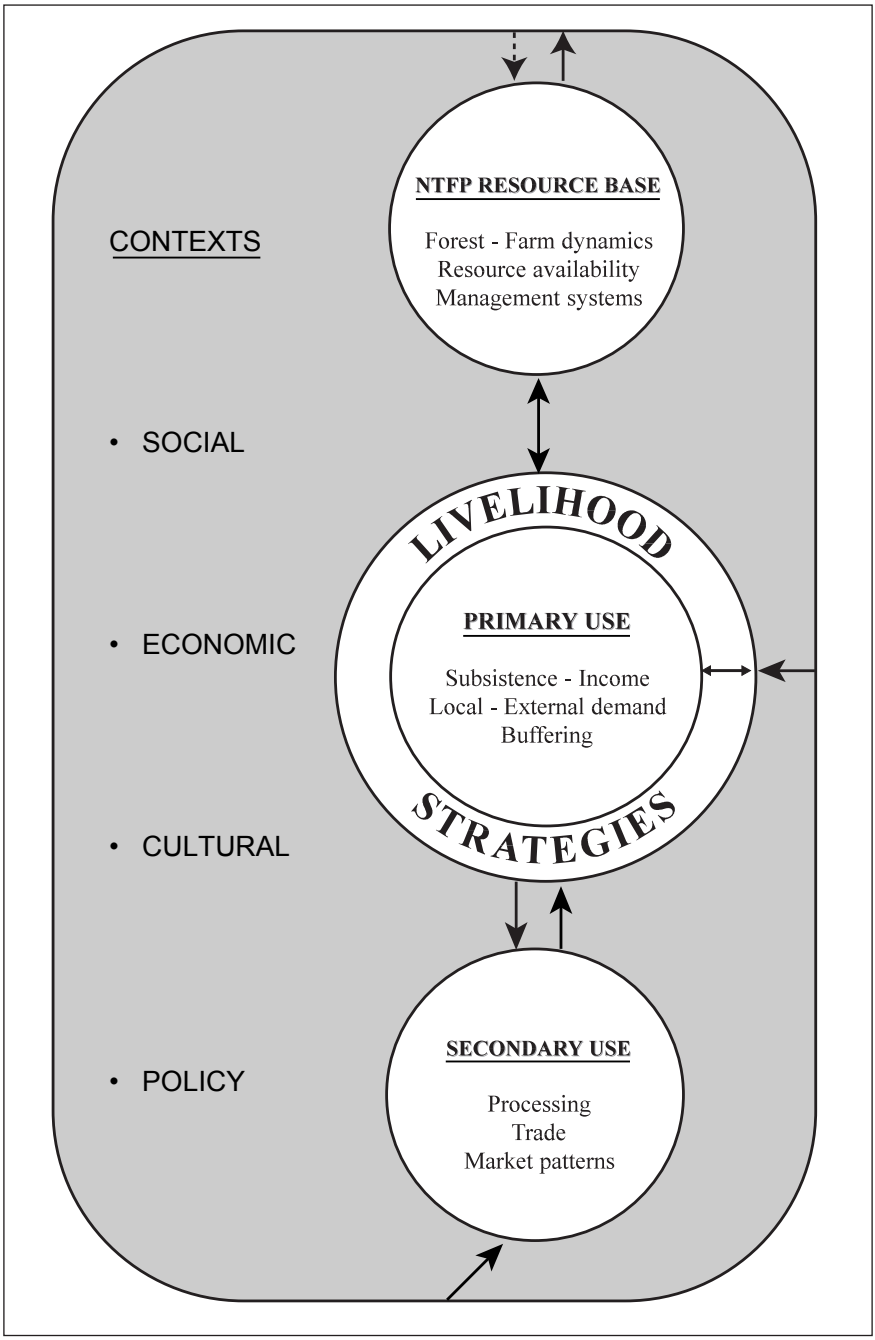


Figure 1. NTFP research circles

This was particularly true as we did not adequately explore how exploitation fits into broader dynamics of livelihood strategies.

In subsequent stages of the work the CFMU has found that workshops and working groups, combining the experience and expertise of a varied group of participants (e.g., forest users, foresters, academics and politicians), has provided the most effective method for understanding the issues and problems associated with NTFP use and management.

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Chapter Nine

Forest Products Research in Relation to Conservation Policies in Africa

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Introduction

This chapter focuses on the interactions between state forest and wildlife conservation policies and local land and resource rights in the region of sub-Saharan Africa. These topical and regional foci will structure my comments concerning the direction of non-timber forest product (NTFP) research. Specifically, I will discuss two policy developments that have the potential to greatly reform patterns of NTFP tenure and utilisation in much of the region. The first is a new emphasis among government conservation agencies and international conservation NGOs on the need to integrate "local" development concerns into conservation projects. While this approach goes by a variety of names, I will refer to it as "integrated conservation-development projects" (ICDP, from Wells and Brandon 1993). It is epitomised in two new land-use control models – protected area "buffer zones" and "wildlife migration corridors" – which government and non-government conservation officials in Africa are now endorsing as a means to promote environmental protection while simultaneously helping secure local land and resource rights (such as the extraction of NTFP). The second policy development concerns the initiation throughout sub-Saharan Africa of government land titling programmes, ostensibly to create the necessary conditions for increased agricultural production (see Bassett and Crummey 1993). These titling programmes, and the push to eliminate customary land law in general, intersect with ICDP projects in complex and sometimes contradictory ways (Neumann 1995).

First, I will briefly elaborate on these two policy trends. These cases will then provide the basis for a discussion of what I think are some of the major NTFP research issues or questions that need to be addressed. Following from this, I will speculate on some the methodological and conceptual challenges that these questions raise. For my own research purposes (and thus in this chapter) I define the term NTFP rather broadly as any non-timber product that is dependent on the maintenance of a forest environment. In much of sub-Saharan Africa this would include drought-reserve grazing, dry-season water sources, honey and wild meat sources, as well as those products derived directly from trees such as fuelwood, thatching and fruits.

Land Titling and Conservation Policies: Prospects for NTFP

Land titling

Throughout much of Africa, European colonial administrators of the early 20th century tolerated and often actively promoted the retention of "customary land law" in areas of African settlement and occupation (Coulson 1971; Berry 1992). Customary land law, in the eyes of European administrators, was characterised by the communal ownership of land and a direct linkage between a fixed tribal identity and a rigidly bounded territory. Toward the middle of the 20th century, administrators began to view communal ownership under customary land law as a key impediment to the expansion of commercial agriculture (Bassett 1993). After independence, African political elites often continued to view customary land law as inefficient, but in most countries there was not a rush to overhaul customary systems. This situation changed in the 1980s as the World Bank began to fund a series of land surveying and titling projects across the continent. The Bank's rationale is similar to that of colonial administrators; communal ownership of land inhibits the growth of agricultural production (Bassett 1993). The legal surveying of land in preparation for private individual or group titling is well under way in many countries, sometimes initiated by the central government, sometimes by local NGOs, villages or individuals. Combined with IMF structural adjustment programmes which allow for foreign ownership of private land, these titling projects are currently producing a rapid and dramatic restructuring of access and control of forest lands and NTFP in many tropical African countries.

The logic of privatisation can be challenged in several ways, not the least being the lack of evidence that private titling is a sufficient, or even necessary, condition for improving agricultural output (see Bassett and Crummey 1993). More important, for the purposes of this chapter, is that the conceptualisation of customary land law in Africa which underlies the logic of the titling programmes is highly debatable. It is essentially an

evolutionary model which asserts that land ownership will progress from a communal form (tribal, chieftainship, clan) to a private, individual form (Bassett 1993). Much of the research on African land tenure, however, does not support a linear, uni-directional pattern of change in ownership from communal to individual. Two decades of historical research has demonstrated that much of what today is considered ancient custom is recently invented, derived from years of co-operation and conflict among local African elites, colonial administrators and the mass of peasants and pastoralists (e.g., Berry 1992; Ranger 1993). Research into contemporary systems reveals multiple forms of overlapping and inter-penetrating land and resource rights that encompass both group and individual claims (Peters 1987; Neumann 1992a; Peluso 1992). In short, a plot of land may have multiple claims upon it, both group and individual, that can include rights to water, fuel, grazing, cultivation plots, and any number of other activities and NTFP (Peters 1987; Fortmann and Bruce 1988). These rights of access and use may vary according to season, social identity, species or type of usage (Wilson 1989; Neumann 1992b; Campbell 1993; Peters 1994). Land titling programmes, based on the relatively more rigid concept of private property, cannot address the complexity and flexibility of existing land and resource tenure. Land titling entails a fundamental shift in social relations, from rights in living resources and NTFP to rights in surveyed, privately owned plots of land (Peluso 1995). Under these conditions, questions of whose rights or which rights will be privatised become critical (Shipton and Goheen 1992).

Buffer zones and wildlife migration corridors

The particular political ecology of sub-Saharan Africa has recently given rise among conservationists to an interest in establishing protected area buffer zones and wildlife migration corridors (Newmark 1993; Wells and Brandon 1993). Buffer zones are lands adjacent to parks and reserves where land use and economic development activities are restricted to those which will not have adverse ecological effects on the protected areas (see Mackinnon *et al*. 1986; Oldfield 1988) The concept embodies the dual goals of added protection for the protected area and the improvement of local livelihoods through sustainable development within the buffer zone. The buffer zone idea can be traced specifically to the biosphere reserve model within the Man and the Biosphere (MAB) programme (Batisse 1982) and more generally to the systems approach developed within human ecology. Wildlife migration corridors are areas of habitat, usually linear in form, that provide for the free movement of migrating species between protected areas. The theoretical basis for wildlife migration corridors can be traced to the theory of island bio-geography, specifically the hypothesis that the level of geographical isolation is directly related to rates of extinction on islands and a consequent equilibrium level of species diver-

sity (MacArthur and Wilson 1967). Applied to conservation, parks and forest reserves become analogue islands, and habitat corridors become "bridges" which allow interactions between potentially isolated populations. Like buffer zones, migration corridors are presented as a means to strengthen local land and resource claims and promote community development (e.g., Newmark 1993).

Recent interest in these new land-use designations stems from the concern among conservationists that parks and reserves and the species they contain cannot be protected in isolation from larger ecosystems. Wide-ranging seasonal wildlife migrations are usually not restricted within a single contiguous protected area boundary. Conversely, human activities outside the protected areas may have adverse effects within these areas and thus land uses which minimise impacts are to be encouraged, while incompatible uses are to be restricted. The interest in improving local livelihoods is to a large degree conservationists' responses to decades of African peasant and pastoralist resistance to the loss of customary rights of access to land and resources within protected areas (e.g., Neumann 1992a). From the colonial era and continuing into the post-colonial period, forest and wildlife conservation has been typically characterised by top-down, often coercive, policies that displace African settlement and land use. Increasingly in the 1980s, conservationist literature emphasised the need to reconcile conservation with the needs of local people and it has since become *de rigueur* to emphasise "local participation" and "community development" as keys to the success of any conservation project (Omo-Fadaka 1992; Wells and Brandon 1992; Cleaver 1993; Baskin 1994). Thus buffer zones and wildlife migration corridors are offered as models of ICDP that simultaneously provide ecological protection and legal protection for existing land and resource rights.

The land area which might fall under these types of land-use controls is potentially enormous. The buffer zone proposals with which I am familiar usually call for a 10-km wide strip around protected area boundaries. Depending on the size of the original core reserve, this could easily increase the area of restricted land use under central government control by 100 per cent or more. In several African countries, the proportion of land already enclosed within park and reserve boundaries ranges from 10 to 25 per cent. While the model assumes that land-use restrictions will be compatible with local economic development needs and be based upon local participation in management and decision making, this remains to be worked out on a case-by-case basis. Integrated conservation models can often sound alarmingly similar to traditional set-aside areas controlled by armed rangers. Recently, for example, a senior UNESCO scientist writing about "conservation units" that would include a core protected area and surrounding buffer zones suggested that these units "be managed as a single entity, with marked and patrolled boundaries and entry only through manned gates and

access roads" (Lusigi 1992). In other words, entire communities would be enclosed within a militarised boundary with land-use activities closely monitored by central government authorities.

In many cases, the policies of private land titling and ICDP converge (Oldfield 1988; Cleaver 1993). Several cases from Tanzania are illustrative. The first is a buffer zone proposal, including riverine and spring forests, outside the north-eastern boundary of Serengeti National Park. Conservation officials' interest in a buffer zone in this area was based on the assumption that local livestock grazing and NTFP extraction were compatible with conservation goals and thus pastoralist resource access and property claims could be supported and strengthened. Ultimately, conservationist support encouraged an initiative by community organisers to survey their lands and file for village title deeds (KIPOC 1992). In the case of Tarangire National Park, pastoralists saw a proposed buffer zone as another mechanism for outsider penetration into local land and resource control. They refused to participate in the buffer zone programme until they had hired their own surveyors and legal assistance to gain title deeds to their village lands. Again, titling was done at the village level rather than by private individual. A wildlife migration corridor proposal in the forested areas near Kilimanjaro National Park has the backing of some Maasai pastoralists who see it as a way to strengthen their claims on fuelwood and grazing access against the encroachment of agriculturalists (Newmark 1993). Whether or not this would include the titling of lands by villages is not clear. Finally, the sale of tourist lodge sites in buffer zone areas to outside investors has caused alarm among some local communities who are faced with the loss of access to valuable NTFP when forest commons are titled to private individuals for tourism development (Neumann 1995).

Implications for NTFP

These two policies provide specific examples of more generalised trends in state and international interventions into land use, ownership and access that can greatly affect NTFP use. The discussion of land titling and ICDP projects raises a number of questions that have general relevance for NTFP use just about anywhere, but particularly in tropical third world countries. First, most ICDP projects employ terms such as "local people", "compatible land uses" and "local participation" whose meanings are ambiguous or simply unexamined. Who and what is local? How are the criteria for compatibility established and who controls and monitors land use? Land titling, whether as part of a national development strategy or a ICDP project, is proceeding with little understanding of customary ownership of or rights to use NTFP (e.g., URT 1992). What happens with regard to NTFP tenure and utilisation when land is removed from the jurisdiction of customary land laws and privatised? Many interventions are based on the recognition of customary rights to land and resources as a key to sustainable NTFP

extraction and the improvement of local livelihoods. Given the complex history of customary land law in Africa and the fact that much of what passes for traditional tenure is only a generation old, how do we define and identify local customary rights to NTFP in our research? In the following discussion I will set out these questions as the framework for exploring research priorities. In the final section, I will address some of the methodological issues in NTFP studies.

Who and What is Local?

The question of the local is not unique to NTFP research and critiques of the notion of local are fairly common. Nevertheless, ICDP projects frequently conceptualise an undifferentiated local population as beneficiaries and "local people" is still used as a unit of analysis in much applied research. In this section I want to "unpack" the notion of local and in the process indicate the need for research designs which address the heterogeneity of communities dependent upon NTFP use. It is absolutely crucial that research design address the fact that villages are often politically fractured and socially differentiated in complex ways. Fractures in the local community may run along gender, class, age or ethnic lines of identity. The relative weight which individuals give to these identities is often dynamic, changing depending upon the social context and upon the particular issue at hand. Thus divisions within the community will shift accordingly, perhaps at times nearly disappearing as communities present a unified front to a perceived threat from outside, sometimes multiplying in internal struggles over land and resources.

In Africa, gender is one of the key factors in determining ownership of and access to land and resources (e.g., Rocheleau 1988; Carney and Watts 1990; Schroeder 1993). Lines of differential access and ownership between men and women may be drawn depending upon the type of activity, type of product, the species, the location or the intended use of the product. It is quite possible that men and women of the same community make conflicting claims on NTFP. In such a situation, interventions for forest conservation and community development may favour one group over another and exacerbate inter-gender conflicts. There are cases where the promotion of tree planting for NTFP use had the unforeseen effect of usurping women's land rights in favour of men's (see Schroeder 1995). NTFP research on tenure and utilisation must include a recognition of the differing interests and activities of men and women and be designed so as to understand the consequences of interventions.

Pronounced socio-economic stratification within communities can lead to the formation of class interests which may disagree on the question of NTFP use. Conflict may be particularly strong in cases where NTFP extrac-

tion for market sales is being promoted as a sustainable development alternative. In such a situation, profits may flow to the wealthy who have the capital, knowledge and resources to mobilise labour and transport products to market. In effect, where patron-client relations exist, sustainable development projects based on NTFP extraction can serve to perpetuate or reinforce those relations without substantially improving the livelihoods of the "local people", with the exception of a very few individuals.

Finally, the question of the local brings us to the growing donor infatuation with NGO-sponsored and managed rural development. A recent modification within the development paradigm has been a pronounced disillusionment with the ability of the state to implement development projects and a growing emphasis on the direct funding of domestic, grassroots NGOs (Clark 1991; Hanlon 1991). In this thinking, states are viewed as corrupt, inefficient and lacking in political legitimacy and thus actually tend to block development. NGOs, on the other hand, are viewed as institutions of democracy, responsive to local needs and cost effective. Direct funding of domestic NGOs is a way to circumvent the state and go straight to the targeted local population. Since the protection and regulation of sustainable NTFP use is commonly a part of rural development schemes, NTFP research is needed to investigate the validity of all of these assumptions.

To begin, NGOs are not inherently or automatically democratic (see Hanlon 1991). That is, decision making is through boards of directors or executive officers and there is no public electoral body through which organisations could be held accountable. In fact, accountability is generally confined to the funding sources, not the people affected by development projects. The level of representation is an open question. Who are the organisers of local NGOs, what are their economic interests, and who stands to gain through NGO-initiated projects? NGOs appear just as susceptible to corruption as government bureaucracies, and opportunities for personal enrichment at the expense of real improvement in rural livelihoods just as common. Case studies now being published indicate that the same inefficiencies and lack of attention to local needs and aspirations characteristic of state projects are found in NGO-oriented projects (Korten 1994; Vivian 1994). Money directed toward these, evidence shows, may create a new supply of NGOs that are established principally to tap the funding flow and have no history of community interaction (Korten 1994). Domestic organisers who present themselves as "local" representatives may be former government officials and politicians with the knowledge, training and connections to quickly switch hats as funding priorities shift. This is not to say that all NGOs are suspect. What the rise of NGO involvement in forest-related development projects does mean is that there is a great need for research into the origins and roles of NGOs and the consequences of their activities for NTFP tenure and use.

How Does Land Titling Affect NTFP Tenure and Use?

Titling of land formerly under customary law is occurring at a rapid pace throughout Africa. As land becomes surveyed and privatised, access to and ownership of forest lands and NTFP are likely to be dramatically altered. Exactly how remains an unanswered question. In recent years, research in agro-forestry and social forestry in general has revealed the seemingly endless complexity of property systems related to NTFP (e.g., Fortmann and Bruce 1988; Wilson 1989; Peluso 1992; Schroeder 1993, 1995). Rights to trees may be held by one or several individuals, though the land may be owned by another party. Access rights may vary seasonally, perhaps depending on the fruiting cycles of valued tree species. Rights to a particular forest area or resource may be overlapping or nested according village, lineage, household and individual property rights. As an example, on Mount Meru in Tanzania, rights to hang bee hives in particularly productive sections of forest are exclusive to the male heads of three lineages (Neumann 1992b). Access by non-lineage members to the area for other NTFP is allowed, though activities which disturb honey production are prohibited and right-holders must be compensated in the event of damage by fire or cutting. The question, then, is what becomes of these multiple and shifting rights to NTFP when ownership is transformed to rights in land after surveying and titling (Peluso 1995).

One aspect which requires investigation is the different effects on NTFP tenure and use stemming from titling of land to an individual versus titling to a group, such as a village. In Africa, both are occurring. Group titling has the greater potential not only to allow the continued existence of many of the complex, overlapping sets of rights to NTFP, but also to secure those rights against further erosion. Legal title deeds are far more secure than customary claims based on ambiguously defined, usually unwritten property rights. If a village titles its land, clearly their access to the NTFP within would be greatly protected against loss. There could still be a great deal of flexibility and complexity of rights to NTFP within the community if these rights were not divided up among community members as part of the titling process (Peluso 1995). In other words, if the village lands were simply bounded and titled without further identification or division of rights to resources within the circumscribed lands, access to NTFP might continue with little transformation. Conflicts could arise, however, in cases where people outside of the group receiving the title deed have claims to NTFP within the newly bounded village lands. This is often the case where a particularly scarce product, such as a dry-season water source or honey source, is shared among several villages or even ethnic groups. Access for people who are not considered members of the group receiving title may be cut off. At the very least, their continued access would be legally dependent on the goodwill of the titleholders.

The titling of land to private individuals has the potential to result in significantly greater alterations of NTFP tenure and use than group titling. The process of individual land titling generally does not include the division of property rights to harvest NTFP among people with customary claims. There is ample historical evidence from Europe to suggest that the titling of land to individuals will curtail customary access to NTFP with dramatic consequences for both rural livelihoods and the forest environment (e.g., Hay *et al*. 1975; Thompson 1976). Sometimes in Africa land is titled to foreign investors (an increasing phenomenon as liberalisation deregulates foreign investment) without the prior knowledge of those people holding claims to customary rights to NTFP (e.g., Neumann 1995). In other words, there is no opportunity for asserting customary claims to NTFP before property rights are permanently fixed in the hands of a single individual. Land grabbing is not restricted to foreign investors as local and national elites are able to use their knowledge of the legal system and government bureaucracies to gain title to land formerly held under customary law.

There are many questions that need to be investigated in order to understand the effects of land titling on NTFP. What is certain is that titling transforms flexible, multi-dimensional rights to forest resources into rigidly and permanently circumscribed rights to land (Peluso 1995). Are there conditions under which land titling can actually support continued access to NTFP and if so, what are they? What are the ecological consequences of land titling and under what conditions are they negative or positive? Can group titling provide the flexibility to allow access for non-members where there has been a history of multiple-group access? What are the potential effects of titling on the livelihoods of NTFP-dependent community members? How will different groups of community members, such as men and women, wealthy and poor, landholders and landless, feel the effects of titling? How will group membership be determined when allocating access to NTFP on group-titled lands? Would, for example, non-resident kin be entitled to access?

How is Forest Use Controlled and Monitored?

One of the earliest administrative acts by European colonial powers in Africa was to establish state-controlled forest reserves in the most significant forest zones. This typically entailed the criminalisation of many customary forest uses and the elimination of customary tenure, though some subsistence uses were allowed. The history of forest-access control in Africa, however, is not simply a straightforward record of increasing power by the state at the expense of local, customary control. In general, it is true that the state has strengthened and expanded its authority, but there have been counter trends as well. During the colonial period, government authorities attempted different models for local control, including "native forest reserves", which allowed for local communities to manage

and receive the benefits from village forests (Neumann 1992a). The accounts by forest officers and local elites found in the archives sound remarkably similar to contemporary ICDP models. From the 1930s through the 1950s, colonial governments initiated these projects with the hope that they would divert pressure away from state forest reserves and train local leaders in sustainable forest management for community development. Control on the ground was vested in the institution of "native authorities", the chiefs and village headmen who served as intermediaries between the colonial administration and the masses of Africans. In many cases, for a variety of political reasons, the native authority lacked legitimacy among the people in whose name they were managing native forest reserves. Furthermore, ultimate control remained in the hands of the colonial state. Designation of forest reserves was made by the colonial Parliament at the recommendation of the Conservator of Forests. The range of uses was restricted by the central government authorities and activities were monitored by the officers of the Forest Department.

This survey of history points out, first, that many of customary rights of access to NTFP were criminalised by the colonial states, a process that is still contested today. Second, calls for "local participation" and local benefit sharing are not all that new, and were perhaps more fully developed at different times and places during the colonial period. Third, these proposals remain subject to the same sorts of politically charged questions: how is access controlled, to what degree is the institution of control seen as legitimate by the community, how is the range of uses determined, and who takes responsibility and authority for monitoring compliance? Increasingly in contemporary cases, local groups, often in the form of NGOs, are demanding autonomous control of land and resources which they view as customary property rights that have been usurped by the state. These demands are politically quite radical, and most conservationists and state authorities are reluctant to go so far as to grant sole control of forests and wildlife habitat to villages or other local political entities. Local participation and local benefit sharing is not the same as local power to control use and access which, in the end, is what many communities seek. Ultimately, many of the ICDP proposals are attempting to legally fix the types of land and resource uses that can or cannot take place. These proposals are based on the assumption that local participation will produce mutually agreeable goals. The question remains, who holds final authority when goals and ideals diverge, as they inevitably will from time to time.

Clearly, one of the key issues for NTFP research is the extremely sensitive and contentious question of political empowerment. Problems of NTFP use cannot be treated as merely technical in the many cases where NTFP use serves locally as a symbol of peoples' ability to control the means of their own livelihoods. The question of power is behind many of the issues now being faced in ICDP models like buffer zones and migration corri-

dors. Research is needed to document and analyse the wielding of power in the different types of institutions, whether state bureaucracies or local informal arrangements, which control and monitor NTFP use. For example, in the case of village titling, do institutions exist that will promote equitable access? What sort of institutions exist to inhibit individual enrichment at the expense of group access when forest lands are titled? How do state and local institutions interact in the process of decision making over access and use? In what institutions does the ultimate power to control access and use lie? What is the effect of this power on local livelihoods and the ecological conditions which sustain NTFP utilisation? What is the gap between *de facto* and *de jure* controls on access?

How Do We Identify Customary Forest Rights and Ownership?

ICDP projects, or any interventions for the sustainable utilisation of NTFP that include the integration of local livelihood needs in the planning process, must begin by documenting local customary property and use rights of land and resources. Colonial administrations, with very different motivations, also made documenting customary land laws a priority, hiring government ethnographers to survey Africans about their histories and traditions (Coulson 1971). This was essential for the functioning of the British colonial policy of indirect rule (Berry 1992). If colonial rule was going to be conducted through customary political systems they first had to be documented. As historical research has shown, customary systems were not based on static and ancient norms, but were dynamic and constantly subject to negotiation and the application of *ad hoc* rules. In this context, the very act of surveying and documenting land and resource rights by colonial authorities became a process of collaborative invention of meanings, definitions, rules and norms. It is a process subject to contest, for the act of writing permanently fixes rules of access and ownership that were previously flexible and negotiable. Contemporary research into customary rights to NTFP is just as politically charged and may be just as likely to produce customary law as to document it.

A key issue in identifying customary rights, once again, is power. NTFP research into local, customary systems of property and access control must first recognise the internal and external distribution of power in the community or group under study. Research must identify the forms that power takes and how it operates to control the use of NTFP. It must also be sensitive to allegiances which develop between parties to bolster or create the power for one group to advance its claims over that of another (Shipton and Goheen 1992). An example is the logging companies which intervene in disputes over customary rights of forest access and ownership by

funnelling money and legal assistance to the parties which favour timber concessions. Research must also recognise that claims of customary rights may shift for NTFP which become commodified. Commoditisation of forest resources is increasingly part of ICDP proposals, based on the logic that the more economically valuable a resource is the more likely "locals" are to protect it. A sudden change in the value of a NTFP from subsistence resource to marketable commodity may have the effect of attracting claims, thereby complicating the task of identifying customary rights. In short, customary claims are often highly contestable and research which attempts to document customary claims may actually have the effect of amplifying or even producing conflicting versions of history and custom. Sorting it all out requires attention to the operation of power.

The essential point here is that different groups may have various interpretations of custom. Men's may be different from women's, the rich from the poor, and the youth from the elder. This is not to say that claims are simply invented out of thin air. They are not. Customary claims, in varying degrees, are derived from social practice. Locally derived and understood meanings attached to land and resources carry with them sets of obligations, responsibilities and rights that apply differentially according to social position. The issue of invented tradition arises over more basic questions of the power to designate categories and narrate history, which ultimately have the effect of assigning rights, responsibilities and obligations (Shipton and Goheen 1992). In other words, it is essential that we understand whose version of history is being narrated and who has the power to make their version the legally sanctioned one. The likely result of one version being chosen over another means that some parties will lose out in terms of access rights. In situations of rapidly changing economic conditions (such as the shift to private titling), it is often the "losers" who most staunchly defend "tradition" and do so selectively and creatively.

The process of identifying and documenting customary rights of ownership of and access to NTFP is a messy affair. Numerous parties are involved, all bringing their own, sometimes wildly divergent, sets of meanings, categories and definitions. The researcher, the state official, the widowed mother, the charcoal marketer, the large landowner and the pastoralist will typically have notions of customary rights which are conceptualised within the context of their varied social experiences. The questions we need to bear in mind in carrying out this research must address the social complexity of situations and the wielding of power in the process of making claims based on custom. Who writes/narrates the history of customary practice? What do forest resources mean and to whom? Whose categories and definitions of land and resources are going to be employed? The state's? The researcher's? The "locals"? How do social alliances and affiliations affect customary rights? What happens where categories or definitions are mutually incompatible? For example, where the state has outlawed access but

use continues based on local claims of customary rights, is this merely an expression of *de jure* versus *de facto* rights? Or does conceptualising the situation with such neat classifications mask the greater complexities of the social relations which regulate access to NTFP?

A Note on Methods

The thoughts I have on methodology are not necessarily a statement of what every study should include or that all researchers should be employing all of these methods. Rather it is a quick summation of some of the methods which are needed to address the questions I have raised above. They may be included in a single inter-disciplinary study, but I have in mind, more realistically, that most studies will employ one or two.

First, I believe that some degree of historical analysis is key to any investigation of forest use. This might include demographics, environmental change, the evolution of settlement patterns, the role of the state, as well as an effort to document customary ownership and access and the dynamics of customary practices. Historical analysis is important for a number of reasons. Ideas tend to be recycled. I have found many cases in colonial archives which echo contemporary ICDP proposals. The argument that "local people" must be involved in forest and wildlife management and conservation was part of the broader ideology of indirect rule during the colonial period. Buffer zones were proposed for Tanzania's reserves as early as the 1920s (though for very different reasons). There are lessons to be learned from colonial interventions, lessons on what works and does not work socially and ecologically. These lessons may include insights which help to explain successes and failures. Historical analysis is an important method for documenting shifts in the control of NTFP ownership and access through time and thus for understanding the roots of the contemporary situation and the origins of conflicting claims, particularly between the state and local communities. Documenting, for example, past patterns of local forest use and the effects of state conservation policies on those uses is critical for explaining contemporary state-society interactions. Gathering oral histories is essential for documenting local institutional structures which regulate NTFP use, and for identifying customary claims to NTFP ownership and access. Oral histories, collected from representatives of the various social divisions within a community, can also help to identify the origins of conflicting and contested claims to NTFP.

Second, ethnographic methods are essential for any research which attempts to understand patterns of NTFP ownership and access. Specifically, an ethnographic approach is the principal means to uncover the culturally constructed meanings which structure NTFP use. These meanings include gender identity and the practices, rights and obligations that are associated with being a man or a woman in a particular society. They also include

spatial categorisations, religious and spiritual connotations associated with particular places or forest species, and the social connotations and consequences of harvesting NTFP for the market versus for subsistence. Too many interventions to promote sustainable NTFP use are driven by positivist, neo-Malthusian thinking in terms of population pressure on forest resources. Such approaches do not address the deeper meanings attached to the forest and its uses. Understanding failed interventions and planning successful ones is, to an important degree, dependent upon ethnographic investigation.

Finally, the creation of a multi-dimensional matrix of important variables might be useful for structuring and unifying an overall research agenda. The matrix, at the most general level, could include social, cultural, biological, temporal and spatial variables which affect NTFP access and use. Individual studies would choose (or could be categorised according to) which portion of the matrix they address. For example, an ethno-botanical study might be designed to contribute to knowledge in the cultural, social and biological portions of the matrix. A matrix would also be useful for identifying the existence of gaps in knowledge, and thus help direct research funding. The matrix could accommodate multiple analytical levels, from macro-structural factors (such as structural adjustment programmes, land-titling programmes, global environmental conservation agendas and patterns of international debt) to the intra-household dynamics of gender relations.

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Chapter Ten

Living in Abundance

The Forest of the Wayampi (Amerindians from French Guiana)

Pierre Grenand and Françoise Grenand

The theme of "abundance and harmony with nature", which is applied to populations in tropical forests, has become a symbol widely used by environmentalist groups. An amazing feature of this appropriation is that it emanates from groups advocating the protection of the environment and, in particular, of animal species.

Amerindians from the Amazon basin are no protectors of nature, in the sense understood today, because the concept itself is completely foreign to them. Moreover, by listening to their daily conversations, we can deduce that they are passionate hunters and fishermen. Paradoxically, the fact is that the Amazonian environment, where they still live in the wealth of their traditional culture, is in a healthy state. For this reason they have been considered "forest conservationists" (Posey 1982).

If one takes the trouble (and the pleasure) to share for a while the subsistence practices of some of these societies, it is not the notion of protection in itself (nature as conceived from the perspective of animals and plants) as much as the notion of abundance and thus renewal of the species (nature as conceived from a human viewpoint), that is apparent. To quote Robinson and Redford (1991), it seems we are dealing here with a real *sustainable* harvest of natural resources.

We have chosen the Wayampi to illustrate the theme of adaptation to an environment. We shall see how practices and representations have helped to maintain, even to restore, this abundance at critical times in their history. First we shall present the dominant adaptive features of Amazonian societies.

This region of the globe has not witnessed any Neolithic revolution similar to that of the Old World. The first tools might have been similar,

but the adaptive choices have been dramatically different. In a universe dominated by hunter-gatherers, an agriculture based on tubers, in particular on bitter manioc, seems to have appeared in the region over 3000 years ago, but an external influence cannot be excluded (Roosevelt 1989).

A unique aspect is that, in parallel to this slash-and-burn agriculture with its long-cycle, long-fallow periods, so-called activities of predation have survived and even developed; hunting, fishing and foraging. In comparison to the effort involved in those activities necessary to provide the protein indispensable to survival, the cultivation of manioc, even more than sweet potato or various American yams, offered definite advantages; high productivity, hardiness, limited pest susceptibility and especially the possibility of spreading the harvest over one or two years – the cost of natural storage in the soil is much lower than artificial storage. This system combining hunting, fishing and agriculture with long fallow periods still dominates most little or not deculturised societies from the Amazon basin.

Before the Christian era, riparian societies along large rivers and predominantly sedentary savanna societies appeared, practising a permanent agriculture based on vegetable protein-rich maize (Roosevelt 1989). It was planted on lands fertilised yearly by the rising waters or on artificial hilltops with elaborate drainage systems (Denevan 1970). There was no animal husbandry, however the first European chroniclers observed proto-domestication of some animals (turtles, ducks) in these societies. Because these stratified societies were eradicated in the course of the 16th and 17th centuries, they have no relevance to the present study.

In all other forest societies, the varied and clearly bi-polar activities have corresponded to, and still do, a unique pattern of sexual division of tasks; a female-dominated agriculture as compared to male-dominated predation activities.

Nevertheless this over-riding view should be tempered because the Amazon and its surrounding areas enclose societies which ideologically stress, and even base their representation of the world on, one subsistence activity. However none of these activities are completely rejected, even the Palaeolithic activity of gathering. We therefore are presented with a true balance, widely agreed upon in the societies experiencing it, and without any indication of a real evolutionary tendency. And this, in spite of the wide possible debate on the differentiation between certain Amazonian civilisations which have or are believed to have domesticated nature (Descola 1986) and other civilisations, such as Tupi societies which in permanence fight a threatening nature on the verge of annihilating them. In any case, these societies present characteristics closer to the hunter-gatherers described by Sahlins (1972) than to the European agricultural societies which started a slow but definite evolution from the Neolithic.

The Wayampi: History and Environment

The Wayampi society is a perfect example of the Amazonian model because all subsistence activities practised in this vast region are well represented in this society. In 1990 it had a small population of 835 members of the Tupi-Guarani language group, further divided into three regional subgroups localised in the basin of the Oyapock river in French Guiana and in that of the Amapari river in Amapa (Brazil).

Before reaching their present situation, they have experienced a troubled history (P. Grenand 1982; Tilkin-Gallois 1986) which should be summarised from the point of view of adaptation to the environment. It is often forgotten that small societies have, like any other population, their own history which is significant as much for their vision of the world as for their symbolic or religious representations.

The emergence of the Wayampi environment as it is today is based on the conflict between two colonial powers, France and Portugal, as well as on favourable natural conditions; a region whose waters drain into both the Guianas' rivers and the northern tributaries of the Amazon, with an uneven relief and streams interrupted by rapids and waterfalls. The history of the Wayampi, significant in its shortness, represents a real alternative lesson to development.

1690 : The Wayampi occupy the Lower-Xingu, south of the Amazon. The population forms a network of several Tupi-Guarani ethnic groups most likely making up a coherent cultural cosmos of tens of thousands of people (Betendorf 1909).

The Wayampi, as well as the other populations of the region, are riparian. They practise slash-and-burn agriculture, and constitute large communities along big rivers with ample fishing resources, especially in the rapids of the Volta Grande. Traces of this period in their history can be found in oral tradition with invocations for fishing dams and dances of appeasement, still executed today, which refer symbolically to the fishing of the enormous pirarucu (*Arapaima gigas*) and piraiba (*Brachyplastystoma filamentosum*). It is also during this period that they discover metal tools.

Following several clashes linked to the competition between Flemish, English and Irish on one side, and Portuguese on the other, the hegemony of the latter materialises mostly through the activities of Jesuits who establish four missions in the region to gather the Amerindians (Hemming, 1978).

The main sociological constraint of the missions is the compulsory interethnic acculturation, not to mention religious pressure, of which present-day Wayampi do not have a clear memory, but which is reflected in their extreme suspicion of any missionary indoctrination.

1736 : By this date, the Wayampi have crossed the Amazon and have settled on the left bank, on the lower Jari and its eastern tributary, the Rio Iratapuru, occupying a territory of roughly 12 000 km^2. Population is still significant even though a diminution is possible as compared to the last period.

This migration movement through a region controlled by forts and missions was probably induced by the Portuguese who then practised a policy of desertification between their possessions and those of the French in Guiana. Both Portuguese and French sources detail the use of the Wayampi for warfare. During this period, the Wayampi have hostile encounters with the still relatively numerous native populations, mostly Karib but also some Tupi-Guarani.

Their mode of subsistence is most likely still very similar to that of the previous period, since the lower Jari and the nearby Amazon offer similar possibilities. However, through their raids into the northern parts they visit small streams and the inner forests of the Amapa, thus becoming familiar with the characteristic flora and fauna of the Guianas Plateau

They are credited by French sources with firearms which were more probably used for war and dissuasion rather than for hunting. Even though the Wayampi are still very much dependent on the Portuguese for their supply of metal objects, and are still under the influence of the missionaries, their warfare activities provide them with a greater autonomy as the missionary power loses its grip.

1770 : The Wayampi population can be estimated plausibly at about 6 000 individuals. They occupy a vast territory, covering roughly 15 000 km^2, from a central point which all present-day subgroups locate at the Kumakakwa Fall on the upper Jari. These territories unfold as far as the Araguari to the east, and up to the sources of the Oyapock to the north.

This period is marked by an increasing distance from the Portuguese, major warfare (in particular against the Wayanas) and by an intense assimilation process of remaining ethnic groups.

The Wayampi gradually move from a riparian to a forest habitat, most villages being built along tiny streams, oddly keeping their pile dwellings, a relic of their adaptation to the floodable banks of the large rivers. It is most probably at this time that they adopt the archery of the regional Karib groups (especially the Apalai and Wayana), including the use of curare. Basket weaving is strongly influenced by the Karib. Pottery, fabric weaving and agriculture, especially with the importance of maize and peach-palm (*Bactris gassipaes*) keep their specific Tupi-Guarani characteristics.

Political autonomy is regained. The clan system is flourishing as well as vendetta and factionalism around strong men, the two major characteristics of Tupi-Guarani societies.

1815-1830 : The Wayampi have broken off contacts with the Portuguese and the Brazilian doctrine of submission fails by 1840. Consequently the Wayampi lose access to firearms and metal tools. They thus start to approach the French peacefully. It is during this period that the thriving population, already well-adapted to the forested environment of the Guianas, will lose three-quarters of its members in fifteen years of devastating epidemics.

Paradoxically this is also the period of maximum territorial expansion; without abandoning the regions occupied in the last period, they enter the basin of the upper Oyapock to its confluent with the Camopi river. They now occupy an area of 19 000 km^2. Village communities react to epidemics by dispersing; they are divided between riparian and forest habitats. Communications are still by canoe for some, but the network of walking paths develops dramatically.

From now most communities will depend more on hunting than on fishing for their subsistence. Axes and metal blades, even though in small quantities, have revolutionised agricultural techniques; it is now possible to select plots of land based not only on the low density of big trees to cut down, but also according to the qualities of the soil. Time spent on clearing is reduced; small trees are no longer barked to wait until they die where they stand, and big trees are not carved out in order to keep a fire for months in the hollows.

The vastness of the territory furthers the emergence of limited groups of communities with preferential relationships, encouraging only irregular contacts with other sub-groups organised on similar bases. On the other hand, they will be under various influences based on their nature of contacts. This phenomenon will further contribute to each sub-group's specific identity markers which are still recognisable today.

1880 : The area occupied by the Wayampi still covers about the same territory with the exception of whole areas which had to be abandoned due to epidemics. Habitat is henceforward characterised by pockets of dwellings far from each other, the surface actually occupied is therefore no greater than 7 000 km^2. Population numbers are between 700 and 800 individuals. Complete separation between southern and northern sub-groups occurs by 1895. Except for the furthest north sub-group, which actually has closer contact with the Creoles than with the French, contacts with the outside world are so rare that the Whites will remain unknown for four generations, except in recollections from the past, to communities located between the Inipuku and the Amapari.

Despite sporadic contact, the weight of epidemics will remain heavy on communities, with relatively significant repercussions on the capacity for production of numerous villages; even though the potential for hunting and fishing remains intact, oral tradition recalls starvation. The most-isolated

groups thus become a model for resistance. The alternative is tragic; contact simultaneously brings metal tools, disease and death, isolation cuts off epidemics while dismantling networks for supply of manufactured items. Moving further back into the forest, a process which had already started in the previous period, becomes the rule. Isolation is such that most communities forget the use and manufacturing techniques of the dugout canoe; only the temporary canoe made out of fresh bark is now used.

The Wayana benefit from this situation; from enemies they become the only link with the western world, especially for the northern Wayampi sub-groups. They thus gain considerable political and social importance, especially through matrimonial unions. It is also the period of linguistic and cultural influences which are still evident today.

1940 : Northern Wayampi
All communities, except one, are isolated in the hills of the watershed between the Oyapock and the Kouc. A population of 230 individuals occupies an area of around 3 000 km^2. From this date and during the years to come, contacts with the French will be renewed. Strangely enough the wish for contact is mutual. For the Wayampi it is motivated by the desire to be rid of the suffocating domination of the Wayana (Hurault and Fribourg-Blanc, 1949).

Subsistence activities remain the same as those of the previous period. The reappearance of the rifle in its modern form and the discovery of medical care are revolutionary; the Whites always considered as death carriers, now appear to be able to triumph over it.

The occupation of the territory remains an uneven distribution of sub-groups. Contact with the French is still considered positive and their domination, discrete at first, is perceived more as an alliance and accepted.

1968 : Southern Wayampi
The population of these communities is made up of 300 individuals scattered over a territory of 6 000 km^2. Contacts with FUNAI, the Brazilian organisation for the protection of the Amerindians, are accepted but not welcomed. For the Wayampi, it is linked with serious threats to their territory, in the form of the construction of the nowadays-abandoned Perimetral-North road and sporadic intrusions of gold washers and trappers (Campbell, 1989). Contacts with these people, as well as with collectors of balata gum, although rare, started at the beginning of the 20th century. The aggressive character of these contacts, especially the abduction of women, nurture traditions of fighting among the southern Wayampi with direct links to their heroic past.

It is among these sub-groups, with the exception of the furthest south communities currently extinct, that the highest degree of isolation can be found. Communications are strictly by foot. Their subsistence relies only

on the forested environment; hunting is dominant. Fishing is practised in small streams with bows or traps. Besides slash-and-burn agriculture, they have significantly developed arboriculture inside and around their villages.

Today : The Wayampi, all sub-groups included, unevenly occupy an area of 9 000 km^2, and travel over a territory of 7 400 km^2, not including the area covered by the small neighbouring ethnic group of the Emerillons, also of Tupi-Guarani language, located north-west of the territory. Population is increasing rapidly by natural population growth from 490 inhabitants in 1970 to 850 in 1992.

In the course of the last thirty years, contact with the Wayana has decreased while contact with the French or the Brazilians has correspondingly increased. For the furthest north communities, their hunting and fishing territories are shared with the Emerillon. Most recently, all Wayampi groups have progressively joined Panamerindian movements linked to the COICA, through regional federations. Their commitment is still limited.

Meanwhile their mode of subsistence, somewhat modified by new techniques, the widespread use of rifles, the introduction of the outboard motor, the fishing net, etc., remains extremely stable in its practice while avoiding intensification. The widespread use of metal tools in particular contributes to changing the Wayampi into a society of abundance. The forced settlement may have been more or less accepted, but it is nevertheless counter-balanced by high temporary mobility, and the development of double and even triple seasonal dwellings can be observed.

Contemporary concern centres on the problem of land. The notion of demarcated territory, which so far had been extremely vague, acquires meaning with threats of intrusion and external political control, whether it is the indigenous territory of the Wayampi in Brazil or the extended territory covered by the Wayampi of Guiana which is at stake. Whether it is the Wayampi from the south who set up vigils to prevent gold washers or whether it is the Wayampi from the north who threaten to move their villages into the midst of the forest in case of tourist invasion (in relation to the project of the National Park of South French Guiana), we are undoubtedly seeing genuine historical behaviour, reviewed and modified to adjust to modern times.

As for the upper Oyapock, ongoing research reveals particularly interesting results. Due to high demographic growth, large numbers of teenagers with high productivity enter the market. The increasing use of outboard motors has given rise to a lengthening by at least one-third of the communal territory along the river, with its depth remaining unchanged. Because of this carefully managed expansion of territory, firstly neither the number of hours spent nor the exhaustion felt by the men have increased, and secondly hunting and fishing pressures on the territory have not risen.

Therefore, as we shall discuss further, production per inhabitant shows remarkable stability between 1974 and 1994. The main conclusion which could be drawn is that the communities of Wayampi in the upper Oyapock have not changed their dietary habits and that their production is mostly directed to satisfy self consumption needs.

At the end of the 20th century, following the acceptance of several external contributions and undergoing strong pressures for assimilation, their lifestyle as well as its founding representations, remain largely unchanged. The second part of our overview, which represents the synthesis of observations spanning thirty years, will show, from contrasting angles, how the concept of abundance is lived and thought. It is meant to be a case analysis, with no reference, for the time being, to theoretical debates on Amazonian cultures which stimulate cultural ecology.

The Reality of Abundance

The economy of abundance of the Wayampi can be characterised by three criteria :

- an excellent knowledge of their environment, which governs a wide-scale utilisation of the diversity of life;
- high yield in all areas related to subsistence;
- relatively short working hours.

The first criterion is linked to a true sociology of knowledge which warrants discussion. The other two criteria, more specifically ecological, will allow us to appreciate the effectiveness of knowledge.

The nature of knowledge

Emphasis has often been placed on the fact that among the Wayampi an excellent knowledge of the environment coincides with the exceptional diversity of the resources exploited (P. Grenand 1980, 1992, 1993). It can be shown that they name most animal and vegetable species of their actual territory. There are of course exceptions to this rule, e.g., insects are seldom named; the nomenclature for small rodents is also limited. This restriction does not mean that the cognitive approach is not useful. The behaviour of the Wayampi towards identification of new species has allowed us to verify that it is the “intellectual necessity” put forward by Levi-Strauss (1962) which is the dominant feature; it has also allowed us to understand the universality of the approach which drives Man to isolate then aggregate every single living form encountered (Berlin 1992). However even if recognition, definition and then denomination does not necessarily imply utilisation, they are surely non-exclusive approaches; it can be considered, and the following supports it, that knowing lots of species in order to use some

and to select the most interesting is a prerequisite. This process is just an extension of the cognitive approach, and in this case cannot be separated from cultural choices, which themselves imply prior relevant knowledge. It is not out of context to recall the observation made by Brown (1986) based on a currently most complete ethno-scientific literature; those who practise an agriculture of subsistence name five times more plants and twice as many animals than hunter-gatherers. Knowledge of nature thus might not be related to maximum dependence.

The example of wild vegetables in the Wayampi universe is particularly relevant to illustrate the fact that cognitive and utility approaches do not exclude each other. The Wayampi of the Oyapock valley differentiate and name 1 152 living forms or types in the vegetable kingdom. Of course, every individual does not possess the whole of this knowledge, but the cohesion of the community makes it possible for each to access this cognitive store of knowledge. In this group, 673 species (58 per cent of the whole) show direct *primary* utility for Man. This observation can be complemented by a second assertion; it has been shown (P. Grenand 1993) that the Wayampi show interest in the vegetable world in a *secondary* manner, in relation to their hunting and fishing activities. Simply, a good knowledge of the vegetable world is a prerequisite, to know what animals eat, in which environment and in which season. Out of the 1 152 living forms known to the Wayampi, 424 (36 per cent of the total) are known to be food for animals, some of which may also be of direct utility. This shows the importance of the knowledge about animal consumption of vegetable matter for hunters who wish to optimise catches. Finally we have identified 279 vegetable types (24 per cent of the total) bearing names but with no utility value, even secondary, to the Wayampi man or woman; in this sense we shall call them not useful.

Let us examine now additional information provided by the nomenclature of plants (F. Grenand 1989). The Wayampi possess two categories of terms to define flora. The first are terms that cannot be broken down by the speaker: "their meaning is not apparent because they are indivisible" (Haudricourt 1987: 150). For example, the words **asemã** (*Ocotea rubra*) and **takalawelu** (*Bellucia cacatin, Henrietta succosa* and *Miconia punctata*). The second category includes terms which are "composite words, syntagms or synthemes" (Haudricourt, 1987: 150), which can be semantically divided, such as **wïla-munuwi** "peanut tree" (*Heisteria microcalyx*) or the **takalawelu-lã** "false takalawelu" (*Miconia serrulata*). Both can in turn become the base for composites by adding one or, more rarely, two elements, e.g., **takalawelulã-sili** or "false takalawelu, fine variety". If we compare these basic rules of word formation to utility criteria, it can be seen that both types of words, as well as some of their composites, are used to designate plants of primary or secondary utility.

The opposite is not true; "not useful" types are hardly ever named by indivisible terms. The 279 types included in this last group have names

Table 1. Relation between nomination and utilisation

Wayampi term	Translation	Utilisation
takalawalu	indivisible term	primary and secondary
takalawelu-kï	takalawelu-‘clear’	primary and secondary
takalawelu-ïpo	takalawelu-‘liana’	secondary
takalawelu-ka’a	takalawelu-‘herb’	secondary
takalawelu-ka’alulu	takalawelu-‘other plant sp.’	secondary
takalawelu-lã	takalawelu-‘false’	secondary
takalawelu-pilã	takalawelu-‘red’	secondary
takalawelu-sili	takalawelu-‘fine’	secondary
takalawelu-si	takalawelu-‘white’	secondary
takalawelu-sõwï	takalawelu-‘blue’	secondary
takalawelu-u	takalawelu-‘big’	secondary
takalawelu-yowa	takalawelu-‘hairy’	none
takalawelulã-sili	takalawelu-‘false’-‘fine’	none
takalawelulã-yowa	takalawelu-‘false’-‘hairy’	none

formed by adding one or two elements to a basic term describing a “useful” type according to the two criteria of primary and secondary utility. Rare exceptions correspond probably to species known to other ethnic groups but of which the Wayampi have lost the knowledge. The table above illustrates this cognitive process. Such certainty leads us to go beyond the distinction between intellectualisation and utilisation, to suggest that maximum knowledge of an environment makes it possible to make choices of widest possible use. It can therefore be put forward that it is essential for the Amerindians to differentiate between plants which are useful and those which are not – a differentiation strictly linked to cultural choices. In fact, a complete knowledge of the environment proves essential to make full use of its diversity.

Acquisition and variability of knowledge

The perception and identification of the world are prerequisite conditions to understanding and exploitation. Knowledge is necessary for everyone and no Wayampi escapes the need to learn. To be able to identify and name a huge number of animal and vegetable species is considered prestigious. The cognitive approach is of course not limited to acquisition of knowledge, for it is also the basis for explanation (the location of a species, its role in mythology or in history, even in personal anecdotes), or for practices related to the use of these species in Wayampi culture.

Learning about nature is for the whole population. However specialisation of knowledge will develop in line with the distribution of tasks

Example of a comprehensive learning approach based on observation

A father and his son have gone into the forest to hunt, and come to a Guarea kunthiana tree bearing fruit.

The father: "This is a ya t oa'ï, my son."
The son: "Yes, it is an old ya t oa'ï plant."
The father: "There are two young ones next to it, and germination clusters too."
The son: "The biggest is covered with ripe fruits".
The father: "Its fruiting is late this year. Toucans love these fruits, you know. Since the other fruits liked by the toucans ..."
The son: "Like for example the kwa po'i fruit, the kunawalu'ï fruit, or the wasey (1) palm fruit ..."
The father: "Yes, because those have already fallen, it is this tree we have to look for at the end of the season; we can be sure to find groups of toucans there. We shall have good toucan hunts."

The father looks for a fruit on the ground, gives it to his son who takes it in his hand, looks at it for a while, then throws it away: the lesson is over.

(1) kwa po'i: *Ficus trigona* and *F. clusiaefolia*; kunawalu'ï: *Prunus myrtifolia*; wasey: *Eulerpe oleracea.*

between men and women. In a survey on production, it has been observed that, over a period of one year, for the same number of men and women, men went into the primary forest 1 751 times, as compared to 95 trips by women. Such evidence implies huge differences in levels of knowledge.

Learning methods are the same for everyone; the key word being observation. As far as observation of nature is concerned, the technique consists of isolating before aggregating. A father will thus show his son a particular type of tree, often in a precise context of direct or indirect use, and his comments on it will re-integrate this type into a relevant group.

Such an approach in learning applies to all fields of knowledge and starts as soon as a child is able to speak. From the canoe seat, mothers identify edible fruits growing on the river banks or name the different species of swallows skimming over the river. Undoubtedly the child's understanding will be long lasting. From a very early age, he or she will be able to distinguish thousands of life forms and subtle differences in the

surrounding plant world, while an ordinary Westerner will only see an indistinct vegetation mass. In a myth telling the story of the wife of the Creator gone to look for her husband, the twins in her womb, already endowed with the ability to speak, notice the surrounding environment: "Let us find papa. This is the way he took." And while she was walking, the children saw something red and pretty. They told their mother, "Pick some for us to play with". These were balisier fruits, pretty dead leaves of **waapitã**, wild pineapples, and canne-congo fruits.

In the comprehensive view of the universe characteristic of the Wayampi, there are no restrictions. From their first excursion, the young members of the community are shown the main edible fruits, animal tracks and waste, and their habitats, thorny and prickly plants, those with burning sap, insects and dangerous snakes. They are also told *in situ* the most informative stories and legends, and the anecdotal origins of localities. In a relative short time they know the basics, in an essentially repetitive way.

The inescapable consequence of *knowledge* is the capacity to *recognise* an object among a group. In order to recognise what is essential, it is necessary to know all. This expanding process of knowledge moves from the isolation of each new discovery to its aggregation with what is already known, following the rule "it looks like...", "it is different from...". This simple method makes it possible for a child to create his or her own cognitive knowledge which he or she will keep comparing to that of the adults. This represents in reality a never-ending process for every Wayampi, even adults. Each unknown species, each fruit thought to be rare, each unusual flower, to mention only the plant world, is brought back to the village to be submitted to the wisdom of the collectivity. Lengthy discussions follow in the course of which all knowledge is examined to classify and identify the unknown species.

Practical life is also the source of particular forms of knowledge. Women, for example, by daily cleaning game and fish, know trees and their fruiting period, through the seeds and the pulp found in stomachs, even though they have hardly ever seen the live species.

There is no "final examination" of this learning process except the ability to move and to flourish in the expanse of the forest. Even though there is no specialisation of knowledge in the Wayampi society other than that of the shaman, members like to identify experts or simply highly motivated people among them. Women are thus known for their knowledge of medicinal plants, even though it is not their exclusive domain.

On good use of the Wayampi universe

We now examine the second element in understanding the economy of abundance of the Wayampi, the criterion of high yield, which is mostly due to the large number of species which are exploited. However, exploited species and useful species are not the same and it is even less the case for

exploited species and known species, even though the utilisation rate can be considered high for both animals and plants (Boom 1987; Redford and Robinson 1987).

The example of fishing and fish can help to highlight the complexity of the question. Even though the size of streams and rivers and the number of species vary according to the basins, and thus influence the time spent and the catch for each of the three modern sub-groups, fishing is of major importance in the life of all Wayampi. For the communities from upper Oyapock, it comes second after hunting, with an annual production of 4 tons gross, or 28 per cent of the protein of the community.

Inventories established by the National Museum of Natural History in 1976 confirmed that the knowledge about fish of the two Wayampi sub-groups of Guiana is nearly exhaustive, since they identify 100 scientific species with a total of 102 names. Still, names do not strictly match species, since certain species have several names (nine names for four Latin species), and others have no name at all (three names for six Latin species). There are only three unknown species. Lastly, seven species living in river basins which they do not visit any more are still named and remain in the memory of the community.

A survey of the fishing production of adult males conducted by us in 1976-77 for all producers in the community, found that nine species, or groups of related species, constitute the bulk of the annual production. In decreasing order:

Hoplias macrophtalmus	1817.50 kg
Myleus pacu	496.25 kg
Pseudoplatystoma fasciatum	225.25 kg
Ageneiosus brevifilis	191.86 kg
Leporinus frederici	141.70 kg
Myleus ternetzi	140.34 kg
Myleus rubripinnis	132.30 kg
Prochilodus rubrotaeniatus	124.70 kg
Leporinus despaxi, *L. granti* and *L. melanostictus*	121.24 kg

This is a total of 3 391 kg, i.e. 85.6 per cent of the weight of fish caught. The most important species are either big or gregarious, sometimes both, thus making catches large at the various favourable periods of the year. With these results, one may challenge the use of such refined ichtyologic knowledge. Different answers, classified as environmental, are given by the Amerindians, e.g., the knowledge of food chains of carnivorous or omnivorous fish; we think there is another answer.

If we compare our 1976-77 survey to the detailed survey we carried out in 1979-80 which recorded the production and consumption of two fami-

lies every hour, we note that big fish are not caught daily (just like big birds and game). Such catches, which are strictly a male responsibility, are attributable to important fishing ventures in terms of time and distance.

On the other hand, small fish (and to a lesser extent small birds) are part of the daily consumption of families. They are not only easy to catch (in the immediate vicinity of the village), but also no longer the exclusive responsibility of men; women and especially children catch them. A survey of production by children has been made separately on a sample of individuals aged 8 to 15 and reveals an important contribution of small species. Only teenagers are an exception; their interest resolutely turned towards bigger species as proof of their budding capacities as hunter-gatherers on the path of adulthood. This tendency results in lower total production and bigger hunting and fishing efforts.

It can be said that a complete knowledge of living species undoubtedly plays its role in the economy of subsistence in terms of complementarity, and could be expressed by the following statement: "I eat a lot thanks to big species; I eat every day thanks to small species". Exploitation of small species close to the settlement, not only leaves more time for other activities but reduces the burden of fishing pressure on big species. As evidence that this complementary representation of nature has been internalised by the Wayapi people, none of the small species (with the exception of the piranha, *Serrasalmus eigenmanni*) are subject to any types of taboo on their capture or their consumption (F. Grenand 1985).

The time element

The last aspect of abundance to be considered is the small amount of time dedicated to the supply of animal protein. The survey carried out in 1976-77 over a period of one year, records the number of times and the time spent on hunting and fishing activities for a representative sample of the community. Results show that in 61 days of an average of 6.30 hours spent outside the village, a man has a gross production of 493 kg, including mammals, fish, birds and reptiles, i.e. an average of 8 kg gross per day. These figures, even though they do not take into account all parameters, are indicative of abundance. A similar abundance is shown in a survey conducted using the same procedure by Ouhoud-Renoux (1994) in 1993-94. For an identical population surveyed, annual production amounted to 551 kg per person. According to this researcher, "the positive difference is negligible, given seasonal differences from one year to another".

Agricultural activities are heavier. They require around 40 work days of 6 hours per person for cultivation of an average area of 0.51 ha (Grenand and Haxaire 1977). Clearing is a male responsibility, but women dominate all other activities. The average area has sharply increased since it was estimated at 0.34 ha in 1950-55 (P. Grenand 1981). To this 40 days, we add for women only, 42 times 5 hours on average to collect firewood. For manioc

only, production per week and per woman reaches 57.1 kg, yield per hectare reaching 18.4 tons (F. Grenand 1993).

In contrast to the 396 hours per year necessary by each producer for the collection of animal protein, 450 hours are required per year for the management of agricultural land. If we add the time spent for gathering, we get a more balanced picture. Following the examination of the criteria necessary to understand the various facets of abundance, let us now take a closer look at the actual experience.

Why Abundance?: the Wayampi Discourse

For all Wayampi, success in life is expressed by a basic dual principle; "with my game animals and my fish, my wife can offer my friends and relatives collective meals; with the manioc beer from my wife, I can offer the community a feast." Under its pragmatic shell, this concept rests on the basic beliefs of the society.

Contrary to widespread belief, Amerindians consider themselves as individuals, rarely equal. A strong competitive climate and rivalry, both qualitative and quantitative, are constantly present. For men it translates into terms of hunting and fishing success; big catches, high tonnage; for women it is in terms of culinary art; profusion as well as diversity of culinary preparations.

Equality rules on two major points: a complete sharing about the presence or the profusion of a species, to give everyone a fair opportunity; catches have to be carefully distributed and shared either as gifts or as collective meals. To eat or drink by oneself is in the utmost bad taste and quite uneducated to the Wayampi! The subtle game of kinship relations, but also the weight of tensions between families, also arise here and there. The sharing of knowledge and of production is compulsory not only because it triggers strong social cohesion but also because, when it is not respected, it will be seen as a desire to put oneself on the fringe. A certain vision of the world thus becomes apparent as a basis for social ethics and production modes. The question is, what type of vision of the world is it?

The Wayampi universe comprises several super-imposed flat worlds. In the centre lies the Earth, "as flat as a manioc pancake", built by "architects" preceding the Creator of humanity. According to Wayampi beliefs a second team of "architects in a dance" moored the first sky to its present position. This is the kingdom of the vultures, masters of decomposition and rot. Another higher sky is the home of the Creator of the world and of the purified souls of the dead (**t a ï w e**). At the lower level lies an underworld, also flat, where life is dominated by humanised giant sloths, the **w o' o**, perfect mirrors of our animality. The forest covering Earth is said to be "increate" or existing without having been created, beyond the constraints of time, and encompassing all natural forces. Humanity, as it

is, is the work of the Creator **Y a n e y a**, but it has been destroyed twice, by fire then by flood, before taking this imperfect, tangible shape.

On Earth groups of concentric circles are organised around villages and reaching to the forest. Men are located in the centre of these circles; the further away from the centre, the deeper into a space ruled by supernatural entities. The battle for life is thus super-imposed on a metaphysical struggle. Why this double battle? Each species in nature belongs to a "master" called **-y a**. Ultimately, each animal species is dominated by a specific master in a hierarchical system extending from the most important species to the smallest, where all members of one species flock around its master, who like a magician can move them, disperse or consolidate them as he likes. All these masters are dependent on a supreme master called **K u lu pi** . Scarcity or abundance of game or fish depends on this fixed system of domination of nature, and the subsistence activities also fit into this spatial structure, with female agriculture related to close-by circles and male activities of predation related to faraway circles. More tolerated than accepted, men have to behave and take care to act within them. Their intimate knowledge of species helps them feed their families in the village but also helps them detect omens, **m o l ã w ã**, and identify with certainty taboo game animals during forbidden periods, **m a nï w o n a y k o y** (F. Grenand 1985). Most of all, they have to learn to limit their catch and this is the greatest temptation. The problem can be expressed this way; in a system based on wild resources, with abundant game and fish easy to catch, why and then how to control one's greed? The equilibrium of the system lies in the delicate interpretation of the limits of what is acceptable. From there comes the link with supernatural entities experienced through a subtle system of aggressions, **y a pi si**, and of alliances, **y e k w a y**, both being a reflection of the relations between the Wayampi and the neighbouring ethnic groups.

This relation translates into the emergence of an *ethos* in perfect harmony with practices which can be summarised by a simple but strong statement: "masters of nature let me take some of their subjects, without any unexpected evil return; if I take too many, my society will be threatened with ill-being first, then with biological death". Common forms of revenge from the masters affect the child, a fragile member of the community, or the hunter and fisherman with a psycho-pathological syndrome of inability to produce, called **p a n e** (P. Grenand *et al*. 1987).

A fundamental theme of thought can be seen, not only for the Wayampi but also for all Tupi-Guarani (Viveiros De Castro 1992); the theme of animality as opposed to divinity. The principle of human life is made up of an animal component (**t eã ng e**), master of all desires and considered immoderate, and a spiritual component, which we shall call soul (**l a ïw e**), bearer of the best in us, in particular of the altruist character which prompts us to generosity through sharing and giving. It is this same component

which brings us nearer to the Creator, whom humans have not forgiven for having abandoned them in their imperfection. Humans have in a way moved away from the divine state by not having been able to, or known how to, maintain their share of their primordial immortality, and are therefore under the constant threat of a third destruction. Wayampi ethics evolve in this relation to the conflicting and distressed world.

There seems to be a paradox in this; on one hand, society feels threatened by the principle of animality, and on the other hand, it embodies this same animality as prey. Our perishable body, **l e t eke**, is nourished by meaty prey, considered "real food". Without it our body would separate from our soul.

Solution to this paradox is found in the subtle equilibrium between divinities (including humanity) and animality. This equilibrium lies in balanced behaviour, **wo t e ekoy**. Its opposite is excess, **ei te pï a s o**, translated by conflicts between the a yã, a generic term used to describe the masters of the animals, -ya, the shadows of the dead turned into our reincarnate animal double, **t ea nge** after death, and the cannibal monsters of the forest and the waters, **a yã po l o s u'u** and **ïpo**. This conflict results in disease, even death, unless the shaman, **p a y e**, the only link between humanity and supernatural forces, or chtonian or celestial worlds, succeeds in restoring the lost equilibrium. Occasionally, but still significant, this shift towards animality results in metamorphosis, **inu**, an often recurring character of Wayampi mythology (F. Grenand 1982).

This division of the universe between inaccessible divinity and animality is the delicate conflicting element of the daily life of the Wayampi. Attempting to control destructive excesses, it provides an ethical framework which results in sustainable exploitation of resources within their ecosystem.

Conclusion

The comprehensive view of the methods of exploitation and understanding of the environment that we have reached, suggest that the Wayampi society is definitely a permanent society which, in spite of perturbations caused by repeated colonial aggression, has kept mostly pre-Columbian practices. We have demonstrated that (Grenand and Grenand, to be published) the Wayampi have a dramatic vision of alliance with our world, however they know how to integrate technology while minimising its risks. This has been verified (P. Grenand 1995) for the transition from the bow to the rifle; the introduction of other objects, now seen as essential, such as the outboard motor or the nylon casting net, deserve a detailed study.

Supported by the information at our disposal, we can assert that the Wayampi communities, whether from Brazil or from French Guiana,

presently reject all forms of development offered. It was clear that, during the preliminary discussions on the creation of the National Park of South Guiana which would include three ethnic groups in October 1994, suspicion astonishingly surrounded job proposals, such as those for keepers and eco-tourist guides. Without further analysis, this suspicion could be well illustrated by a statement by a Wayampi friend who, for 25 years, has maintained a personal interest in all development projects concerning his ethnic group: "Shall we have to become policemen on our own land?" This remark represents the expression of an anomaly: how can defensive and coercive regulations on the environment, generated by foreigners, strangers to the forest and its holistic operating mode, properly apply to an environment already under the complete control of the Wayampi who act with the consciousness and aim of perennial abundance?

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Chapter Eleven

Technology and the Organisation of Production, Processing and Marketing of Non-Timber Forest Products

Eric L. Hyman

Introduction

The production and processing of non-timber forest products (NTFP) may significantly increase the incomes and employment of low-income people in and around forests while preserving the ecological sustainability of the resources. However, there are relatively few successful examples of NTFP enterprise development combining profitability, equity and sustainability. Technology, a critical factor in enterprise development, includes equipment, tools, processes, products, materials, skills, and systems for converting inputs into outputs and distributing and using the outputs for consumption. This chapter focuses on marketable NTFP from small-scale producers and examines the following issues: resource sustainability and technologies for collection; technologies for pre-processing and processing; and the organisation of production, processing and marketing. Examples of NTFP enterprise development are given, with particular reference to the experience of Appropriate Technology International (ATI). Technologies for regeneration and cultivation of NTFP are discussed by Peters in Chapter 2 of this volume. This chapter concludes with a discussion on some research issues on NTFP technology.

NTFP Producers and the Technology Gap

Small-scale producers of NTFP and other products often lack access to improved technologies that could increase their productivity and competitiveness. *Technology* encompasses knowledge of equipment, tools, products,

processes, materials, skills and the organisation of production and marketing. Small-scale producers do not always have the ability to conduct their own R&D or testing of a new technology. Despite the potential benefits from development of technologies for small-scale producers, governments and universities or science and technology institutes have generally focused research on technologies for larger enterprises. Even where research has been conducted on behalf of small-scale enterprises, the next step of encouraging the commercial manufacturing and use of these technologies is often absent. External assistance can play a catalytic role in promoting the use of more productive technologies for small-scale producers. Table 1 indicates some of the potential beneficial impacts of technological assistance. They relate to increases in productivity, improvements in product quality, increases in local self-sufficiency and development of local skills. The degree to which they occur varies according to local conditions and type of product.

Changes in technology can also make existing products and production processes uncompetitive, shifting access to resources and employment to different groups. A common example is the substitution of natural products by synthetics, as in the case of pine oleoresins, some medicinal plants, natural dyes, etc. Also, increased value of throughput may create unsustainable demand on the resource. This highlights the need for a full assessment of the potentials of technology as well as all its side effects.

Since the appropriateness of a technology for local conditions can vary considerably across and within countries, some adaptation is often required before a technology can be transferred to another location. The up-front costs of developing, adapting and demonstrating new technologies can be amortised over a long time because the benefits continue to accrue as use of the technology spreads. The adoption of technologies by small-scale producers is frequently characterised by an S-shaped curve. At first, the number of adopters may be low, but it gradually rises at an increasing rate before levelling off as saturation of demand is achieved. Consequently, the cost effectiveness of technology promotion can be increased by expanding the resources available for replication and diffusion activities.

Technology dissemination projects need to be carefully designed to ensure their continued impact after project activities have concluded. By working with the private sector and creating market-based incentives for production and use of more productive technologies, the conditions necessary for continuation can be achieved. It is usually easier to upgrade the technologies of existing enterprises than to establish new ones because existing firms have some investment in place and the entrepreneurs and employees have demonstrated business and technical skills (Jeans *et al*. 1991). Government policies can also have a large and differential impact on the profitability of production at various scales and on the technologies used (Stewart 1987; Stewart *et al*. 1990).

Table 1. The potential of technological assistance to help small-scale producers (Source: Hyman 1993)

A. Increases in productivity
1. Faster production to increase sales volume
2. Savings in labour time
   a. Cost savings
   b. Freeing up unpaid household labour for other purposes
c. Shifting of labour to higher-valued uses of time
3. Substitution of lower-cost materials
4. Increased process efficiency to extract more product from a given amount of raw material or allow use of lower-cost raw materials
5. Reduced fuel costs
6. Lower working capital requirements to reduce interest costs and the burden of debt
7. Lower fixed capital requirements
8. Increased output to open up bulk markets
9. Lower product prices for consumers

B. Improvements in product quality
1. Improved product consistency and reliability
2. Higher sales prices for producers due to better grade goods
3. Allow a switch to higher-valued products
4. Better packaging for bulk markets
5. Generation of marketable by-products
6. Greater durability of products for consumers

C. Increases in local self-sufficiency
1. Use of locally available materials
2. Increased marketing independence
   a. Greater farm-level processing of agricultural products to reduce the need for immediate sale at peak harvest periods when prices are low
   b. Better organisation of marketing channels to expand information and reduce transaction costs
3. Greater capacity for local repair and maintenance of equipment
4. Decentralisation of power or fuel supplies for greater reliability
5. Better availability of products for consumers

D. Development of local skills
1. Increased capacity for further innovation
2. Enhanced ability to enter new product lines or markets
3. Creation of new possibilities for local manufacturing

Resource Sustainability and Technologies for Collection of NTFP

Resource sustainability is the ability to maintain a desired level of production indefinitely without reducing the stock of the resource. Sustainable resource use requires careful selection of the species and sites as well as control of the harvest rates (see Peters, Chapter 2, for a detailed discussion). Poverty may force NTFP gatherers to maximise short-term income by harvesting as much as possible, even at the expense of future income. Lack of long-term security adds to the poverty factor. This problem is exacerbated if the number of NTFP gatherers increases through population growth or migration. NTFP that occur in low density are particularly susceptible to over-harvesting if they are valued highly enough to be gathered.

Providing a way for NTFP gatherers to earn greater returns and have a stake in long-term resource sustainability through processing could help reduce short-term over-exploitation. However, higher NTFP prices associated with local processing might also increase the incentive for people to devote more time to collecting these resources. Profitable collection and processing does not guarantee that sustainable practices will be followed, particularly if there is uncontrolled access to a common-property resource. Despite the highly organised and profitable industry based on wild medicinal plants in Indonesia and India, some important plants are being over-harvested toward extinction (Duerbeck, personal communication 1994; Zuhud and Haryanto 1994). A similar situation can be found in parts of Africa (Cunningham 1993).

NTFP are frequently obtained from common-property or public land. Communities often have developed ways of controlling access to resources through limited harvest periods, extraction quotas or allocations of land. For example, the density and location of allspice trees (*Pimenta dioica*) in the Guatemala Petén suggest that this species has been managed since Mayan times, at least through prohibitions on felling. However, local controls there and in other areas have been breaking down with the growth of central governments and influx of new settlers unfamiliar with sustainable, traditional practices.

Government agencies generally lack the budget and staffing to enforce restrictions on harvesting open-access resources effectively through a policing approach because the areas are large and often remote. Even if a ban on trading certain NTFP does not stop harvesting, it may block gatherers from adding value locally through processing. NTFP projects may need to help establish local systems for controlling access or limiting the amount harvested by individual gatherers, while ensuring an equitable distribution of the benefits to the community. Equitable control of access to common-property resources often combines individual and collective controls or a shift towards production on private lands (Arnold 1995).

The sustainability of a NTFP depends on the rate of harvesting relative to regrowth and regeneration as well as the stage, timing and method of harvesting (Peters 1994; de Silva and Atal 1995). Due to poverty and poor knowledge of alternatives, people may use resource-damaging harvesting technologies, especially if this activity is not very profitable. As a resource becomes more scarce over time, new methods may be needed for collection and regeneration or product diversification. The harvesting technology can also affect product quality.

NTFP development can help conserve natural forests by increasing their perceived value to local people due to the income generated while potentially maintaining biodiversity, unlike most alternative land uses (Peters 1994). Most NTFP can be harvested sustainably if collection builds on indigenous technical knowledge and institutional arrangements exist or are established to maintain the resource (Richards 1993). NTFP development is more likely to encourage forest preservation when the products are of high value and relatively abundant and a sizeable number of people can derive a significant share of their income from the resource. NTFP commercialisation can also generate funding for conservation activities in environmentally sensitive areas (Plotkin and Famolare 1992). However, it can also lead to over-exploitation and loss of biodiversity if the appropriate control mechanisms are not put in place (see Wilkie and Godoy, Chapter 5).

The fact that NTFP can be harvested sustainably does not necessarily mean that they will be harvested sustainably. Excessive or careless NTFP collection can have negative impacts on ecosystems. The magnitude of the impacts depends on the species composition of the forest, the nature and intensity of harvesting, and the characteristics of the species harvested (e.g., primary species, early pioneer or secondary species, or late secondary species; Peters 1994). Serious damage can be inadvertently caused to other plants or animals in harvesting NTFP. Processing may also have significant environmental impacts.

However, even if NTFP are harvested sustainably, they may not make a major contribution to long-term conservation of forest resources because of the 1) tendency toward domestication or replacement of NTFP with synthetics; 2) inconsistent supply of most extractive products; 3) lower short-term income potential from NTFP than from unsustainable logging, mining, agriculture or ranching; 4) small size and volatility of export markets for many NTFP; 5) failure of governments to address broader land and resource-use rights; 6) preferences of people for earning a living through settled agriculture rather than NTFP collection; and 7) lack of familiarity of new migrants with sustainable harvesting of NTFP (Richards 1993).

NTFP collection probably cannot stem pressures for clearing forest land for commercial logging, agriculture, grazing or mining, which may be more profitable than NTFP collection in the short run (Reining and Heinzman 1992). Local people might not be able to guard forests from illegal loggers

or colonisers. The bigger problems include the failure of governments to address broader land and resource use rights and preferences of people for earning a living through settled agriculture rather than extractivism (Reining and Heinzman 1992; Richards 1993).

For these reasons, it is important to identify and alleviate any significant resource and environmental impacts of NTFP collection as they occur. The number and size of plants harvested or animals captured and the area affected should be monitored and the rates of harvesting adjusted to achieve sustainable levels. Establishing new institutional arrangements for monitoring and mitigation (such as collaboration between producer groups and NGOs) can be important in achieving resource sustainability and minimising negative environmental impacts of enterprise development.

Technologies for Pre-processing or Processing NTFP

Many NTFP can be pre-processed or processed through relatively simple and available technology, although it may not be known in the areas where they are found. *Pre-processing* includes storage and preparation of a product for sale to processors or intermediaries. Lack of pre-processing or poor pre-processing can reduce the incomes of NTFP gatherers and the sustainability of the resource. It can lower the product price due to inferior quality or reduce the saleable portion of the harvest, making it necessary for gatherers to harvest larger quantities (Reining *et al*. 1992).

For example, dried allspice berries from the Guatemalan Petén sell for a lower price than the cultivated berries from Jamaica and Mexico. Since the wild Guatemalan allspice berries are irregular in size, they are more difficult to process with mechanised equipment than the cultivated berries. Wild allspice may have a "green" market niche as an organic spice, but this would require better pre-processing. Allspice berries have to be dried soon after harvesting to avoid spoilage. During the first stage of drying, a temperature of 70-75ºC is optimal as higher temperatures result in loss of essential oils and lower temperatures may cause uneven dying. Fuelwood can be used, but care must be taken to keep smoke from the berries to prevent an undesirable smoky flavour. The second-stage drying can be done in the sun. With wild allspice, market prospects might be better for essential oils extracted from the berries and leaves than for the spice. Allspice berry and leaf oils are used in foods, cosmetics and soaps (Amaya *et al.* 1993).

Better storage techniques can improve product quality by reducing deterioration of the raw material or losses from pests. Drying allows a product to be stored until seasonal prices are most favourable so that producers do not have to sell at the peak harvest time when prices are low. Drying or processing are particularly important for forest fruits, which are often all produced around the same time of the year. The type of storage facility, temperature and humidity, stacking or packaging of the product,

protection against pests, and length of storage affect the costs and benefits of storage (Clay 1995).

Gatherers often sell NTFP unprocessed because they need money immediately; are not organised into groups; lack knowledge of processing techniques; capital and markets; and cannot afford to take risks. Processing close to the resource base may be less feasible than processing close to the markets or users if the raw material supply is dispersed or small, capital costs are high or infrastructure is inadequate. Some NTFP are subject to large natural fluctuations in supply, which can make large capital investments in processing unviable in the absence of a diversified product line. Others, such as wrapping leaves, are used in unprocessed form.

Local processing can be more efficient than centralised processing in distant facilities when it reduces transport costs of bulky raw materials, decreases raw material losses or quality deterioration in transport and storage, or reduces labour costs. For example, local processing is advantageous in producing natural fibres from plants through decorticating, retting (wetting to loosen fibres) leaves or bark, or beating with a mallet. Packaging is also important in preserving product quality and attracting buyers and the best type varies with the scale of production, market and product type. For example, oxygen-absorbing packets may be cheaper than vacuum packaging of Brazil nuts at a low product volume (Clay 1995).

Product diversification is important in decreasing the raw-material supply risks faced by NTFP processing enterprises and evening out seasonality in their capacity use rates. Since industrialised country markets usually require high purity and uniform product quality, the processing of goods for export may require greater managerial capacity and more costly technology than domestic developing-country markets.

The potential gains from local processing were shown in Peru for annatto, a food colouring extracted from achiote (*Bixa orellana*) seeds. The extraction process for annatto is relatively simple: 1) extraction in a stainless steel tank through agitation in an alkaline solution and washing; 2) precipitation with an acid; 3) filtration; 4) drying; and 5) grinding. Local processing reduced transport and storage losses, but export marketing proved difficult in that case (Hyman *et al*. 1990).

The preferred characteristics of an NTFP can vary across different markets. For example, babassu palm oil soap produced by an enterprise in Brazil had too much added scent for the US market, but was not scented enough for the Italian and French markets. Potential domestic uses of some NTFP have been neglected. Cohune (corozo) palm (*Orbygnia cohune*) nuts are used to produce an industrial oil in Mexico, Honduras and Belize, but not in Guatemala, where the palm fronds are only used as a roofing material for houses and source of shade for pasture or farmland. Yet, cohune oil's industrial properties are similar to coconut oil and African palm oil due to a high lauric acid content and the production technology is simple.

Equipment requirements for a cohune oil mill include a solar dryer, electric shell cracker, hammermill, screw press, filter, sieving device and storage bin. Cohune oil can be used in soap making through a simple hot process.

The production process for potpourri is simple, but the market appeal depends on the selection of materials, processing and packaging. The materials may be cut into smaller pieces and the natural colours retained or bleached and then dyed after solar drying. If dyed, the potpourri is then sun dried again after colouring. Some potpourri materials may be naturally fragrant, but the product is often enhanced with aromatic oils (Amaya *et al*. 1993).

In the Philippines, the gatherers pre-process rattan where it is cut. The poles are scraped with a machete and stacked vertically to air dry for 2-14 days. The drying time can be reduced in a simple batch dryer and the raw material quality improved through a chemical dip that prevents fungal damage and staining. Chemical treatment would be profitable because it increases the price of the poles, but is rarely done. Poles are stored until a full truckload is obtained. First-stage processing of rattan (splitting, coring, and wickering) is often done by the provincial traders. Although transport costs would be lower if first-stage processing were done by the gatherers, it requires imported equipment costing between US$4,000 and US$12,000. Due to the shortage of raw materials, the furniture industry in the Philippines has used more of the available rattan in products for the high end of the market and has increasingly substituted iron, wood, other vines and grasses for some of the rattan. Production of low-end rattan furniture has shifted to Indonesia, where this resource is more abundant (Kilmer 1994).

For traditional medicines and cosmetics, plant parts may be cleaned and used directly in foods or beverages, or dried first in the sun or an oven. They can also be crushed or pressed to release oils or juice, ground into a powder, dissolved in a tincture, burned as incense, pelletised, or put into capsules, tea bags, pills, cosmetics, lotions, shampoos or colorants. One problem with traditional medicines is the difficulty of ensuring their authenticity for uniform dosages due to highly variable raw materials and low stability after processing (de Silva and Atal 1995).

Resins can be processed into essential oils by distillation. *Gums* are used in making adhesives, sizing for paper, foods, medicines and polishes (Chihongo 1994; Coppen 1995). High-value *essential oils* can be extracted from many NTFP in small-scale distillation units with manageable worker training requirements. Due to their volatility, essential oils are useful as scents and food and beverage flavourings. Some are used in adhesives, medicines and veterinary products, paints, insecticides, textile processing, cosmetics, paper and printing, and production of petroleum products, rubber and plastics (de Silva and Atal 1995). Essential oil should be stored in a cool place, protected from light and drafts, and proper packaging is important. Up to one gallon of an essential oil can be stored in a dark glass bottle, but galvanised steel or aluminium casks are best for larger quantities.

Some 500-600 essential oils are commercially important on the world market (Lintu 1995). World market prices vary tremendously for different essential oils – from US$1.10/kg for turpentine to as much as $4,400/kg for rose oil. While synthetics have a major share of the market for aromatic chemicals, the demand for natural products is still significant (de Silva and Atal 1995). The processing equipment needed for essential oil distillation can be manufactured in many developing countries at relatively low cost and can last ten years or more if made of mild steel (30-40 years with stainless steel). Stainless steel or aluminium are necessary with corrosive materials. Small distillation units can hold 100-250 kg of dried plant material per batch.

The most common production process for essential oils is *steam distillation*, where water is heated to a high temperature under low pressure. The steam is then fed into coils in a chamber below a perforated tank holding closely packed (and, in most cases, dried) plant materials and passes through the tank. The volatile oils are driven off by the steam and carried through piping to a condenser or heat exchanger, where they are cooled to 25-30ºC. Next, water and oils are collected and separated in a flask or separator based on their difference in density. The by-product *marc*, left after removal of the steam and essential oil, may be marketable after grinding for production of incense, tooth powder or spices. *Water distillation* is used to obtain essential oils from some flowers that would be damaged by steam. With this process, the plant material is covered with water and boiled and then the vapours are captured. Disadvantages of water distillation include its relative slowness and the risk of burning the plant materials or hydrolysing esters in the oil.

Other methods – cold pressing, solvent extraction or gas extraction – are needed for water-soluble essential oils. Citrus oils are usually extracted through *cold pressing*, which is inexpensive and simple. *Solvent extraction* results in a high yield of oil, but is only appropriate for large, capital-intensive facilities. Solvents with a low boiling point are used, such as hexane, pentane or petroleum ether. The essential oil is then separated from the solvent in an evaporator. To reduce production costs, the solvent can be recovered for reuse. Oils for food or aromatherapy produced through solvent extraction have to undergo vacuum distillation to remove all traces of the solvent. *Gas extraction* yields very high quality oil, but involves use of liquefied carbon dioxide under a high pressure and low temperature, which is not economical in most LDCs.

UNIDO has designed a model plant that can handle a variety of NTFP processing methods, including aqueous or organic solvent extraction, continuous extraction, preparation of solid extracts and oleoresins, and distillation and fractionation of essential oils (de Silva and Atal 1995). However, purchasing the whole set of equipment would be unnecessarily expensive if only one of these processing methods were used.

Honey processing is not difficult, but requires careful management of temperatures and good hygiene. The equipment for processing honey includes a tank with a pre-heating chamber, electric heating elements, temperature gauge and thermostat, gear pump and filter, processing chamber, cooling unit, settling and filling tanks, and control panel. Small-scale equipment is available with a capacity of 50-200 kg of honey per day. Honey can be packaged in sealed plastic or glass containers (EDA 1993; ATI 1995; Sinha 1995a).

Most commercial silk is produced by the larvae of the *Bombyx mori* moth ("silkworm"), which feeds on cultivated mulberry leaves. *Tasar silk* is a stronger fabric produced by a different type of silkworm (*Antheraea proylei*) that feeds on the leaves of tasar forest oaks. The oak leaves are generally harvested from communal forest by individual silkworm growers. In India, tasar silk sells for a higher price than mulberry silk. Because most of the Indian tasar silk is from wild silkworms and is relatively rough, the country imports large amounts from China and South Korea. Since tasar silk cocoons are perishable and bulky to transport, reeling is best done locally and two alternative technologies are available – the semi-dry process and the wet process (Sinha 1995b).

Individuals gathering the *Suilus luteus* fungus in Ecuador bring it to a central facility for sale and processing. Initially, the gatherers did pre-processing by hand at their homes (peeling the sheath and cap) before taking the mushrooms to the centre for sale and processing (slicing, drying and packaging). ATI recommended that the mushroom gatherers in Ecuador move pre-processing, cleaning and peeling to the processing centre for greater control over species identification and exclusion of immature mushrooms and broken stem materials before paring and slicing. Workers at the processing centre were provided with gloves, mouth and nose protectors, and washable aprons to prevent allergic reactions. Storage of the fresh mushrooms was improved through better pest control. Drying was necessary because fresh packing of the mushrooms was not feasible in the remote area of the Ecuador project due to the perishability of the product. A more efficient dryer was proposed to reduce the variation in the moisture content of the product, energy costs and operator time. Since dried mushrooms are hygroscopic and low levels of rehydration attract insects and rodents, better packaging was suggested to decrease the risk of rehydration of the product and to increase its attractiveness to buyers (Chapela 1995).

Organisation of Production, Processing and Marketing

For small-scale producers to take full advantage of the benefits of improved technology, changes may be needed in the organisation of production, processing and marketing. NTFP gatherers are usually low-income people in rural areas and the additional income earned from these

products can be very important (Arnold 1995; see Townson 1995, for a detailed annotated bibliography). Women and children and indigenous groups frequently play a major role in collecting and processing NTFP. Many NTFP are only available seasonally or are only collected when agricultural work is less pressing or is not generating cash.

The role of traders and gatherers has been extensively discussed in the literature. A prevailing view is that traders make excessive profits by taking a large part of the collector's benefit, particularly under monopsony relations (Ryan 1991; Clay 1992; Peluso 1992; Schwartzman 1992). Some attempts have been made to fully assess the role of traders and their real net profits (Padoch 1988; Woon and Lim 1994; Ndoye 1995).

NTFP gatherers usually receive a small share of the final value of the products. While middlemen and processors perform valuable services, they receive the bulk of the net profits from NTFP. The net margin tends to increase along the value chain even though the relative share falls, as shown by Afsah (1992) for processed Brazil nuts (Figure 1). The price difference can also be large even if the product is unprocessed. For seven different unprocessed NTFP, the average price difference between a village in Western Nepal and the New Delhi market was 332 per cent and only a small part of the difference was due to export and import taxes (Rawal 1993).

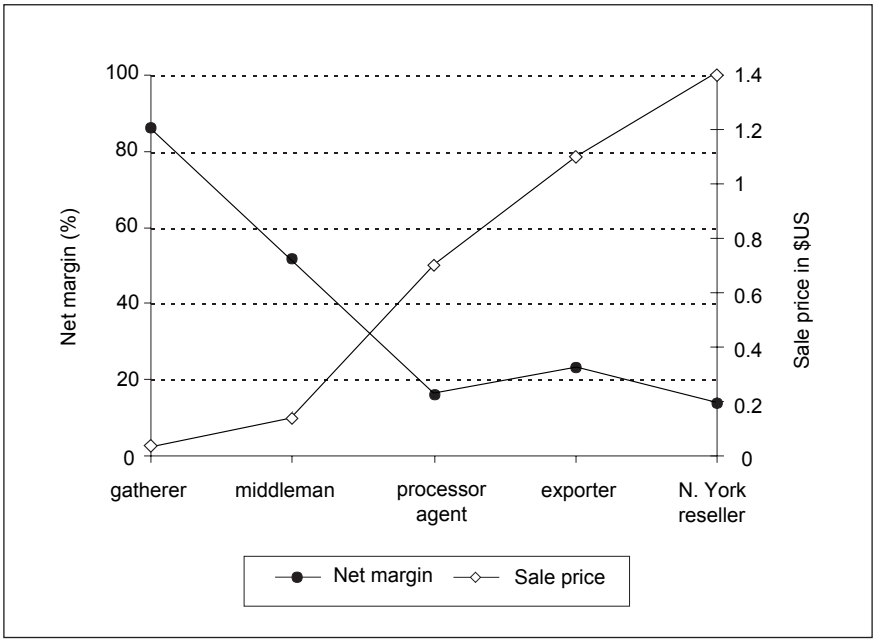


Figure 1. Value chain for Brazil nuts (based on Afsah 1992).

Unorganised gatherers typically sell small amounts of NTFP with little or no processing. Individually, these small-scale producers control only a small amount of the product, exercise weak bargaining power, and have little information on the prices, requirements and location of alternative markets. Many levels of intermediaries are involved in the marketing chains of these commodities, especially in remote areas. Often, there is little price competition as buyers carve out local territories for exclusive purchasing, especially where transport and transaction costs of dealing with many low-volume producers are high. Monopsonies or informal cartels are particularly a problem with NTFP that are perishable, have a short harvest season, or are located in remote areas. A producer attempting to hold out for a higher price could end up unable to sell at all. However, in the absence of intermediaries, small-scale NTFP gatherers might not be able to market these products on their own. Intermediaries take market risks by investing their capital to make immediate payments in cash and often provide other valuable services such as credit (Pswarayi-Riddihough and Jones 1995).

The incomes of NTFP gatherers can often be raised by restructuring production, processing or marketing by organising co-operatives, producer groups or private companies in which the gatherers have an ownership stake. In many cases, assistance from an outside agency, such as an NGO, is important in developing new methods of organising small-scale producers (Durst 1994; Hyman 1995). Government policies also affect the income of small-scale producers. For example, chicle (*Manilkara sapota*) harvesters in Guatemala earn substantially more than gatherers of other NTFP because the returns at each stage of the value chain for this product are prescribed by law (CATIE 1992).

Where the socio-cultural characteristics of NTFP gatherers are fairly homogeneous, producer associations or co-operatives can be established to regulate extraction rates and facilitate resource regeneration. For example, co-operatives are now collecting resin from chir pine (*Pinus roxburghii*) on forest reserves in Garwhal, India, in place of government contractors (EDA 1993). Yet, co-operatives are often susceptible to management problems (Pswarayi-Riddihough and Jones 1995). Looser associations of gatherers can fill the gap left due to reduced control by traditional authorities, but might not function well if major socio-economic or cultural differences divide the membership.

By becoming more vertically integrated with processing and marketing, NTFP gatherers can increase their income and share the risks. When processing units are established closer to the forest, several layers of intermediaries can sometimes be avoided or forced to pay more competitive prices, allowing NTFP gatherers to obtain a higher share of the value of the final product. Local processing can also promote resource sustainability because traders selling raw materials to outsiders may have little commitment to a particular product or location since they can handle

other products or move on to other areas if supplies of one NTFP become depleted an area.

While local processing of NTFP offers a great deal of untapped potential for increasing incomes in rural areas, it might not be viable in some cases due to costs, technical or managerial complexity, or the nature of the markets. If the final product is bulkier or more perishable than the raw material, it may be desirable to locate processing closer to the end users of the product. Where local processing is feasible, small-scale producers often cannot take on this task individually without being organised and having access to technical assistance and financing (Jeans *et al*. 1991).

NTFP gatherers can also be organised into co-operatives for marketing unprocessed commodities to take advantage of economies of scale and improve their market information and bargaining power with buyers. Even without undertaking processing, a marketing co-operative can sometimes increase the incomes of producers substantially by reducing the number of intermediaries or reaching more remunerative markets. Co-operative marketing is less risky than group production or co-operative processing. The potential income gains to NTFP gatherers are often largest when producers have an ownership share in both processing and marketing.

Since export markets for some NTFP are specialised or small and may change rapidly, NTFP enterprises could benefit from market information systems that provide advice on trade logistics and prices and specifications in different markets (CSC/FAO 1994). Advertising, distribution of samples and test marketing could be provided through a producers' association. Information on international markets and quality standards for certain NTFP is available from the World Federation of Proprietary Medicine Manufacturers, International Federation of Essential Oils and Aroma Traders and the International Organization for Standards (Chandrasekharan 1994). A commercial database containing updated market information for some NTFP has been developed by INDUFOR (Tan *et al*. 1996)

Some NTFP have a large export market. For example, the production of furniture and handicrafts from rattan recently generated US$275 million in annual gross revenue for the Philippines, including export earnings of US$235 million. This industry also illustrates the perils of success for a NTFP; exports fell 16 per cent from 1989 to 1992 due to declining supplies of the resource. A study of the functions, participants and technologies in the rattan sub-sector in the Philippines found that rattan cutting is controlled by local or provincial traders who identify production areas, organise gatherers to collect a specific amount, pay advances, arrange transport, complete government paperwork and pay forest charges. Concessionaires often sub-contract collection to groups of cutters working under a group leader (Kilmer *et al*. 1994).

An important NTFP harvested in Western Nepal is the rhizome of jatamansi (*Nardostachys grandiflora*). The essential oil produced from jata-

mansi is used in traditional medicines, cosmetics and flavoured tobacco in India. It is also increasingly popular as a fixative for perfumes and aromatherapy products in other countries. In the past, gatherers sold jatamansi from common-property lands to traders locally, either unprocessed or with minimal pre-processing. The distribution chain for jatamansi typically involved four levels of intermediaries between the gatherers and the processing companies in India. ATI financed establishment of a small-scale, essential oil plant in Humla, Nepal, in December 1994 (Achet *et al*. 1993; Koontz 1994; ATI 1995).

Similarly, ATI and EDA Rural Systems, an Indian consulting firm specialising in micro-enterprise development, are establishing a company to assist small-scale beekeepers who obtain honey from hives placed in natural forests. The new company will buy raw honey from the beekeepers for processing and domestic marketing under a common brand name (Sinha 1995a). ATI and EDA Rural Systems are also promoting tasar silk production by reorganising production and marketing to increase the supply of tasar silk and the availability and quality of tasar silkworm eggs. Decentralised production of the eggs is important because their quality deteriorates in long-distance transport and they need to be available just before the oak trees produce new leaves. Raising silkworms at the household level is easy and requires no special equipment, but disease-free eggs and good hygiene are needed to keep mortality rates low. For each tasar silk grainage enterprise producing the eggs, about 150 small enterprises will be established to reel cocoons purchased from the growers (Sinha 1995b).

Issues for Research on NTFP Technology and Enterprise Development

NTFP are still a relatively new area of applied research and practice. In general, the biological and ecological uncertainties associated with NTFP exploitation are greater than the economic uncertainties, but socio-cultural and economic practices can vary a great deal. The research issues include a better understanding of the resource base and the links between resource sustainability and harvesting techniques; development of improved processing, conserving and storing techniques; the economic potential of NTFP; new product and market development; and research on organisational aspects. Table 2 provides a summary of some urgent research needs.

Enterprise development for NTFP is as much related to technological adoption as it is to development of new technologies. The linkages between research, extension and enterprise development activities are especially weak for NTFP and gaps in research co-ordination and methods add to this weakness (see Table 3).

Table 2. Issues for research on NTFP in technology and enterprise development

Resource base and harvesting techniques

1. Biology of plant and animal products – growth, reproduction and mortality rates – and inter-relationships among products
2. Optimal rates of resource use in both ecological and economic terms
3. Identification of natural fluctuations in populations or yields of NTFP and their causes
4. Development and adaptation of systems for controlling access to NTFP and managing extraction rates under various environmental and socio-cultural settings
5. Viability of natural forest management for NTFP, including artificial regeneration and enrichment planting
6. Relationship between NTFP development and maintenance of forest resources, particularly with low-cost technologies for collection of NTFP (stage, timing and method of harvesting)

Processing, conserving and storing techniques

7. Low-cost technologies for small-scale pre-processing and processing
8. Techniques for conserving semi-processed and processed products and transport and storage under remote conditions

Economic potential of NTFP

9. Relationship of NTFP to household livelihood strategies
10. Potential for NTFP to make a significant contribution to poverty alleviation (especially for women and indigenous groups) and equity issues in production, processing and marketing

New products and market development

11. Existence and magnitude of economies and diseconomies of scale and agglomeration in production and processing of specific NTFP
12. Market assessment and marketing strategy for various NTFP and the likelihood that extractivism will be replaced by cultivation or synthetics over various time horizons and that niche markets or patches of extractivism can co-exist with domestication or substitution

Organisational aspects

13. Potential for development of co-operative production, processing and marketing
14. Applicability of the concept of intellectual property rights for NTFP

Table 3. Gaps in research co-ordination methods

1.	Methods for assessing long-term resource sustainability and cumulative environmental impacts are not well developed
2.	Generalisability of research findings across countries and ecosystems is not known
3.	Research and enterprise development are not well linked due to proprietary information and strategic bias
4.	Little research for NTFP development and diversification is being done by either the private sector or the public sector
5.	Co-ordination among public-sector agriculture, agroforestry and forestry institutions is weak in this inter-disciplinary area
6.	Better monitoring and evaluation of existing programmes and sharing of lessons learned from positive and negative experiences would be beneficial. Few means exist for promoting replication of successful programmes and sharing research findings

Conclusions

Most NTFP gatherers receive relatively low returns because they use rudimentary technologies for collection and pre-processing and are often not involved in processing or distribution. NTFP are a strategic area for increased development assistance because they can involve a large number of low-income, small-scale producers and there is potential for increasing their incomes significantly through improved technology for collection and local processing and reorganisation of production and marketing. Improved technologies can increase productivity and, in the case of harvesting techniques, may also improve natural-resource sustainability. Changes in technologies used can also make new types of activities and products possible and render existing ones less competitive. Access to technology encompasses knowledge of the options, necessary skills and ability to source equipment and secure financing.

The sustainability of NTFP collection can be improved through better equipment and tools in harvesting, more careful collection and extraction, and improved storage and transport practices. However, more research is needed on optimal harvesting rates and methods for many NTFP because rates of growth, reproduction and mortality of the resources are often unknown. Many technologies for processing NTFP are simple, labour intensive and have relatively low capital costs.

To be efficient, production and processing of NTFP frequently has to be scaled up in terms of numbers of producers and quantities per producer.

Table 4. Potential interventions for NTFP development.

	Potential interventions
Collection	* Determine sustainable harvesting rates * Provide better harvesting tools * Train collectors to minimise adverse effects through better harvesting techniques * Lobby for policy changes to help collectors gain better-defined land or resource-use rights * Strengthen indigenous common-property, resource-management systems * Organise associations of collectors to control harvesting rates * Diversify the resources collected * Reduce environmental impacts of resource collection
Pre-processing	* Train collectors to begin pre-processing activities (e.g., sorting, cleaning and drying) * Improve existing techniques for pre-processing * Provide access to equipment or inputs for pre-processing * Make financing available for pre-processing * Establish collection and assembly centres for groups of collectors to do their cleaning, sorting and drying or pay for pre-processing services. * Improve storage practices
Marketing of primary commodities	* Organise producers into trading groups or marketing co-operatives to improve their bargaining power * Inform producers about prices in other locations and market channels * Help marketing co-operatives reach more profitable markets, including access to working capital * Reduce the number of levels of intermediaries in marketing * Reduce transport costs through bulk shipments * Develop infrastructure or services for transport

Table 4 continued

Processing	* Provide access to technology and financing for processing of NTFP * Make financing available for processing * Develop commercially valuable by-products * Establish private or co-operatively owned facilities for local processing to lower transport costs, reduce number of intermediaries, decrease storage losses and generate more value added locally * Improve quality control * Diversify the products processed * Reduce processing costs or increase productivity * Decrease environmental impacts in processing
Marketing of processed products	* Conduct a market assessment and prepare a marketing strategy * Train processors in quality control and product specifications of various markets * Inform processors about prices in other markets * Link processors to manufacturers and consumers using the processed products * Promote the purchase and use of sustainably produced products to increase demand on the domestic or export markets * Improve packaging and labelling * Obtain a premium price for environmentally sustainable production * Make financing available for storage, transport and marketing
Regeneration or cultivation	* Increase natural regeneration by enrichment planting in natural forests * Adopt agro-forestry techniques for domestication or cultivation * Improve vigour or productivity through development of higher-yielding or higher-value varieties * Increase or intensify production by better agronomic practices (e.g., use of fertiliser, thinning and replanting, irrigation, etc.)

Organisation of producers and the marketing of NTFP (especially for export) are often more of a challenge than making appropriate technologies available. These enterprises can be owned or managed by a group of small-scale producers or may link NTFP gatherers to other private sector firms.

Table 4 contains examples of potential interventions for assisting production, processing and marketing of an NTFP. Assistance for processing can be structured to recover costs and avoid creating continuing dependency. Operating cost subsidies should be avoided because they are only likely to be available temporarily or reach a small proportion of potential beneficiaries. Furthermore, NTFP processing and marketing enterprises will only continue to benefit small-scale producers over the long term if they are commercially viable.

To help ensure that the enterprises are sustainable, an ongoing system should be instituted to monitor the effects on the resource base and control access to the resource or promote regeneration. More collaborations between the private sector and development assistance or conservation NGOs could help achieve the economic and environmental objectives.

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Chapter Twelve

People's Dependency on Forests for Food Security

Some Lessons Learnt from a Programme of Case Studies

Britta Ogle

Forests and trees contribute in complex ways to the livelihoods of rural families. Farming households in the vicinity of forests often combine their agricultural production with collection of forest produce and make use of a multitude of such products as feeds, foods, fuel and medicines. Indirectly, numerous other forest products contribute to food security as they are used to make farm implements, for food storage or preservation or are traded to ensure that basic needs are met. Many studies have documented such direct or indirect roles of forests and trees.

The extent to which rural families are dependent on forests and trees for food security, or more generally use forests and forest products to improve their economy, is less clear. In situations where agricultural productivity is low, better-off households may use forests and forest produce to complement and improve the household economy, while poorer households, who find livelihoods difficult to sustain, may rely on the forests as the primary means of survival or in crisis situations. In may areas, as pressures on the forests increase, more products are extracted, consumed or sold, more encroachment takes place and the depletion of forest resources can be rapid. The poor, more forest-dependent households will then find livelihoods even more difficult to sustain. In other situations local regulation may keep the level of extraction of some products in balance with regeneration or resource management may lead to changes but not necessarily a more precarious food security situation for the poor.

Over the last decade, considerable attention has been given to the role of forests and trees in food security in general (Falconer and Arnold 1989, Falconer 1990, FAO 1990). The FAO/SIDA Forests, Trees and People

Programme (FTPP) also initiated some methodological work on the question of people's dependency on forests and trees for food security, and recently supported small field studies carried out by multi-disciplinary teams in four countries. These pilot studies also provided "dependency" information for forestry professionals. In this chapter the approach to the field studies is presented, and some of the issues arising are discussed.

Planning of the Pilot Studies

The concept for pilot studies on people's dependency on forests and tree products for household food security was proposed during a small seminar in Sweden in 1991 (Longhurst 1991). At that time, the FTPP already had been working for several years with food and nutrition issues in relation to forestry, and those who attended the seminar were all familiar with those concerns.

In its initial phase, FTPP had supported institutions in different countries to explore specific issues, among them linkages between forestry and food security. The working group at the seminar comprised researchers from institutions with previous connections with FTPP, and resource people connected to FTPP administration. The group reviewed existing information on forestry and food security and discussed conceps and research approaches based on participants' earlier work. They also explored potentially useful approaches to learn more about "dependency" on forests and forest products in different settings. Ideas for pilot studies were drafted in co-operation with participants from Bolivia, Tanzania, Thailand and Vietnam. The outcome of the meeting was a draft guide for pilot studies (Longhurst 1991) and a decision to carry out pilot studies in these four countries.

The need for information for "global guidelines" was raised during the initial seminar but the agreed guidelines were flexible enough to allow diverse study designs. The meeting suggested that the pilot studies should be followed up with local and national seminars to discuss the outcomes, and that a final meeting of all teams should be arranged to review lessons learnt. FTPP agreed to support the studies financially and to provide technical back stopping if requested.

More detailed proposals were submitted to FTPP and contracts were signed with the institutions in Bolivia, Tanzania, Thailand and Vietnam which were to lead the pilot studies. All proposals included a comparison between two local communities with respect to forest dependency, use of rapid rural appraisal or participatory research (RRA/PRA) techniques and multi-disciplinary teams. The studies were designed to include several visits to the study sites but to use no more than six weeks for fieldwork. A summary of the time frame for the different activities is provided in Table 1.

Table 1. Time frame for FTPP dependency field studies

1991	1992	1993	1994
		Fieldwork 3 Vietnam	
	Fieldwork 2 Thailand	Fieldwork 2b Bolivia	
Planning seminar Uppsala	Planning Bolivia		Local seminar Tanzania
	Fieldwork 1	Final reports Thailand,Vietnam	
Teams, writing proposals, letters of agreement signed	Final data collection Thailand	Fieldwork 2 Tanzania	
RRA training Thailand	Fieldwork 2 Vietnam	Local seminar Vietnam	
Fieldwork 1 Thailand	Fieldwork 2a Bolivia	Local seminar Thailand	Final report 1 Bolivia
Training, planning and fieldwork 1 Vietnam	Training, planning and fieldwork 1 Tanzania		Final seminar All groups

Each team designed a study to suit their specific needs and attempted to include:1) a description of use of and dependency on forest products; 2) a description of changes in availability and access to these products; 3) a description of strategies to cope with the changes; 4) an identification of the most vulnerable groups and an analysis of factors influencing vulnerability; 5) an identification of priority action to support the vulnerable; and 6) a testing of some rapid and qualitative methods and approaches. The specific objectives developed by each group are provided in Box 1.

Box 1. Specific objectives developed by study teams

Bolivia

- Determine and analyse strategies and social practices in management, access, use and conservation - especially interrelationships between population, food security (FS) and forestry
- Determine and analyse decision-making processes which consider management, access use and conservation of forests and trees (F&T) for sustained development of community life
- Determine and analyse factors which influence vulnerability to food insecurity. Describe direct and indirect contributions of trees and forests to food security
- Describe food production systems in the two eco-zones and their relation to the specific objectives above

Tanzania

- Describe and analyse the current role of F&T in household food security (HFS), especially in food insecure households
- Document perceived changes and trends in access to and dependency on F&T for FS and describe strategies people use to cope with them
- Identify priority issues expressed by communities, *vis à vis* dependency on F&T, for FS for community forestry to consider in their planning

Vietnam

- Describe physical and social dependency on F&T, including coping strategies in times of crisis
- Identify and analyse factors which influence regular, seasonal and occasional dependency
- Identify and analyse changes in dependency which have occurred more recently and identify groups most vulnerable to changes in access
- Assess the usefulness of the tested methods in providing relevant information for the forestry sector to identify and monitor its support to these groups

Thailand

- Describe effects of closing forest areas, on villagers who depend on F&T for food security
- Compare forest dependency of villagers close to and more distant from the forest
- Test practical methods to gather information for forestry sector policy and practical use

Figure 1. Vietnam: framework to investigate the dependency on forests and trees for household food security

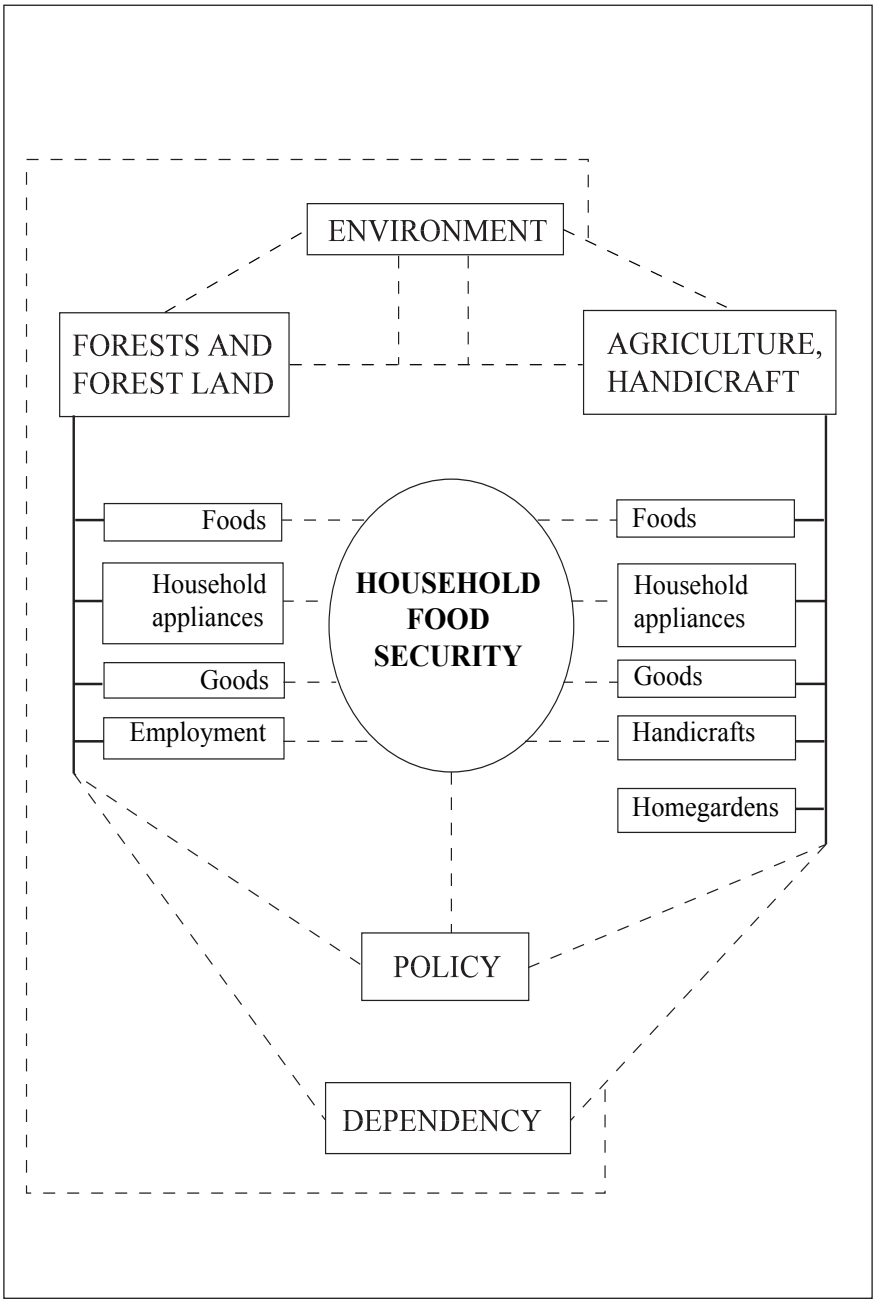
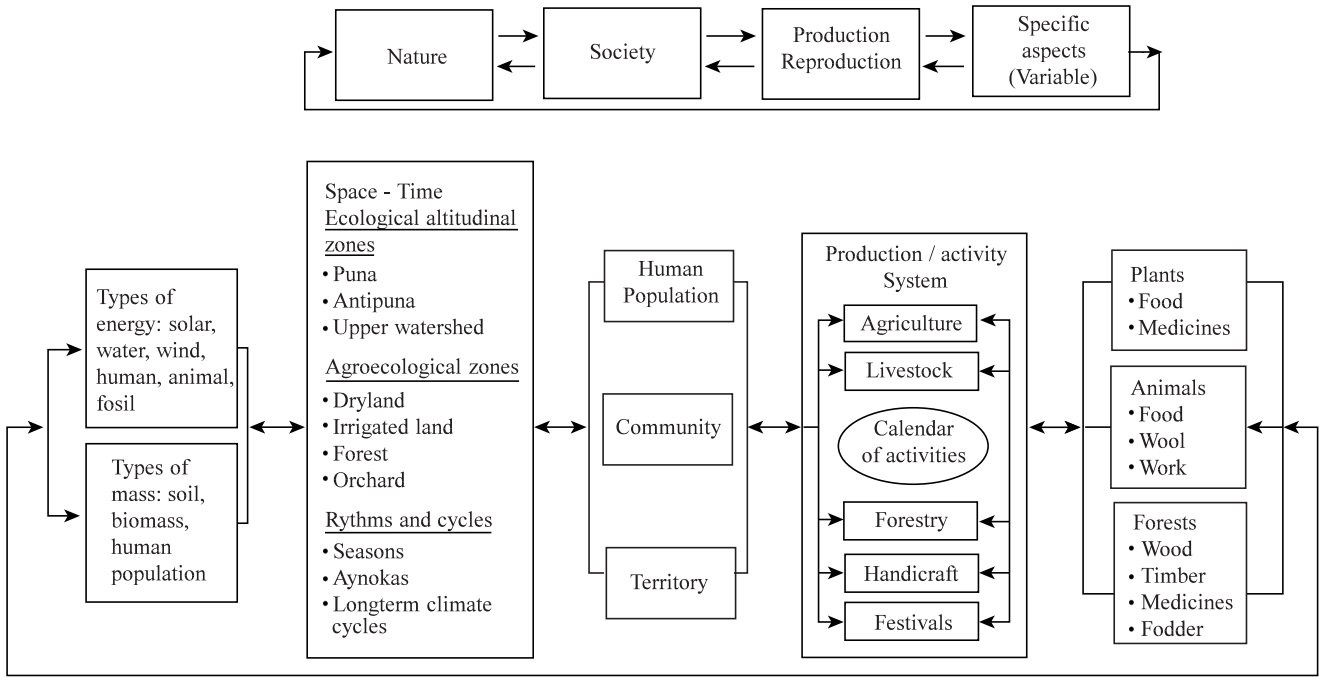


Figure 2. Bolivia: micro planning or the energy-mass, space-time model



Source: based on Romero (1992)

Figure 3. Tanzania: a conceptual framework of the relationship between forests, trees and household food security

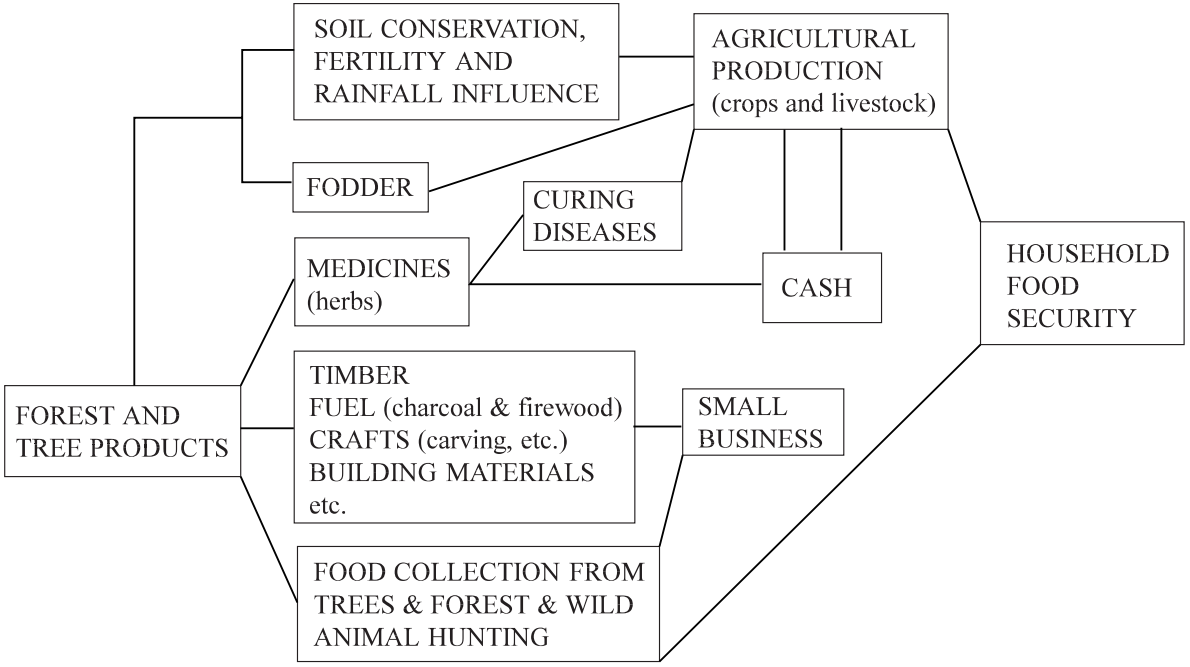
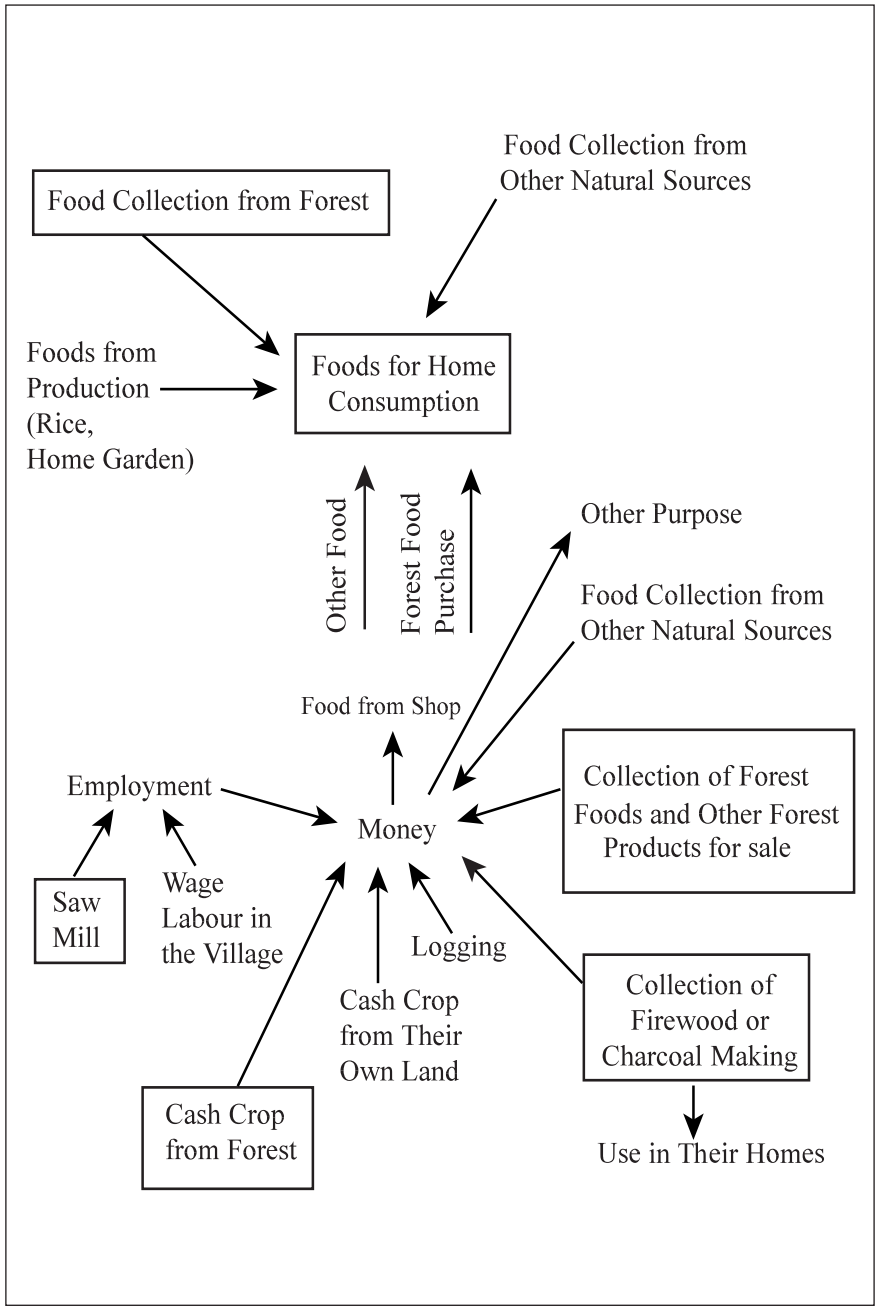
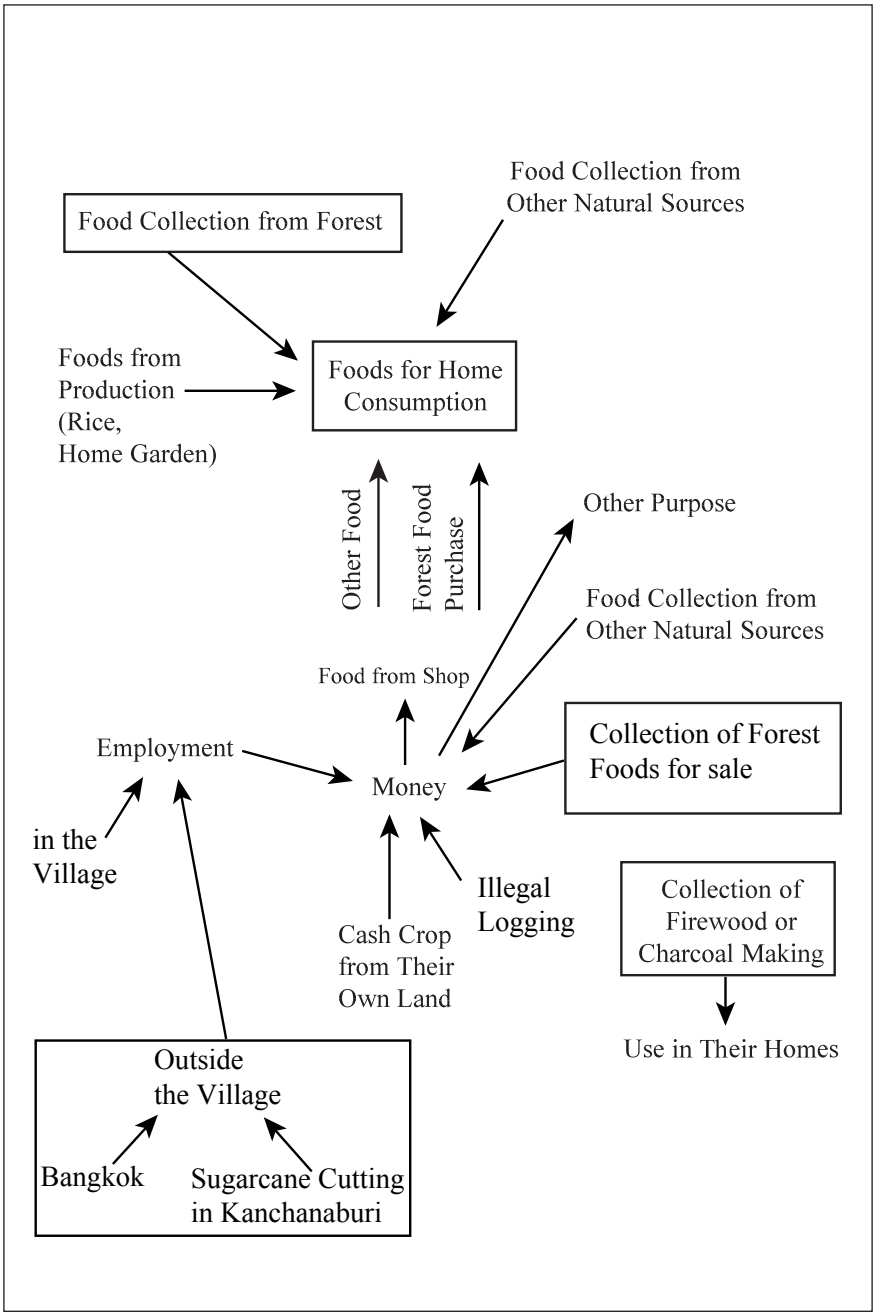


Figure 4a. Thailand: a conceptual framework of the relationship between forests, trees and household food security before forest closure



Figures 4b. Thailand: a conceptual framework of the relationship between trees, forests and household food security after forest closure



As part of the planning, each team jointly prepared framework diagrams for their studies (Figures 1-4). For all teams this was the first time they had worked in multi-disciplinary groups. For many team members, it was also the first time considering the role of forestry in food security. The joint planning thus became an important opportunity for conceptual considerations, inter-disciplinary communication and mutual learning. The flow charts were central tools in the conceptual discussion as they helped clarify the multiple factors involved in household food procurement. As such they gave team members a simplified, common conceptual basis and were useful in planning and cross-checking of topics to include in the investigations. Only one team, the Thai group, continued to make use of these diagrams in the analysis and in visualising trends and dynamics of forest dependency.

Institutions Involved

Each team leader selected individuals with the expertise considered appropriate for the study, and who could be engaged through local institutions. Table 2 summarises the professionals involved in the four countries. This meant that the studies were both led by different types of institutions and that institutions from several sectors and at a number of levels were involved. Members of the Thai team were from several university departments headed by the Medical Faculty, University of Khon Kaen. In Bolivia, the research team was a sponsored project group within the Agro-ecological University of Cochabamba. In Tanzania, the main institution was the national Tanzania Food and Nutrition Centre (TFNC), and they in turn collaborated with the Section for Community Forestry at the Ministry of Tourism, Natural

Table 2. Professionals involved in the case studies

	Country			
	BOLIV	**TANZ**	**THAI**	**VIET**
Medical Doctor/Nutritionist	1	2	3	2
Forester		3		4
Anthropologist	1			
Bio-statistician			1	
Community Development Officer	1			
Economist	1	1		2
Lawyer				1
Sociologist	1		1	1

Resources and Environment, and with government staff at provincial and district levels. The lead institution in Vietnam was a regional research centre under the Ministry of Forestry, the Forestry Research Centre (FRC), Vinh Phu, in collaboration with several national institutions (Institute of Nutrition, Department of Geo-Economics, Women's Scientific Research Centre) and with the local forestry department staff.

Thus the participating institutions varied considerably in their experience of field surveys and research as well as in mandate. This naturally influenced both the planning and outcome of the studies. The Thai group members, as academics, had more experience with field research and could more easily integrate this kind of survey into their work programme and follow through with analysis and report writing. On the other hand they were more limited in the kind of follow-up actions possible. The Vietnamese team which included more local professionals had opportunities to incorporate findings into the work programme in the area. In Tanzania, where the lead agency was a national centre involved in policy making, the team leader considered the concept of forestry and food security so new that she initiated a policy dialogue with national-level decision makers through a sensitisation seminar, before the pilot survey was planned in detail.

Within FTPP, the overall responsibility for financial and technical support of the studies was with the International Rural Development Centre (IRDC) at the Swedish University of Agricultural Sciences.[1] Contracts were signed between lead institutions and IRDC. Staff from IRDC assisted the teams in Tanzania and Vietnam in RRA/PRA training and initial planning and visited all teams and field sites during the study implementation. There were more contacts and collaboration between IRDC and the teams in Tanzania and Vietnam as these groups requested support at several points. In comparison, FTPP had only limited contacts with the Bolivian team (only one visit) and this team was also the only one which had not been working previously with FTPP on forestry and nutrition issues. FTPP administrators participated in local seminars in Tanzania, Thailand and Vietnam and in the final meeting in Vietnam. The Bolivian group submitted an interesting proposal for a local follow-up workshop but, for several reasons including transfer of staff involved in the study, their analysis and reporting from the study was not completed.

Study Areas

In each of the four pilot studies, two communities were selected as study areas. The communities differed either in distance to the forest, agro-ecological setting or period of settlement. One of the pilot studies (Thailand)

[1] During 1996 the IRDC has changed its name to the Department of Rural Development Studies.

also illustrates the effect of closure of a forest on the livelihoods of different socio-economic groups. Some features of the four areas and studies are summarised in Boxes 2-5.

Box 2. BOLIVIA: Forests and trees in the lives of the communities of Chorojo and Samaipata

The AGRUCO group at the Agro-ecological University of San Simon, Cochabamba, has carried out the study in two communities, one Andean and one Valley area. The population in Chorojo and Samaipata is approximately 3 000 people. The group has studied the most prominent practices in use and management *vis à vis* household food security (HFS) and forestry as well as vulnerability to changes in access (physical and economic) to forest resources. It has collected information during two periods, the sowing season and the dry-cold period, and used participatory techniques, interviews, group meetings and observations as well as secondary information. The AGRUCO group works closely with the communities, using participatory group dynamics to select study areas. Communities were also involved in writing up index cards describing products, use, access and sustainability.

For further information contact: Dr. Freddy Delgado/Ing Stephen Rist, AGRUCO, Agro-ecológica Universidad Cochabamba, Bolivia

Box 3. TANZANIA: Two villages in Mtwara Rural District

The Tanzanian Food and Nutrition Centre (TFNC), in collaboration with the Section for Community Forestry, Forest and Beekeeping Division, has carried out a study in two villages of one district in Mtwara region, south-east Tanzania. The population of the two villages is around 4 700 people. The villages differ in their access to forest and one is close to a proposed forest reserve. The population is Makonde people, mostly farmers using a local form of forest-fallow system where they inter-crop cassava, cashew and many annual crops. The team has used PRA/RRA techniques to explore production systems, livelihood strategies, reliance on forest products, food shortages, food crisis and food insecurity, coping strategies and changes in access to forest and tree products. The study shows increasing stress in the production system, partly due to population increase and migration to the area, but mostly caused by expansion of cassava production due to favourable prices to the producer.

For further information contact: Ms. Hidaya Missano, Tanzania Food and Nutrition Centre, P.O. Box 977, Dar Es Salaam, Tanzania

Box 4. THAILAND: Two villages in Phue Wiang District, Khon Kaen Province

The team from the Faculties of Associated Medical Sciences, Public Health, and Humanities and Social Sciences, Khon Kaen University, has compared dependency on forests and trees for food security in two villages before and after enforcement of a major policy change which included closure of the forest. One village is situated near the forest and, in 1989, the study team carried out case studies there on use of forest food products using food recording in seven households for a one-year period. The other village is located further away from forested areas but near a sawmill and the closure of the forest has thus caused a major change in the main source of income for the villagers, as well as limited their direct access to forest foods. The population of the two villages is around 780 people.

For more information contact: Dr. Sastri Saowakontha, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand

Box 5. VIETNAM: A study among Dao people in Yen Houng Commune, Ham Yen District

The team from the Forest Research Centre, Vinh Phu, has studied dependency on forests and trees for food security of one minority group, the Dao people, in two forest communes in Yen Houng. The Dao people have access to very limited paddy land in the narrow valleys and therefore produce most of their food and fodder (hill rice, cassava) on forest land, using a fallow system. Migration to the study area occurred during two different periods, most recently in 1979.The team has collected information from eight villages (brigades) at different altitudes in the two co-operatives. It visited at three different times of the year and looked at general, seasonal and intermittent use of products (use at key times). The population in the two areas is about 1 700 people.

For more information contact: Ms. Nguyen Thi Yen, Forest Research Centre, Bai Bang, Phuong Chau, Vinh Phu, Vietnam

There were considerable differences in previous contact between the communities and the institutions (researchers) involved in the studies. The Thai group had already carried out a study involving one year of food recording in case households from the study area. In Vietnam, the FRC was involved in several activities in the study area on questions of land

allocation, and farm forestry research. The Bolivian group had ongoing participatory collaboration with the communities. In contrast, the Tanzanian group had no prior activities in the study areas and selection of sites was only made after a national awareness seminar with decision makers and visits and discussions with provincial and district forestry officials.

Methods and Approaches

One of the aims of the studies was to explore more qualitative, rapid and participatory methods in learning about dependency issues in local communities. All teams thus made use of RRA or PRA techniques in the initial exploratory investigations, but the approaches used later in the study or for specific sub-topics varied. Each team decided what would be most appropriate and relevant for their needs and selected methods partly dependent on the professional background of team members and what they perceived as relevant, and partly dependent on previous involvement in the study area. A summary of the methods and approaches is provided in Table 3.

Table 3. Methods and approaches

	Country			
	THAI	VIET	BOLIV	TANZ
Pre-study seminar (sensitisation)				●
Review of secondary data	●	●	●	●
Community meetings	●	●	●	●
Inventory of species used	●	●	●	●
RRA techniques				
SSI * with groups	●	●	●	●
* key informants	●	●	●	●
* individual	●	●	●	●
Observation	●	●	●	●
PRA				
• participatory work with community		**(●)**	●	●
• field trips with farming groups			●	
Preparation of index cards			●	
Case studies/in-depth interviews	●	●	●	●
Food recording	●			
Questionnaire surveys on sub-topics	●	●		●
24-hour recall on food consumption		●		

The Thai team could draw on lengthy experience of rapid appraisal work at their own university of Khon Kaen. The teams in Tanzania and Vietnam had no previous practical experience on work with RRA or PRA techniques and requested support from FTPP for training. The Bolivian group was already using participatory techniques in their ongoing work with local communities. The Vietnam group used participatory work with the communities more in the follow-up activities than during the pilot study.

Through use of RRA or PRA techniques, the teams collected information on topics such as history of villages, production systems and trends in production and productivity, off-farm activities, forest products used, trends in use, seasonality of use of forest products, land-use rights and socio-economic differentiation in use of forest products. Through use of semi-structured interviews or focus group discussions in selected households, the teams also collected information on coping strategies among food-insecure households.

Three of the groups (Thailand, Tanzania and Vietnam) also used some formal questionnaire surveys to elicit quantitative data in a sub-set of the communities. In Thailand, for example, changes related to the closure of the forest were examined through formal recall among all households in the study communities. Thus they made comparisons, before and after forest closure, of agricultural production on forest land, changes in employment, income, frequency and types of forest products used for consumption or sale, and could analyse this by socio-economic group. From six households they also obtained household food records (before and after forest closure) and could illustrate by source (forest or fields) the quantity and frequency of use of different types of products over different seasons.

Findings Regarding the Role of Forests in Food Security

At several points during the studies findings from the work were presented and discussed in seminars at different levels. Reports were prepared in Thai, Vietnamese, Swahili and Spanish and, before the final seminar, FTPP helped publish English summaries (Missano *et al*. 1994, Nguyen Thi Yen *et al*. 1994, Saowakontha *et al*. 1994). The report from the Bolivia study is only available in Spanish (Serrano and Rist 1994).

The pilot studies provide good illustrations of the major, and neglected, role of forests and forest products and the relationships between forests, forest products and the food system as a whole. Several important aspects of the forest-food security relationship were illustrated, some of which are discussed below. Most examples are taken from the work in Tanzania, Thailand and Vietnam as the Bolivian group have submitted only one part of their findings.

First, in two of the study areas (Tanzania and Vietnam), farmers make use of different types of forest fallow systems and the households thus depend fully or partly on forest land for production of staple foods and vegetables. With rising population pressure (growth and in-migration), communities have gradually had to go further to find new forest fields or shorten the fallow cycle. Problems of lower productivity, transport over long distances and disputes between old and young farmers about land use were some of the issues emerging. In the Thai study, most households (80 per cent) had also cultivated cassava on forest land until 1990, when an earlier rule of forest closure was strictly enforced by the Thai Government. This study provides detailed information on the major economic and dietary consequences of this action for different socio-economic groups. Only the Thai study provides in-depth data on the relationship between livelihoods, private property and common property resources, and illustrates the effects of a policy change on the use of forest products.

A second (and major) type of information resulting from the studies focuses on forest products used. All teams have lists of those forest products used as foods, medicines, fodder or many other purposes. In line with earlier studies elsewhere, the total number of forest products used as foods, regularly or seasonally, by the study communities was found to be large. It varied from around 90 in Vietnam to well over 100 in Tanzania and Thailand, and includes both plant foods (fruits, vegetables, mushrooms, bamboo shoots, roots, etc.) and animal products (including small rodents, game, birds, snails, etc.). Only the Thai study provides quantitative information on consumption of all these "natural products" as well as information on their relative importance in the overall diet in specific households. Through recall by all households in the communities, the study also illustrates how the closure of the forest and the ban on cassava production in the forest, resulted in a major decrease in the use of many forest plant foods, even if the use of these was not restricted. Many farmers and labourers gathered, trapped or consumed products when they were in the forest to work on their "agricultural fields", thus use was very "opportunistic". This type of gathering and use decreased when special trips were needed. The reliance on purchased food increased suddenly to replace that previously gathered in the forest. Also many households had to migrate to the next province for wage labour on sugar cane plantations. For poorer households, without the resources needed to allow some members to migrate for labour where others continued with their home production, the result was a sudden deterioration of the quality of the diet.

All studies illustrate the major role of forest fruits and vegetables in household diets in comparison to produced or purchased alternatives. In the Tanzanian case, for example, one forest product, mingo'ko (a wild yam) was important as it complemented home-produced staple foods. Ming'oko was also of interest as the consumption and marketing of this product has increased as the staple food cassava has also become a major cash crop.

Many other non-timber products were indirectly important to food security and nutrition, e.g., medical products. A large number of plants were used as home remedies, but some medical products (both plant and animal) also provided occasional income, especially in the study areas in Vietnam.

Food-insecure Households and Forest Dependency

Important information from the studies concerns the food security situation at the household level. A large proportion of the households in the study villages (Tanzania, Thailand and Vietnam) was either seasonally or chronically short of basic foods. By using local criteria to stratify the communities into different socio-economic categories, the teams could analyse the food security situation of different groups. To people in the study communities, food security was primarily a question of sufficient staple food, that is rice or cassava, and food insecurity was perceived in terms of "months of shortages" of these foods. Poor households made use of the forests to meet staple food needs in several ways, e.g. through production on their own forest fields, labour on fields of better-off households, selling or exchange of non-timber forest products (NTFP) for staple foods or direct consumption of forest foods. For the poorest households, ensuring an adequate supply of staple foods throughout the year was the most difficult task. Supplementary foods can always be gathered, trapped or hunted. In the most food-insecure households in the Thai case, the closure of the forest meant loss of income from day labour, loss of the only available land for own production and loss of easy opportunities to gather foods for sale, exchange or consumption.

Lessons Learnt regarding Methods and Approach

Another major feature of the FTPP studies was the attempt to explore the use of more informal and participatory methods to generate information for forestry professionals for planning. For this purpose the studies were designed in an inter-disciplinary manner, training in RRA/PRA techniques was included (but the groups were also encouraged to make use of other methods as they saw necessary), and seminars were held at different levels (village, regional and international) to maximise exchange of experiences. Also in this regard, many lessons were learnt.

All researchers involved found that the RRA/PRA techniques used were very suitable for a topic that is both complex and specific for each area. Their use of these techniques however differed considerably.

The Thai researchers were familiar with RRA techniques and made most use of these. In later phases they combined this with more extensive focus group discussions on key issues. They also combined these informal methods with a formal survey more than other teams. The Tanzanian and Vietnamese team members were relatively inexperienced in use of

RRA/PRA, but found the techniques practical and suitable for the topic. For all three teams the emphasis was generally on information gathering rather than empowerment. A more participatory orientation evolved in the Tanzanian study as the team became connected to a local community action programme which had an emphasis on participation and empowerment (Johansson 1995). The methods used in the Bolivian study differed as participatory group dynamics was used for selection of study areas and throughout implementation.

A further aspect of the studies was the multi-disciplinary nature of the teams. All involved found this very useful and appropriate for the topic but, in terms of analysis in the final report, the Thai group developed a more integrated approach. The researchers were more experienced and "less multi-disciplinary", and while the topic was forestry and food security, the team did not include forestry professionals. Recent policy changes had constrained the relationship between foresters and the local population. In the Bolivian group disagreement within the group on their own analysis of the information has contributed to delays in finalising the work.

Initially, the studies did not include plans for follow-up actions other than seminars to share information. Yet some follow-up activities were instituted as it became important to further the studies with more participatory approaches and especially with food-insecure households. These actions varied with the mandates of the institutions of participating team members, and perhaps also with individuals and the extent which they could (and would) at that time act on what they had learnt. Thus the Vietnamese group, through the FRC farm forestry programme, increased their involvement and support activities in the study communities, assisted with land allocation, credit facilities, new techniques for forest and home gardens and building a community house for future information sharing. The Tanzanian group, with the RIPS programme, became involved in setting up a water committee and a revolving fund to improve the water situation in one of the sites. They continued to work with RIPS on further studies in the surrounding region and, at the national level, received government approval for a multi-sectoral task force to continue to work on questions of forestry and food security in a 5-year national programme. The Thai group, from their university positions, could only suggest recommendations, and attempt to publicise information on the impact of deforestation on food security and promote inclusion of these issues in various curricula and policy fora.

Suggestions for Future Studies

The researchers involved in the pilot studies and FTPP administrators also met in a final seminar in Hanoi in December 1994 to discuss lessons learnt (Ogle *et al.* 1995). In addition to presentations and discussion of individual studies, the participants prepared a set of critical issues which they consid-

ered important for future study on the topic of dependency on forests for food security. The outcome of this was some general principles, e.g., the need to focus more on households which are most vulnerable to food insecurity, and on trends and a short list of issues considered most important for future studies (Table 4).

Table 4. Key issues in studies on people's dependency on forests and trees for food security

General
- Identify and focus on households that are most vulnerable to food insecurity
- Focus on trends (what is getting better? what is getting worse?)
- There is a need to bring out rural men's and women's perceptions on forest resources for comparison with "official" views

Specific

Outside community
- Macro trends (deforestation, population changes, food security, etc.)
- Locality relative to forests
- Tenure
- Policy and regulation

Within community
- Men's and women's visions for the future
- Dependency (who, when, what products, what purpose, from where?)
- Interrelationship between agriculture and forestry (role of foresters/trees in livelihood strategies)
- Social-cultural views on forests/forest products
- Trade vs. household economy (including who, where, level?)
- Management practices by people/forestry departments

The short list summarises the participants' views on the type of information which is critical for local-level planning by villagers or forest department staff. At this point the participants also discussed methods and approaches for future studies. The group agreed that this kind of research should be inter-disciplinary, with a core group of invited key actors considered appropriate for the specific case (e.g. foresters, agriculture staff, nutritionists, community development workers). According to the case they may be drawn from local and national level.

All researchers also agreed that participatory techniques were important but they made clear that this takes time, as trust and confidence need

to be built up in order to discuss sensitive information. Focus group discussions, participant observations and key informant discussions were mentioned as useful techniques. The classification of socio-economic groups within communities, based on the communities' understanding of poverty/wealth and on cross-checking information both with key informants and with poor and food-insecure households themselves. Further in-depth interviews, observation and group discussions should then be carried out with these households. Through analysis of these, the researchers should gain an initial understanding of the local situation and also of key issues which may require further research. Local people will thus have had the opportunity to determine the research agenda.

One of the purposes for the studies was the development of methods for local planning. This was also included in the objectives set by the teams. At the final seminar there were also several examples of how teams had used the studies in planning initiatives. Each team also discussed ways to continue work with dependency issues. The discussions at the final seminar were focused on lessons learnt regarding content and method, and the underlying assumptions were still connected to some type of guideline as discussed at the beginning of the study. We did not discuss what we had learnt regarding the research process or implications for ourselves as researchers or as part of institutions with such varied mandates. We did not discuss possible core questions to guide selection of institutions to involve in studies and implications of this on the research process. Neither did we discuss what we had learnt regarding international comparisons across language, cultural and regional boundaries which, in retrospect, would have been useful to analyse for the benefit of future international collaborative field studies.

What did FTPP and IRDC Learn?

Among the issues we can analyse in retrospect is the question of the roles of FTPP and IRDC in the studies and what we can learn from this. The original idea focused on learning more about "dependency" and on development and testing of practical methods for learning about dependency. We hoped that in turn this would generate guidelines for those who wished to incorporate concerns about "forest products–food security" into policy and activities (Longhurst 1991).

The studies took place during a very dynamic period of development of participatory approaches in community forestry. For FTPP this was also a period of major change when the focus moved from one of a rather conventional international development programme with a number of country projects, to a more split, global approach with several decentralised units of regional and national groups to lead the programme, and a global unit focusing on networking, institution strengthening, information distribution and method development. Planning and development of many of the

programme's activities became more of a joint effort between partner institutions. As an example, in the East Africa region, the major objective became identification of strategies in support of efforts by people to best utilise their natural resources, especially forests and trees.

In the initial planning of the dependency studies there was no discussion of action-oriented or empowerment-oriented research, and more emphasis was placed on developing relatively fast "methods" of learning about dependency. In very conventional ways the idea came from FTPP, the finances from FTPP, technical support if requested was provided through FTPP. While FTPP and IRDC were "institutions" which participated in the studies, our role, our use of information, and implications of the outcome of these studies to our continued work were not discussed. We did not reflect on how we should use the lessons learnt from the studies in our future work and the influence of such reflections on study design and analysis.

Thus, a very positive aspect of the original concept was that it supported a learning process for all involved researchers and institutions, with relatively little control from FTPP. Using this design, the dependency studies have provided yet more examples of the complex and site-specific character of forestry and food security relationships. They did not result in simple technical answers. Rather they made us acknowledge that we do not have many "solutions" to deal with the complex and diverse food procurement situations of poor households and that there is a great need to find new approaches and partnerships in a development which allows more effective use of local and diverse initiatives.

In retrospect we should also have discussed this aspect of the design, and implications for future studies when summarising the outcomes. It is only now that we come back to the question of when is a global comparison useful, for whom and for what purpose?

What should be the purpose of comparative international research or "international" case studies, and what should be the core questions or foci? Should we focus on issues which are decided internationally, or aim towards research processes which improve the capacity of local research institutions to work with diverse and local specific situations. If it is more on the latter, then we need to expand the opportunities for researchers to meet, including those working with international development agencies, in order to improve capacity based on field experiences and academic discourse. One example of such a structure is given by Rocheleau in what she calls the "spinning wheel" model, where institutions collaborate in participatory research, "each spins on their own axis, yet contributes to a broader, shared circulation of participatory research for diverse and sustainable development" (Rocheleau 1994). How this process can be improved in such a way that our learning as "outside" researchers or institutions does not compromise local learning and development, is a question which we consider important for international institutions to continue to explore.

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Annex I

Report of the CIFOR Workshop on Research on Non-Timber Forest Products

Hot Springs, Zimbabwe
28 August-2 September 1995

Introduction

The workshop was attended by eighteen researchers working on different aspects of NTFP, in different tropical regions. The discussions were based on twelve papers prepared for the meeting, and were organised within the following six-part topic structure proposed in the CIFOR Working Paper No. 6 (January 1995), *A Conceptual Framework for CIFOR's Research on Non-Wood Forest Products*.

- Forest-woodland dynamics
- Non-market and market dynamics
- Technological changes
- Use of labour and the household economy
- People's perceptions, preferences and opportunities (cultural dynamics)
- Policy development

Each of the six topics was first discussed in plenary session, and the draft lists of research questions that emerged were then further elaborated in small group sessions. The reports that follow reflect the fact that both the background papers and discussions concentrated on issues and possible research questions, with relatively little attention being paid in this initial meeting to methodology.

General

Discussion highlighted the following general issues:

- The importance of setting research in historical perspective, and recognising that the present usually reflects one point in a process of continuous change. This change, rather than being deterministic and uni-directional, follows multiple possible paths that combine causal and random (i.e., unexpected) relationships.
- The shift from the earlier association of gathering for the market ("extractivism") with exploitation of both the resource and workers, to the emergence of concepts of sustainable extractivism based on traditional management systems, followed by criticisms of this concept as being inconsistent with conservation, inefficient and inequitable.
- The continuing co-existence of two fundamentally different types of use of NTFP, one by households/communities that are dependent on these products to meet subsistence needs, the other market oriented. The latter involves more people, but the former is still central to the forms of organisation of populations in large areas of tropical forests.

Ecology and Management of Forest-Woodlands

The background documentation identified a number of points relating to forest-woodland ecology, and to the impact of exploitation on that ecology:

- There are three basic types of plant population structure reflecting constant rate of seedling establishment, sporadic or irregular seedling establishment and regeneration which is severely limited. The establishment, growth, reproduction, longevity and management potential of pioneer, late-secondary and primary species are markedly different.
- The great majority of trees rely on animals for pollination and dispersion, and require viable populations of these animals if they are to be sustained.
- Harvesting is likely to be concentrated in formations that have relatively high densities of valued species. Growing demand will have differential impacts on the extinction, management and domestication of different species. Exploitation of one species can have follow-on effects on other species. Over time the composition of the forest stock is likely to shift to less-desired species.

The workshop discussion dealt mainly with the overlapping area between ecology and management. It was recognised that there are different

perspectives on the relationship between "nature" and "humans", and considerable disagreement on just how large and important is the area of intersection. The need to specify a number of terms that are rarely adequately defined by those using them was also emphasised. The following points were made in this connection:

- The term "biodiversity" must be divided into its component parts (e.g., genes, species, communities, ecosystems) if we are to understand the impact of a particular change on biodiversity.
- Another term which must be defined is "forest" (e.g., in terms of reflectance patterns from a satellite, or of a production forester's objectives, or of an indigenous forest dweller's view, or in ecological terms)
- When discussing the "sustainability" of a given activity it is necessary to specify for whom, for how long, at what level of economic/social circumstance, with what rate of return. One must also specify realistic time frames over which to expect management and conservation systems to continue. (It was noted that there appears to have been greater success at harvesting plants sustainably than harvesting animals sustainably.)
- It was suggested that "management" be defined as an activity that is purposeful, is directed (although it can have many non-targeted impacts, both desirable and not desirable), and attempts to increase returns on targeted systems by redirecting flows of energy and nutrients towards the manager. When management systems are changed, energy and nutrient flows change and often this also has major social effects.

The discussion also drew attention to the great variety of existing management systems many of which have been undescribed, under studied and under appreciated. Neglected areas include:

- There has been little documentation of wild animal management practices, and insufficient recognition that forest management systems focused on non-animal management have frequently led to dramatic decline in animals in the systems being managed.
- The distinction between "NTFP" and "timber" is artificial and often results in bad policies, because it suggests that smallholders who manage NTFP are not also managers of timber. A more appropriate framework for research could be small-scale integrated forest management, or the study of how ecosystem functions can be managed for improved ecosystem services for smallholder livelihoods. If the term "NTFP" is to continue to be used, then careful attention must be paid to "unpacking" it to recognise that, for example, animals are not equivalent to fruit or latex in their responses to management and to harvesting.

- Forest management schemes frequently have focused only on the relationship between "manager" and "product", neglecting often complicated interactions (caused by the management action) which result in changes of both a social and biophysical nature.
- The emphasis on "extractivism" has tended to obscure the extent to which management is already practised in many systems. In particular, there has been little work done on smallholder forest management systems of any kind. Most studies concentrate on only the first few years of swidden-fallow management; longer-term management of more mature forest is largely unstudied. In practice, existing smallholder management systems tend to be sophisticated, widespread, both short-term and long-term, and integrate agriculture and forestry temporally and spatially.

The background documentation also highlighted the importance of understanding the factors shaping the pattern and sequence of the transition from a stage when NTFP production is growing through the expansion of extraction from wild stocks, to stages characterised by management of the existing resource or by cultivated stocks. This transition occurs as the demand/supply balance shifts, as quantities and quality from wild sources decline, and as prices rise. Inelasticities in supply of naturally sources products in the face of rising demand and prices lead to development of domesticated sources and synthetic alternatives. Another impetus behind domestication is greater control over quality and costs.

Research questions
The following research questions were identified:

1. *Understanding management practices*
   - What are the impacts of technological innovations and change on management practices?
   - What factors explain the diversity of management systems and practices in an area?
   - What are the impacts of tenurial arrangements on management practices?
   - Are there characteristics of small-scale and smallholder forest management systems that differentiate them from large-scale industrial systems?
   - How have management practices been affected by ecological changes?
   - What rates of use are ecologically optimal? Do ecological and economic optima differ?
   - How can complex livelihood strategies be translated into manage-

ment practices?
- What "subsidies from nature" support specified management practices?

2. *Interactions between natural, managed and domesticated resources*
   - What are the driving forces?
   - Is there an inevitable shift from natural to managed to domesticated resources?
   - How is income generated from wild forest resources spent (invested and/or consumed)?

3. *Impacts of management practices*
   - Impact on ecosystems?
   - Valuation of the costs and benefits of managerial alternatives?
   - Impacts on non-target species and on non-target users and populations?

Markets and Marketing

Points that were raised in the background documentation related mainly to spatial and temporal patterns of demand, marketing mechanisms and interventions, and valuation problems that make it difficult to understand and predict reactions to market forces.

- The thesis that access to supplies of imports and to markets for exports in general leads to more intensive exploitation of fewer products and species. Understanding the factors governing choice of products to export and replace.
- The role of intermediaries (middlemen) in trade of products characterised by perishability, seasonality of demand or supply, dispersed smallholder production and poor transport infrastructure. The weak bargaining power of many producers, in particular in the face of monopsonistic buying. Price controls and other measures that restrict small producers' access to markets for certain forest products.
- Difficulties in establishing the real costs and returns from an NTFP activity because of its joint production nature, integration with other household activities, linkage to multiple livelihood objectives, and the failure of the market to reflect the values of environmental and other "external" costs and benefits. This makes it difficult to understand. and hence predict, people's interactions with markets.

In the discussion, attention was drawn to the potential impact and risk of market development of NTFP. For example, how will consumption patterns change with rising incomes, and what will the consequences be

for producers who have invested in NTFP? What changes to forest composition and function will increased commercialisation of NTFP bring? Concerns were also voiced about the failure of the market to accurately reflect environmental externalities and other values, and the limited amount of research on this subject.

Another key point identified was the tendency for macro-policies affecting NTFP to be restrictive, focusing on the control and often discouragement of production of NTFP. The strong political element in much policy making in this area was also noted; the impact of policies may largely reflect the interests of those setting the political agenda. The fact that the forest is of value may therefore not be enough to ensure its conservation. This indicates the need for identifying the power relationships in a given situation.

Research questions

1. *Research fundamentals*
   - What are the conditions within which the commercialisation of NTFP a) enhances strategic goals of forest resource users, and b) enhances conservation of forest-based biodiversity?

2. *Market intervention*
   - Is the micro-scale a more appropriate level for intervention than the macro-policy level given the greater ability of producers to influence the micro-level?
   - How do consumption, investment and other producer decisions change with increased incomes? What changes, if any, occur in forest composition and function as the result of increasing incomes?
   - How can incomes be raised through sale of NTFP in an equitable fashion?
   - What policy changes can be made to increase market incentives and reduce market disincentives?

3. *Market evaluation and development*
   - Methods are required to evaluate products most suitable for further investment based on costs, returns, FOB price, capitalisation required, etc.
   - What are the guidelines for the commercialisation of a NTFP (marketing, market studies, price formation, value added, etc.)?
   - The need to understand the role of marketing mechanisms, including: a) the role of intermediaries in NTFP trade; b) the adequacy of existing producer/trader relationships; c) measures that affect access

to markets (regulations, charges, access to credit and information).

- What is a producer's knowledge of product pricing; is it an important issue for further study?
- How does the tapping of new markets affect household labour; will commodification have a negative impact on certain groups?
- How do we take into account existence values? Is more rigorous recognition of the lack of reflection of environmental externalities, etc. in valuation of forests required? If the answer is yes, how can this be achieved?
- The need to understand differences in longer term trends in market prospects for different products; therefore research is needed into income elasticities of demand.
- Are local as opposed to export markets more stable? How do we create robust systems given fickle markets?
- What are the changing patterns of demand for subsistence and marketed products and what implications do these have for production technology?

4. Legal issues

- Is there a market for land use easements that would: a) enhance strategic goals of forest resource users; and b) enhance conservation of forest-based biodiversity ?

Technology

Background documentation highlighted the importance of technology in increasing returns to the producer. NTFP activities can be affected by technological change in extraction, agriculture and ranching as well as in industry. Technological change is also likely to modify expected trends in forest product harvesting, use and values. It can make some NTFP obsolete, and provide new opportunities for others. Factors influencing choice of technology include access to technology, the need to contain rising labour costs, constraints of capital costs, scale economies, etc.

During the discussion it was emphasised that a historical perspective is essential to understanding changes in the extractive sector over time. Activities that are intermediate between extraction and agriculture tend to be overlooked. The evolution from extraction could lead to domestication, but could also involve products that are difficult to domesticate and might be replaced by substitutes. Some could also survive as extractive activities because they are appropriate to the particular niche they occupy. In the move towards domestication it is important to take account of the impacts of such changes on consumers and producers.

Research questions

1. *Trends and processes of technological change*
   - What are the driving forces behind technological change? Why are new technologies developed for producing and processing NTFP; why are they adopted; and by whom?
   - Is the rise and fall of extractive goods, and then the rise and fall of agricultural goods, really the rise of modernity/modernisation? Is it a uni-directional trend, i.e., is extractivism destined to be replaced by cultivation or other substitution?
   - What are the time horizons involved and will co-existence occur?
   - If domestication is an inevitable process for some NTFP resources, will the results of this process be positive for consumers, and also provide new opportunities for producers?

2. *Technology development*
   - What is the possibility of low-cost technology development for subsistence uses - particularly processing, regenerative technologies and harvesting?
   - What is the role of "local" and "external" agents in bringing about technological change in NTFP-related activities?

3. *Transfer/diffusion/adoption of technology*
   - What possibilities exist for technology transfers South-South, North-South and South-North relevant to the needs of NTFP producers, etc.?

4. *Impacts of technology*
   - How do changes in technology affect: a) relations/equity between genders, age groups, ethnic groups and throughout the production-distribution system; b) the strategic goals, including but not limited to livelihoods, of forest users; c) sustainability of resources and other environmental impacts, i.e., whether domestication results in the loss of intra-specific genetic variation?
   - What are the economies and diseconomies of scale, agglomeration and location of production, processing and marketing of NTFP? How do these decisions affect the appropriateness of the technologies selected?

5. *Indigenous knowledge and rights over knowledge*
   - Are the "research and development" roles of resource users being acknowledged and paid for? How can traditional knowledge and

technology be valued? In what way does this consideration affect current and future land-use systems?

Household Strategies

The presentations and discussions in this session described seven areas that are important in identifying research issues relating to the household:

- Defining a household: Such a definition is culturally specific - but is a key factor that needs to be examined wherever one is working. Fundamentally, a household is a group of persons linked by kinship; and is a resource-using unit, of different types, sizes and perspectives.
- Household goals: these can include provision of food and essential subsistence and consumptive goods, cash for purchasing goods and services, savings and social security, concern to mitigate risk, and local social and cultural factors, e.g., status, leisure. The importance in understanding changes in goals over time.
- Strategies of household resource use: the availability of options for use of household labour, capital, land, etc.; decisions about how to allocate these resources in order to meet household goals, taking into account physical access, social limitations, household specialisation, etc.
- Land-use systems: the different sources of NTFP (forest, bush fallow, farm land, pasture land); the factors influencing people's ability to exploit NTFP from a variety of locations (resource availability, access, ability to combine this with other activities, returns to labour). The lack of information about which are totally forest-dependent sources, and why resources are exploited in different mixes at different points in time.
- Grouping of forest uses: activities to meet subsistence needs; activities to earn income; activities with both income and subsistence uses; activities to generate savings. The need for better knowledge about trade-offs between income and subsistence needs, about seasonal and dynamic dimensions, and about how to translate these complex, multiple activities and goals into forest management.
- Access and property regimes: the impact of different forms of tenure, and different degrees of security, on a household's decision making over a group of rights to resources.
- Who makes decisions and who has decision making authority: at what level does decision making take place outside the households, e.g., state managers, traditional rulers, community; within the household who uses and manages, who benefits and who loses; what is the situation across households: possession or lack of power by the poor, ethnic groups, gender groups, etc.?

Research questions

1. *The dynamic role that resources play in household strategies*
   - Role of forest-earned income: change over time and seasons, consumption vs income needs; what affects these changes?
   - Role of forest goods and services in meeting subsistence needs?
   - Role of variability in resources (especially seasonal dimensions)?
   - Role played by life-cycle of household, plus what is the relationship between NTFP production and use and household life-cycle issues, and the age distribution of the population?

2. *How do tenurial arrangements shape household decisions about resource use?*
   - What are the different tenurial arrangements?
   - What key aspects of tenure encourage sustainable use of resources (title, decision making, benefits, inheritance, time scale)?

3. *Variation within and among households*
   - Within: what are household components and different roles in use, decisions, benefits, options?
   - Among: how do households differentiate on resource use, access, specialisation, benefits, composition?
   - How do both of the above affect use and management of forest resources?

4. *Impact of institutions and policies on household strategies*
   - How do macro-level policies frame household resource-use options?
   - What are institutional arrangements between units and how do they interact with households' resource-use options?
   - What is the appropriate unit of analysis for the scale above households?

5. *When is the household the right unit of analysis?*

Cultural Factors

The background documentation drew attention to the tendency to focus on a concept of an undifferentiated local population; and the need to address the reality of politically fractured and socially differentiated groups, with pronounced socio-economic stratification resulting in differential capture of benefits. The importance of understanding the sources of intra-

community power was stressed, and the need to be able to recognise those cultures that are intimately linked to the multiple use of the forest and tend to be subsistence oriented, and those that base their relation with the forest on its commercial exploitation.

The discussion considered the degree of fragility of cultural practices and knowledge. It was pointed out that culture is rather robust, and at the same time flexible, adapting to new circumstances. What may get lost in this cultural evolution process is part of the knowledge. It is necessary to make explicit those problems that arise if some of that knowledge is lost.

A point that attracted attention was the effects of "commoditisation" on traditional culture, and how the latter could maintain its essence while entering into market relations. The need to differentiate the cultural elements that are more vulnerable and also those that may lead to less sustainable practices was mentioned. Some important technologies like firearms, axes or outboard motors for boats may play a key role in accelerating cultural change. The risks of trying to "freeze" a culture was noted, instead people should have the right to choose their own evolution, market and technology adaptation.

Following the model of culture as a text, it was pointed out that there is no single interpretation of the text, and that it is re-elaborated as the reader goes through. If this is the case, the important issue is who sets the context and who decides.

The possibility that cultural traditions create an impediment to responses to new challenges was discussed. Traditional cultural values should not be considered as "free of problems", and they sometimes are used as a tool of exclusion. It was proposed to extend the study of the cultural dimension also to the consumers. The possibility of conflicts between protected areas and traditional rights was also considered.

Research questions

Three main group of questions emerged in the session.

1. *Knowledge and management*
   - What role does local knowledge (or the lack of it) play in influencing sustainable development, both positively and negatively?

2. *Cultural change*
   - What are the inter-relationships between culture and response to market opportunities and new technologies?
   - How are cultural values and social organisation (political authority, class relations, gender and generational authority) influenced by interactions with dominant cultures, and how does this affect forest management and use?

- How are cultural change and identification used politically to grant or deprive populations of forest rights?
- What aspects of traditional forest management practices have been or can be integrated into market-oriented practices?

3. *Culture, social organisation and power*
   - What are the sources of intra-community power, how is power differentiated among groups and how does this affect conservation and management?

Policies and Institutions

The background documentation drew attention to the following issues:

- Because they give high priority to conservation objectives, many governments have adopted forest and environmental policies and regulations designed to limit rather than encourage production and sale of NTFP. Restriction of output is often favoured as a means of pursuing conservation because it is seen as easier than addressing the issue of land clearance. The choice of regulatory measures to restrict output reflects the difficulties in monitoring large and often remote areas of forest.
- NTFP extractive programmes have been advanced as being a compromise that can be compatible with the above approach. However, it is also argued that encouraging increased output for the market, and developing new markets for NTFP, is likely to undermine conservation.
- Policies that change the extraction-cultivation cycle include land policies that affect title to land and security of tenure, labour laws that affect labour costs, and infrastructure policy that increases access to markets (and inputs). NTFP activities can also be affected by broader economic, trade and environmental policies.

The presentation and discussion focused on the following five policy and institutional issues, identifying assumptions relating to each that are pertinent to the formulation of research questions:

The commodification/commercialisation of NTFP - as a means to both promote conservation and improve local livelihoods; assumptions:

- that commercialisation will relieve poverty and increase social equity.
- the people gaining new income have control over the exploitation of the resource.
- that valuation of the forest is equivalent to cash value.

The promotion of land titling - as a means to improve security of tenure and thus improve conservation practices; assumptions:

- that there is a causal linkage between titling and security.
- there is one uncontested version of customary claims to be legally recognised.
- titling and conservation are coupled.
- titling should be done by outsiders at a higher level.

Devolution of control - to transfer decision making over resources to "local" entities; assumptions:

- "local" institutions exist or can be created to fill this role.
- there is an identifiable "local" community.
- this leads to more equitable resource distribution.

The expanding roles of NGOs - in writing and implementing policy; assumptions:

- that NGOs are more efficient than the State.
- they are more participatory and democratic.
- they are closer to the grass roots, they reach where the State cannot.
- they are accountable.
- they will not interact competitively.
- they have the right to go where they want.

Criminalisation of customary rights to forests and NTFP - and nationalisation of forest lands and resources; assumptions:

- "scientific" management is the most socially beneficial and ecologically sound.
- the State has local legitimacy.
- the State has the ability to enforce.
- urban ethics are better than local ethics.

Research questions

Discussion and the identification of possible research questions concentrated on four main areas:

1. *Relationship between commodification and forest conservation and management*
   - What are the relationships among policies promoting commodification, the valuation of the forest, and conservation and sustainable management?

- Under what conditions are conservation easement payments an effective alternative for raising local incomes and conserving resources?

2. *Relationship between property laws/policies and existing forest rights*
   - How do property laws and policies affect the security of existing multiple and overlapping forest rights?
   - What are the consequences for forest conservation, management and local livelihoods?
   - What is the process by which local property claims are identified for conservation interventions and where definitions and meanings of land and resources are accepted as "customary"?

3. *Relationship between sectoral polices and local-level management*
   - How do policies encourage, support or constrain sustainable local-level and smallholder forest management and NTFP commoditisation and use? In particular the following policies were mentioned:
   - Inter-sectoral and macro-policy impacts (including structural adjustment)
   - Agricultural policies, price supports, subsidised credit, etc.
   - Infrastructure, labour law, industrialisation, small enterprise and other policies and policy measures that impact local commercial activities.
   - Environmental policies.

4. *Institutional interactions*
   - What are the interactions among institutions within communities and among institutions at different levels?
   - How do these interactions affect forest conservation and sustainable management?

Conclusions

The meeting noted that the background papers contained much material of potential interest to a wider audience. It agreed that an edited set of papers selected from those presented should be assembled and published as a proceedings volume. Authors agreed to revise their papers to reflect the discussions that had taken place at the workshop.

It was also agreed that there should be a small follow-up meeting to focus on methodology, and to select some field objectives from the extensive and often complex sets of questions raised in the workshop. This meeting would bring together a small number of persons with NTFP research

projects presently under way, to develop a core set of questions and methodologies that they would be prepared to incorporate into their research. This group of activities, together with application of the same methods at CIFOR research sites, could then constitute the nucleus of a network of participating research projects able to generate comparable data of relevance to analysis of policy related NTFP issues.

Annex II

Report of the CIFOR workshop on Research on Non-Timber Forest Products

Soto del Real (Madrid), Spain
11-16 February 1996

Introduction

The meeting was convened as a follow-up to a CIFOR workshop on the same subject held in Hot Springs, Zimbabwe, in August-September 1995. That earlier, larger, meeting developed possible research questions (see Annex I). The present meeting was intended to arrive at a set of priority questions, and to develop a programme of follow-up activities and procedures.

Nine researchers participated in the meeting, including seven who had been at the earlier workshop, and was held at the Centro de Investigación de Espacios Protegidos Fernando González Bernáldez, in Soto del Real (Madrid). Documentation included the report of the Hot Springs workshop, a secretariat note identifying the research issues that had arisen most frequently at that meeting and two further notes from participants analysing its results and putting forward proposals for the prioritising process.

Discussion

The opening sessions were devoted to the task of identifying the best way of pursuing the objectives of the meeting. These discussions focused on the following points.

The first was concerned with the difficulties of developing a conceptual framework within which to define and order research questions, given the present state of knowledge. Weaknesses and gaps in understanding the broader environments within which NTFP use and management take place, which had made the CIFOR initiative necessary, undermine efforts to

construct such a framework. Problems are further compounded by the very large number of inter-related factors that need to be taken into account.

It was agreed that the six-part categorisation used at the Hot Springs workshop was not ideal because its categories are arguably not conceptually equivalent, in the sense that some cut across others. Households and technology for example, enter into questions of markets and management. Many of the questions could be posed at various levels of society. However, the meeting felt that it would not be possible at that stage to identify a satisfactory alternative, and that the task of defining priority questions might more usefully be approached in another way.

Although it is difficult to compare and generalise from much of the information that is available, because of its situation-specific nature and the variety of methods used in its assembly, a great deal of data related to NTFP issues does exist. It was argued that this has not yet been adequately analysed and interpreted, and that much might be learned from a more rigorous review of the existing information base.

Another issue discussed concerned the aim of having researchers incorporate the selected questions into their research. For this to happen, it would be necessary to approach the task of prioritising questions from the perspective of the researchers as well as in terms of defining issues of global concern. Attention is also needed on the form of collaboration, and support, which is most likely to secure the necessary degree of commonality of approach and sharing of results.

At the conclusion of the initial day's discussion, participants agreed to proceed by trying to define a small number of key questions from the bottom up. It was also agreed to consider the value of commissioning a rigorous and in-depth review of existing information for at least one of these questions, as the most useful next stage for the CIFOR programme.

Questions

Five broad questions were tabled as subjects that could be explored through a review process:

1. How does integration with the market affect forest management?
2. What is the role of forests in people's livelihoods?
3. Under which conditions will people manage forests in a sustainable way?
4. What are the political mechanisms to accommodate all interests?
5. What is the role of forest diversity in influencing the success of NTFP uses?

The results of these discussions follow.

Question 1. How does integration with the market affect forest management?

The issues related to the inter-relationships between forests, people and markets attracted a lot of discussion, as it was recognised that this could provide a framework for examining many of the issues that had been raised. In its final form the question was formulated as follows:

How does commercialisation of smallholder forest products relate to:

a) welfare (income generation and distribution, role of forest products income in household livelihood systems, equity, possible diversion of products from subsistence use to the market, etc.);
b) forest management (pressures to over-harvest, or to conserve and practise sustainable use, or to move towards domestication);
c) tenure and control (reinforcing or undermining local collective management systems; shifts to open access, government appropriation or privatisation);
d) forest structure and function (differential impacts on different species and on ecological structure).

Where necessary, exploration of this question should differentiate between different types of resource (plant, animal, destructively or sustainably harvested, etc.), product (inferior, normal, luxury), market (local, urban, industrial and/or export), and different phases in the market cycle (emergence, expansion, decline). It should also distinguish issues related to changes in competitiveness and profitability.

Question 2. What is the role of forests in people's livelihoods?

After a discussion of the objectives of the question, three points were raised:

a) do we already know enough to be able to answer the question?
b) is it clear what information we are trying to obtain through the question?
c) can this question result in generalised answers in the way the other questions can?

It was concluded that the other questions do not adequately cover the issues raised by this question. A focus on how livelihood systems affect people's use and management of forests emphasises factors external to the forest, and the role of individual decisions in shaping how forests are used. Both of these components need to be considered, and that the question should deal with the main "factors" influencing the level of importance of forests in local livelihoods.

Question 3. Under which conditions will people manage forests in a sustainable way?

Discussion quickly led to the recognition that this was another very broad question, and that it heavily overlaps with the first one. Thus "conditions" were defined as being linked mainly to market involvement and institutional conditions. Similarly, sustainable forest management was defined in terms of current management systems, the state of the forest and the welfare of the people.

Discussion of this question highlighted the need for agreement on indicators, and on how to measure performance in terms of these indicators. It also highlighted the need to specify that the term "people" is being used to mean local people, and incorporates an assumption that they will act in their own best interests.

Question 4. What are the effects of changing conditions of governance on welfare, forest management and the forest resource?

This question was originally formulated to focus on what sort of political mechanisms exist to accommodate both local and state concerns relating to control over and access to forest resources. Discussion concentrated on the inherent conflicts caused by the differences in scale between local and national interests, and the lack of models of institutions that incorporate shared ownership. It was agreed that the focus should be on governance rather than ownership. This overlapped with Question 1.

Question 5. What is the role of the forest resource in influencing the success of NTFP use?

The original question was posed to highlight the importance of biodiversity (forest structure and composition) in the development of sustainable systems to exploit non-timber tropical forest products. Some types of forests, e.g., those with high species diversity, low density of conspecific trees, and a large number of complex ecological inter-relationships, will be inherently easier to exploit on a sustained yield basis than others, e.g., those with lower diversity and simpler structure. Subsequent discussion of the question, however, revealed that most participants were of the opinion that the forest management systems evolved by local communities to exploit NTFP are of greater interest and relevance than the initial characteristics of the resource base. Given that the first question, on commercialisation, contained analyses of resource types, domestication and forest structure and function, a consensus was reached that Question 5 should be dropped.

By the end of the examination of possible questions, it had been agreed that Question 1, dealing with the inter-relationships between forests, people and markets, should be given highest priority for further research.

Literature Review

The meeting agreed that an in-depth review of existing information related to Question 1 would be the most logical next step for CIFOR to pursue. The following proposals emerged from a detailed discussion of the requisitions for such an exercise.

- The main objective of the review should be to collate, analyse and synthesise the available information, in order to provide data on as many as possible of the issues raised in the question, and to identify research needs and hypotheses (or at least identify the right questions and methodologies).
- Output should also be designed in such a way as to provide an information base for other researchers. It should therefore include evaluation of the methods used in the studies reviewed, indicating the researcher, and providing sufficient information on methodology and rationale to enable other analysts to interpret the relevance of the results for their own needs.
- An annotated bibliography could be a useful by-product of the exercise, but should not be its main purpose.
- The coverage should include published material, grey literature and doctoral and other dissertations, located and obtained through standard searches, supplemented by site visits.
- Separate searches and reviews may prove necessary by region or/and major language. If this is the case, care must be taken to ensure that they follow a common structure, methods and definitions of coverage and aims.

It was agreed that the review should be centred in one or more locations with good access to search and library facilities covering the relevant subject and geographical area literature. It was pointed out that people are more likely to provide access to unpublished material if the researcher heading the review is a recognised authority on the subject.

Research Networks

Research networks range from those controlled by a central managing and funding entity, and working to a common agenda and with a common methodology, to loose mechanisms to facilitate periodic communication

among research entities sharing a common interest in a particular subject. CIFOR's budgetary constraints preclude the establishment of a financially supported network for this purpose for the moment, but it would like to work with a group of researchers and research projects willing to adopt more commonality of approach than is usually the case with voluntary networks.

Conclusions

At its conclusion, the meeting agreed upon the following:

1. Priority should be given to carrying out an in-depth review and analysis of existing information relating to the issues formulated in the question on commercialisation (Question 1 above).

2. CIFOR will produce terms of reference for the review, to be circulated for comment and will initiate a search for a suitable person to carry out the study.

3. Participants at the meeting will send to CIFOR material and references relevant to the review.

4. CIFOR will further examine how best it can work with research projects wishing to take part in collaborative research on this subject.

The book contains a number of commissioned background papers presented at the workshop on 'Research on non-timber forest products' (Hot Springs, Zimbabwe, 28 August - 2 September 1995). Bringing together the experience from different regions and professional backgrounds, the book attempts to analyse the complexity of multiple use of forests from a multi-dimensional perspective that incorporates environmental, social, economic, technological, political, historical and cultural factors.

Current topics of discussion are reviewed. These include the possibility of matching the conservation and development agendas through promoting NTFP as proposed by a number of initiatives, the uni-directional path of development from extraction to intensive agricultural production, the roles of NTFP on people's livelihood strategies, the internal differentiation amongst communities, the different forms adopted by actions meant to secure tenure and their diverging effects, as well as the meaning and convenience of using NTFP as an analytical category.

A general conclusion to be drawn from the book is the need to build up an inter-disciplinary research agenda, as well as the need to employ more than one approach or method in addressing the complex situations that characterise the multiple use of forests.

The Center for International Forestry Research (CIFOR) was established in 1993 under the Consultative Group on International Agricultural Research (CGIAR) system in response to global concerns about the social, environmental, and economic consequences of loss and degradation of forests. CIFOR's mission is to contribute to the sustained well-being of people in developing countries, particularly in the tropics, through collaborative strategic and applied research and related activities in forest systems and forestry, and by promoting the transfer of appropriate new technologies and the adoption of new methods of social organization, for national development.