INTRODUCTION: NTFP RESEARCH IN THE TROPENBOS PROGRAMME

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When the term non-timber forest product (NTFP) was coined about ten years ago to replace the more disparaging appellation of 'minor' or 'secondary' forest products, there were high expectations as to what their exploitation could contribute to the sustainable management of tropical rainforests. The notorious article by Peters, Gentry and Mendelsohn (1989) in *Nature* suggested that fruits and latex in a Peruvian forest plot represented more than 90% of the forest's total market value, leaving less than 10% for sustainably harvested timber. De Beer and McDermott (1989) pointed to the importance of non-timber forest products for the 3 million forest dwellers in Southeast Asia, quantified their contribution to the local and national economies and made a case for realising the potential benefits of NTFP development. In Brazil, the anthropologist, Mary Allegretti, and the leader of the rubber tappers' movement, Chico Mendes, launched and made a political success of the concept of extractive reserves as a combined strategy to secure forest peoples' rights to forest resources and promote environmental protection (Allegretti, 1990; Schwartzman, 1989). The combination of scientific interest and political struggle at grassroots level set the stage for an initially almost euphoric belief among scientists and environmentalists in the potential of NTFP exploitation to contribute to forest conservation and improved livelihoods. The implicit message to policy makers was not to kill the goose that lays the golden eggs.

The Food and Agriculture Organization of the United Nations (FAO) was the first international organisation to take up the message. It dedicated a forestry paper to the issues and potentials of NTFP development in order to encourage efforts to strengthen programmes for sustained NTFP use (FAO, 1991; see also FAO's contribution to this volume).[2] Many organisations followed and Tropenbos was among them.

NTFP studies have been part of the Tropenbos programme from its very start, with attention being paid to the significance of NTFPs for the subsistence of forest-dependent people, as well as to the potential of commercial extraction to contribute to the conservation of tropical rainforests. Responding to the diverging views on the latter, Tropenbos published a strategy for NTFP research in 1995 that focused specifically on the identification of the conditions under which commercial NTFP extraction could act as a conservation strategy and socially desirable

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[2] The FAO prefers the term non-wood forest product (NWFP) in order to distinguish clearly between the three main outputs of forests and trees: (a) wood products, including roundwood and sawnwood, pulpwood, chips, fuel wood, small woods, etc. (b) non-wood forest products, including resins, essential oils, medicinal plants, live animals, bush meat, etc. and (c) forest services, including ecotourism, grazing, bioprospecting, etc.. De Beer and McDermott (1989) do include fuel wood in their definition of non-timber forest products. Tropenbos defines non-timber forest products as 'all tangible animal and plant products other than industrial wood, coming from natural forests, including managed secondary forests and enriched forests' (Ros-Tonen *et al.*, 1998). This excludes NTFPs from plantations and other human-made vegetation types. As will be seen in this volume, several authors also refer to NTFPs in the case of products of forest origin coming from plantations, home gardens and agroforestry systems (e.g. van Dijk and Wiersum, van Valkenburg, de Jong). This underlines the need for more refined concepts (see the last chapter).

form of land use in tropical rainforest areas (Ros-Tonen *et al.*, 1995). This book presents the results of almost ten years of NTFP research under the Tropenbos programme. The authors were invited to present the results of their studies against the background of the alleged potential of NTFPs to contribute to forest conservation, participatory forest management and improved livelihoods for forest-dwelling people. Thus the papers not only contribute to the evaluation of the Tropenbos research strategy, but also further the insights into the potentials of NTFP development.

In this chapter I will first present an overview of Tropenbos NTFP studies and briefly review the research strategy. I will then consider the main issues - forest conservation, participatory forest management and improved livelihoods – which form the common thread running through the papers in this volume. Finally, I will point to the main lessons that can be learnt from Tropenbos NTFP research.

1. NTFP RESEARCH IN THE TROPENBOS PROGRAMME

The Tropenbos programme encompasses three types of NTFP projects. The first group of projects deal with NTFPs as part of a more comprehensive project on indigenous forest use and management. The work of Clara van der Hammen (1991) (Tropenbos-Colombia), Janette Forte (Tropenbos-Guyana), Marileen Reinders (Verhey and Reinders, 1997) (Tropenbos-Guyana) and the social cluster in the Tropenbos-Cameroon programme (van den Berg, 1998; Biesbrouck 1996a-b, 1997, 1998; Nkoumbele and Seh, 1998; Tiayon, 1998) belong to this group, as well as the work previously undertaken by Wil de Jong (1993; 1995; 1998) in West-Kalimantan (Box 1).

Box 1 NTFP studies from the perspective of indigenous forest management

Tropenbos-Colombia:

1. *Natural resource management with indigenous communities:* project aimed at drawing up regional natural resource management plans jointly with indigenous communities, through the documentation and analysis of actual forest use. Information collected includes shifting cultivation, hunting, fishing and gathering of NTFPs, and the cultural value of natural resources. The project combines indigenous and western knowledge through a participatory approach. Researcher in charge: Clara van der Hammen (Tropenbos-Colombia programme)

Tropenbos-Guyana:

2. *Amerindians as manipulators, consumers, producers and actors in their natural environment:* project aiming to increase knowledge of economic, cultural, social and ecological aspects of the management and use of the natural environment by Amerindians (the Caribs) in the NW district and Pomeroon region from a household perspective. Special attention is given to changes in management and use resulting from factors like education, contacts with other inhabitants, absorption into the cash economy and changes in government policy. Relationships with timber and gold mining companies also form part of the study. Researcher in charge: Marileen Reinders (Utrecht University).

Kariña (Cuyuni/ Barima areas

migratory way of life of scattered groups of
gold mining and logging. Researcher in charge:

Tropenbos-Cameroon:

project describing the role of the local population in forest exploitation,

sustainable forms of forest management. Researchers in charge: Karin
Jolanda van den Berg (Wageningen University), François Tiayon and Francis Nkoumbele (University of Yaoundé I).

Tropenbos-Indonesia:

5. *Forest management practices of Dayaks in West Kalimantan:* project evaluating the potential of existing indigenous management practices for the development of sustainable and economically feasible smallholder forestry. Researcher in charge: Wil de Jong (New York Botanical Garden) *(completed).*

A second group of projects specifically study the forest's NTFP potential. This group comprises the non-timber forest plant resource assessment coordinated by Joost Duivenvoorden (Tropenbos-Colombia), the study of NTFPs in the NW District by Tinde van Andel (1998) (Tropenbos-Guyana), the study on NTFP use and potential in South Cameroon undertaken by Han van Dijk (1998) (Tropenbos-Cameroon), and the study on NTFPs in East Kalimantan (Tropenbos-Indonesia) completed in 1997 by Johan van Valkenburg (Box 2).

Box 2 NTFP studies in the Tropenbos programme focusing on the forest's NTFP potential

Tropenbos-Colombia:

1. *Non-timber forest plant resource assessment in NW Amazonia:* appraisal of resource availability of vegetable NTFPs in NW Amazonia (Colombia, Ecuador, Peru), using a land ecological approach. Includes research on markets and potential NTFP supply of vegetable origin in three pilot areas. Coordinator: Joost Duivenvoorden (University of Amsterdam).[3]

Tropenbos-Guyana:

2. *NTFPs in the NW District and Pomeroon region:* project aiming to increase knowledge of NTFPs in the region through an extensive inventory of NTFPs of vegetable origin and of economic and ecological aspects of their use, extraction and management. To assess the abundance and diversity of NTFPs, 1-hectare inventories are made of different forest types. Includes regular market surveys. A sub-project, executed by Caroline Sullivan of Keele University (UK), deals with economic aspects. Researcher in charge: Tinde van Andel (Utrecht University).

Tropenbos-Cameroon:

3. *The integration of NTFP resources in multiple-use forest management:* project aimed at assessing the economic and ecological characteristics of NTFPs and at formulating concrete recommendations for integrating NTFP resource management into sustainable forest management systems and strategies. The objective is to determine the actual and potential value of NTFPs to local people, assess the impact of exploitation on NTFP resources and identify opportunities for increasing the benefits of extraction for local people. Researcher in charge: Han van Dijk (Wageningen Agricultural University).

Tropenbos-Indonesia:

4. *The economic and ecological potential of NTFPs in East Kalimantan:* study of the economic and ecological potential of rattan and other NTFPs in East Kalimantan, describing the forest vegetation and the abundance and importance of various NTFPs, focusing on rattan and indigenous fruit trees. The inventory gives harvestable volumes of potentially commercial species, with projections of sustainable yield. Researcher in charge: Johan van Valkenburg (Hortus Botanicus/Rijksherbarium Leiden) (*completed).*

Finally, some recently completed studies deal with specific products and focus on aspects of their sustainable use. They were undertaken by Carlos Rodríguez (1991) on commercial fishing (Tropenbos-Colombia), by Hans-Ulrich Caspary on wildlife (Tropenbos-Côte d'Ivoire) and by Willem Assies (1997) on the social, economic and political aspects of Brazil nut exploitation in the Bolivian and Brazilian Amazon region. An ongoing study in this group is being carried out by Nicole Guedje (Guedje *et al.*, 1998) on the sustainable harvesting of *Garcinia lucida* bark (Tropenbos-Cameroon) (Box 3).

The project carried out in Côte d'Ivoire (Bonnéhin, 1992) stands somewhat apart from these, as it deals with the prospects for domestication through vegetative propagation of two forest tree species (*Coula edulis* and *Tieghemella heckelii*) in the Taï region. The idea behind this study is that the integration of these species into local farming systems would reduce the pressure on the

[3] This project is part of a joint effort of Latin American and European universities to obtain an improved appraisal of the resource availability of non-timber forest plant products in Northwest Amazonia. The project includes research on NW Amazonian markets for non-timber forest plant products and potential supply of these products from mature forests in three pilot areas. The INCO-DC programme of the European Community funds the project as a whole. In Colombia it receives support from the Tropenbos-Colombia programme.

protected forest areas in Taï National Park. As such, it does not deal directly with NTFP extraction from forest ecosystems.

Box 3 Studies in the Tropenbos programme on specific non-timber forest products

Tropenbos-Colombia:

1. *Diagnosis of commercial fishing:* project aimed at developing a management model for commercial fisheries, based on a comprehensive diagnosis that includes social, economic, cultural and biological aspects, in order to define possible scenarios for sustainable extraction. Researcher in charge: Carlos Rodríguez (Tropenbos-Colombia programme) (*completed).*

Tropenbos-Cameroon:

2. *The sustainability of NTFP harvesting: the case of Garcinia lucida.* The aim of this study is to determine the effects of the harvesting of bark and seeds on *Garcinia lucida* populations and to define a sustainable harvest system for *G. lucida* bark, based on participatory monitoring and evaluation techniques. Researcher in charge: Nicole Guedje (University of Yaoundé I).

Tropenbos-Côte d'Ivoire:

3. *Domestication of two fruit tree species from the Taï forest:* project investigating the prospects for domestication and integration through vegetative propagation of two forest fruit trees (*Coula edulis* and *Tieghemella heckelii*) into local farming systems in the Taï region. The ultimate objective of the project is to reduce the pressure on the protected forest areas in the Taï National Park. Researcher in charge: Léonie Bonnéhin (Wageningen Agricultural University).
4. *Hunting wildlife in the region of Taï National Park:* a study focusing on the importance and volume of village hunting and poaching, covering the different stages of game exploitation from hunting and consumption to trade. The study addresses the question of whether the actual exploitation and marketing of game can be transformed into a more sustainable utilisation system. Researcher in charge: Hans-Ulrich Caspary (Humboldt University, Berlin).

Bolivia/Brazil:

5. *The social, economic and political aspects of Brazil nut exploitation in the Amazon region:* project aimed at establishing the socio-economic and cultural parameters of sustainable extraction of Brazil nuts. Researcher in charge: Willem Assies[4] (*completed).*

2. THE EVOLUTION OF A RESEARCH STRATEGY

As stated in the opening address by Erik Lammerts van Bueren, Tropenbos felt the need to come forward with a systematic approach when optimistic views were expressed about the potentials of NTFP development. There were reasons enough to doubt the prospects for a successful NTFP-based conservation strategy. Over-exploitation, substitution by synthetics and exploitative commercialisation systems discourage extractors from managing forest resources sustainably (Richards, 1993). We also stressed the fact that extraction is seldom an exclusive livelihood, but is usually combined with other, less sustainable forms of land use, such as farming, gold mining or logging. We also questioned the contribution of commercial extraction to improved livelihoods, as many extractors live in poor and isolated conditions, with little access to such basic amenities as education and health care. Finally, we pointed to other pitfalls and potential dead ends, such as the tendency towards substitution with cultivated or synthetic alternatives, conflicting land and product uses and the loss of indigenous knowledge and skills necessary for the extraction of non-timber forest products. In sum, we did not want to accept commercial NTFP extraction as a simple panacea for deforestation (Ros-Tonen *et al.*, 1995).

[4] Project jointly financed by WOTRO and Tropenbos and carried out in association with the Programa Manejo de Bosques de la Amazonía Boliviana (PROMAB) based in Riberalta, Bolivia. The latter project is a joint effort of the Instituto para el Hombre, Agricultura y Ecología, the Universidad Técnica del Beni and the Prince Bernhard Centre for International Nature Conservation of Utrecht University.

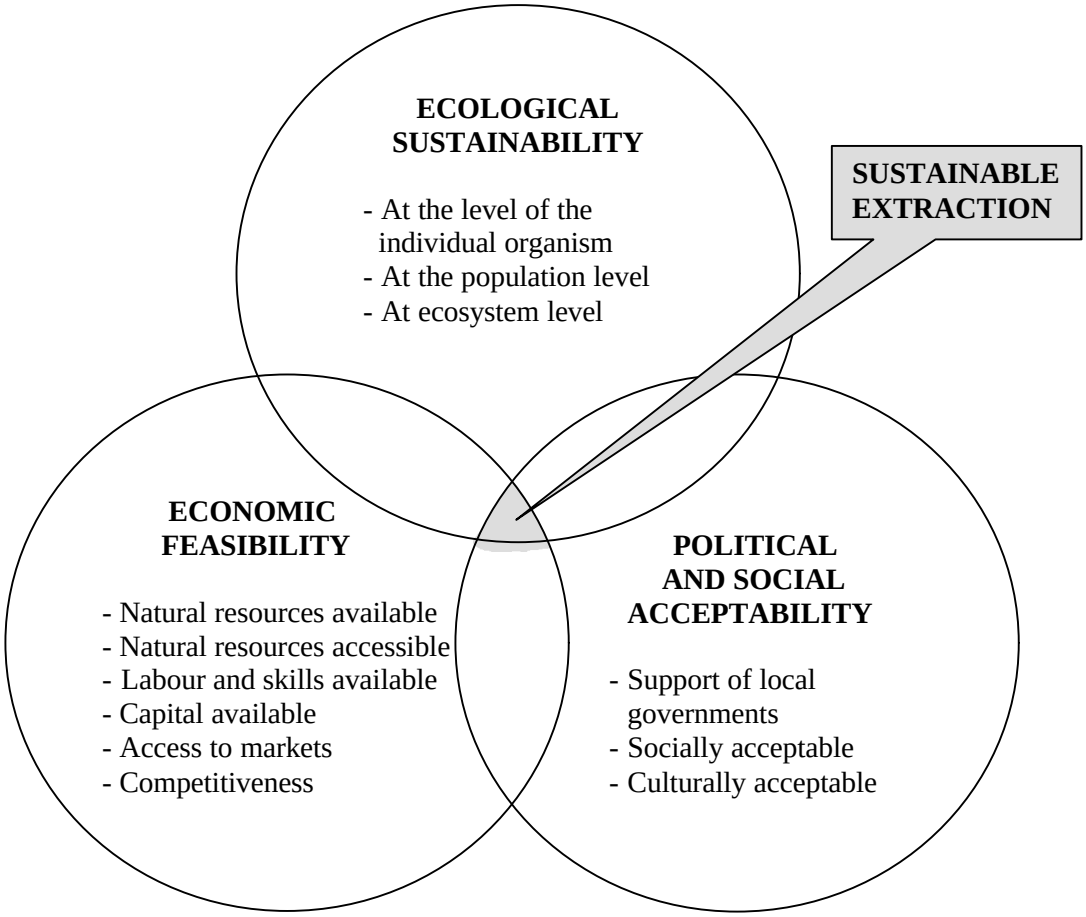

Figure 1 The main attributes of sustainable NTFP extraction (based on Ros-Tonen *et al.*, 1995)

The main objective of the Tropenbos research strategy for NTFPs was to provide a scientific basis for the commercialisation-conservation link and to make it operational for policy makers and land-use planners by providing an insight into the conditions for sustainable commercial extraction. Following the definition of sustainable development by Barbier (1987), we provided an overview of attributes of sustainable extraction, distinguishing between ecological sustainability, economic feasibility and socio-political acceptability (Figure 1). The idea was to develop, on the basis of this overview, a checklist of attributes and requirements for the sustainable commercial extraction of NTFPs. In addition, it was intended to develop a methodology for the application of this checklist in land-use planning. With at least two programmes - Tropenbos-Colombia and Tropenbos-Cameroon - aimed at developing land-use plans, we wanted land-use planners to consider commercial NTFP exploitation as a potential land use just like logging and farming. The identification of conditions for sustainable and successful NTFP exploitation was viewed as an essential step towards the integration of NTFP use in land evaluation. The individual case studies were monitored and evaluated for their contribution to the identification of factors determining (or obstructing) successful and sustainable NTFP exploitation.

Several points should be taken into account in relation to a checklist for NTFP use. In the first place, the NTFP concept comprises a wide diversity of products with varying characteristics and prospects for sustainable harvesting. The ecological conditions for the sustainable harvest of Brazil nuts, for example, are quite different from those for the sustainable harvesting of wildlife

or entire plants. A general checklist for NTFP-based forest use should therefore be refined for each of the specific products involved. Secondly, a checklist cannot cover the dynamics of market-oriented NTFP use. Products with no market today, can be exploited tomorrow if a trader shows up in a village who wants to buy them. By the same token, the production of what looks like a promising product today may collapse next year if it can be obtained more cheaply elsewhere. Finally, when defining NTFP extraction as a land utilisation type, additional options for subsistence and income-generating economic activities should be available and included. Commercial NTFP use cannot be defined as an exclusive land use, as in practice it is a seasonal and part-time activity combined with subsistence activities and other forest uses.

Although the checklist has not yet been published, two efforts have been undertaken in the Tropenbos programme to develop a methodology for including NTFP use as an option in land-use planning. The first is the land evaluation undertaken in the Tropenbos-Cameroon area by Barend van Gemerden and Gerard Hazeu (1999). In this evaluation, the collection of NTFPs was explicitly defined as a land-use type, along with nature conservation, timber production, shifting cultivation and plantation agriculture (Hommel and van Kekem, 1998). Combining data on the occurrence of NTFP plant species in various forest types and distance between forest and habitation, a suitability assessment was made at reconnaissance level (1:100,000) of NTFP use. The focus here was on subsistence use, however, and not on commercial use as we proposed in our strategy document.

In the Tropenbos-Colombia study area, a suitability assessment is being carried out as part of an EC-financed project on vegetable NTFPs in NW Amazonia. In this project, which also covers parts of the Peruvian and Ecuadorian Amazon, ecological surveys are combined with market surveys to produce maps that provide realistic estimates of NTFP usefulness per forest type (see the contribution of Duivenvoorden *et al.* to this volume). The outcome of this project will help to design location-specific strategies for NTFP development, but in the Colombian case subsistence forest and NTFP uses also prevail, implying that it is not realistic to propose commercial NTFP extraction as a land utilisation type that is isolated from other forest uses. In their contribution, Carlos Rodríguez and Clara van der Hammen make it sufficiently clear that 'indigenous management implies the use of the biodiversity as a whole, (and) not just the exploitation of a few products with commercial value' (this volume).

These lessons indicate that there is a need to place the research strategy as proposed in 1995 in a broader perspective. As a first step, the three expectations of what NTFP development could bring about will be re-examined. These comprise its contribution to forest conservation, improved livelihoods and participatory forest management.

3. THE POTENTIAL CONTRIBUTION OF NTFP EXTRACTION TO FOREST CONSERVATION

A central hypothesis underlying much NTFP research is that commercial extraction, through adding value to the forest, may provide an incentive to conservation and sustainable forest management. The underlying reasoning is that local authorities and forest resource managers will have an interest in preventing indiscriminate forest use or conversion of forest to other land uses when NTFP extraction contributes to the Gross National Product and export earnings. For local communities, increased income from the trade in NTFPs is thought to provide a stimulus to protect their forests and manage them sustainably. Many NTFPs can be harvested without significantly altering the forest structure, thus maintaining the forests' environmental value and biological diversity. All these factors have led to the notion that the commercial extraction of

NTFPs is a potentially sound conservation strategy (e.g. Fearnside, 1989; Nepstad and Schwartzman, 1992).

This commercialisation-conservation link is now being strongly disputed. Any harvesting of NTFPs does have a number of ecological impacts, including a gradual reduction in the vigour of harvested plants, decreasing rates of seedling establishment of harvested species, potential disruption of local animal populations and nutrient loss from harvested material (Peters, 1996). Compared with logging or conversion of forest to other land uses, however, these impacts are viewed as minimal, especially in the case of NTFP use for subsistence. However, it is the low extraction levels rather than the ecological ability to maintain yields that makes the extraction of NTFPs sustainable. It is incorrect to suggest that NTFPs can be harvested indefinitely without proper management practices to sustain their yield.

There was ample evidence of over-harvesting even at the time that NTFP exploitation was promoted as a nature conservation strategy. The very same Brazil, where extractive reserves raised great expectations for the participatory management of forest resources, had in the past witnessed the depletion of its Brazilwood (*Caesalpinia echinata*) and rosewood (*Aniba rosaedora*) resources (Ros-Tonen *et al.*, 1995), which were exploited to obtain natural dye and essential oil, respectively. De Beer and McDermott (1989) reported the overharvesting of rattan, edible bird's nests and other NTFP resources in Southeast Asia. Various other examples of overexploited NTFPs can now be added, such as wildife in Guyana and Côte d'Ivoire (see van Andel and Reinders, this volume and Caspary, this volume), palm heart (*Euterpe precatoria*) in Bolivia (Peña and Zuidema, 1998) and the bark of *Garcinia lucida* in Cameroon (van Dijk and Wiersum, this volume). In general, it may be said that, the larger the market for an NTFP, the higher becomes its value and the greater the danger of overexploitation (Sepp, Walter and Werner, 1996).

Taking plant parts such as bark, roots or palm heart (in the case of single-stemmed species) in fact kills the individual tree and can only be done if special measures are taken to guarantee the plant's recovery or regeneration. Only products which can be harvested without killing the individual plants or animals, which are abundant or which regenerate easily offer good prospects for sustainable management (Peters, 1994). Examples are Brazil or Amazon nut (*Bertholletia excelsa)* exploited in Bolivia and Brazil (Assies, 1997), palm heart from multi-stemmed species[5] such as *Euterpe oleracea* and the aerial roots of 'nibi' (*Heteropsis flexuosa* (Araceae)) and 'kufa' (*Clusia grandiflora* and *C. palmicida* (Guttiferae)), which are used as plaiting material for basketry and furniture in Guyana (van Andel and Reinders, this volume).

Even if products are identified which offer good prospects for sustainable management, they can only be sustainably harvested on a commercial scale if a procedure is followed which comprises careful species selection, yield studies, monitoring of regeneration and harvesting adjustments. Such a procedure is described in Peters (1994) for vegetable NTFPs, while van Wieren (this volume) presents a model for the sustainable management of wildlife. Although sustainable exploitation of selected species is thus feasible from an ecological point of view, various social factors impede this happening. Why should people who live in poor conditions and have few

[5] In contrast to single-stemmed species, such as *Euterpe precatoria*, multi-stemmed species such as *Euterpe oleracea* regenerate more rapidly. Their high abundance and rapid growth seem to offer good prospects for sustainable extraction. Maintaining a minimum diameter for palm heart and applying a rotation system that allowed vulnerable areas to regenerate proved to be effective in preventing over-harvesting (van Andel *et al.*, 1998). In the long term, however, it could prove to be necessary to extend the rotation period in order to maintain the rootstock (Dijkman, personal communication).

alternative income opportunities, spend money on expensive yield studies or refrain from getting an income because harvest levels ought to be adjusted to ecologically sustainable levels? Maybe this will happen in some isolated, externally sponsored projects, but expecting this from communities that are involved in a daily struggle for subsistence can hardly be seen as realistic.

Another reason to doubt the conservation value of extractive economies to which we already pointed in 1995 is that extractors combine NTFP harvesting with other, ecologically often less sustainable, economic activities to make a living. It was Assies (1997 and this volume), who launched the concept of the *agro-extractive cycle,* on the basis of his socio-economic study of the Brazil nut economy in Bolivia and Brazil, to clarify this. In this cycle, the Brazil nut gatherers combine their activities with rubber tapping and agricultural activities, to make a living in the forest throughout the year. If one of the extractive activities declines in importance, which actually happened as a result of collapsing rubber prices, they compensate the loss by expanding their agricultural activities. The sustainability of the 'cycle' is thereby threatened because of increasing conversion of forest to farming land.

Moreover, Assies made it clear that, like any other sector in economic life, the organisation and dynamics of the extractive economy is profit-driven rather than based on the aim of satisfying social needs or promoting ecological sustainability. In order to keep production profitable, the costs per unit of the product need to be minimised, resulting in either a tendency towards production in plantations (Homma, 1992) or in a reorganisation of the production cycle. The latter occurred in the Bolivian Brazil nut economy where, in a process of vertical integration of extraction and processing, urban-based labour gangs, who have no affinity with forest conservation at all, replaced the forest-dwelling extractors, who are becoming increasingly marginalised (Assies, 1997, and this volume).

This and other examples show that it is not easy to realise in practice the conservation potential of commercial NTFP exploitation. Much work is still needed to identify promising products and to improve harvesting methods and management systems.

4. NTFPs AS A MEANS OF IMPROVING PEOPLE'S LIVELIHOODS

One of the attractive promises of NTFP development is its potential for improving the livelihoods of people who depend on the forest for their basic needs and cash income. An important motive for promoting the commercial extraction of NTFPs has therefore been the expectation that increased marketing of NTFPs may lead to higher incomes.

Such expectations have been packaged in commercial messages for such products as Ben & Jerry's Rainforest Crunch ice cream made with Brazil nuts[6], which are marketed through Cultural Survival Enterprises (USA). CSE was founded in 1989 to expand and develop markets for NTFPs from organisations of forest residents and to pay fair prices, thus ensuring a far larger return than, for instance, the regular 3% which extractors of Brazil nuts receive of the New York wholesale price (Clay, 1992).

[6] The slogan 'You're not eating ice cream because you like it, it's for charity!' provides a nice example of such a message (http://www.hoovers.com).

Although it has been suggested that 'the sale of Rainforest Crunch helps support native residents of the world's rainforests', the Brazil nuts are in fact being gathered by the very same non-indigenous Brazilian rubber tappers described in Assies' study. The major provider of Brazil nuts for the Rainforest Crunch had to be the Xapuri cooperative in the Brazilian state of Acre. The nut-processing plant of this cooperative was established with funding from the Ford Foundation, Cultural Survival and some other international donors after Chico Mendes' death, and was closely linked to the rubber tappers' movement and the proposal for extractive reserves. The cooperative, although often presented as a success, soon ran into problems through competition from Bolivian producers, who had the comparative advantage of substantially lower labour costs. Faced with such competition, the Xapuri plant finally had to dismiss its personnel in 1993. It subsequently adopted a piecework-based put-out system to reduce its labour costs and social security bill. Thus the claims that the Xapuri plant would be able to substantially increase the gatherers' income and provide improved labour opportunities thus finally had to be tuned down (Assies, 1997).

The foregoing is not to deny that NTFPs contribute substantially to forest people's incomes. Various studies reported on in this book are sufficiently clear about this. The potential for improving people's livelihoods through an extractive economy should not be exaggerated, however. In the first place, NTFP use is basically associated with poverty. It is the socially most marginalised people who are the main actors in NTFP extraction. This holds true for the Bagyeli ('pygmy') people in Cameroon, the Amerindians in Guyana's North West District, as well as for the Dayaks in Indonesia. For these peoples, NTFP extraction is generally a subsistence-oriented, part-time and seasonal activity (van Dijk and Wiersum, this volume) complementary to other economic activities such as farming, mining or timber logging. Only in a few situations is extraction capable of providing a livelihood. In general, however, people prefer other jobs, once alternative employment opportunities become available.[7] Many non-timber forest products are still 'minor' in this respect. Except for bush meat and some NTFPs traded on national and international markets, society's appreciation of NTFPs is generally low, while extraction is looked upon as an inferior economic activity (*cf.* Dove, 1993).

Moreover, the extraction of NTFPs is often based on exploitative labour and trading relations (*cf.* Browder, 1992). In all the Tropenbos studies carried out in South America, a similar picture emerges of debt-peonage, in which the extractor is seldom or never paid in cash for his work. Instead, the buyer of his product advances him merchandise, which can be paid off with the harvested products. Because the buyers demand higher prices for the merchandise advanced as compared with what they pay for the NTFPs, they place the extractors in a situation of permanent indebtedness, from which it is hardly possible for them to escape. This system is called *endeude* in Colombia (Rodríguez and van der Hammen, this volume), 'bonded labour' in Guyana (Forte, this volume), *aviamento* in Brazil and *habilito* in Bolivia (Assies, 1997). It will be clear that these in-debt relationships hold little promise for improved livelihoods, where these are based on the extraction of forest products. Promoting commercial NTFP extraction without tackling such unequal production and marketing relationships will not result in a socially desirable land use (Ros-Tonen *et al.*, 1995).

Other factors which limit the potential of NTFPs to contribute to forest dwellers' incomes are the poor infrastructure and high transport costs in tropical rainforest areas, which hinder

[7] Van Andel and Reinders (this volume) make clear that there are exceptions to this 'rule'. Although they note that 'indigenous harvesters seem to perform a job that most other Guyanese are not willing to do', the Amerindians themselves 'prefer independent NTFP harvesting to the monotony of wage labour.'

successful marketing of NTFPs. Also the lack of organisation among harvesters and lack of access to credit and storage facilities limit the opportunities for commercial extraction (Verhey and Reinders, 1998; van Dijk, 1998). Moreover, forest-dwelling people generally live in poor conditions, where even the most basic health care and educational services are lacking. Forte's conclusion (1997) that the Amerindians in Guyana's North West District are unable 'to make more than marginal use of the endowment apparent in their geographical environment' because of 'such poor conditions of basic existence', therefore probably extends to many other forest-dwelling people all over the world.

The problem with non-timber forest products from natural forests, - with the exception of mono-specific stands or oligarchic forests where one or two species dominate - is that they often occur at low densities and are irregularly distributed (van Dijk, 1998; van Valkenburg, 1997). This leads van Dijk and Wiersum (this volume) to the conclusion that focusing on human-modified vegetation types might offer better prospects if the primary aim is to generate incomes. Such habitats have a higher species density and are generally located closer to the villages and cultivated lands. Similar conclusions are put forward in the contributions of van Valkenburg and de Jong, based on their studies in Indonesia.

In sum, the marketing of NTFPs extracted from natural forests cannot simply be expected to function as a vehicle for improving the livelihoods of forest-dwelling people. It is inherent in NTFP-based livelihoods that they tend to disappear. Once people are offered other opportunities, they often invest in other economic activities, such as cash crops[8] or trade (e.g. Dijkman *et al.*, and de Jong, this volume). Thus, if the aim is to raise forest peoples' incomes, opportunities to do so will probably best be found outside the forest. Support for NTFP development can be recommended only in situations where such alternative options are absent or difficult to integrate into people's way of life. In such cases, it must be realised that support should also be given to the satisfaction of basic human needs and the improvement of the social conditions under which extractors live and work (*c.f.* Forte, 1995; Browder, 1992; Ros-Tonen *et al.*, 1995).

5. THE ROLE OF NTFPs IN PARTICIPATORY FOREST MANAGEMENT

A third important reason why NTFPs have become a major issue on the international agenda is the political struggle of rubber tappers in Brazil. In this context, the concept of extractive reserves was put forward as a combined strategy to get the rubber tappers' property rights legally recognised and to promote forest conservation and sustainable use at the same time (Allegretti, 1990; Schwartzman, 1989). In fact, extractive reserves were seen as a model for participatory forest management.

From the very beginning, several authors questioned the effectiveness of extractive reserves as a conservation strategy (e.g. Anderson, 1990; Browder, 1992; Fearnside, 1989). In general, however, the concept was regarded as a useful way of organising collectors of forest products and mobilising them in order to secure and defend their rights to natural resources, to escape exploitation by landowners and merchants, to build their marketing capacity and improve their living conditions.

[8] The resulting cash crop production system may, of course, involve the cultivation of financially lucrative NTFPs in either enriched forests or mixed plantations (*cf.* Wiersum, this volume).

Central to the concept of extractive reserves is the issue of recognised and legally protected rights to land and resources. Although secure tenure is not a guarantee for successful extraction, as Assies' study (1997) has made clear, several studies in the Tropenbos programme have confirmed that the potential of NTFPs to contribute to sound forest management very much depends on who owns the land. The prospects are better in cases where extraction areas have a legal status, as the development of participatory local resource management models requires confidence and long-term collaboration among the parties involved.

A good example is the experience of Clara van der Hammen and Carlos Rodríguez, who are conducting participatory research with indigenous communities in the Caquetá region of Colombia on the cultural aspects of natural resource use and management. As their contribution indicates, indigenous households are actively participating in the research and conducting their own studies in order to recover traditional knowledge of indigenous management systems. In a slow process, by which more and more households gradually became part of the project and several community workshops were organised, a situation was reached in which an entire community became involved in a dynamic discussion on the state of resource use. These discussions and the results of research now form the basis for a participatory natural resource management plan for the legally recognised territory of these indigenous people.

How decisive secure land tenure is in this context, is also illustrated by an experience in the Tropenbos-Cameroon Programme, where efforts are being undertaken to develop participatory methods for the sustainable harvesting of *Garcinia lucida* (Guedje *et al.*, 1998). This small understorey tree is found on steep slopes at elevations exceeding 500 m above sea level and its bark is used as an additive in palm wine production. Experiments were set up to determine the effect of various harvesting techniques and there are plans to develop a simple sustainable exploitation and management strategy for the *G. lucida* resource, based on local knowledge and practices and participatory monitoring of the harvest. In this case, however, the resource grows in restricted areas at some distance from the villages (van Dijk, 1998). Because it is an open-access resource, no specific group feels responsible for the management of the resource and it is proving difficult in practice to protect the experimental stands from unplanned and unexpected stripping (van Dijk, personal communication).

Various experiences in the Tropenbos programme have also shown that the intervention of outsiders may help in the development of participatory forest management systems. The Colombian case, for example, is helping to revitalise indigenous knowledge of traditional management techniques and to apply this knowledge in natural resource management plans. An interesting result of these efforts is the publication of a book by two Indians (Matapí and Matapí, 1997) in which they document the indigenous world view, the use of natural resources and the social organisation of the Upichía tribe (now known as Matapí). Another example can be found in the study among Dayaks in West Kalimantan by de Jong, which was carried out as part of an NTFP enterprise development project. This project - a common effort of the governments of Germany and Indonesia and the Pontianak-based NGO Yayasan Dian Tama - is part of a Social Forestry Development project in the district of Sanggau and is being implemented in what is known as a 'Participatory Forest Management Area'. Analogous to the extractive reserve concept in Brazil, this is a model concession for communal forest management on some 102,250 ha of state forest land (de Jong and Utama, 1998). NTFP development is receiving particular attention in this project with a view to meeting the twin goals of increased incomes and forest conservation, based on the participation of the local stakeholders.

Although such externally sponsored and supported initiatives may encourage local people to engage in participatory management, in general, the expectations about the sustainable management of NTFP resources should not run too high. For forest people, NTFP extraction is just one way, beside others, of making a living. In general, it is the need to survive and the wish to earn money for desired 'luxury' items that primarily motivate their participation.

6. THE TROPENBOS NTFP RESEARCH STRATEGY IN RETROSPECT

In the Tropenbos NTFP research strategy, a strong case was made for the integration of NTFP use in land-use planning. For various reasons explained in Section 2, we focused on commercial extraction as a potential strategy for the conservation of tropical rainforests.

It has become clear in the past few years that the conservation potential of *commercial* NTFP extraction is limited. Although sustainable extraction of selected NTFPs is possible from an ecological standpoint, poverty and a lack of alternative income-generating options are unlikely to encourage extractors to reduce unsustainable harvesting levels. Moreover, it seems fairly impossible in practice to define commercial NTFP extraction as a separate land-use type, as it is combined with subsistence uses of NTFPs, farming and other economic activities.

At the same time, research has confirmed that NTFPs - albeit often for lack of other employment opportunities - play an important role in the livelihoods of forest-dwelling people and may contribute substantially to their incomes, both directly and indirectly. From this perspective, it is justified and commendable that attention should continue to be paid to NTFP use in forest land-use planning. The effort in the Tropenbos-Cameroon Programme to identify areas that are particularly suitable for NTFP-based livelihoods, may serve as an example. NTFP assessments such as those developed by Duivenvoorden *et al.* in the Tropenbos-Colombia area and other locations in Northwest Amazonia may be of help in identifying the most promising vegetation types and market conditions. In any event, it should be taken into account that assigning land to NTFP extraction implies that the forest will also be used for farming, while commercial NTFP use forms only a fraction of subsistence uses.

While subsistence use of NTFPs hardly affects the structure and composition of the forest, commercial NTFP exploitation often exceeds sustainable levels. The challenge is to develop sustainable harvesting methods for products extracted from natural forests. Such methods will be adopted only if they have been developed in joint efforts with the extractors, make use of traditional knowledge and are easy to apply. The best chance of achieving this is through a participatory and interdisciplinary approach (*cf.* de Jong and Utama, 1998 and Rodríguez and van der Hammen, this volume) in situations where commercial extraction forms a substantial part of people's livelihoods.

If the aim is to improve people's livelihoods, the prospects of doing so on the basis of 'wild' products are restricted to a few products which occur in high densities. Where such species are absent, opportunities for raising incomes through the trading of products of forest origin are better sought in human-modified vegetation types which have higher densities and are more accessible (*cf.* van Dijk and Wiersum, this volume). Research can help in providing insight into marketing opportunities, the possibilities for the domestication of commercially attractive forest products and their integration into farming or agroforestry systems, and in the development of yield-raising methods and techniques.

The importance of wildlife in NTFP-based livelihoods, as documented by Rodríguez (1991), van der Hammen (1991), van Dijk (1998), Caspary (this volume) and van Andel and Reinders (this volume) demands more scientific attention to the development of sustainable models for wildlife exploitation and management. Hunting may seriously affect the structure and composition of the forest, as animals play a key role in seed dispersal and pollination (Redford, 1992) and are easily over-exploited. In van Wieren's contribution to this volume, a model is proposed for determining optimal harvesting rates from data on growth and densities that are easy to estimate in the field.

Research cannot solve all problems related to the sustainable management of tropical rainforests and the poor living conditions of forest-dwelling people. Critical to indigenous and other forest-dependent people is the question of land tenure and secure access to forest resources. This can be solved only at policy level. What research can contribute is an insight into the - often complex - tenure rights of NTFPs, the characteristics of the forest, and the way people make a living from it, so that forest-based livelihoods are recognised and included in land-use planning and forest management plans. Land-use planning is essential to ensure that all aims of forest management can be fulfilled (e.g. protection of natural biodiversity, indigenous land and resource rights, timber exploitation and non-timber forest use). As far as forest management plans are concerned, it is important to design multipurpose and participatory management systems containing a place for timber and non-timber use by local populations. In developing such management systems, it is important to bear in mind that NTFP use forms part of a total livelihood strategy of which other forms of forest land use also form a part. The role of enriched forests and other human-modified vegetation types as a source of NTFPs deserves more attention, as a way of reducing the pressure on natural forests. Moreover, research can contribute to forest management planning through the development of decision-support models that simulate various possible scenarios.

7. OUTLINE OF THIS BOOK

This volume is structured in three parts. The first part places the location-specific studies described in Part 2 in a more global context. In this chapter, I have presented the main issues linking the various NTFP studies carried out under the Tropenbos programme. In the next chapter, Janette Forte places the NTFP-related projects in Guyana in a context of global discourses, such as those on intellectual property rights and the protection of indigenous knowledge and rights. She argues that, rather than focusing on Intellectual Property Rights legislation or the marketing of NTFPs, it would be more helpful to indigenous communities to draw up partnership arrangements and contracts for sharing profits generated as a result of their knowledge. Her contribution is a warm plea for recognising the link between cultural and natural biodiversity as a guide for research and a strategy for biodiversity conservation.

Part 2 contains the descriptions and results of case studies carried out in the framework of the Tropenbos programme. The authors dwell upon the question that runs as a common thread through this volume: that of the role that NTFP exploitation can play in tropical rainforest conservation, improved livelihoods of forest-dwelling people and participatory forest management. The first contributions refer to case-studies carried out in Middle and South America. Tinde van Andel and Marileen Reinders argue that NTFP use in Guyana should be included in land-use planning and forest laws, in order to prevent conflicting claims to forest land and to create better conditions for Amerindians to organise themselves for the sustainable management of forest resources. If such conditions are realised, they see various opportunities

for realising the ecological potential of NTFP extraction and to develop it further as a culturally appropriate forest use.

Carlos Rodríguez and Clara van der Hammen (Tropenbos-Colombia) believe that NTFP use can only serve as an alternative for regional development if all aspects - including those related to indigenous culture and knowledge - are taken into account and the plans are developed in a participatory manner. They emphasise that although the trade in a few non-timber forest products may offer interesting income-generating opportunities, it may also cause imbalances in the indigenous management models, which are based on the use of biodiversity as a whole.

Joost Duivenvoorden *et al.* proposes a combined forest ecological and socio-economic approach to gain insight into interregional variations in, and interactions between, NTFP trade patterns and NTFP supply. They expect that the application of this approach in three study sites in NW Amazonia will result in more refined location-specific recommendations on NTFP development, providing an alternative to prevailing generalist approaches.

On the basis of his study of the Brazil nut economy in Northern Bolivia and the Brazilian state of Acre, Willem Assies puts forward various arguments against the viability of commercial extraction as a strategy for conservation and sustainable rainforest management. He makes it clear that the dynamics of the NTFP trade lead to the marginalisation of forest-dwelling extractors, resulting in an expansion of agriculture and migration to the cities. He argues that such a context does not provide many incentives for the sustainable and participatory management of forest resources, nor does it contribute to improved livelihoods.

Han Overman and Josefien Demmer[9] address an interesting question that is relevant to the conservation potential of NTFP use, namely the effect of income on forest use. Their data on forest use by the Tawahka Indians in Honduras suggest that NTFPs that are successful in terms of income generation outcompete themselves as a source of livelihood, as richer households decreasingly rely on the forest as a source of food or income. They hypothesise that increasing exposure to the market will initially increase the pressure on forest resources, but that this pressure will decrease once people become more wealthy.

The next two contributions refer to studies carried out in Africa. Han van Dijk and Freerk Wiersum use their research results from Cameroon to underpin their suggestion for a dual approach to NTFP management. One aspect of this approach is the multiple-use management of natural forest for the sustainable production of both timber and non-timber forest products, while opportunities for commercial NTFP production can better be sought through optimised and intensified management of human-altered vegetation types.

Whereas van Dijk and Wiersum focus mainly on vegetable NTFPs, Hans-Ulrich Caspary (Tropenbos-Côte d'Ivoire) specifically deals with the use of wildlife, the management of which has so far received too little attention. Although he is not optimistic about such options for wildlife management as trophy hunting or wildlife tourism, he argues that the cultural and economic importance of wildlife use demands the integration of game resource management in land-use planning and forest management plans. The experience with wildlife management in East and Southern Africa could possibly serve as an example. He further recommends the study

[9] Their study is not directly part of the Tropenbos programme, but is being supported through supervision and the publication of its results.

of the employment of traditional, cheap and selective hunting techniques, the possibilities for captive breeding and the density of game populations; the latter being a parameter that needs to be known to enable the establishment of sustainable harvesting rates.

The last two chapters in Part 2 deal with NTFP use and potentials in Indonesia. Comparing the costs and benefits of various tree-based land-use systems with low external input, Johan van Valkenburg evaluates various management options for NTFPs in East Kalimantan. He concludes that NTFP extraction from natural forests is a competitive land use only if the environmental costs of watershed protection, erosion control, etc. are taken into account. Even then, it is an economically viable option only from a national and regional perspective, but not for individual landowners. Like van Dijk and Wiersum, he recommends that further research be geared towards integrated forest management, including both timber and non-timber resources, and the opportunities to further develop traditional agroforestry systems in, for instance, depleted permanent production forest.

Wil de Jong puts forward a reformulated exploitation-conservation proposition. He argues that commercial exploitation will lead to alternative procurement, e.g. through species management or the planting of NTFPs in plantations or home gardens. Such alternative procurement may follow different pathways with varying conservation effects. In his view, the challenge of NTFP development lies in altering a less favourable pathway that a forest landscape will undergo towards a situation with substantially more complex and diverse forests. Using the results of his study on Dayak forest management in West Kalimantan, he demonstrates that *tembawang*[10] deserves special attention in this respect, as this can be a viable alternative to oil palm estate development, while being more benign to the conservation of biodiversity. The challenge for research therefore, lies in the identification of those features of NTFPs that make them the most suitable for smallholder management or production.

That brings us to the last part of these proceedings, in which various NTFP experts share their opinions on the future perspectives for NTFP research. They elaborate the statements which were put forward during a forum discussion at the Tropenbos NTFP seminar in January 1999. Freerk Wiersum advocates an approach that focuses on the management characteristics of NTFPs instead of the characteristics of their collection and use. Arguing that local people manage NTFP resources under diversified management systems, he strongly favours a research line which focuses on the identification of different types of indigenously developed forests and the factors that determine their dynamics and sustainability. He further emphasises the importance of studying the role of NTFP production in integrated land-use systems. Jenne de Beer proposes a research agenda that is primarily guided by the priorities of forest-dwelling people and which is supportive of forest resource management. Wim Dijkman *et al.* propose employing sensitivity and elasticity analysis to determine whether NTFP extraction is ecologically sustainable, and aggregating species diversity and interactions into functional groups in order to study its effects on the structure and functioning of the forest. As far as the social aspects of NTFP exploitation are concerned, they recommend that more attention be paid to the social dynamics and the transitional nature of NTFP extraction. Sip van Wieren proposes the development of user-friendly harvest models to determine sustainable harvesting levels for the exploitation of wildlife. Finally, Mirjam Ros-Tonen aims to synthesise all recommendations, thereby making a plea for more refined concepts and research questions.

[10] *Tembawang* is a tree-planted swidden that eventually turns into a full-grown forest garden of a natural forest-like structure and diversity.

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EMERGING LOCAL AND GLOBAL DISCOURSES ON NTFP USE AND STUDY: A VIEW FROM GUYANA

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1. INTRODUCTION

On 22 November 1998 I sat in on a Village Meeting in Sebai, a Mixed Amerindian community of about 230 persons (Warau/Carib/Arawak), located about 12 miles up a creek of the same name and some 22 miles distant from the sub-regional centre of Port Kaituma. The Captain was accused of poor administration of village resources, including marketable logs and palm hearts. One villager announced that people from the Aruka River were increasingly coming over to cut palm hearts (*Euterpe oleracea*) in the Yakirikat Creek, which formed one boundary of Sebai's titled land, and asked what the Captain was doing about that.

The Captain's response was succinct: for all his pains on behalf of the village, he received a monthly stipend of G$ 2,800 (equiv. US$ 16) from the Government. For that pittance, would he also have to be a watchman in the distant Yakirikat Creek area? He also pointed out that the Aruka 'cabbage cutters' would invariably claim that they were cutting down palm trees located on the State-owned bank of the Yakirikat River, not over on the village side. Since no Sebai households were sited in the area, who was there to dispute the Aruka claim?

A major part of Sebai folk came over originally from the Aruka River and the communities continue to be closely linked by ties of consanguinity and affinity. No doubt, a large number of palm hearts are harvested illegally from Sebai's titled area, but the bad guys in this instance are family and friends, all as poor as the Sebai villagers. Village administration in Sebai can be said to be non-existent and the same is probably true of the Aruka River settlements.

Stories such as this illustrate the complex world in which discussions of NTFPs take place. In a thoughtful introductory piece entitled 'Whose Knowledge, Whose Genes, Whose Rights?' Stephen B. Brush concluded:

> 'Effective conservation cannot be planned or accomplished without addressing the issues of poverty, domination and exploitation. Nevertheless, these problems are centuries old in most places. Understanding them strains the modest theoretical and methodological tools of social science. Solving them is beyond the grasp of the available political tools. Yet the value of human life, cultural diversity, and biological resources is so great that we cannot shirk from the challenge of finding viable conservation methods. The press of poverty and

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> population growth and the urgency of protecting human dignity make this challenge as difficult as any intellectual or political challenge in the modern world' (1996: 18).

It is precisely such a challenge that a seminar such as this one takes up, focussing on the indigenous management of forest resources in the interests of both equity and conservation.

This paper examines some of the emerging discourses, local and global, on NTFP use and study. The context includes such factors as advances in biotechnology, the establishment and consolidation of supranational institutions, particularly since the 1990s, designed to regulate international flows of 'natural capital'; an increasing acceptance of indigenous rights and wider recognition of the link between cultural and natural diversity.

2. THE CARIB STUDY AREA

Sebai village is located in the upper Kaituma/Barima/Barama watershed area, in which the Carib Studies Programme is being carried out by three Tropenbos-sponsored researchers, including myself. My own research focus is not primarily directed at the knowledge or use of NTFPs by the indigenous inhabitants of this area, but rather at the geopolitical and socio-economic processes that have shaped indigenous life in the Carib heartland.

One of the surprises of my research so far has been the realisation that this population has not been, either in this or the last century, strictly peripheral to the dominant colonial (later independent) society. Exposure to gold (and, later, manganese) mining has left its stamp on all facets of indigenous life, so that here, as elsewhere, the global dimensions of modern life are all-pervasive - in patterns of consumption and recreation, in the willingness of a significant number to seek out industrial labour, in some cases even bonded labour[3], in preference to subsistence life, and the widespread interest in the fluctuations of the gold price on the London Stock Exchange (see the discussion of 'modernity' in, for example, Miller (1995).

The principal subsistence and commercial NTFP in the Port Kaituma/Sebai area is wildlife, including fish, a finding in line with van Andel's comprehensive study in the wider North West District (1998). At the same time, I met very few Amerindians in the Port Kaituma/Sebai area who would admit that they used 'bush medicines,' in answering one of the questions I posed to over 150 heads of household during my last period of fieldwork. In an area of endemic malaria, where most people had suffered recurring bouts of malaria annually since the upsurge in the early 1980s, still the majority insisted that they used only modern pharmaceutical preparations. 'We don't know anything about bush,' as if knowledge of herbal remedies was a yardstick to measure savagery.

There is often, of course, a chasm separating what people do from what they profess to do, and this is where the lived experience of the field worker has its justification. In the case of the

[3] Bonded labour is a form of debt-peonage which exists in the North West District, in which the worker is seldom or never paid in cash for his work. Instead he is advanced goods by his employer, so that many labourers find themselves unable to free themselves from contractual obligations to the employer (*cf* the system of *aviamento* in the article of Assies (this volume) or *endeude* in the paper by Rodríguez and Van der Hammen (this volume).

Kaituma/Sebai area, the attitudes stated by Amerindians to the use of bush medicines can be understood in relation to:
- the considerable population of non-Amerindian Guyanese (and now non-Guyanese Asians) in the townships of Port Kaituma and Matthews Ridge, forming a social and ideological hegemony;
- the traditional antipathies to Amerindians expressed by the other ethnic groups;
- the establishment of well-equipped hospitals, accessible to all, in Matthews Ridge and Port Kaituma by the manganese company in the early 1950s; and
- the fact that malaria is not an indigenous disease.

It is in scenarios like this one that outsider-led research projects into NTFPs, for example, can play and have played key roles in coalescing cultural revitalisation, a revaluation of indigenous knowledge and an awareness of the potential marketability of such knowledge to outsiders.

3. NTFP RESEARCH AND EXPLOITATION IN GUYANA

Reinders' ethno-medicinal investigation in the Barabina area of the North West (1993) was probably the first of the post-1990 NTFP projects in Guyana. It was followed by the study of palm heart harvesting in the North West District made by Dennis Johnson for the Amerindian Research Unit of the University of Guyana (in Forte, 1995) and a study carried out in the Mixed Arawak village of Kurupukari (now Fair View) by Johnston and Colquhoun (1996). Then, almost simultaneously, projects were executed by van Andel and collaborators in the North West (from 1996), the Foundation for Ethno-biology in Surama (from 1995)[4], GEF-UNDP[5]-Iwokrama, also in the North Savannahs (see Forte, 1996), and Hoffman (1997), who worked with the liana *nibi*.

Also ongoing in this period has been the Conservation International (CI) work on developing a balata (*Mimusops globosa*) handicraft industry, aimed at the tourist trade and the 'fair trade' export niche, the setting up of an NGO called the Amerindian Handicraft Association and, more recently, of the Handicraft Industrial Development Agency (HIDA) and the establishment of a number of medium and small-scale factories making *nibi* and *cufa* furniture. During 1997 and 1998, CI teamed up with Hoffman to explore the possibilities of working with a regional Amerindian grouping named the Region Two Coordinating Committee on the sustainable utilisation of lianas used in the furniture and handicraft trade (see Verheij and Reinders 1997). A number of exploratory meetings were held and a two-day workshop brought together harvesters from several different areas with resource persons from CI and the Amerindian Research Unit.

The largest commercial NTFP exploited is the palm heart, on which at least three studies have been made, and an excellent monograph has been produced (van Andel *et al.*, 1998). Although it is not exhaustive, the brevity of this list underlines the point that the study and use of NTFPs in Guyana is still in its nascent stage. Nonetheless, a number of issues have already emerged, including the following:

3.1 The Darwin Initiative-funded project of the Foundation for Ethno-biology in Surama

[4] Funded by the Darwin Initiative and associated with Dr Conrad Gorinsky.

[5] Global Environmental Facility / United Nations Development Programme.

This project began in 1995 as a partnership between the U.K.-based Foundation for Ethnobiology (FEB) and the Surama community. The 'Surama Resource Centre', called 'FEB' locally, was built in the centre of the village and stocked with some pieces of equipment, including a small generator, portable computer and printer and, for a while, a satellite telephone. The project also owned a motor cycle. The three full-time staff of the FEB were salaried, as were at least two other local principals, one in Annai and the other in Surama. Two of the full-time staff were data processors, but other persons were hired to collect and dry samples of various plants, which were shipped out of Guyana at various times.

This project was started before the Environmental Protection Agency (EPA) was set up, which might account for the dearth of knowledge at the regional and national levels of what exactly was happening in Surama. The only counterparts seemed to be a few individuals within Surama, but since they were key local leaders, the project was never subject to any scrutiny either within or outside the village.

The patenting of active ingredients of the greenheart seed, one of which he named 'rupununine,' and of the fish poison called 'kunami' by the London-based principal, Dr. Conrad Gorinsky, eventually came to light in Guyana and was publicly condemned, at least in the capital city. Gorinsky also set up a biotechnology company named Biolink, which has at least one Surama principal. The case was also publicised internationally, which perhaps contributed to the withdrawal of funding for the project by the Darwin Foundation (see the home page of RAFI (Rural Advancement Foundation International) based in Canada: http://www.rafi.ca).

Even though some awareness of the controversy which had developed around the project internationally filtered down to the village level, the absence of public censure of the principal was more in keeping with Amerindian mores. The local opinions I was aware of ranged from total ignorance of the project's aims and *modus operandi*, to gratitude for some jobs and training, to the feeling that Gorinsky was being demonised by larger, ill-understood forces, perhaps because he was part Amerindian. Some people outside Surama and within the larger region were more readily critical of the Surama operation, but few seemed to know what it had entailed anyway. Locally, people did not have strong feelings at first, but over time, with increasing interest aroused on the issue, particularly as a result of the Iwokrama programme, the words 'intellectual property rights' invariably came up at every public discussion (over 20 of them, in eight communities) that I attended.

3.2 The Iwokrama-sponsored project on biodiversity use and ethnobotany

During this same time period, I was coordinating a biodiversity project in this same region on behalf of Iwokrama, which involved researchers and others of the same village. At that time, the view held by key Surama leaders was that the Iwokrama-sponsored project would steal their knowledge, while the Gorinsky-led one was grounded in Surama and would benefit them. Over time, however, Gorinsky stopped visiting, some of the equipment broke down, and the FEB project lost momentum. Village interest, here as elsewhere in the North Savannahs, shifted to the collaborative management of natural resources in partnership with the Iwokrama programme (see North Rupununi District Development Board (NRDDB) and Iwokrama, 1998). Earlier local views on either project became irrelevant as against the immediate benefits derived, and as the whole issue of valuing local knowledge was more deeply explored.

Some time after the end of my own work with the Makushi Women's Project, Iwokrama arranged a formal consultation with the NRDDB to discuss the issue of copyright of the information contained in the two Reports it had commissioned. Copyright belonged to the UNDP and the

Ministry of Foreign Affairs, which had jointly financed the project, but was formally transferred to the NRDDB. The reports are to be published soon in one volume with a formal copyright claim by the NRDDB as publisher. Iwokrama has also been extending its links and outreach beyond the NRDDB to encompass the entire Rupununi. A two-day 'Outreach Workshop' for some 200 persons was held in Lethem, the regional centre, on January 20–21, 1999, to discuss issues of development and conservation and networking with the Iwokrama programme.

3.3 The COICA meeting in Georgetown

In mid-1996, the Fifth Congress of the Coordinating Secretariat of Organisations of Indigenous People from the Amazon (COICA), held in Georgetown, Guyana, passed a resolution about the patent registered by a U.S. citizen, Loren Miller, for the processing and commercialisation of *ayahuasca*, a sacred plant from the Amazon. Miller is the owner of the International Plant Medicine Corporation, a pharmaceutical laboratory with headquarters in the United States. COICA's vigorous reaction to Mr. Miller's action led to a correspondence, strong and polemical on COICA's part, between them and the funding agency, which was widely publicised internationally. The issue received more international and local publicity in early 1998 than it did at the time, and it was and still is most certainly being publicised locally by indigenous organisations, particularly the Association for the Amerindian Peoples Association (APA), the local affiliate of COICA.

In part, both the Gorinsky-led project and the fall-out from the COICA resolution have accelerated local ventilation of the issues of biodiversity and the privatisation and commoditisation of nature and social knowledge. There certainly increasing recognition, if not understanding, of buzzwords like IPR (Intellectual Property Rights), CBD (Convention on Biological Diversity), bioprospecting and biopiracy, even in remote indigenous communities. It would not be overstating the case to say that any future project concerned with NTFPs or more general biodiversity research will be much more closely examined at the local level, whatever might be the view taken by the players in the capital city, including the Environmental Protection Agency (EPA).

Some of these future projects may well choose to ignore local responses once the necessary state permissions have been secured, but even if their primary objectives have more to do with employment opportunities for foreign-based researchers, their conduct should still take into account how they are viewed by the host community.

4. THE INTERNATIONAL SITUATION

The Convention on Biological Diversity was launched at the 1992 UNCED 'Earth Summit' in Rio de Janeiro, focussing attention, both worldwide and in Guyana, on the precarious situation of the planet's remaining biodiversity. A number of authors has analysed the diverging interests of North/South, developed/developing, in what was from the start a contested arena, 'nature', and in which there is still no consensus on definitions, goals, the reasons behind the dwindling of biodiversity or how best to manage what biodiversity is left.

On this battle front, writers such as Nijar (1996), McAfee (1999), Purdue (1995), and Zerner (1996) argue that 'Northern' interests have focussed on carbon emissions that contribute to global warming, the need to preserve some tropical forests as carbon sinks (by selling carbon credits), the need to slow the rate of species extinction, and the reconceptualisation of nature as a world currency, and of biodiversity as tradable genetic resources, (see Articles 1, 15(7) and 19(2)

of the Convention on Biological Diversity). This without any reference to environmental limits to growth, the historical and spatial inequalities within and between nation states, or to any 'Southern' agenda. In McAfee's words:

> 'The 1990s have seen the establishment of supranational institutions designed to regulate international 'environmental investments' and the transboundary flows of natural resources, including genetic information and knowledge about nature. These structures of eco-economic governance include environmental treaties, especially the Framework Convention on Climate Change, the Convention on Biological Diversity and the Global Environment Facility, among others. These new multilateral institutions work closely with the World Bank, with United Nations agencies that have taken up green agendas and with mainstream conservationist organisations, many of which now embrace international mandates… [They] recast the popular environmentalist account of the spoiling of Eden by industrialism run amok into a parable of policy failures correctable by market solutions. The key to those market solutions, according to the theory, is the privatisation and commoditisation of nearly every aspect of nature, from molecules to mountainscapes, from human tissues to the earth's atmosphere' (1999, in press).

4.1 World Trade Organisation/Trade-Related Intellectual Property Rights (TRIPS)

Even before the CBD was opened for signing in Rio, the commoditisation of nature was underway in the TRIPS negotiations. Although the 'South' argued that intellectual property rights were not a trade issue at all and was already covered by an existing UN organisation, the World Intellectual Property Organisation (WIPO), key Northern interests were able to shift Intellectual Property Rights negotiations to the General Agreement on Tariffs and Trade (GATT), which led to the establishment of the World Trade Organisation in 1995. Article 27 of the WTO/TRIPS (GATT: 379–80) obliges member states to enact IPR legislation within a prescribed time.

> 'In summary, countries are obliged to enact legislation which (1) reproduces the IPR regime of industrialised countries, in particular the USA; (2) extends patenting to micro-organisms and 'modified' life forms; and (3) obliges nations to provide patents or other forms of protection to plant varieties' (Nijar, Paper 2: 8).

These clauses in Article 27 allow biotechnology to patent any genetically modified organism, since DNA is not considered to be an essentially biological process. At this point, enter the bio-pirates, recently featured on the cover of TIME magazine (November 30, 1998). In TIME's words [Gene Piracy]:

> 'The confrontation between industrialised countries and resource-rich emerging nations is heating up. Drug companies have been methodically testing animals and medicinal plants for decades. But now, innovations in genetic research are enabling scientists to cast a far wider net - covering entire rain forests… in their search for cures. 'We see a tremendous battle shaping up', says Andrew Kimbrell, director of the International Center for Technology Assessment in Washington. The fight, he says, will be fought in part over how to revise world trade laws. Some Western countries want to exempt plants and animals from being covered by international property rights. 'Third World countries', says Kimbrell, 'are certain to object.' The Convention on Biodiversity, drafted in 1992, is the closest the world community has come to tackling the dispute. But there is no consensus. The U.S., which has the greatest number of biological research labs, refuses to ratify the convention. 'Congress blocked it', Kimbrell says, 'because there's a certain

> element opposed to all international environmental efforts. They feel it limits U.S. options.' (McGirk, 1998).

Few knowledgeable writers foresee any benefits for indigenous peoples from global trends in IPR legislation (Daly, 1996; Patel, 1996). The economist Herman Daly, at a public lecture at the Institute for Social Studies in The Netherlands in September 1996, argued against free trade and capital mobility (this went unheeded, since Brazil is even now in free fall), and the myth (also stated in the CBD) that natural resources can simultaneously be 'conserved' and 'sustainably used'. According to Daly:

1. Many nations have grown to the point that the limiting factor in their further growth or development is no longer man-made capital but remaining natural capital… [and] therefore seek to appropriate whatever natural capital remains in the international commons, and to trade for natural capital with those less-developed countries still willing and able to supply it… But of course all countries cannot be net importers of natural capital… For the aggregate of all countries net imports of anything, including natural capital, are zero (p. 4).
2. Free trade tends to push the world economy to grow beyond its optimal scale relative to the containing ecosystem… creates the illusion that by making natural capital more available to some nations, trade is capable of making it more available to the aggregate of nations (p. 4).
3. To avoid wars, nations must consume less and become more self-sufficient. Yet free traders say we should become less self-sufficient and more globally integrated as part of the overriding quest to consume ever more. It is the worst advice I can think of (p. 13).

5. THE NATIONAL SITUATION

In the post-CBD period, the Guyanese State, with financial and other support from the Global Environmental Facility and other multilateral agencies, passed the Environmental Protection Act (6 May 1996), and subsequently established the Environmental Protection Agency (EPA), charged among other things with regulating research in NTFPs. All of the NTFP projects mentioned above were carried out before the formation of the EPA, although the majority had to be approved by various Government agencies, including the Office of the President.

Legal summaries of the status of IPR in Guyana (Scotland, 1996; Khan, 1998) concur that IPR-related legislation in Guyana is hopelessly outdated and that the current situation affecting trade mark and patent applications is in crisis. According to Khan:

> 'To illustrate the extent of this crisis, my firm has quite a large amount of trade mark and patent applications which have been filed since 1992 (some even earlier) which have not been processed. In terms of numbers, we have - as at the end of 1996 - approximately 1,140 outstanding applications to register Trade Marks in Part A of the Register; approximately 112 Part C Trade Mark applications; and approximately 1,068 miscellaneous applications, such as assignments, mergers, changes of names and addresses, searches and renewals. We also have approximately 45 Patent applications pending… In the face of this disastrous situation… we sign treaties, we become members of international intellectual property organisations, we hold various internationally attended workshops, symposia and conferences pontificating on the virtues of and respect for intellectual property rights, while those of us who do daily battle in the proverbial trenches of the Trade Marks and Patents Registry cannot even get a single trade mark or patent registered (43–44).' (Khan, 1998:43-44).

If top legal firms based in the capital are frustrated with the non-functioning of the Deeds Registry, poor and powerless indigenous groups located in the distant hinterlands areas of Guyana who might be thinking of approaching the national bodies charged with regulating IPR-related issues, would probably fare worse. The crisis in the Deeds Registry of Guyana, however, is irrelevant to Gorinsky-type bioprospectors who move directly to the Patent Offices of developed countries to register their finds.

Few of the knowledgeable people working in this area, however, are sanguine about the chances of secure IPR reversing the poverty of indigenous and other people who still possess valuable local knowledge. McAfee points out that no nation has become developed from the sale of primary commodities, that such groups/nations start out from a weak base anyway, and that 'meanwhile, the international 'market price' of genetic resources is falling from its already low level, and biotech firms are patenting far more molecules than they have any idea of whether or how they'll ever 'develop' ('drift net patenting'). So IPR claims and market deals won't do a whole lot for most local/indigenous groups' (pers. comm.).

6. CONCLUSION

The link between NTFP development and biodiversity conservation/equity in the pre-CBD era rose to prominence with the extractive reserves associated with the anthropologist Mary Allegretti and local leader Chico Mendes in the late 1980s. Throughout these years, activists and others have argued bitterly over the wisdom of this course, those against arguing that drawing poor people even closer into market relations would only lead to their further long-term impoverishment, while diverting scarce resources from the struggle for land and other fundamental rights. This debate was perhaps most sharply drawn in the exchange between Survival International's Stephen Corry versus Cultural Survival's Jason Clay, the former arguing that a focus on marketing products like Rainforest Crunch, or extracting products for 'The Body Shop' furthered the underdevelopment of traditional peoples (Corry, 1993).

Prominent organisations in this field, like the Malaysian-based Third World Network, incline more to Corry's view, but take the realistic position that since they probably cannot change the terms of the exchange in the short run, they might as well draw up draft contracts which can be used by governments and/or indigenous peoples *vis à vis* collectors of biological resources (Nijar, Paper 1). Certainly the people themselves - in Sebai, the Rupununi, and elsewhere - want information on tradable items, including NTFPs, now (see statement of the Chairman of the NRDDB in Iwokrama 1998: 4). Increasingly, however, they will insist on partnership arrangements, and on the drawing up of contracts for sharing profits generated as a result of their knowledge. From their position of relative powerlessness, they probably will have to rely more on goodwill than the acuity of their lawyers. However, Tropenbos researchers can be guided by the growing consensus that the best way to save what remains of biological diversity is to work alongside the remaining pockets of cultural diversity, the world's traditional peoples.

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NON-TIMBER FOREST PRODUCTS IN GUYANA'S NORTHWEST DISTRICT: POTENTIALS AND PITFALLS

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1. INTRODUCTION

Although various researchers and NGOs have advised Guyana to diversify the forest-based portion of the national economy (Sizer, 1996; Ziegler and Zago, 1993; Iwokrama, 1998), NTFPs still remain a neglected resource in Guyana. The lack of information on export volumes and domestic consumption makes it difficult for the government to include NTFPs in its land-use and economic planning. The absence of effective entities monitoring harvested quantities and the impact of NTFP extraction on the forest obstructs the development of sustainable harvesting policies. The Guyanese government, under pressure from the economic recovery programmes of the IMF and World Bank, is desperately looking for ways to increase its revenues in the short term, sometimes losing sight of long-term sustainability.

Together with the Rupununi savannahs in southern Guyana, the other major Amerindian region of the country, the Northwest District is an important area for commercial NTFP extraction. The region's 20,117 square kilometres are inhabited by some 20,000 people, of whom 75% are Amerindians, belonging to the Arawak, Carib or Warao tribes (Forte, 1997). NTFP extraction offers an attractive additional income, relatively easy to combine with subsistence activities such as fishing, hunting and shifting cultivation. With approximately 88% of the Guyanese Amerindians living below the poverty line, some inherent contradictions in Guyana's society seem to impede the potential role of NTFPs in the improvement of people's livelihoods. Indigenous harvesters seem to perform a job that most other Guyanese are not willing to do (Hoffman, 1997).

The commercial exploitation of the interior forests is regulated by the Guyana Forestry Commission (GFC). Inadequate facilities, finance and personnel have forced the GFC to limit its activities to the allocation of harvesting rights, control of timber exports and revenue collection. Forest service extension into rural areas is weak and national forest policy is often unclear to local communities (Sizer, 1996). It is only recently, under the influence of international donor agencies and NGOs, that Guyana has begun to consider its Amerindian inhabitants as stakeholders in the decision-making process in forestry issues (Government of Guyana, 1996a; 1996b). To support this process, various studies in the Tropenbos-Guyana Programme aim to obtain more insight into the economy, ecology and floristic diversity of NTFPs, and the social and cultural factors influencing their trade and use (van Andel *et al.*,

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1998; Forte, 1997; Sullivan, 1998; Verheij and Reinders, 1997). In this paper we present some integrated results from two PhD studies on the ecological and social aspects of NTFP extraction in the Northwest District, focussing on NTFPs with substantial commercial value. We also make some recommendations that might help to ensure their sustainable extraction.

2. METHODOLOGY

The first PhD project, 'Non-Timber Forest Products of the Northwest District and the Pomeroon region of Guyana', is being carried out by van Andel and has the following objectives:

- to make a complete survey of plants harvested as NTFPs and of their uses;
- to study the harvesting and processing methods used by local communities;
- to understand the role of these plants in the local economy;
- To assess the abundance and diversity of NTFPs in different forest types.

Figure 1 Commercial extraction of NTFP in Guyana's North-West District

The major part of the fieldwork was done in Kariako (Barama River) and Santa Rosa (Moruca River). One-hectare plots were made in seven different forest types. Market surveys were held in Santa Rosa, Charity, Mabaruma and Georgetown (see Figure 1). Additional research on palm heart harvesting was done in the coastal swamp region (van Andel *et al.*, 1998). Export figures of NTFPs were calculated from commercial export invoices in the archives of the Guyana Forestry Commission. Extensive interviews were conducted with NTFP harvesters and processors. Data on plant use by three Amerindian tribes in several vegetation types have been

published (van Andel, 1998; van Andel *et al*., 1998) or presented in MSc reports (de Jagher and Smeets, 1997; Groenewegen and Smedema, 1998; Bröker and Huyskens, 1998). The PhD thesis will consist of a guide containing names, botanical descriptions, illustrations, and uses of plants in the Northwest, as well as information on abundance, habitat preference, harvesting and marketing of these NTFPs.

The second PhD project, carried out by Reinders, is entitled: 'Amerindians as consumers, producers and manipulators in their natural environment: Livelihood strategies and resource use and the influence of mining among the Caribs of the Barama river'. This project looks at the relatively isolated Caribs, who are confronted with mining activities close to their dwelling grounds. The effect of mining on their lives is taken as a central point of departure. Fifteen families were followed throughout the year in order to study the amounts and types of resources used, the areas where the resources were taken from, the activities performed and the trade and sales of the products and purchases from the local shops. In addition, the life histories of people were recorded and the background to their choices for making a livelihood formed the subject of lengthy interviews. Comparisons were made between resource use of the Caribs living in a relatively large community established around a school and church and in the more traditional and smaller settlements of extended families. Complementary MSc studies have been done by van Breugel (1998) on the influence of an agricultural development project on social relationships in an indigenous community, and by Campen (1997), who made an anthropological evaluation of a community farm and agroforestry project in two Amerindian villages. A third MSc study was carried out on ethnicity and the economic integration of Amerindians into the Charity market (Verheij, 1998). If we include the PhD research by Forte (1997), all the anthropological projects are aimed at discovering the socio-economic and cultural factors of forest use, as well as the difficulties encountered by Amerindians in participating in the national economy. The research method of participant observation was combined with interviews, household and market surveys and participatory research methods.

3. MAJOR COMMERCIAL NTFPs

In this paper, we will focus on those NTFPs from the Northwest that already have a share in the market. Table 1 lists the region's main commercial NTFPs in order of importance.

Table 1 Major commercial NTFPs in Guyana's NW District

Product	Species	Extraction region	End use	Markets	Price/unit (beneficiary)
palm heart	*Euterpe oleracea*	coastal swamps Barima River	canned delicacy	Georgetown France, USA	$0.06 / palm heart (harvester)
wildlife	*birds, mammals* *reptiles, fish*	Charity, Mabaruma coastal swamps	pets, skins meat, fish	Georgetown USA, Europe	$2.50-10/ animal (trapper) to $10,000/ animal (USA)
nibi	*Heteropsis flexuosa*	Pomeroon	furniture	Charity,	$5-10/ bundle (harvester)
kufa	*Clusia spp.*	Pomeroon	furniture	Caribbean	$0.14-0.35/root (harvester) $20-700/ furniture
troolie palm	*Manicaria saccifera*	Pomeroon, Waini	roofs	Essequibo Pomeroon	$0.03-0.11/ leaf (harvester) $127-408/ roof
mangrove bark	*Rhizophora mangle*	Mabaruma	tanning	Georgetown	$0.02/ lbs. (harvester) $0.06/ lbs. (tannery)
tibisiri	*Mauritia flexuosa*	Pomeroon, Moruca	craft fibre hammocks	Georgetown Caribbean	$0.35/basket (craft maker) $42/ carpet
mokru	*Ischnosiphon arouma*	Pomeroon, Moruca	basketry	Georgetown	$0.20-$7/ basketry

All prices are given in US$. The exchange rate in 1997 was 1 US$ = 142 Guyana dollars.

3.1 Palm heart

Palm heart from the multi-stemmed *Euterpe oleracea* is the most important NTFP of the Northwest District. The palm occurs in large quantities in the brackish coastal swamps and is capable of regeneration through suckers after its stems have been cut. The French-Guyanese firm of AMCAR started a canning factory on the Barima River in 1987. Ten years later, the factory processed more than 23,000 palm hearts per day, employing some 160 persons in the purchasing and canning activities. Factory workers, of whom 25% are female, are recruited principally from the larger Amerindian towns of Santa Rosa and Mabaruma. The company does not employ people to cut palm hearts, but buys them from local extractors on a freelance basis. About 1000 cutters sell regularly to AMCAR and exchange palm hearts for either cash or food. The canning industry is the main source of income for indigenous communities in the coastal swamps. It also attracts people from adjacent areas in the Northwest, who come to cut on a temporary basis when other means of subsistence fail.

3.2 Wildlife

The wildlife trade also generates considerable domestic income. A total of 7,500 licensed trappers are employed in Guyana, 75% of whom are Amerindians (Ziegler and Zago, 1993). It is unclear how many unlicensed trappers and middlemen this trade supports. In the Northwest, live mammals, reptiles, aquarium fish and birds are sold to shopkeepers or wildlife dealers on the regional markets. The large profits, however, stay in the hands of foreign traders. A trapper might receive $ 10 for a rainbow boa, while the animal is worth $ 170 in Georgetown (van Breugel, 1998). Nevertheless, wildlife is more lucrative per individual item than any other NTFP. Even if it takes a whole day to catch a macaw, it still pays more than an average day of nibi or palm heart harvesting (Hoffman, 1997; van Andel *et al*., 1998). Animals are one of the few NTFPs brought from remote areas, as they are worth the transportation costs. Wild meat and fish are the main protein source in the interior and are traded in communities, local markets and gold mines. An increasing number of restaurants in Georgetown offer wild meat on their menu. There is also a significant domestic market for parrots, monkeys and songbirds, but quantitative data are lacking. However, wildlife provides just occasional cash. The trade in living animals is permitted only from July to December, and seasonal variation strongly limits their availability.

3.3 Nibi and kufa

The aerial roots of several hemi-epiphytes form another group of commercial NTFPs, used as plaiting material for basketry and furniture. The most important are the roots of ‘nibi’, *Heteropsis flexuosa* (Araceae), and ‘kufa’, *Clusia grandiflora* and *C. palmicida* (Guttiferae). The woody kufa roots are used for frames, while the flexible nibi roots are woven around these frames, in designs similar to rattan furniture. The main area for commercial harvesting is the Pomeroon River region, where Amerindian and East Indian craftsmen make cheap furniture in small workshops. Some is sold locally, but the bulk is transported to Georgetown. Small amounts are made in Mabaruma as well, but these workshops can hardly compete with the mass production in the Pomeroon area. The more elaborate furniture is made in Georgetown factories, which purchase their raw material from middlemen in Charity. Liana Cane Interiors Ltd., one of the largest enterprises of this kind, used some 60,000 nibi and 20,000 kufa roots in 1997, employing 56 persons on the work floor.

The furniture business benefits a large number of people. Nibi harvesting is the most important income for families in the lower Pomeroon basin. Amerindian collectors may stay in the forest for weeks, combining root collection with hunting and fishing. A person can cut one or two bundles of 100 root pieces per day (Hoffman, 1997). Nibi is sold per bundle and kufa per root to middlemen from the Charity market. Extractors generally consider the price they receive to be

too low in relation to the hard work and the long distance to harvesting sites. Tense relationships exist between Amerindian extractors and the middlemen. The latter are mainly of East Indian origin and have better access to traders, markets and credit (Verheij 1998). They may take advantage, where possible, but no extreme abusive relations were observed (Hoffman, 1997). Caribbean traders sometimes travel directly to the Pomeroon to place their orders. They are willing to pay higher prices and advances to the collectors, but complaints were heard about the reliability of the orders (Verheij, 1998).

3.4 Troolie

The large leaves of the troolie palm are widely used for roof thatch in the coastal region. Troolie grows in the same swamps as *Euterpe oleracea*, but occurs in narrow patches rather than in solid belts (Fanshawe, 1952). Leaves are traditionally used for the roofs and walls of Amerindian dwellings, but thatched roofs are gaining popularity for tourist accommodation and poultry farms. A well-made roof could last 4 to 8 years and is much cooler than corrugated iron. Even though this forest product hardly ever reaches Georgetown, it provides an income for quite a number of Amerindians. They are hired to construct roofs or paddle with boats full of leaves from remote swamps to the populated areas. Most extraction takes place in the upper Pomeroon and bundles of leaves are sold at the Charity market. Several troolie trucks leave Charity every week for the Essequibo and Demerara Coast. The main clients are commercial farmers, who keep their animals cool under troolie roofs.

3.5 Mangrove bark

The bark of the red mangrove, commonly used for tanning leather, is harvested by Amerindians around the Waini River mouth. Entire trees are cut down and skinned, the bark is sliced into manageable pieces and sold to middlemen in Mabaruma. The produce is shipped with the fortnightly ferry to the capital, where the actual leather production takes place in small tanneries. Mangrove bark has lost economic importance since the 1970s, probably as a result of the decline in cattle production in the Rupununi. In the 1960s over 250 tons were harvested annually for the domestic market. Production dropped to 8 tons in 1991, but increased again to 53 tons in 1996 (GFC, unpublished data). The bark is not exported. According to the GFC, some tanners prefer mangrove to synthetic substitutes.

4. EXPORTS

Even for products that have been traded for years, there is little information on the number of people employed in collecting, processing and trading them. From the limited documentation from GFC tax forms, the New Guyana Market Cooperation (NGMC) and unpublished production figures, it proved possible to calculate only the total export figures of NTFPs for 1996 (Table 2). The sum of $ 4,2 million might be a conservative estimate, as exporters often give low product values for reasons of tax evasion, while wildlife is smuggled out of the country in substantial quantities. Nevertheless, these figures do provide some insight into commercial NTFP extraction in Guyana.

Canned palm hearts are exported principally to France. Until recently, production was still rising, but since 1996 exports seem to have stabilised (van Andel *et al*., 1998). According to the factory management, rusting cans and a dip on the world market caused this decline, but it might as well be the result of resource depletion. Guyana's wildlife exports are significant on a global scale. In 1992, the country was the fifth largest exporter of birds in the world (Thomas *et al*., 1996; World Bank, 1995). In fact, real export figures might be much higher, as profits generated by illegal trade would add significantly to these revenues. Guyana signed the CITES

agreement in 1973, but souvenir shops in the capital are still selling jaguar and puma skins. These animals are listed in Appendix I and thus officially banned from international trade (CITES, 1973)[4]. For species listed in Appendix II (toucans, monkeys, parakeets and macaws), trade is permitted only if it does not threaten their continued survival. Guyana exports these animals in large quantities, regardless of the fact that no research has ever been done into the effects of harvesting on their populations.

No more than 30% of the nibi and kufa crafts are sold on the domestic market. In 1996, over 30 enterprises in Georgetown exported furniture and crafts (van Andel, 1998). Although craft shop owners predicted a growing market, export figures seem to be dropping (Table 2). This may be caused by the fierce competition among producers, a shortage of raw material or by a declining demand. The craft business seems to be triggered more by the tourist industry in the Caribbean than by tourism in the country itself. Total export revenues are probably higher than given here, because exporters tend to report low values to avoid taxes. On the Caribbean islands furniture is used in tourist accommodation and crafts are sold again for fairly high prices in souvenir shops. The prices paid by tourists for Guyanese handicraft products have much to do with an idealised romantic view of Amerindians, a group now largely extinct on most islands (Verheij, 1998). Other NTFP fibres used in handicrafts are *tibisiri* for carpets, hammocks and car seats and *mokru*, plaited into baskets and other souvenirs (Table 1). It is not known what percentage of the exported crafts in Table 2 was produced in the Northwest. These NTFPs might have a limited export value, but they do contribute to the local household economy in Amerindian reserves, and offer initiatives for empowerment on a small, but manageable scale.

Table 2 Export values in US$/year of major NTFPs in Guyana

Product	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Wildlife	1,871,828	banned	banned	-	2,100,000	-
Palm heart *	-	-	1,500,000	2,071,162	1,965,978	-
Nibi & kufa *	-	-	-	190,133	137,120	125,165
Tibisiri	-	-	-	11,209	10,401	4,850
Medicinal plants	-	-	-	5,361	6,213	-
Mokru	-	-	-	1,823	131	75
Total	**-**	**-**	**-**	**2,279,688**	**4,219,843**	**-**

\- = Data not available
* = Harvested only in the Northwest District

A wide variety of medicinal plants are sold on the city markets. Although modern medicine is widely available, people prefer to treat some diseases with herbal medicines (Reinders, 1993). Plants are harvested in nearby forested areas. Prices are too low to make extraction from remote areas economically viable. Fresh and dried herbs are exported in small quantities to countries with many Guyanese immigrants. Export documents mention the products as 'tea bush' or 'medicinal herbs', without any reference to the species, to avoid customs problems (NGMC, 1996; 1997). The great diversity of medicinal plants could have a much larger export potential, if processed in a more sophisticated manner and sold as 'rain forest medicines' (van Andel, 1998).

5. ECOLOGICAL AND MANAGEMENT ASPECTS OF NTFP EXTRACTION

[4] The Convention on International Trade in Endangered Species of Wild Fauna and Flora is a global treaty in effect since 1975 to protect plant and animal species from unregulated trade. Appendix I of CITES protects threatened species from all international trade. Appendix II regulates the trade in species not threatened with extinction, but which may become threatened if trade goes unregulated. Appendix III gives countries the option of listing native species already protected within their own borders.

NTFPs are often viewed as a promising forest use, as the impact of their extraction is minimal compared to logging, mining or cattle ranching (Nepsted and Schwartzman, 1992). The long-term potential value of NTFPs, including plants, animals, ecotourism and pharmaceutical prospecting, could outstrip the value of the timber itself (Sizer, 1996). The challenge is to identify conditions for successful NTFP extraction, which contribute to the conservation of forests, offer an increased income to forest-dwelling people and stimulate the economic development of the country (Ros-Tonen *et al*., 1995). Only the commercial extraction of NTFPs, in contrast to extraction for subsistence, has the potential to contribute to the economic development of forest-dependent people (Boot, 1997). To be economically successful, an NTFP must have a lasting market appeal. Distributors must be guaranteed a consistent supply of the product, which calls for a sustainable harvesting of the resource. This means that extraction should not have any long-term deleterious effect on regeneration or on ecosystem structures and functions (Pollak *et al*., 1995). The ecological impact of NTFP extraction depends on the nature of the harvested product. It makes a difference whether entire individuals are harvested or only parts (e.g. leaves, fruits, or eggs). The latter might not kill the species, but could slow down its growth or reproduction. The different effects of extraction on individual species affect the size and structure of the population, which ultimately determines the availability of the resource (Boot, 1997). What this means for the ecological and management aspects of extraction of the main commercial NTFPs in Guyana's North West District is discussed below.

5.1 Palm heart

AMCAR operates under the assumption that *Euterpe* populations of which all mature stems are felled, will permit a second harvest in about five years (Johnson, 1995). Results of the study by van Andel *et al*. (1998) point out that nowhere in the Northwest are harvest cycles that long. After several years of exploitation, *Euterpe* populations steadily decline in stem size, clump vitality, reproduction and yield. In several areas, the neglect of traditional farming has led to a total dependency on the palm heart industry and high pressure on the *Euterpe* swamps. This results in very short fallow periods (7 months to 1 year), overharvesting and socio-economic problems. Where people combine extraction with subsistence farming, less damage is done to the vegetation and rotation cycles are longer (2 years). Although the present palm heart harvesting cannot be considered as sustainable, it is much less environmentally destructive than the gold and timber industry. No heavy machinery or polluting chemicals are used, soils stay intact and nutrient cycles do not seem to be much disturbed. When flying over the Northwest District, one immediately notices the large holes in the forest cover caused by logging or mining operations. In the palm heart exploitation areas the canopy looks fairly intact from the air.

It is of vital importance to the socio-economic wellbeing of the Northwest that AMCAR should continue its activities in the region. The company should develop a management plan to guarantee the continuous supply of palm hearts, while ensuring the recovery of overharvested areas. A long-term rotation system should be designed, with harvest cycles of at least 4 to 5 years. Extraction might be intensified in undisturbed areas. The following silvicultural practices should be included:

- Leaving at least one mature stem per cluster to enhance growth;
- Protection of suckers and young stems when felling large stems;
- Selective clearing of lianas and shrubs inhibiting growth of saplings;
- Effective control over harvested areas.

Maintaining a minimum diameter for palm heart is a powerful method of preventing the extraction of immature stems. The price for palm hearts could be raised a little, to ensure a fair benefit for the extractors and measures should be taken to prevent accidents happening during harvesting. A public management plan would create a better image of the company and allay the suspicions of social and environmental organisations. *Euterpe* swamps represent a concentrated resource that is potentially simple to manage compared with more species-rich heterogeneous forests. The abundance and rapid growth of the species offers good opportunities for sustainable extraction (Anderson, 1988).

5.2 Wildlife

The exploitation of wildlife may be currently sustainable in remote communities, but increasing human population, greater road access and commercial markets are likely to change this situation. This is especially relevant in southern Guyana (Iwokrama, 1998), but also in the Northwest, complaints of declining animal populations were heard. The use of land dredges and river dredges seems to be diminishing the fish resources in gold mining areas. Changing settlement patterns, resulting in densely populated towns like Santa Rosa and Mabaruma, have increased the local demand for fresh meat and fish. As wildlife resources around these villages are almost depleted, people now depend heavily on salted fish. The breeding of wild animals for consumption could be considered as an alternative food source.

It is currently not possible to estimate the impact of the wildlife trade on animal populations, because there is no information available on extraction rates, mortality and population dynamics of target species (Iwokrama, 1998). The Wildlife Division of the Office of the President monitors wildlife exports and maintains a quota system for all species legally exported from Guyana. Exports were banned in 1993 in order to establish a better quota system and improve administration and control procedures. After a diagnostic assessment of wild species by the IUCN (1994), the trade was reopened in November 1995. But there are still no estimates of sustainable harvesting levels for the majority of the wild animals. A closed season for trapping was set from January to June, but it is not known if this period relates to breeding seasons (de Souza, 1997). According to Ziegler and Zago (1993), the export of wildlife from Guyana could be a profitable and sustainable use of renewable natural resources, if properly regulated. Problems of wastage and cruelty, which are characteristic of this trade, should be addressed and resolved. Sizer (1996) argues that trapping does lasting damage to the forest and is thus inherently unsustainable. It may provide significant short-term employment for collectors, and certainly generates large profits for exporters and retailers abroad, but unless it can be adequately regulated and monitored, with quotas based on scientific research, it should be prohibited again.

In response to the concerns of local communities in southern Guyana, Iwokrama has organised several workshops to discuss wildlife management problems with all relevant stakeholders (Iwokrama, 1998). Similar workshops in the Northwest would be a first step towards the conservation and sustainable management of wildlife in the region. A project in Shell Beach, which involves Amerindians in the protection of sea turtles, could be seen as an example. Turtle eggs have always been a favourite dish for the local residents. Through environmental education and rearing pigs as alternative protein source, the pressure on this endangered species has decreased. More surveys of commercial animals are needed to assess population sizes, spatial distribution and breeding seasons. Only with these data can sustainable extraction models be designed. Harvesting rules may be difficult to implement in remote areas, but since the trade is concentrated on regional markets, the control of illegal practices should start there. More effort should be taken to raise public awareness of the need to protect endangered species.

5.3 Nibi and Kufa

The majority of nibi and kufa roots either wrap around the tree trunk or contain many knots, which makes them unsuitable for plaiting. The preferred roots for craft production drop straight from the tree branches to the ground. If less than 50% of its roots are removed, an individual epiphyte will survive. According to Hoffman (1997), present harvesting techniques of nibi and kufa roots are unlikely to decimate populations, because people harvest far fewer roots than they leave behind. He considered the ecological sustainability of nibi and kufa to be promising, because plants occur in relatively high abundance, roots can be removed without killing the plant, and there is a year-round availability. Because it takes decades before these epiphytes have settled in treetops, nibi and kufa roots are found only in primary forest. The maintenance of this forest is thus essential for the future supply of these products. Unfortunately, most primary forest along the Pomeroon has been given out as timber concessions. Logs are even felled in Amerindian reserves and sold to sawmills. Companies sometimes offer extractors to harvest all suitable nibi and kufa before they start logging. But since a tree full of nibi or kufa can be worth more in aerial roots over a few years than being felled once for timber, it would be better to spare host trees. Extractors should be careful not to destroy young roots.

Liana Cane Interiors plans to increase production and is willing to cooperate in sustainable harvesting. In 1998, a workshop for local extractors was organised with the help of Conservation International. To prevent the harvesting of immature kufa roots, the company offered to pay a higher price for large roots. Local craft making for the export market was also encouraged. This triples the original value for the nibi in the villages (Hoffman, 1997). The export of nibi and kufa furniture is likely to become more important in the future, since rattan resources in Asia are declining through overharvesting and deforestation (de Beer and McDermott, 1996). Extractors could get a larger share of the profits by forming an organisation that sells directly to Georgetown factories. The Charity market bond should play a role in monitoring the volumes of raw material put up for sale. A storage place for roots should be created, so that harvesters could wait for a better price, instead of having to choose between taking a middleman's first offer or paddling back home with their harvest (Verheij, 1998). Given the economic importance of nibi and kufa, the possibilities for sustainable harvesting and the increasing international demand, there is an urgent need to develop adequate management plans for these species.

5.4 Troolie

Because of the patchy distribution of troolie, leaves are not always widely available. Troolie does not occur around Santa Rosa and Mabaruma, so leaves have to be brought from elsewhere to meet the large demand in these towns. In the dry season, when transport is difficult, the price of troolie rises. People in Santa Rosa grumbled that troolie had become as expensive as corrugated iron. Palm heart cutters were blamed for damaging troolie trees, causing a shortage of the product. But these accusations are false, as troolie trees are seldom damaged during palm heart harvesting. Troolie is still present in large quantities along the Waini and Barima Rivers and no signs of overharvesting have been observed.

5.5 Mangrove bark

Requests for permission to harvest mangroves on a larger scale have been submitted recently, but the GFC does not want to hand out permits before a proper management plan is developed. Although the species occurs in near mono-specific stands along the coast, the felling of trees could have certain risks. Mangrove forests play an essential role in protecting the seashore and river banks against damage by the tides. The dense aerial roots form a natural barrier against the waves and prevent the soil from being washed away.

To minimise the damage, the GFC has advised harvesters to fell only trees growing further away from the waterfront. No studies have been done on the impact of harvesting on mangrove ecosystems in Guyana.

6. SOCIAL ASPECTS OF COMMERCIAL NTFP EXTRACTION

6.1 Social benefits

The great social advantage of commercial NTFP extraction is that it allows most harvesters to return home every day. People involved in hunting, fishing, palm heart, troolie, nibi or kufa harvesting spend considerably more time with their families than those working in logging or mining concessions. Harvesters, who stay away for weeks in forest camps, mostly move with their wives and children. In fact, spending weeks in camps for fishing or hunting has always been part of Amerindian life. The NTFP trade allows harvesters to combine their work with farming and to maintain their indigenous culture, a trend also noted by Hoffman (1997) and Sullivan (1998). The NTFP trade greatly accords with the individual lifestyle of Guyanese Amerindians (Rivière, 1984). The decision to harvest NTFPs can be made on an ad-hoc basis, whenever a family is in need of cash. NTFP extraction minimises the contact with ethnic groups outside their own social sphere, so there is less risk of abuse or discrimination. Despite the stressful relations between extractors and buyers, most Amerindians prefer independent NTFP harvesting to the monotony of wage labour (Forte, 1995; Hoffman, 1997). Daily earnings may be variable, ranging from $ 2.5 (nibi) to $ 11 (palm heart and wildlife), but are regularly higher than those offered by the few other employment opportunities in the region.

6.2 Gender division of labour

In traditional indigenous households there is a crucial gender division of labour. Men are responsible for burning a piece of forest for agriculture, while women do the planting, weeding and harvesting. Women process the staple food of cassava, while men bring in game, fish and most other NTFPs. This traditional way of life is under threat from the long periods of absence of able-bodied males. If household heads are working in cities, mines or logging concessions, farms tend to be neglected (Forte, 1995). Women are now performing male activities, such as plaiting cassava processing equipment from mokru, burning off forest for farming and even hunting (van Breugel, 1998). Their workload has increased even more now that children are attending school. When their men return, their earnings rarely suffice to feed the family until the next pay cheque. This trend can be reversed only if job opportunities become available within the Amerindian reservations (Forte, 1995). Because of the greater dependency on manufactured goods, the need for cash in Amerindian villages has increased. In the Pomeroon region, the income from logging has decreased to such a degree that women now bring in the major amount of cash. They have taken advantage of the opportunity offered by a tibisiri craft shop, where orders are shared and knowledge is exchanged among participants. Men are reluctant to join their wives in their tibisiri work, as it is traditionally associated with women's work. They continue to focus on commercial NTFP extraction and logging, while some have taken up the position of middlemen on the Charity market (Verheij, 1998). The need for women to have their own income is important, since alcoholism is a widespread problem among Amerindian males.

6.3 NTFP extraction: development or underdevelopment?

NTFPs are often said to increase the income of forest-dwelling people and to stimulate the economic development of the region (Vasquez and Gentry, 1989). One wonders therefore why so often only the poorest indigenous families are involved in commercial NTFP extraction. For most urban Guyanese, the interior forests are an unknown and dangerous place, which should be 'developed' as soon as possible. Amerindians are on the lowest step of the social ladder in

Guyanese society. They are looked down upon socially, economically and politically (Sanders, 1972). Amerindians encounter many obstacles to equal participation in the regional markets. They are unfamiliar with prices and transport costs, and do not have access to credit or storage facilities. The distrust and unfamiliarity between the different ethnic groups operating in the market prevent the development of durable trade relations (Verheij and Reinders, 1998). The lack of functioning Amerindian organisations or market cooperatives inhibits their independence in trade. Handicapped by a failing educational system, precarious health conditions and poverty, the economic potential of the forest to indigenous peoples will not be realised if the families involved are simply not able to make full use of it. The conservation and sustainable use of forest resources in this region can be realised only if development projects include the support of basic human needs (Forte, 1995). Unless it is acknowledged in Guyana that Amerindians over the centuries have built up an integrated knowledge of the forest environment and that their management techniques can play a crucial role in sustainable harvest systems, NTFPs will not play their attributed key role in improving people's livelihoods.

6.4 Regional administration of forestry

A little over half of the forested area of Guyana falls under the control of the GFC. Amerindian reserves represent some 5% of these State Forests, and are controlled by village captains and councils. The GFC has no jurisdiction over resources within titled Amerindian lands or over arrangements made between village councils and private companies. Most State Forests have already been leased to timber and mining companies. Because of the inefficient forest laws, Amerindian reserves are an easy option for new enterprises looking for remaining land. Cases are known where traditional dwelling grounds have been allocated for commercial forest exploitation. Private businessmen and logging companies hand out free chain saws and buy the logs without any legal contract. Royalties are seldom paid for products harvested from indigenous lands and reservation boundaries are not clearly marked. Amerindians often lack the know-how and financial means to effect binding contracts or seek legal recourse when agreements break down. Amerindians cannot request the GFC for legal advice, but have to deal with the Regional Democratic Council, whose bureaucracy scares off many people from lodging complaints. Unfortunate deals are usually announced too late for any practical intervention to be effective (Forte, 1995).

By law, any such agreement should be approved by the Minister (Toppin-Allahar, 1995), but the law does not specify which person or department should be addressed. A motion for review of the Amerindian Act was accepted by Parliament in 1993, but the process seems to be moving at a snail's pace (LaRose, 1995). It is thus not surprising that, in practice, agreements are made without official approval (Forte, 1995). The extent of lands allocated to Amerindian communities under the Amerindian Act was not based on sustainability studies of their subsistence patterns (Toppin-Allahar, 1995). Twenty years after the publication of the Act in 1977, many communities have grown to such an extent that agricultural land has become scarce. The Act contains no provisions for the protection of wildlife or vulnerable habitats (Iwokrama, 1998). Apart from those communities living within reservation boundaries, many Amerindian villages have not been granted title as yet. They are clearly in the weakest position, and have no other option than to move away when mining or logging companies come in, just as they have done for centuries.

6.5 Participatory forest management

Since Guyana lacks a credible institutional and legal base for the management of Amerindian reserves and each community has its unique natural, socio-economic and ethnic setting, villages must design their own management plans. Small-scale rotation systems for NTFPs should be designed, with some areas designated for harvest and others for regeneration. Strict agreements

among villagers are needed to avoid harvesting in recovering areas. But communal systems are fragile in the face of strong commercial markets and the lure of large profits is causing a breakdown in social cohesion and management rules within the community (Freese, 1998). Participatory forest management therefore depends on cooperation among all stakeholders: extractors, village councils, traders and exporters.

No association of NTFP extractors has ever existed in the Northwest; every harvester is a direct competitor of his neighbour. No clear agreements are made among villagers on the division of working space. Differences in tribal background and church affiliation also obstruct successful organisation. The 'Tragedy of the Commons' is still a topical phenomenon among Guyana's rural poor. Communal ownership should be arranged for those lacking land rights, as control of resources is a prerequisite for sustainable management (Freese, 1998). Community-based management would allow people to continue NTFP extraction without having to move their homes. Subsistence agriculture should definitely be stimulated to guarantee food security and relieve pressure on NTFP resources. Yet some people are so dependent on the cash provided by NTFPs that they cannot afford to slow down harvesting and start farming. In order to bridge the shortfall of income, self-help days could be organised, during which villagers work together in exchange for food. SIMAP successfully implemented these programs in other rural communities. However, a strong dependence on food aid should be avoided (van Breugel, 1998).

Village administration is essential to control the amounts of NTFPs marketed by the community. Extractors must be registered and harvest quotas should be set for vulnerable populations. Training is needed in administration, law, marketing, farming techniques and designing village-based management plans. The government, Amerindian organisations and other NGOs concerned with rural welfare should stimulate these activities. Sizer (1996) suggested a Community Forest Conservation and Development programme, providing basic technical assistance to communities interested in developing forest-based enterprises. The programme would include training in community strengthening, contract negotiation and finance. Access to small loans is needed to start small enterprises. Ideally, transportation and stock should be in the hands of the Amerindians themselves (Corry, 1993). Priority should be given to the establishment of relationships of mutual trust. Over the years, Amerindians have seen many failed projects and have become sceptical of outside interventions. Guidelines for communities on how to proceed and who to contact could contribute to the development of local initiatives.

6.6 The contribution of NTFPs to forest conservation

Export revenues of NTFPs in Guyana are dwarfed by countries like Indonesia ($ 238 million in 1987) or Brazil, which exported $ 53 million in 1990 (de Beer and McDermott, 1996; Broekhoven, 1995). But when the figures are recalculated for population size, Guyana exports more NTFPs per capita than Indonesia or Brazil (van Andel, 1998). Since NTFPs contribute significantly to the economy of the Northwest, they deserve a place in the regional land-use planning. The main gold and timber producing areas are located far away from the market towns (see Figure 1). Here, NTFP extraction seems to have little chance of competing with the large-scale forest exploitation by multinational companies, but in the coastal swamplands, NTFP harvesting appears to be the most viable form of land use. The potential for commercial farming, mining or logging is minimal here, due to waterlogged soils and the absence of valuable timber species or minerals. But even though the extraction of NTFPs from forests dominated by one or few species (palm heart, troolie, mangrove) may be biologically sustainable and provide substantial income for local people, it does not help to conserve the biodiversity of these forests (Boot, 1997). This can be achieved only if NTFP extraction is able to prevent or reduce deforestation and when NTFPs yield more revenue than other land uses. The extraction of nibi and kufa, in which primary forest is essential for gathering the products required, could indeed contribute to forest preservation. But if prices for the raw material are low, the products are either overharvested or extractors may shift back to timber cutting.

7. PROPOSALS FOR FURTHER RESEARCH

More research is needed on the growth rates, population sizes and optimum harvest levels of those NTFPs that have already proved to be economically viable. Tropenbos-Guyana has preliminary plans for further research on the sustainable extraction of palm heart. Similar projects should be launched for wildlife, nibi, kufa, troolie and mangrove bark. But diversification of the market reduces the risk of commercial failure and there are several 'new' NTFPs from the extensive Northwest forests with a potential for commercial extraction. Researchers have suggested the breeding of wildlife for consumption and export (Sullivan, 1998), bee keeping (Forte, 1995), collection and reproduction of orchids (abundant in brackish swamps), processing of *Euterpe* fruit juice (van Andel *et al*., 1998), characteristic tribal crafts (as opposed to mainstream tourist items) and prospecting for medicinal plants (Sizer, 1996). The scientific identification of plants and animals is essential, as similar local names may be given to a variety of species. Preliminary investigation should be carried out on the potential for increasing the supply of these products. Communities should be directly involved in the marketing and transport of NTFPs. Consumers are willing to pay a premium for products from well-managed forests, where environmental and social impacts are reduced to a minimum, laws are respected and employment conditions are fair. Producers should consider 'eco-certification', to distinguish their products from others and to improve their market share. Good management often results in long-term savings, compared to the costs of purchasing wild products from independent extractors (Anderson, 1988).

8. CONCLUSIONS

Commercial NTFPs provide an important source of income for Amerindians in the Northwest of Guyana, although they do not fully enjoy the profits made in the NTFP business. Some communities depend heavily on NTFPs for their survival, as in the case of palm heart harvesting. Neglect of traditional farming and a complete dependency on the palm heart industry has led to overharvesting of the resource.

All major commercial NTFPs have an ecological potential for commercial extraction, but there is a lack of information on population densities, growth rates, and sustainable harvesting levels. The absence of land-use planning and government control has prevented the development of management plans for these NTFPs. The main problem associated with the commercialisation of NTFPs in the Northwest are the low prices paid for the raw material, the lack of storage facilities, lack of organisation among harvesters and high transport costs. Most commercial products are harvested close to regional markets, which would be the main areas for the monitoring of harvested volumes, price regulation and control of illegal trade.

NTFPs can play an important role in participatory forest management. Particularly where the scope for conflicting land uses is minimal, NTFP extraction seems the most viable form of land use, but the present forest laws make it difficult for indigenous peoples to manage their reserves sustainably. There are signs that the governmental bodies are willing to incorporate NTFPs and Amerindians into their mandate, but much still needs to be done at all levels.

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NON-TIMBER FOREST PRODUCTS AND INDIGENOUS MANAGEMENT OF THE FOREST ALONG THE MIDDLE CAQUETÁ RIVER: COMPLEMENTARITY AND NEW OPTIONS

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1. NON-TIMBER FOREST PRODUCTS: A HISTORY OF INTERCULTURAL CONTACT

For the Amazonian indigenous peoples, the history of contact with global society has been marked since the end of the last century by the exploitation of a non-timber forest product, rubber. During the period of rubber exploitation a scheme based on terror was instituted, which is still part of the collective memory of the present indigenous communities along the Middle and Lower Caquetá and Putumayo rivers (Taussig, 1987, Dominguez and Gómez, 1990).

Besides rubber, a number of other gum products (*chicle, juansoco* and *balata*), as well as fish and the trade in otter (*Lutra* spp.), caiman and jaguar fur have been part of the region's economic history.

The exploitation of rubber took place under different modes of '*endeude*' relations (in-debt relations), a mechanism that has been perpetuated as the typical socio-economic relationship for the Colombian Amazon. This mechanism is still very common, although its expressions have undergone some minor changes as a consequence of large-scale integration and contact with the market economy.

The *endeude* is an economic relationship consisting of a chain of intermediaries among the big and local traders, characterised by the advance of merchandise as payment for the extracted or collected products. This chain implies a mutual dependence between patron and client and is characterised by low levels of money circulation. In most cases, the client is in debt to the patron because of high prices for merchandise and the low prices of extracted products.

The impact of the exploitation of non-timber forest products on the indigenous communities has been considerable. In the first place, the over-exploitation of labour and the introduction of diseases decimated the population. The exploitation resulted in most cases in considerable displacements of the workers, as the resources are dispersed in the territory in places far away from the settlements. The absence of adult men during much of the year meant the alteration of ritual cycles and therefore of cultural reproduction. The acquisition of merchandise introduced a new form of ownership and the need to build individual houses in order to lock away the newly-acquired individual property, so that the *maloca* or collective roundhouse lost its role as community housing (Rodríguez and van der Hammen, 1993). In other words, a process of

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cultural change, new settlement patterns, demographic changes, and of major integration has taken place, also stimulated by governmental policies.

The extraction of products like gums and animal skins generated a series of economic booms for the Amazon region until these products disappeared from the world market during the 1960s. In the first case this was due to substitution by synthetic products and, in the second case, to the prohibition of the fur trade. These economic booms were primarily advantageous for traders and intermediaries, who gained large profits thanks to the low prices paid to the indigenous gatherers, but for the indigenous people they were periods of exploitation. At the same time, however, they were periods in which they had access to a series of products like axes, knifes, hooks, nylon, matches, shotguns, sewing machines and outboard motors (Rodríguez and van der Hammen, 1993).

Since the 1960s, the only products that are being commercialised towards the centre of the country are large catfish and, on a smaller scale, ornamental fish. Commercial fishery has been consolidated as the main economic activity of the Middle and Lower Caquetá region, where the *endeude* and patron-client relationships are still present.

2. NON-TIMBER FOREST PRODUCTS AS AN ALTERNATIVE FOR REGIONAL DEVELOPMENT

Since the end of the 1970s a series of government programmes has been developed for the indigenous communities and, in general, the Amazon region has received special attention. Both the State and the private sector have generated new ideas and plans for the development and occupation of the Amazon region, based on ideas of integration and participation in the national economy. The advances in the environmental debate have played an important role; for example, a special institution was created in order to guide the development of Amazonia. It included a research and experimental station from where a series of proposals was elaborated for alternative production systems, such as adapted agriculture, agroforestry, captive animal breeding and fish-culture. Many of these alternatives are based on non-timber forest products. The proposals tried to offer production alternatives that were better adapted ecologically, but which could offer a monetary income at the same time. Special attention was paid to the possibility of ending existing commercialisation mechanisms for extracted products like fish, as these implied patron-client relations characterised by *endeude*, which was considered to be unjust and inequitable.

During a workshop for indigenous leaders of the Middle Caquetá region, supported by the Tropenbos-Colombia Programme, the history of State intervention and development programmes carried out in the region was reconstructed in a collective exercise. From a local point of view, the communities saw these projects and programmes as sources of income, as they could work as guides and workers. Nevertheless, they perceived all the proposals as something external. In most cases, they did not really understand either the reasons or the objectives of these projects, but they always hoped they would last as a source of income.

3. TOWARDS PARTICIPATORY RESEARCH

The proposed alternatives were not generating the expected results and some of them were clear failures. Alternatives were often proposed based on the use of resources, while no information was available on the socio-cultural, socio-economic, biological and economic aspects of the

extraction, exploitation and management of these resources. The communities have managed these resources in various ways and they possess valuable information which is important to know and take into account.

In response to this situation, a discussion was started on the causes of these failures and new research strategies were proposed which considered the indigenous point of view. Indigenous knowledge systems received attention through studies of ethnobotany and ethno-ecology.

In this context, a project was started under the Tropenbos-Colombia Programme, dealing with indigenous environmental management in the Middle and Lower Caquetá region. One of the major objectives of this project is to generate relevant information on the management and forest use models employed by the indigenous communities. This information includes both the communities' symbolic vision and the quantification of actual resource use, the latter through a participatory recording of consumption patterns. It is very important to have detailed knowledge of the cultural framework that regulates the use of resources, as well as of the physical magnitude of resource uses, when alternatives have to be proposed.

In the Indigenous Environmental Management project a participatory research strategy has been developed which includes joint research and indigenous communities' own research on themes related to traditional knowledge. In order to quantify resource use, forms were designed for the daily recording of the consumptive use of products obtained through agricultural activities, fishing, or hunting and gathering.

This monitoring of resource use was first carried out at the level of individual households, including roundhouses, isolated households, households forming part of an indigenous settlement, and some colonist households, covering a large territory. This provided valuable information on species and space used and comparative information on resource management at the regional level. The next methodological challenge was how to follow the use of a community as a whole. To meet this challenge, a slow process was started with the Andoke community. Starting with a few households, little by little, more households became part of the project, ending with the whole community recording its consumption of forest and agricultural products. The community became involved in a dynamic discussion which was consolidated as a permanent community observatory of the state of resource use and as a basis for the design of a natural resource management plan for its legally recognised territory.

Community workshops were held to improve the monitoring process and to discuss recording difficulties. As a result, registration forms were redesigned and the names of species and places were unified. In addition, results were discussed and several themes were noted as requiring further study. In this way a scheme was developed for intercultural dialogue between science and the indigenous knowledge system.

4. TRADITIONAL MANAGEMENT VERSUS ACTUAL USE

One of the most evident characteristics of the model of indigenous forest use is the management of biodiversity at all levels. With respect to agricultural diversity, more than 140 crops and varieties are being managed (Annex 1). Over 100 fish species are being used at the regional level (Annex 2) and more than 60 animal species are being hunted, including mammals, birds, reptiles and amphibians (Annex 3).

The management of diversity is one of the main characteristics of indigenous forest use. It follows temporal processes and seasonal changes, according to annual and even multi-annual cycles, the seasonal availability of the resources and the spatial diversity of the different landscape units and habitats (van der Hammen, 1991, Rodríguez and van der Hammen, 1996, van der Hammen and Rodríguez, 1996). The sustainability of indigenous models is based on cultural and ecological principles, of which the following are the most important:

- There is only a limited amount of energy that has to be kept flowing among all creation.
- Everything in nature has a spiritual owner, nothing can be used without permission.
- The territory is a multi-ethnical space in which each ethnic group has its own mythical birthplace which it has to take care of.
- In this multi-ethnic territory each ethnic group has its own task in order to help maintain the balance.
- The *maloca* or roundhouse is the basic unit of interaction with nature.
- The shaman is the person in charge of establishing a harmonious relationship with the spiritual owners.
- The spirits that gave origin to the different ethnic groups still support them, therefore these beings like tapirs, palms, certain fish species, and birds are considered to be sacred.
- Animals have their own sacred sites and respect for these places guarantees the harmonious sharing of the territory between animals, plants and human beings.

Traditional indigenous management of the tropical forest can be considered to be a successful form of conservation, as it does not include a fundamental transformation of ecosystems. A high proportion of the Colombian Amazon is considered to be untouched, undisturbed and unaltered, and this situation is the result of indigenous intervention and management over decades, centuries and even millennia.

Actual forest management by indigenous communities is based mainly on traditional models and is dominated by subsistence consumption. However, socio-cultural changes have transformed the use patterns, sometimes leading to pressure on specific resources with market value. Examples are the meat of hunted animals commercialised at the local level, and large catfish, commercialised at the extra-regional level. This pressure may cause imbalances and sometimes even jeopardise the sustainability of the resource.

5. CHALLENGES FOR NTFP RESEARCH

This situation presents a double challenge. One part of that challenge is the search for alternative resources or products for which there are no well-established markets. On the other hand, there is need for research aimed at developing sustainable ways of using resources that are currently being exploited.

The use of non-timber forest products has been proposed as a valuable alternative, but this will only be successful when a broad approach is adopted, which integrates basic research (biological and ecological aspects) and research into social, cultural and economic aspects. Total control of all or part of the commercialisation process is essential in order to break with already established mechanisms of mediation. This means that basic research will have to respond to the challenge of directing its efforts towards the needs of local population. This implies more applied research, including experiments which may contribute to the development of sustainable management models. Research should also take into account the cultural impact and define its

proposals as part of a natural resource management plan. In this context, it is important to include local knowledge and research carried out by the local people themselves.

The Tropenbos-Colombia Programme has considered and developed both these challenges. In order to define the sustainability of large catfish exploitation, the present basis of the local economy, a detailed study of the historical, social, cultural, economic an ecological aspects of commercial fisheries has been carried out in the Lower and Middle Caquetá region (Rodríguez, 1991; in press). As a result, reliable information is now available on the magnitude of extraction from a database encompassing more than one decade. This provides a firm basis for developing sustainable commercial fishery and for considering the future management patterns of the resource. In this process, the participation of fishermen and traders, together with inter-institutional action, will allow all the actors to agree upon such a plan.

Figure 1 Catch areas along the lower Caquetá River

The Indigenous Environmental Management project has taken some initiatives to develop income-generating alternatives based on non-timber forest products. Lianas are traditionally used to make traps and baskets and are also used in the construction of houses. They are in growing demand as a raw material for the furniture industry in the centre of the country. Research on this resource covers botanical aspects, life cycles, growth, abundance and use of lianas, using both scientific and traditional knowledge and including some experiments in planting and forest enrichment. So far there seem to be few options for planting and enrichment, but a huge volume of information has been generated on uses and traditional knowledge. This will make it possible to formulate alternatives and improve strategies for the future. The project has created an interest in recovering techniques of manufacturing traditional products made of the *yaré* liana, such as traps and basketry. Younger generations no longer know these techniques.

The mechanism of joint research with local communities has created an interest in alternatives that are based on traditional as well as scientific knowledge, up to the point where different proposals have been generated for the study of other resources. These include the management of palms and fauna, and some studies are to be started on the *pui* palm used for roofing, and on macaws, parrots, and butterflies.

The interdisciplinary approach and methodologies developed in the Indigenous Environmental Management project in the Middle and Lower Caquetá river basin, have revealed in considerable detail the symbolic, economic and social context in which the natural resources are being used. Traditional patterns as well as the pressures and economic situations that generate new use patterns have been clarified.

The exploitation of non-timber forest products undoubtedly constitutes an important aspect of indigenous management. Nevertheless, there is an important point to consider: indigenous management implies the use of the biodiversity as a whole, not just the exploitation of a few products with commercial value.

The search for income-generating alternatives through non-timber forest products has been proposed as a strategy for conservation and improving people's livelihoods, but these objectives are not easily achieved in practice. In the case of the Middle and Lower Caquetá region, after two decades of projects involving alternative Amazonian products, none of these have been consolidated.

The causes of these failures seem to lie in the limitations of research. Proposals have been formulated externally, without really knowing the Amazonian context and without considering local knowledge or traditional management models. These complex subjects require the consideration of a broad range of social, cultural, economic, institutional and commercial aspects. They also require inter-institutional cooperation not always easy to obtain. For proposals on the sustainable exploitation of non-timber forest products to be successful, they should therefore consider:

- the historical context of the use and exploitation of these products;
- the traditional management models and local knowledge of these resources;
- participatory research proposals and experiments;
- traditional socio-economic and labour relations;
- the ecological impact (the use of biodiversity vs. the use of one or a few resources);
- the cultural impact;
- the economic impact;
- new labour and social relations;
- the establishment of a management plan for the territory and its resources as a framework for the exploitation of non-timber forest products;
- the commercialisation of the products.

The exploitation of non-timber forest products as a mechanism for forest conservation continues to be an interesting option in spite of many historical failures. But to be successful, it seems to be necessary to attend to the whole range of the above aspects in an integrated and participatory manner. If this is not done, false expectations about the potentials of NTFP development will be raised.

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ANNEX 1 POLYVARIETY OF CROPS IN THE TRADITIONAL YUKUNA CHAGRA

Name in yucuna	Common name	Characteristics
MANIOC		
1. Chitapanari	Jeechúwaké	broadleaf
2. Yawaru		low little plant
3. Karipuwaké	Karipuwake	plant with many branches
4.	Kariwake	purple shoot
5.	Inerukaná	
6.	Jeechumerú	
7. Jeeruke	Yuca de puerco	broadleaf
8. Yechake	Yuca de Yecha	chocolate skin
9. Kunuke	Yuca de siringa	small long leaf
10 Yuchike	Y. de Juansoco	milky on peeling
11 Wapaná	Y. de Bodoquera	very long stem
12 Puturuke	Y. de Perdíz	chocolate stem
13 Awe'etuke	Y. de Awe'eretú	short stems
14 Jiñake	Y. de diablo	black stem, dark leaf, red skin
15 Kenake		red skin
16 Wereri	Y. de Tanimuka	white leaf on the back
17 Wajari'ike	Y. de Manicuera	
18 Kuruwanurupi		similar to yawaru, dark stem
19 Tuhirike	Y. de mochilero	yellow primordium
20 Pariwake	Yuca dulce	
21 Jeechútupana	Yuca de blanco	
SWEET POTATO		
22 Kejrú	Yota	
23 Peyawaruna	Pierna de Jeechú	
AROID ROOTS		
24 Iwatá	Mafafa	broadleaf
25 Puumi	Mafafa	slimy, food of the ara bred for feathers
26 Pujyú	Mafafa	idem
27 Puyaná	Mafafa	slimy, to burn the mouth of the manguare drum
28 Ujrí	Mafafa	large leaf, small root
YAM		
29 Kuayú	ñame de diablo	black
	ñame de monte	grows in savannas
	ñame de caracol	type of parasite, grows on trunks
BANANA		
30 Erojopaparune	P. de dormilón	throws off 3 or 4 shoots
31 Pujarúpare	costillade perezoso	has no inflorescence
32 Kamiya'ala	P. de Kari	short, thick
33 Majiguara	P. enano	
34 We'ejiri	Pildoro	
35 Satume	P. de Santo	
36 Jeechupa'are	Costilla de Jeechú	banana
37 Kawachí	Antebrazo de Jeechú	large, green, ripens yellow
38 Popocho	Del Perú (Keyaco)	
FRUIT TREES (Paeji)		
MARAÑON		
39 Jilucajone		large, red
40 Jilukerani		small, red
41 Jilujewana		large, yellow
42 Ipichijewana de Guargauchi	De lombriz	round, without seeds, wild

Name in yucuna	Common name	Characteristics
CAIMO (Jima)		
Inerukana		
Jeechúmeru		
44 Kupirapajimare	Caimo de pajaritos	
45 Ipurenaño		green when ripens
46	Seno de Jeechú	large
UVA (Kajmu)		
47	Grande de Iyariru	
48	Pequeño de Jeechú	
ANON(Kajyu)		
49	Anón propio	
50	Anón de nutria	small, of the flooded forest
MARACA		
51 Jeechúpaje	Cabeza de Jeechú	sweet, small
52 Jiñalapanita	Maraca de pescado	white, of the shore
53 Inerukana		round
UMARI		
54 Mañacureitapa	El más grande	black
55 Jiñalumare	De pescado	green
56 Pusulumare	de Tintín	yellow
57		red
INGA		
58 Pijloro	Guamo de fruta	longest
59 Jiña	De pescado	
60 Walá	De laurel de monte.	for parrots
AVOCADO Piriyé)		
61 Jeechú	De pepa mas grande.	
62 Inerukaná	De hoja pequeña.	
63 Jeechúmeru	De hoja mas pequeñita.	
64 Jema	De danta.	wild, is not cultivated
CHONTADURO PALM(Pipiri)		
65 Jeechú-pipiri	Jeechú	proper chontaduro
66 Kamuná-pipiri	Kamuná	
67 Jiñapiri	Pescado	yellow, small
PINEAPPLES (children of Jeechú)		
67		red
68		yellow
69		orange
PINEAPPLES WITHOUT STARCH		
70 Jarechinamawiro de diablos		
71 Makuemani	de makú	
72 Jeenúmawiro	amarilla	large
73 Kuañamawiro	de bambero	
74 Juupimawirone	de caloche	
ACTUAL PINEAPPLES		
75 Laarú	de guacamayo rojo	red leaves
76 Yawi	cabeza de tigre	large, round, yellow
77 Kayapí	de castaño	has pure juice, for straining

Name in yucuna	Common name	Characteristics
PINEAPPLE WITHOUT SEEDS		
78 Muraná	de pescado	forbidden to scrape
79 Tijwi		forbidden to scrape
COCA (Ipatú)		
80 Jeechú	de Jeechú	
81 Jeeriwaná	hermano de Kanumá	
82 Iyuwacaco	de carguero	round leaf
83 Mamú	de sábalo	large leaf
84 Pachica		round leaf
TOBACCO		
85 Jeechú		large leaf
86 Majnori		small leaf, thick
87 Parori		round leaf
88 tabaco de tigre		white tocacco to cure children
89 lukuri		to make snuff
CHILE PEPPER		
CHILES FOR CURING		
90 Kulaná	Ají dulce	cannot be consumed
91 Awitoóco	Ají amarillo	cannot be consumed
CHILES FOR CONSUMPTION		
92 Jeechú	Dedo de Jeechú	yellow
93 Kuphiracá	Ají de Inerukana	
94 Ichironji	Ojo de pescado	
CHILE TO SNUFF		
95 Karipulakena	de Karipulakena	
96 Jeechútupana	de hombre blanco	
GUAYA		
97 Guaya	Guaya de Jeechú	proper
98 Mura	Guaya silvestre	wild
99 Lupuguayaé	Guaua de danta	wild
CUYAS		
100 Acarú		large, for caguana
101 Kuwijro	de Jeechú con pico	for small funting preys
102 Acarú	redonda	for distributing guarapo
103 Ipatuke	totuma	to keep coca
104 Urero	totuma	for big game
105 Acayá	totuma	to offer hunting
MARACA		
106 Jeechú	de Keyaco	to put healing tar
107 Laarí	maraca de baile	
SEEDS OF THE MARACA		
108 Ijirila	pepa de guache	
109 Sasai	pepa de guache	

Name in yucuna	Common name	Characteristics
PAINT		
110 Kerapiri	bejuco de jabón	for the hair
111 Lana		for the hair
112 Kerajama	pintura de baile	corporal paint
MEDICINAL PLANTS		
113	Remedio de culebra	
114	Remedio de armadillo	
FIBRES		
115 Ma´awi	Fique	small like a pineapple
FISH POISON		
115	de bejuco	
116	de raíz	

ANNEX 2 CATCH COMPOSITION AND DISTRIBUTION OF FISH FOR THE ANDOKE COMMUNITY, MIDDLE CAQUETÁ RIVER, COLOMBIAN AMAZON (MAY 1997-APRIL 1998)

ANNEX 3 CATCH COMPOSITION IN NUMBER OF INDIVIDUALS PER HUNTED SPECIES DURING THE PERIOD SEPTEMBER 1997 – OCTOBER 1998 BY 30 HOUSEHOLDS OF THE ANDOKE COMMUNITY IN THE MIDDLE CAQUETÁ REGION OF THE COLOMBIAN AMAZON

Common name	Scientific name	Name in Andoque	Total
Mammals			
Puerco	*Tayassu pecari*	*i;x*	19
Cerrillo	*Pecari tajacu*	*sɵ'me*	42
Venado Pardo	*Mazama gouazoubira*	*Tóbeo*	4
Venado	*Mazama americana*		2
Tigre	*Panthera onca*		1
Tigre colorado	*Felis concolor*	*adúi;no*	1
Tigrillo	*Felis* sp.		3
Zorra	*Eira barbara*	*no;x;*	2
Bujeo	*Inia geoffrensis*		1
Gurre	*Dasypus* sp.	*Feíko*	6
Gurre 1	*Dasypus septemcinctus*	*ba'tufi*	3
Gurre 2	*Dasypus kappleri*	*ne'dɵ*	3
Oso hormiguero	*Myrmecophaga tridactyla*	*Heorɨkn*	2
Chucha	Didelphidae		1
Danta	*Tapirus terrestris*	*i;tɵ*	102
Chichico	*Saimiri* spp.		3
Churuco	*Lagothrix lagothricha*	*Soó*	8
Mico tanque	*Cebus albifrons*	*Kóyaiɵ*	1
Maicero	*Cebus apella*	*Mekú*	4
Mico	Primates	*Kóta*	1
Mico volador	*Pithecia* sp.	*pɵdɵ'dɵ*	2
Ardilla	*Sciurus* sp.		2
Borugo	*Agouti paca*	*ɵ'ɵ*	173
Guara	*Dasyprocta fuliginosa*	*Txx*	36
Tintin	*Myoprocta*spp.	*Siɵhó*	32
Puerco espín	*Coendou* spp.		1
Rata espinosa	Echimyidae		1
Ratón	Rodentia	*Posi*	5
Yulo	*Hydrochaeris hydrochaeris*	*Seyó*	2
Reptiles			
Babilla	Alligatorinae	*tu'mí;*	79
Charapa	*Podocnemis expansa*	*pa'dɨ*	57
Taricaya	*Podocnemis unifilis*	*Sieñekófi*	7
Morrocoy	*Geochelone* spp.	*Yóyafi*	19
Others			
Grillo	Ortoptera	*sxsx'*	1
Hormiga	Formicidae		1
Hormiga arriera	*Atta* sp.	*Edá*	5
Charapa eggs		*pa'dɨhadɨ*	1
Gallineta eggs			1
Tente eggs		*ku'fihadɨ*	1
Rana	Anura	*o'he*	8
Cangrejo	Braquiuro	*Sɵdɵ*	1
Sapo	Anura 1	*o'he*	1
Mojojoi	Coleoptera		16
Birds			
Ave	Bird 1	*Nɵdi*	1
Ave pequena	Bird 2	*bo'bo*	1

Chamon	Bird 3		1
Pico rojo	Bird 4	*P~~ɨ~~ókodo*	1
Pato	Anatidae	*Koma;da*	3
Common name	**Scientific name**	**Name in Andoque**	**Total**
Birds (cont'd)			
Pato real	Anatidae 1	*koi;gp~~ə~~ipok~~ɨ~~*	4
Chupaflor	Trochilidae		1
Garza	*Syrigma sibilatrix*	*Yofí*	5
Garzón	Ardeidae	*T~~ə~~xdak~~ɨ~~*	2
Pato agujo	Ardeidae 1		1
Paloma	Columbidae		5
Paloma 1	Columbidae 1	*Hap~~ə~~koda*	1
Paloma 2	Columbidae 2	*H~~ɨ~~hink~~ɨ~~*	4
Paloma de centro	Columbidae 3	*Pinafxi*	2
Torcasa	*Columba* spp.		2
Paujil coconuco	*Crax* spp. 1		5
Paujil camarana	*Crax daubentoni*		2
Pava blanca	*Penelope* sp.	*Soi*	3
Pava colorada	*Penelope* sp. 1	*K~~ɨ~~fx*	7
Guacharaca	*Penelope* sp. 2	*Fód~~ə~~he*	3
Pava	*Penelope purpurascens*		4
Paujil	Cracidae		5
Paujil colorado	Cracidae 1	*~~ə~~'paihayo*	1
Pava negra	Cracidae 2		1
Perdíz	Cracidae 3	*Pok~~ə~~do*	4
Azulejo	*Thraupis episcopus*		2
Cocinera	Icteridae	*~~ə~~'í*	2
Mochilero	Icteridae 1	*kx;ti*	1
Golondrina	Hirundinidae	*Kokofi*	1
Carpintero	Picidae		2
Picón	*Ramphastidae*	*se'h~~ə~~*	4
Guacamaya	*Ara* sp.	*a'du*	3
Loro	Psittacidae		5
Gallineta	*Tinamus* spp.	*Payo~~ə~~*	3
Panguana 1	*Crypturellus* sp. 1	*Yoyako~~ɨ~~*	7
Panguana	*Crypturellus* sp.		7
Panguana 2	*Crypturellus* sp. 2	*Foí*	1

Source: Project Indigenous Management of the Tropical Forest, Tropenbos-Colombia programme (Sarmiento, 1998; De la Hoz, 1998)

NON-TIMBER FOREST PLANT RESOURCE ASSESSMENT IN NW AMAZONIA[1]

Joost F. Duivenvoorden[2], Hendrik Balslev[3], Jaime Cavalier[3], Cesar Grández[3], Hanna Toumisto[3] and Renato Valencia[3]

1. INTRODUCTION

Natural forest management through the exploitation of non-timber forest products (NTFPs)[4] has potential advantages over other types of land use in the humid tropics. It may prevent deforestation and biotic impoverishment, and stimulate autonomous developments by local forest-dwelling communities (de Beer and McDermott, 1989; Allegretti, 1995; Anderson, 1990; Falconer, 1990; Nepstad, 1992; Nepstad *et al.,* 1992). However, uncontrolled extraction may cause species extinction and forest degradation (Browder, 1992; Hall and Bawa, 1993; Phillips, 1993). The lowland rainforests of NW Amazonia, which are among the world's most tree species-rich forest ecosystems (Gentry, 1988; Valencia *et al.*, 1994; Duivenvoorden, 1994, 1995; see Fig. 1), offer a tremendous potential supply of NTFPs (Prance, 1994). Yet knowledge of the current socio-economic context of commercial NTFP exploitation in NW Amazonia is inadequate for development initiatives at the local or regional level (Padoch, 1992). Market surveys offer quick and efficient insight into patterns of NTFP commercialisation. Initial studies from a few areas (the Iquitos area in Peru; Padoch, 1988b, 1992; Padoch and de Jong, 1990; and parts of Amazonian Ecuador (Pedersen, 1993; Krogstrup, 1994) indicate that there may be a large local and regional variation in NTFP trade. Information from Colombian Amazonia on commercial NTFP extraction is virtually non-existent. For example, only one forest species (*Leopoldinia piasaba*) is shown on a recent land use map of Colombian Amazonia (Andrade and Etter, 1992) as a non-timber resource. The first component of the present project aims at obtaining a more complete picture of the regional patterns of NTFP commercialisation in NW Amazonia.

Different rainforest types offer different arrays of NTFPs (Grenand, 1992; Phillips *et al.*, 1994). Recent studies in Peruvian and Colombian Amazonia (Duivenvoorden and Lips, 1993, 1995, 1998; Duivenvoorden, 1996; Tuomisto *et al*, 1995) have shown that NW Amazonia is covered by a complex mosaic of floristically different forest communities. Many tribal and non-tribal inhabitants and developmental organisations working at local community or regional levels

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[3] The co-authors are listed in alphabetic order and are the national coordinators of the project. See website http//www.frw.uva.nl/icg/NTFP/flyereng.html for their addresses.

[4] In the context of this project, which focuses on vegetable non-timber forest products, NTFPs are defined as all plant materials, which may be extracted from the natural forest for sustainable human use, without being managed on an industrial scale or for interests well outside the forest areas (based on de Beer and McDermott, 1989). Thus, fuel wood, building poles and small wood products for handicraft and tools are included in most cases, but timber used for large-scale rural house construction activities is excluded.

need information about the quantity, quality, and value of the natural resources in communal reserves, in order to develop commercial NTFP extraction, control over-extraction, and promote better resource management. An example are the "ribereños" in the Iquitos area; Pinedo-Vásquez *et al.*, 1992). Maps showing spatial distributions of forest types with useful plant species are indispensable tools for these purposes (Nepstad, 1992), but are scarce (Kahn, 1988; Peters and Hammond, 1990), outdated and unreliable, or only available as yet for restricted areas (Duivenvoorden and Lips, 1993). Initial potential use assessments of exploited NW Amazonian rainforests concentrated on thick trees and liana species (Boom, 1987; Pinedo-Vásquez *et al.*, 1990; Paz and Miño *et al.*, 1991; Sanchez and Miraña, 1991; Prance *et al.*, 1987; Phillips and Gentry, 1993a, 1993b). Thick trees and lianas, however, comprise only about 10-25% of the total plant species in tropical lowland rainforests (Duivenvoorden, 1994). Many economic valuable NTFPs may be expected to be found among small trees, shrubs, herbs, climbers and epiphytes in the mature forests.

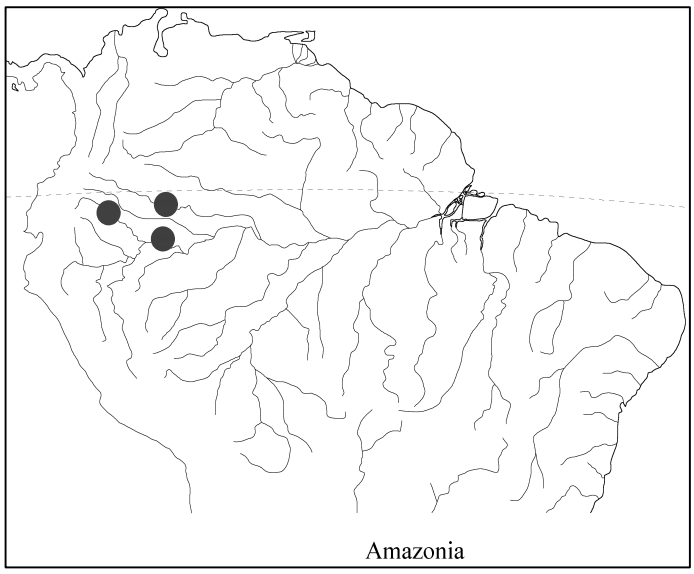


Figure 1 Location of NW Amazonian sites with well-established records of a high forest diversity. The pilot areas of the project (see detailed maps in Fig. 2-4) are located at these same sites

The present study will contribute to the assessment of the economic feasibility of extraction of NTFPs in NW Amazonian rainforests, in order to contribute to their conservation, and to apply and improve forest survey methods as a tool for developing and optimising sustainable non-timber use of the forest land. Measurable, specific objectives include (1) a market survey of non-timber forest plant products in NW Amazonia[5] and (2) a comparative assessment of non-timber forest plant resource availability in different forest types in three pilot areas in NW Amazonia.

[5] Defined as the lowland areas (below 600 m) of Amazonian Ecuador, of Amazonian Peru north of the 4°S latitude, and Colombian Amazonia (i.e. the area south of the Guaviare and Guayabero rivers).

Six universities are carrying out the project; three from Latin America[6] and three from Europe.[7] By January 1999 (the time of writing this article), the project has just entered the final year of its three-year funding period.

2. KEY ISSUES

2.1 Two approaches

The project addresses the issue of NTFP resource availability from two interrelated approaches. The first approach is from the angle of ethno-botany and forest ecology and is directed at obtaining improved quantitative estimates of the potential supply of vegetable NTFPs from pilot areas - one in each of the three participating tropical countries - applying complementary forest sampling procedures (plots and transects). The second approach is from the angle of socio-economics and economic botany, using research into the commercial demand, trade patterns, and market value of NTFPs. This project line encompasses a market survey, concentrating on the situation in Colombia.

Together, these two approaches will provide an insight into the interrelationship between the potential supply and NTFP commercialisation in NW Amazonia, which can be used for local, regional, or national development initiatives. The integration of socio-economic and ecological research into one project is often recommended as beneficial to the overall result (e.g. by Nepstad and Schwartzman, 1992; Anderson, 1990; Poore, 1989; Posey and Balée, 1989; de Beer and McDermott, 1989; Schreckenberg and Hadley, 1989).

2.2 Research questions

Research questions of relevance to the assessments of potential NTFP resource availability in different forests are:
- How do forest types differ in their potential NTFP resource availability?
- How should these differences be evaluated in view of different appraisal methods of NTFP availability?

Research questions of relevance to the market survey are:
- What are the regional patterns of current commercialisation of NTFPs in NW Amazonia?
- What are the potential explanations for these patterns, and what are the options for local and regional development of NTFP extraction in the light of the current market situations?

3. GENERAL METHODOLOGY

The project is being carried out in four work packages (3.1-3.4), each subdivided in one or more tasks. The four work packages and the methods applied are summarised in the sections below.

[6] Universidad de los Andes (Depto de Ciencias Biológicas) with Tropenbos-Colombia, P. Universidad Católica of Ecuador (Herbario QCA), and Universidad Nacional de la Amazonia Peruana (Facultad de Biología).

[7] University of Amsterdam (Hugo de Vries Laboratory), University of Aarhus (Department of Systematic Botany) and University of Turku (Amazon Project).

3.1 Initial seminar

In the initial stage of the project, a three-day seminar was organised in Quito, Ecuador, in which participating scientists and representatives of participating institutes took part. The objectives and organisational structure of the project were presented and the research questions and recent advances in all associated topics were discussed. Uniform sampling and analytical methods were explained, as well as the choice of selected useful species to be quantified along transects, data handling and database management. Finally, issues of intellectual property and ethical considerations, authorship and credits to contributions were discussed and times schemes, milestones, deliverables and final targets were indicated.

3.2 Market survey

The project includes a market survey to be carried out in Colombia. This survey is based on market visits to two major Amazonian cities in Colombia (Leticia, Florencia), focusing on places where plant commodities extracted from natural forests[8] are being sold or exchanged. The market analysis has a qualitative character, following Padoch (1988ab; 1992). It comprises such parameters as product differentiation and categorisation, prices, quantity and quality. The origin (i.e. from extraction in natural forests), provenance and distribution of products to local, regional (inter-Amazonian), national (Andean) and international markets, market organisation, selling for cash or barter, types of vendors and intermediaries (chains of retailers, middlemen, wholesalers, and gatherers) were also the subject of study.

3.3 Assessment of potential NTFP resource availability

Field sampling concentrated on one pilot area in each of the three participating Amazonian countries (in Colombia the middle Caquetá area east of Araracuara, in Ecuador the area of the Yasuni National Park and Waorani Reserve; and in Peru the area of the Río Ampiyacu and Río Yaguas Yacu in the lower Río Napo basin; see Figures 2-4). The size of the study area varied between 1,000-2,000 km^2 in order to ensure a substantial amount of variation in forest, soil, geomorphology, and geology.

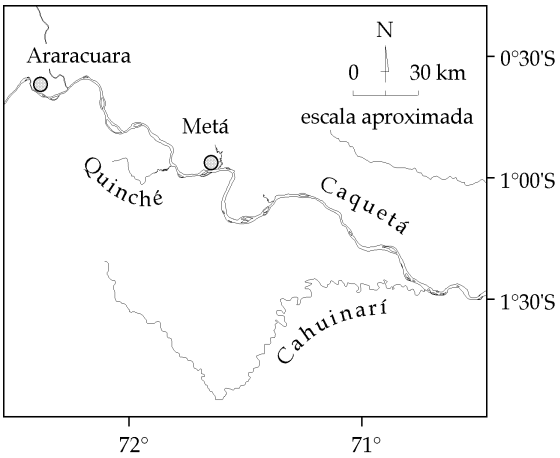


Figure 2 Location of pilot area in Colombia

[8] A distinction between commodities originating from mature forests (see next footnote) or secondary forests is not feasible at this stage, but is appended afterwards whenever possible. The survey is restricted to products from vascular plants.

Tropenbos-Colombia and Landsat imagery) were interpreted according to procedures of the Zonneveld, 1989) in order to facilitate fieldwork planning. During initial reconnaissance visits to the pilot areas, local indigenous communities were given a full

expected results, after which written agreements with collaborating communities were set up. With the help of 1:100,000 preliminary interpretation maps, prepared from aerial photographs Landsat imagery, land units were identified which allowed for the definition of sampling locations in mature forests using a stratified random procedure (

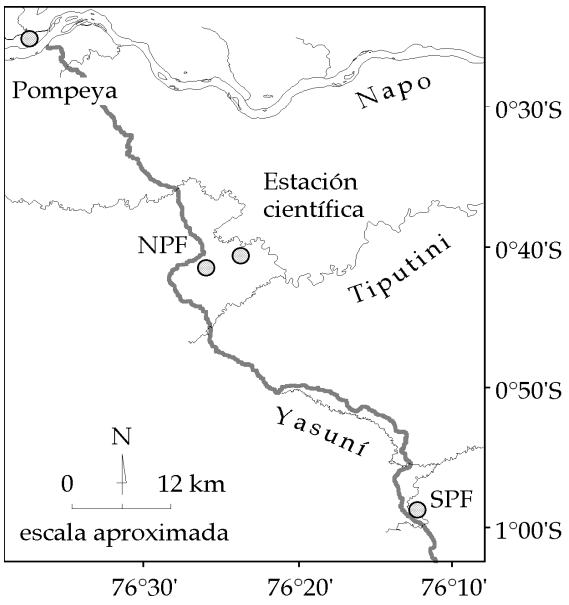
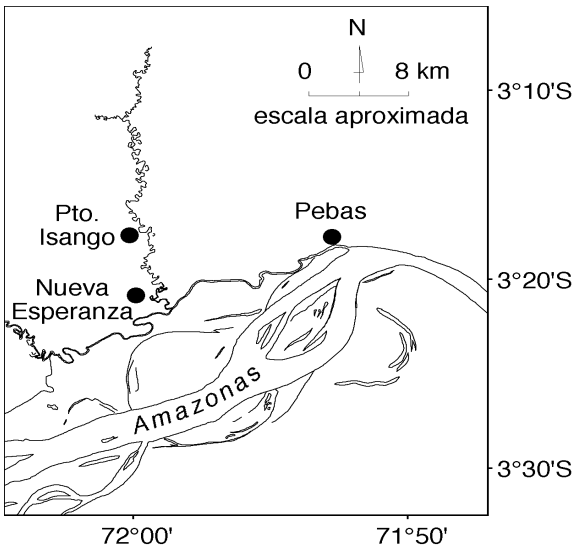


Figure 3 Location of pilot area in Ecuador



Location of pilot area in Peru

Fieldwork started with the precise location and georeferencing of all plots in each pilot area. Transects were located, taking into account plot locations. Plots and transects were located in mature forests[9] according to a stratified random procedure with the aid of the preliminary vegetation maps, i.e. plots and transects were evenly distributed over land units and located randomly in each of these units. Plot sampling, however, was restricted to three broad units: well-drained upland forests, well-drained flood plain forest, and swamp forests dominated by *Mauritia flexuosa* (see Table 1).

Table 1 Overview of plots in different forest categories and number of plot vouchers and transects

	Colombia	**Ecuador**	**Peru**
Total plots (0.1 ha)			
Forest category			
Well-drained floodplain	5	7	9
Well-drained upland	15	10	6
Swamps	10	8	10
Total vouchers in plots	4300	4066	9044
Total transects	19	24	18

Plot sampling is largely based on methods described in Duivenvoorden and Lips (1993), Duivenvoorden (1995, 1996) and Sánchez and Miraña (1991). Vegetation composition and potential use were recorded in plots of 0.1 ha (subdivided into subplots of 10x10 m). In all the plots, ethnobotanic information was obtained from experienced community informants. Emphasis was given to the application and not to processing techniques. Use values will be calculated according to Phillips and Gentry (1993a) and Prance *et al.* (1987). To define forest and site conditions, plot records further included data from physiography, parent material, soil fertility (as reflected by total soil concentrations of Ca, Mg, K, Na, P, N, C), forest canopy height (estimated), and floristic composition of trees and lianas applying a diameter limit at breast height (dbh) of <2.5 cm. The maximum diameter of each species at breast height (1.30 m, or zero height in case of shrubs, small trees, and herbs) were recorded in three classes: <2.5 cm, 2.5-5, and 5-10 cm. The dbh of trees and lianas with a dbh>10 cm was also measured.

Transect data collection and analyses are being carried out largely according to the methods and procedures described in Tuomisto (1994). The purpose of the transect sampling is to provide an ecological characterisation of the sites by indicator species and to obtain quantitative estimates of the abundance and phenological status of selected useful palm species. In each pilot area transects of various lengths have been sampled, each up to 10 m wide. Along these transects, the presence and abundance of useful species, as well as indicator species pertaining to ferns and Melastomataceae, were recorded.

The use values of different forest types and the necessary site characterisations (the latter according to Duivenvoorden and Lips, 1993 and 1995) will be elaborated. Informant-derived use values (Phillips and Gentry (1993a) will be applied, because they reflect the potential usefulness of each species to the informants objectively. In contrast to Phillips and Gentry (1993ab) and Phillips *et al.* (1994) plant taxa will be analysed on the basis of their official

[9] Defined as those forest stands (i.e. built up of trees with aerial crown cover >10%) which are not in a human-induced successional phase (due to clear-felling or dispersed logging) or a young riverine successional stage (i.e. forests dominated by *Cecropia membranacea*, *Pseudobombax munguba*, etc.). Very old secondary forests or stands with natural gap-successional patches may be included.

botanical name, or as morphospecies[10]. Various options (use categories treated separately or combined, community- biased versus generally available information from literature, etc.) will be considered. Proportional use values (Prance *et al.*, 1987) will also be elaborated.

Every participant is responsible for the adequate identification of his/hers own collection. Over 90% of the vouchers collected were sterile. Unidentified species are being codified to allow for data processing and analysis. Researchers from participating Amazon countries have been given facilities to identify sterile and fertile plants in St. Louis, New York and Aarhus, after initial identification in their national herbaria. The overall between-site comparisons of species and morphospecies is being carried out with the help of the reference collection at the herbarium of the University of Aarhus (AAU).

To smoothen data exchange, all partners use a uniform database programme (called NOTIM) which has been developed for both PC computer hardware and the Apple Macintosh.

Preliminary maps will be adjusted to field observations. Final maps will be at the scale of 1:100,000 and contain geology and land form (geomorphology) as main diagnostic legend entries. Map legends will be standardised on the basis of comparative between-site analyses of plot and transect data, and will include qualitative and quantitative descriptive information about soils, vegetation, and potential NTFP use in the mapping units. The map legend and compacted (black and white) map imagery will be incorporated in the final book.

3.4 The final book

The final reports of all the researchers will be edited by the coordinator as chapters of a book about NTFPs as a forest resource in NW Amazonia, and this will be the principal scientific output of the project. The book will deal with the socio-economic and socio-cultural background to NTFP extraction in NW Amazonia, as well as with the results of the comparative assessments of potential NTFP usefulness. The book will be written in Spanish.

After preparation of the camera-ready manuscript, it will be printed (soft-cover, low-budget paperback edition) and distributed to all the partners, including the collaborating local communities.

4. PRELIMINARY RESULTS

4.1 Results to date

The first preliminary scientific results are not expected before spring 1999. Table 2 presents an overview of the results obtained by January 1999. Additional information on selected results follows.

[10] Morphospecies are species which have codes, but no names.

Table 2 Overview of results to date (project status at January 1999)

Milestones and deliverables	Results or products	Responsible partner	Stage reached
Preliminary maps distributed among project [2]	drawn and	UvA and Turku	completed
2. submitted for to local all pilot inspected[3]	communities	Uva PUCE, UNAP,	completed
3. organised in Quito	Seminar	UvA and PUCE	completed
Workplan for survey completed, questionnaires set [4]	Work plan and	UniAndes with student	completed
5. transects located and sampling methods all pilot [2]	Maps and and transects, field carried out	UvA (when possible) PUCE, UNAP,	completed
6. completed in all areas	Transect data	Turku with from PUCE, UniAndes	completed
Field work survey completed	Market survey data	UniAndes with student	completed
8. adequately shown and to all project	Database functioning		completed
9. completed	Plot available	PUCE, UniAndes	completed
Data analysis reported:	Separate reports about:		
• 10a.	transect study	Turku with students from PUCE, UNAP, UniAndes	in progress
• 10b.	market survey	UniAndes	
• 10d.	plot survey	PUCE, UNAP, UniAndes, Uva	
• 10e.	maps compiled	UvA and Turku	
11. Reports transformed into chapters of final book	Chapters about:		
• 11a.	transect study	Turku	
• 11b.	market survey	UniAndes	
• 11d.	plot survey	PUCE, UNAP, UniAndes, UvA	
• 11e.	maps compiled	UvA and Turku	
12. Floristic field data entered in database, plants specimens partially identified in national herbaria and shipped to Aarhus, St. Louis and New York.[5]	Database completed, floristic collections labelled, identified (in national herbaria) and shipped	PUCE, UNAP and UniAndes	in progress
13. Plant specimens identified at herbaria of Aarhus, St. Louis and New York, or elsewhere by collaborating specialists.	Identification of reference collection at AAU finalised, database filled, and sites compared	PUCE, UNAP and UniAndes with Uva at AAU	in progress
14. Final book edited and remaining parts written and formatted	Camera-ready manuscript of final book	UvA	
15. Final book printed and distributed among project participants	Book printed and distributed	UvA	

[1] UvA = University of Amsterdam; AAU = University of Aarhus; Turku = University of Turku; PUCE = P. Universidad Católica de Ecuador; UNAP = Universidad Nacional de la Amazonia Peruana; UNIANDES = Universidad de los Andes.

[2] Detailed maps of pilot areas are given in Figs. 2-4. Table 1 presents a tabular overview of plot and transect distribution in different forest categories, with the total numbers of collected botanical vouchers.

[3] Written agreements were made between the local indigenous communities and the Latin American universities at all research sites, which allow for data collection in collaboration with the communities within the framework of the project. In Colombia the project works with the Miraña community along the Caquetá River; in Peru with Okaina communities of the Ampiyacu and Yaguasyacu river basins near Pebas, with additional input from Huitoto and Bora communities in that area; and in Ecuador with several Huaorani communities in the Yasuní area.

[4] In the past 6 months the market surveys in Leticia and Florencia (the two most important cities in Colombian Amazonia) were finished. They included data on the identification and categorisation of NTFPs, monthly and yearly variation of NTFP production, market structure and organisation (chains of retailers, transport costs, forms of selling and payments, yearly incomes, and profitability), comparisons with cattle ranching and fishery, and literature revision. The responsible scientists are currently preparing a draft manuscript.

[5] Floristic field data entry is now being finalised. Plant collections have been identified as far as possible in the national herbaria as well as herbaria in the USA (herbaria of the Missouri Botanical Garden and the New York Botanical Garden) and Europe (Herbarium of the University of Aarhus).

5. DISCUSSION

5.1 Forest diversity controlling NTFP supply

In sharp contract to timber resources, NTFP resources show a much wider field of potential applications, either for subsistence or commercial purposes. Any strategy aiming to develop NTFP extraction in humid lowland tropical systems should consider the diversity in potential supply from highly diverse rainforests. Some forests (e.g. the oligo-dominant *Mauritia* swamp forests in NW Amazonia) may yield a high production of certain valuable resources (Peters and Hammond, 1990) but be of limited extent. Well-drained upland (*tierra firme*) forests are more widespread and may potentially yield a much wider gamma of NTFP resources, but probably in much lower and more variable quantities (Prance *et al*., 1987; Phillips *et al*., 1994). Use values to estimate the potential NTFP resource supply of forest types make sense for planning purposes only if we know how to recognise and map different forest types. The development of NTFP extraction therefore requires an understanding of the mechanisms responsible for the occurrence and change of spatial patterns of plants in forests and forest types within NW Amazonia as a whole.

Because current information about Amazonian forest diversity and NTFP extraction is based on a limited number of case studies, there is a tendency for research output to be highly generalised. The new estimates of forest resource availability as a function of forest type differentiation to be obtained from the present project will allow us to test whether forests differ in composition and whether the potential usefulness of NTFPs is independent of forest type. If such hypotheses are rejected, programmes of development of NTFP extraction should take account of the nature and spatial distribution of different rainforests at different scales.

The three NW Amazonian lowland areas that form the subject of the present project presumably form a geographical and ecological entity. They are characterised by humid climatic conditions, comparable complex geological and geomorphological structures, a still dominant cover of extremely species-rich virgin rainforests, and by a poor infrastructure, poor living standards and skewed settlement patterns of the Indian, Mestizo and colonist populations. It was recognised that information from one country may greatly contribute to the understanding of otherwise poorly known properties in the other countries. Examples of such information are certain

adaptations of local communities to specific market situations, specific kinds of economic use of NTFPs, and also of comparable patterns of geology, plant distribution and vegetation types.

In view of these common NW Amazonian properties, it might be expected that the Amazon lowland of the three countries involved (Ecuador, Colombia, Peru) would show similar patterns and parameters of current NTFP commercialisation. If this assumption is found to be false, it would imply that further development initiatives of commercial NTFP extraction in NW Amazonia should carefully consider the local and regional particularities of NTFP extraction. Acceptance would permit the extrapolation of conclusions from the market survey from one area to other areas within NW Amazonia.

By combining the information from the NTFP market survey and forest resource appraisals, we obtain a qualitative insight into how the potential supply of NTFPs in the various pilot areas affects and controls the patterns of NTFP commercialisation. From this insight, it might be possible to formulate more refined recommendations about the development of NTFP extraction than on the basis of a market survey alone. Research questions of this kind are associated with the general hypothesis that the current degree of commercial extraction is somehow controlled by, or even in balance, with potential supply of NTFPs.

5.2 Benefits of the multi-scale approach

The region of NW Amazonia is distinct from all other Amazonian lowland areas thanks to at least two phenomena. Firstly, it is covered by forests with extremely high biodiversity levels, as exemplified by the world's highest levels of tree species richness. Secondly, it has a substantial population of indigenous tribes, many of whom still follow a traditional way of life and have a profound knowledge of the use of forest products. In addition, NW Amazonia is still largely covered by virgin forests. Degraded systems are found only at the margin of the basin near the Andes and around large inter-Amazonian cities (e.g. Iquitos), usually where substantial populations of settlers (including mestizos) are found. In view of these overall regional properties, development of sustainable natural forest use by NTFP extraction is one of the more promising alternative forest land-use options. It may either provide income for the forest-dwelling indigenous people, or present less destructive forms of forest land use to settlers with other cultural backgrounds. In fact, NW Amazonia has a long tradition of commercial NTFP extraction (e.g. Padoch, 1988b; Domínguez and Gómez, 1990). Production, however, was usually not on a sustained basis, focused on a few products only, and net local revenues were very low. The current project may contribute to understanding how these revenues may increase.

Because it operates at various scales, the project may benefit different actors simultaneously. On a regional and national planning and decision-making scale, it will lead to an increased consciousness of the importance of non-timber products for local communities. The project will stimulate regional and national planning and development institutions to consider the extraction and use of NTFPs as a viable alternative to Amazonian resource management and protection. At national levels the project seeks compatibility with and complementation to existing territorial planning programmes of national and regional institutions. The maps will provide essential information for the development and application of geographical information systems in this context. The project aims at being consistent with the complex social and economic problems of NW Amazonia, and with current strategies to resolve them (see e.g. Andrade *et al*., 1992).

At local community scale, the project will have several benefits as well. The project will yield estimates of the potential use value of forest types in the area. It will also yield quantitative estimates of the abundance of selected useful species. The market survey will allow this

information to be placed in a local and regional perspective in assessing commercial extraction potentials. Communities may take advantage of the field activities to train their youth about forest uses. In addition, community members obtain a cash income (paid for by national currencies) in exchange for their services. It is outside the scope of the project (this was put forward explicitly when the project was presented to the local communities) to expect direct and immediate improvement of living conditions as a result of the scientific information gathered. Instead, the project seeks to present the results in such a way that they can be picked up and used by the communities or all those interested in concrete extension activities or more detailed research in the field of sustainable NTFP extraction.

Last but not least, scientists from the participating Latin American countries will have the opportunity to improve their field knowledge in NW Amazonia and most will travel abroad to widen their views. The project can therefore be seen as an important investment in building scientific capacity. A well-trained Latin American community of Amazonian scientists is a much needed prerequisite for any progress in the development of the use and extraction of Amazon NTFP resources.

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AMAZON NUTS, FORESTS AND SUSTAINABILITY IN BOLIVIA AND BRAZIL

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1. INTRODUCTION

When the Rainforest Crunch and similar Amazon nut-based products were launched on the North American market in the late 1980s, the inventors of 'caring capitalism' argued that the market could be used to save the rainforest and that this would be 'a moral reason to munch' (New York Times, April 30, 1990:D12). Cardboard boxes in which the nuts are shipped to consumers in the USA and Europe bear the message 'Buy Brazil Nuts, Help to Save the Rainforest.'

These are crude translations of the idea that the commercial extraction of NTFPs can be an important component in strategies for rainforest conservation. Making the forest economically productive, the argument goes, will discourage deforestation. For northern Bolivia, one of the areas where I carried out my research, it has been argued that 'independent of its organisation and the distribution of benefits, (the Brazil nut economy) will be particularly favourable to conservation of the area' (DHV, 1993:10). In other words, it is contended that, given the profitability of the product and the symbiotic relation of the Brazil or Amazon nut tree (*Bertholletia excelsa*) with its forest environment, this environment will be conserved in order to guarantee a continued supply of Amazon nuts.

Between 1994 and 1996, I carried out research (Assies, 1997a) in northern Bolivia and in the contiguous Brazilian state of Acre, the cradle of the well-known rubber tappers' movement inspired by Chico Mendes. The objective was to research the socio-economic and political aspects of Amazon nut exploitation in order to assess its potential contribution to rainforest conservation and the improvement of the living conditions of the rural population. Research in both Bolivia and Brazil where, in response to the actions of the rubber tappers and their transnational supporters, extractive reserves were being implemented, introduced a comparative component. This is of particular interest, since Amazon nuts are an export product and the two areas compete on the world market. Brazil used to be the main supplier of Amazon nuts and the extractive reserve strategy was premised on the economic viability of Amazon nut production. In recent years, however, Brazil has been superseded by Bolivian producers as part of a strategy of non-traditional export promotion aimed at boosting the Bolivian balance of

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payments.

My research sheds serious doubts on the idea that, under present conditions, commercial extraction of NTFP will contribute to rainforest conservation and sustainable development. Sustainability is held to combine ecological sustainability, economic feasibility, and social and political acceptability (Barbier, 1987; Ros-Tonen, Dijkman and Lammerts van Bueren, 1995). In drawing attention to the economic and social dimensions of sustainability, this approach constitutes an important advance over a narrow focus on the ecological aspect. It fails, however, to appreciate the dynamics of the economic system.

Within the framework of the prevailing economic system, the commercial viability of a product basically translates as profitability, which means that economic feasibility is conditioned by the systemic requirements of competitiveness. The ensuing dynamics, I shall argue, may lead to the marginalisation of forest-dwelling, small producers of NTFPs. In northern Bolivia, this results in agriculture, which implies deforestation, increasing its importance in the livelihood strategies of those who remain in the forest, whereas those who migrate to urban areas come to constitute a labour pool for the exploitation of whatever forest product that can be profitably exploited, without consideration for ecological sustainability.

2. A 'TRADITION' OF EXTRACTIVISM

To begin with, my research led me to examine the reputation of sustainability of Amazon nut production. After all, in the promotion of Amazon nut consumption, the creed that they are produced by small producers who have a long tradition of familiarity with the forest plays a key role. Scrutiny of this tradition of extraction reveals the connections between Amazon nut production, rubber tapping and agriculture and demonstrates that the present-day small producers of Amazon nuts are the product of a crisis of the 'traditional' extractive economy.

The rubber boom of the late 19th century was central to the emergence of the extractive economy in the region. In response to demand from the emerging industrial metropolises rubber tapping spread throughout the Amazon region. Large numbers of people, principally male labourers, were recruited and shipped to the Amazon region[3]. At a local level, production was organised in *barracas*; rubber estates which relied on a system of debt-peonage. As rubber production was highly profitable and in order to reinforce dependence on the local *patron*, agricultural activities by rubber tappers were discouraged, if not simply repressed. Food products, ranging from rice, beans and canned meat to luxuries, such as chocolate and champagne, were imported and distributed by the *patrons* who kept track of the accounts. Since food products came from elsewhere, deforestation was minimal at the local level.

Things changed when the rubber boom collapsed after 1913 due to Asian competition. Although the *barraca* system survived the crisis, it was substantially reorganised. Besides rubber, Amazon nuts emerged as a new product and local agricultural production increased substantially, as the capacity for importing food products declined. Another feature of the new configuration was that *patrons* now allowed the rubber tappers to establish families. Initially, the rubber estate had been an essentially male universe, but now women would be incorporated into a system encompassing rubber tapping, agriculture and Amazon nut gathering. They might actually be imported by the *patron* just like any other

[3] In 1903 the new export economy prompted the conflict between Bolivia and Brazil by which the latter country annexed a substantial part of Bolivian territory, the present state of Acre.

item desired by their dependants, provided they kept paying off their debts in produce (da Costa, 1989: 65; Woortman, 1996: 16). Amazon nut production and food production could be functional alternatives (Woortman, 1996). Thus food production was controlled in some cases by the *patron*, who then exchanged the product for rubber and nuts. Nut gathering would be a family activity. In other cases, food production by the newly constituted rubber tappers' families was allowed, with women being mainly responsible. Whether controlled by the *patron* or in the context of *patron*-supervised household production, agriculture became an important element in the annual production cycle. Although this implied deforestation, such deforestation was dispersed, as it was associated with the geographical distribution of the *barracas*.

After a brief revival during the Second World War (Martinello, 1988) the decline of the rubber economy resumed its course. It was accompanied by a breakdown of the *barraca* system and a further shift in favour of household production. As an increasing number of *patrons* withdrew and switched towards more profitable, often urban-based, activities, rubber tapper households were left behind to fend for themselves. The times of the 'big patrons' were definitely over (Aramburu, 1994).

The 'autonomous rubber tapper' in Brazil and the Bolivian *comunidades libres* were outcomes of this involution process of the traditional extractive economy. They are products of the crisis of the estate system[4]. And it is only in these cases that rubber tapping, Amazon nut gathering and agriculture constitute an agro-extractive cycle (Assies, 1997a: 8) articulated at the household level which might enable people to make a living in the forest throughout the year.

Rubber tapping was the cornerstone of this forest-based household livelihood, but this cornerstone soon fell away. Rubber production in both Brazil and Bolivia was kept from total collapse until the 1980s by a price support scheme implemented by the Brazilian government in the wake of the Second World War. The arrangement was dismantled during the 1980s in the context of a revision of the relations between the Brazilian federal government and local oligarchies, neo-liberal policies, and the emergence of rubber plantations outside the Amazon region in the state of São Paulo. As the price of natural rubber fell from US$ 1.80 per kg in the 1980s to less than US$ 0.80 in the 1990s, production in the Amazon region collapsed (Assies, 1997a: 30-35).

The consequences were significant, both in terms of demographic dynamics and in terms of the impact on the agro-extractive cycle. As the rubber trade dwindled, the trade networks it had supported shrivelled. Travelling the rivers to trade rubber for basic necessities with rubber tappers dispersed in the forest now lost its rationale. This, in turn, prompted people to move to more accessible areas. At the same time, the tendency toward subsistence food production intensified. Population and agriculture, and the attendant deforestation, therefore tend to concentrate in the more accessible areas, mainly around the urban centres and newly established road links.

3. EXPORT-ORIENTED EXTRACTIVISM AND FOREST CONSERVATION

Rubber and Amazon nuts are the products that were to underpin the extractive reserves proposed by the rubber tappers' movement. In the region, both rubber and Amazon nuts depend on a symbiotic relation with the surrounding forest and risks of over-harvesting are low. As such, extraction of these

[4] This point should be underlined, since the representation of the rubber tapper promoted by certain intellectual and ecologist circles is often tainted with idealism and romanticism. A 'mythical rubber tapper' has been constructed. Such imagery may be a source of misinterpretation of social dynamics and the aspirations of 'forest peoples' themselves (Aubertin and Pinton, 1996; Assies, 1996; Geffray, 1995:175; Léna, 1992).

products is ecologically sustainable. Whether commercial extraction contributes to forest conservation, however, is another matter. As we have seen, rubber ceased to be much of an option when price support was withdrawn and plantation production expanded in Brazil. Amazon nuts were the other product expected to underpin the extractive reserves. The problem is that the product met with strong competition from Bolivian producers.

Until the mid 1980s, nearly all the nuts produced in Bolivia had been exported in-shell to Brazil. By the mid 1980s, however, Bolivia was 'discovered' as a source of Amazon nuts by US and British importers who purchased nuts at a price about 30% to 40% below Brazilian export prices. Further expansion was facilitated by the World Bank-funded *Fundación Bolivia Exporta*, which aimed to promote non-traditional agro-industrial exports in order to strengthen the Bolivian balance of payments (DHV, 1993:2). While only one processing plant existed in northern Bolivia in the mid 1980s, ten years later, the number had grown to about 22 and virtually all Bolivian exports now consist of shelled nuts. The total export value rose from around US$ 2.5 million in the early 1980s to US$ 30 million in 1997. Their commercial success was related to a form of organisation of the local extractive economy that raises some serious questions about its final contribution to forest conservation and sustainable development of the region.

The Amazon nut economy of present-day northern Bolivia was built on the ruins of the rubber economy. The collapse of the estate system prompted a process of relocation of the population through rural-rural and rural-urban migration (Assies, 1997a: 45). As rubber estates declined, *comunidades libres* emerged, a development that went hand-in-hand with a migratory process which profoundly modified the geography of rural settlement (Figures 1a and 1b).

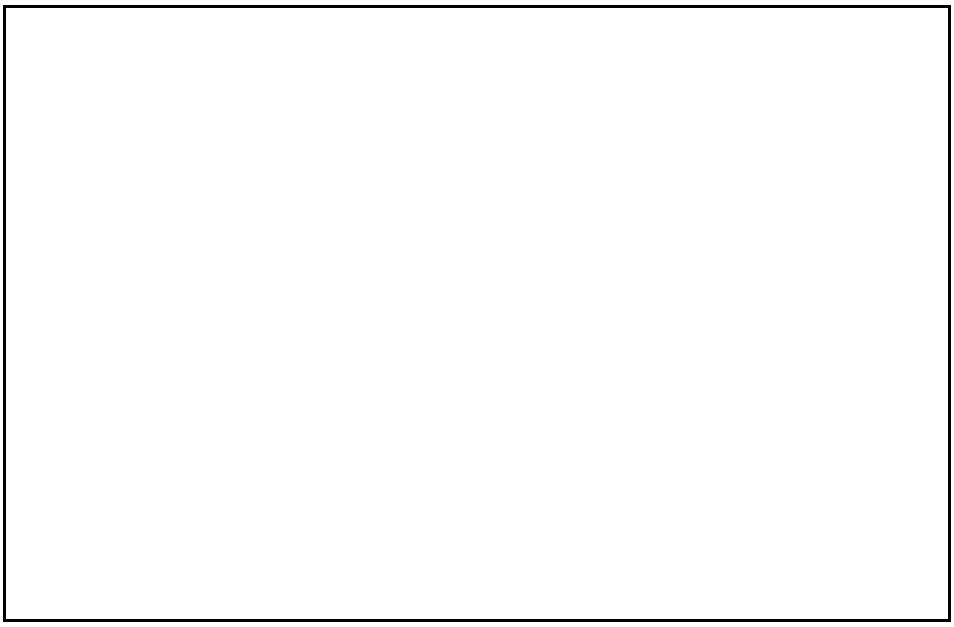

Figure 1a Settlement pattern under *barraca*-system (after Pacheco, 1992)

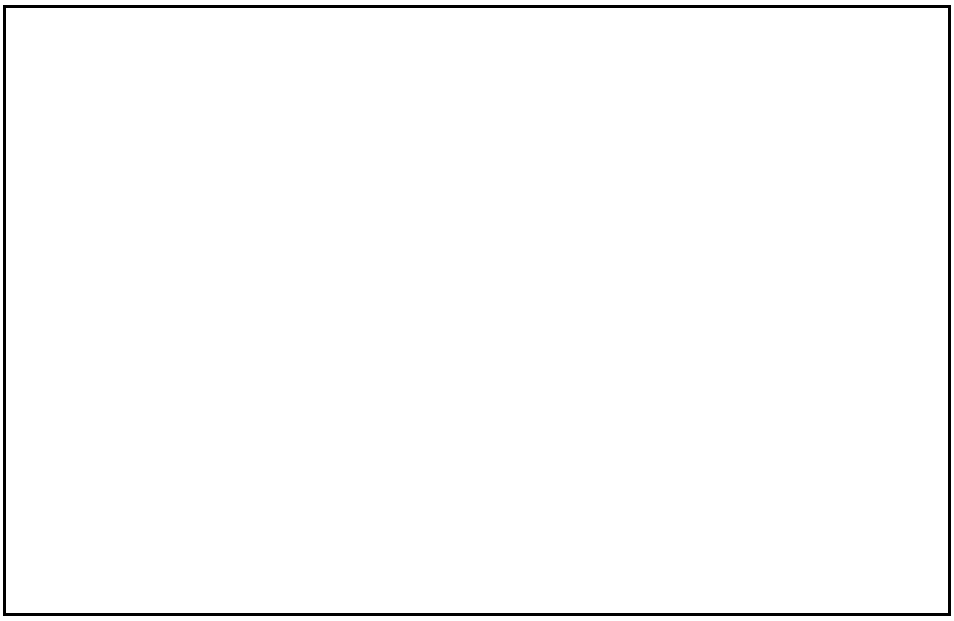

Figure1b Settlement pattern under the *comunidades libres* (after Pacheco, 1992)

At the same time, many people moved to urban areas. The town of Riberalta was the most important pole of attraction with annual population growth rates estimated between 4% and 9% over the past few years (Beijnum, 1996:13; Verheule, 1998). This was the context for the rapid expansion of the Amazon nut industry.

When the promotion of exports from the region was discussed around the early 1990s, it was under the double perspective of strengthening the balance of payments and of forest conservation. Two possible scenarios were foreseen: (i) it was contended that, irrespective of its organisation or the distribution of benefits, the Amazon nut economy could contribute to forest conservation; (ii) it was argued that participation of the peasant sector, that is the *comunidades libres*, in the nut harvest was increasing and might be furthered in order to promote a 'democratisation of the Brazil nut economy' (DHV, 1993)[5].

The latter scenario was recommended, but organisation of the industry took a different course, in which the *beneficiadoras* (processing plants) played a key role. In order to secure the supply of raw material, a process of vertical integration has taken place, with plant owners taking over the often virtually abandoned *barracas* where nut stands are located. Meanwhile a new system of labour relations had emerged. The labour force available in the urban areas has become the basis for a system of contracted labour gangs engaged in the exploitation of forest products. For the Amazon nut harvest, each December, between 5,000 and 8,000 persons, about a third of the working age population, set out from Riberalta for the collection areas, often under the supervision of a labour contractor whose operations are financed by the *beneficiadora* owners. About two-thirds of the total supply of raw nuts is harvested in the *barracas*.

[5] As I have demonstrated (Assies, 1997a:59-64; 1997b) the calculations that informed this proposal strongly overestimated the role of extractivism in household production and income and failed to capture location-specific differentials in rural community dynamics.

The process of vertical integration, in combination with the contract labour system, tends to relegate the small producers of the *comunidades libres* to a residual, complementary role. These small producers of raw nuts may be differentiated according to their distance from the urban centres[6]. Those living close to the urban centres may receive a relatively good price for their produce, but the quantities they can produce are small, since the plots in these areas are small (between 50 and 80 hectares) because of the clustering of the population. Those living farther away may have access to larger forest areas, but the prices they receive tend to be lower. At the same time, the process of vertical integration contributes to the marginalisation of small producers in more distant locations, as unit costs are high in comparison to the more 'efficient' *barraca*/ labour-gang system.

The question whether Amazon nut production contributes to forest conservation cannot be answered as directly as is often done. One usual argument is that, since a NTFP adds value to the forest, it will encourage conservation. Another is that, irrespective of its organisation or the distribution of benefits, the profitability of Amazon nut exploitation contributes to forest conservation, since local capital would otherwise be displaced towards other forest uses, such as indiscriminate logging. A third argument is that NTFPs provide an income for forest-dwelling people who are viewed as a social fence against indiscriminate exploitation.

The first argument - that of added value as a stimulus to conservation - is questionable in the context described. Amazon nuts are a valuable product that cannot easily be over-exploited. This largely accounts for its ecological sustainability. Outside the Amazon nut harvest season, however, the system of urban-based labour gangs also functions in the exploitation of palm hearts (*aÝaí*) which has expanded rapidly in recent years and is expected to deplete the resource within ten years. Equally, the system functions for logging operations which are on the increase. The number of tree species exploited has gone from three to about eighteen over the past years (Beekma, Zonta and Keijzer, 1996). As they do not involve wholesale clearing, these two activities do not immediately menace Amazon nut reproduction. The town of Riberalta, with a rapidly growing population, largely depends on the exploitation of forest resources and pressure will only increase if no alternatives are found.

Also the second argument, which claims that Amazon nut exploitation diverts capital form less sustainable forest uses, is also questionable, since these activities are seasonal and do not coincide. For that reason, I do not think that a direct trade-off exists between them. They are more likely to be articulated into a diversification strategy on the part of local entrepreneurs, as quite clearly is the case for Amazon nut and *palmito* processing.

With respect to the third argument, that local people form a social fence against indiscriminate exploitation, it is important to note that Bolivian competition on the Amazon nut market helped to undermine the viability of the extractive reserves in Brazil, a point to which I shall return. In Bolivia itself, forest-dwelling, small producers tend to be marginalised as a consequence of the organisation of production that underpins commercial success.

[6] The demographic configuration of the region is strongly affected by the improvement of the road system, which tends to substitute the fluvial transportation system. For a recent overview and a somewhat different interpretation see Stoian and Henkemans (1998).

In the livelihood strategies of the rural population agriculture is of central importance in the quest for food security. Its role and the degree of commercialisation are likely to increase in response to expanding market opportunities, particularly in advantageously located areas, which are also the main areas of attraction for rural-rural migrants.

4. AMAZON NUT EXPLOITATION AND PARTICIPATORY RESOURCE MANAGEMENT

Rubber and nuts were expected to be the key supports for the extractive reserve strategy for participatory forest management. While rubber ceased to be an option, Bolivian competition on the Amazon nut market also contributed to the eroded viability of the extractive reserves. As we have noted, the number of processing plants in Bolivia has rapidly increased and virtually all Bolivian exports now consist of shelled nuts. Shelling is done manually with the help of small machines. The *beneficiadoras* in Riberalta provide employment to some 6,000 people, mainly women, during about eight months a year (Coesmans and Medina, 1997; Verheule, 1998). Though working conditions have been improving somewhat in recent years, partly in response to the pressure of product quality requirements of the international market, low wages in processing were, and still are, an important factor in Bolivian competitiveness (de Veld, 1998).

This had direct consequences for Brazilian exporters, including the Xapuri Co-operative and its processing plant, which was created shortly after Chico Mendes' death in 1988 with the help of international donors. The co-operative was meant to provide an alternative to the established Brazilian exporters with their rather unsavoury reputation. By capturing a larger share of value added, it was to contribute to improving local peoples' livelihood and thus to the viability of the reserve strategy. However, as a result of Bolivian competition, aggravated by Brazilian exchange rate policies adopted in 1994, Brazilian exports of shelled nuts, including those from 'correct' sources, have sharply dropped.

Though there were many other reasons for the disappointing performance of the Xapuri Co-operative, Bolivian competition based on about 35% lower wage costs, was among them (LaFleur, 1992). In response to such competitive pressures, the Xapuri plant was virtually deactivated in 1993 and a system of decentralised shelling in rural mini-factories was introduced. The new system relied on piece work and the informalisation of labour relations in order to cut the social security bill. The decision to opt for this system was harshly criticised in an evaluation report by Susanna Hecht, Peter Warner and Willem Groeneveld (IPHAE, 1994) who questioned its efficiency and its effect on quality, as well as its socio-economic impact. To reduce costs, they suggested, the co-operative should reconsider its raw material price policy, that is it should reduce the prices paid to gatherers and control the quality of their product. Whatever the merits of the different options, the crucial point is that Bolivian competition was an important factor in eroding the viability of the extractive reserves. As NTFP production declines in the reserves in Acre, agriculture and small-scale cattle raising expand, while there is increasing pressure to permit selective logging within the reserves (Hall, 1996).

In Bolivia, the system of forest exploitation that arose after the collapse of the rubber trade poses particular problems for forest management schemes. Whereas Amazon nut production is not particularly damaging, logging and palm heart extraction do pose serious threats to the forest. The devastation of the *palmito* stock became a theme for public declarations. The local forestry service repeatedly prohibited further harvesting without much conviction and without much effect, as processors declared that depriving harvesters of this source of income would cause 'a social problem' (*El*

Rumbeador, 5 August 1994). Though the processing industries said they would do something about replacement, this mainly was a public relations gimmick. Plantation-like production of other species with a shorter regeneration cycle, but foreign to the region, is now being proposed. Some processors may thus acquire their own stands or some rural dwellers may have access to a new source of income. Whether urban-based *palmito*-harvesters will benefit and, if they do not, what they will do to make ends meet, remains an open question.

No logging concessions existed in the region until 1992. Logging was done informally. In 1992, despite the Bolivian *Pausa Ecológica* (declared for 1990-95), four concessions were given out in the Pando Department to compensate companies for the loss of their concessions as a consequence of the creation of Chimanes reserve. Though the Forest Law at that time required management plans to be implemented, no such plans were known. The scope for control by the local forestry service was minimal. It is hoped that this situation will change as a result of the new 1996 Forest Law. Enforcement problems are only exacerbated by the current exploitation system which relies on urban-based labour gangs.

As I have argued, this 'urban bias' impinges on the rural smallholder communities and their role in NTFP production and therefore conditions their management practices. It should be clear, in any event, that agriculture is central to smallholders' livelihood strategies. While the diversification of agricultural production or agroforestry was promoted in earlier development projects, this was mostly out of concern for the nutritional conditions of the rural population and as a potential source of income. Only recently has forest management as such come into the picture. The forestry dimension is often emphasised in the advocacy of agroforestry systems, while the agricultural dimension receives less attention. Thus projects often rely strongly on the yields of commercial perennial crops and some tree products[7]. The emphasis on commercial perennials at the expense of food production for subsistence (and for sale) disregards rural dwellers' quest for food security. It would be a delusion to think that income from perennials or from extraction will detract forest dwellers from agriculture. Due attention should therefore be given to this dimension.

5. PROSPECTS FOR DEVELOPMENT?

The foregoing does not provide the most cheerful picture of the potential of Amazon nut exploitation in improving peoples' livelihoods. For one thing, the rise of the Bolivian Amazon nut industry has been a factor contributing to the problems of the extractive reserves across the border.

Co-operative ventures within Bolivia also meet with difficulties. A Riberalta-based peasant co-operative, set up in the 1980s and supported by the Dutch Voluntary Service (SNV), has broadened its activities to include processing in order to capture a larger share of value added. Although the original intention was that the cooperative should process the nuts produced by the *comunidades libres* in order to contribute to the income of the forest dwellers, by 1996, in line with the overall development of the industry, it was considering the purchase of a *barraca* to be operated by urban-based harvesters.

[7] Some ten years ago coffee, black pepper, cocoa and achiote (used as a dye in cosmetics and cheese rind) figured prominently in proposals all over the Amazon region. More recently, achiote, cupuaçu (used for juices and ice cream), and the introduction of new species of *palmito* became fashionable. Quality, however, is a problem, while the markets for such products are limited, quickly saturated (as may happen with cupuaçu), and highly volatile (as in the case of achiote which is suspected of being carcinogenic).

In the initial proposals to promote the Amazon nut trade through interventions by the newly created *Fundación Bolivia Exporta*, the co-operative had been given a central role in democratising the trade, but the emphasis soon shifted to the *beneficiadora* owners. From 1994 they were granted various loans by the *Fundación Bolivia Exporta* to improve processing and the quality of raw material gathered in *barracas* now owned by the *beneficiadoras* (Assies, 1997a:64; 1997b). Export promotion efforts thus linked up with the process of vertical integration of the industry. Attractive profitability and financial self-sustainability are the prime objectives of the *Fundación* and the co-operative was not viewed as fitting such categories.

Bolivia's rise to prominence in the world market for shelled nuts was accompanied by a heavily speculative trade. Moreover, as a bad harvest was expected for 1998, importers filled their warehouses. World market prices rose to about US$ 1.50 per pound of shelled nuts. In order to fulfil their commitments, the Bolivian *beneficiadoras* saw themselves obliged to raise the prices for raw material on the local market, even buying across the border in Brazil. Local prices for a crate of raw nuts (nominally 22 kg, which yields some 7.5 kg of shelled nuts) delivered in Riberalta rose to about Bs 50 in 1997[8].

By 1998, however, world market prices dropped to below US$ 1 per pound of shelled nuts. The relatively good 1998 harvest and the prospect of sharpened quality requirements regarding aflatoxin content by the EU contributed to the plunge. Thus the price for raw nuts delivered in Riberalta dropped to Bs 25 per crate, about the 1994 level. In view of the dynamics of the local trade, purchases from forest-dwelling small producers are likely to be reduced, while labour-gang based production continues to be the main source of raw nuts. Moreover, collectors' income will drop significantly. Although it can always be argued that, in the absence of the Amazon nut industry, things would have been worse, optimistic views about income distribution based on the high prices for raw material in 1996 and 1997, which benefited collectors and *barraqueros*, should therefore be qualified. It should further be noted that the processing industry relies on unskilled labour and that wages show little improvement. On the whole, the prospects for future development of the urban labour market are rather gloomy (Verheule, 1998).

6. CONCLUSIONS

The organisational configuration of the Amazon nut industry in northern Bolivia is an important factor in explaining its competitiveness and its success in marketing a non-traditional export product. However, although the marketing strategy relies strongly on the 'green product' imagery, the dynamics of the industry contribute to the marginalisation of small, forest-dwelling producers. This erodes the social basis for more participatory forms of forest management. Forest-dwellers turn to agriculture, first of all for subsistence and, where possible, on a commercial basis. The dynamics of spatial concentration and competition for land of this type of agriculture in the more accessible areas sets into motion a process whereby 'shifted cultivators' are created. The area under pressure from agricultural ventures thus expands in an ink-spot like fashion. The political ecology model proposed by Durham (1995) provides an adequate framework for analysing such dynamics (cf. Assies, 1997a, 1998).

If the boom period of 1996-97 and high prices for raw material also benefited small forest-dwelling

[8] The price hike that was probably also fuelled by money laundering operations in the region.

producers, owners of small *barracas* and, to a certain point, the urban-based collectors, such circumstances should not give rise to over-optimism (de Veld, 1998). Inequitable income distribution, poverty and the absence of employment alternatives presently underlie economic viability and provide the background for forms of over-exploitation of resources, as illustrated by the ineffectual bans on *palmito* harvesting. In this context, the role of NTFP production, basically Amazon nuts, as an incentive to forest conservation is questionable. After all, they are another exploitable resource, like timber or palm hearts, the difference being mainly that it is so difficult to over-exploit Amazon nuts.

In future investigations of Amazon nut production in northern Bolivia three issues require further exploration:

1. *The dynamics of differentiation among forest-dwellers.* Representing them as basically 'extractors' is misleading. The importance of agriculture as a source of food security and cash income should be acknowledged and, rather than expecting too much from alternatives, possibilities of enhancing its sustainability should be given due attention. Special attention should be directed to the dynamics of social differentiation within peasant communities and to the relations between peasant communities and local 'farmers' (*granjeros*) and the ways in which these affect land-use patterns, access to land, uses of labour and capital, market orientation, the 'shifting' of cultivators, etc.

2. *The impact of the 1996 Forest Law.* Various types of 40-year concessions can be granted under this law. Apart from the 20% of publicly-owned forest areas fit for exploitation that municipalities may grant to local social organisations, concessions are up for bidding. Logging concessions cost a minimum of US$ 1 per hectare; concessions for extractive uses cost a minimum of 30% of this amount. Whereas social organisations pay the minimum fee over the area of potential exploitation under a management plan (logging) or an exploitation plan (extractive activities), for private concession holders the fee is levied on the price paid at auction[9]. Private owners of forest land equally pay the minimum fees and are subject to the other regulations.

A first impact of the law has been that a market for exploitation and management plans has been created. Plans support claims. The process of granting concessions and the actual payment of fees is not very clear, however[10]. Neither are future impacts easy to predict. The law aims at 'integral and efficient exploitation', implying a progressive diversification of activities to be reflected in the implementation of management plans[11]. Another outcome might be some sort of reversal of the present trend towards vertical integration in attempts to shift the burden of fees to local communities. Whether fees can be collected from these communities remains to be seen. The possible consequences for the organisation of the Amazon nut harvest or other forms of forest exploitation are equally uncertain. It also remains to be seen how this legislation will interact with the new land reform legislation in a region where access to land and forest areas hitherto was regulated by 'local law'. In any case, the idea that the new legislation has drastically changed the way forest resources are exploited in Bolivia and has opened the way to sustainability and conservation seems to be premature.

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9 Indigenous peoples also have to pay the fee, but only for the part of their territory effectively exploited.

10 Even before the forestry service had been restructured under the new law, a series of concessions already seems to have already been granted in the region without any consideration for pending claims by indigenous and peasant communities, who should have received priority under this law.

11 The payment of fees per hectare, rather than per volume of product, is meant to curb corruption and is also expected to promote 'efficiency and competitiveness' in the progressively integral exploitation of the concessions.

3. *Developments in the Amazon nut industry*. The rise of the industry resulted in a proliferation of processing plants. Gradually, new relations were established among processing plants, some of them becoming mere suppliers of processed nuts to larger plants. This process of hierarchisation is paralleled by the upgrading of a number of plants that have broader access to capital resources. These plants are becoming professionalised. They capitalise the production process and have started to introduce mechanised shelling, which may reduce unit costs and increase quality. Industrial concentration is the likely outcome of such processes and, in the longer term, four or five large processors may remain (de Veld, 1998). What consequences this may have for the labour market remains to be seen. For the moment, shelling has provided employment for an unskilled, mainly female, labour force. Whether a reduction of employment opportunities in the industry will be compensated for by other and better labour opportunities in the face of a growing labour supply is a critical issue for the future of the northern Bolivian Amazon.

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THE EFFECTS OF WEALTH ON THE USE OF FOREST RESOURCES: THE CASE OF THE TAWAHKA AMERINDIANS, HONDURAS

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1. INTRODUCTION

Many researchers have argued that an improvement in income brought about by the judicious extraction of non-timber forest products will enhance conservation (de Beer and McDermott, 1989; Peters *et al.*, 1989; Prance, 1989; Allegretti, 1990; Anderson, 1992; Clay, 1992; Plotkin and Famolare, 1992). However, little empirical attention has been given so far to estimating the effects of increased income and wealth on the use of natural resources from the forest by rural households (Panayotou and Ashton, 1992; Godoy and Bawa, 1993; Godoy *et al.*, 1995; Henrich, 1997; Santos *et al.*, 1997). In this paper we attempt to fill that gap by examining the effect of wealth on forest use, measured through two indexes: (1) time allocated to forest-based activities, and (2) consumption of forest products.

Time allocation data give an apt measure of the importance of the forest to different families from the standpoint of their labour investments. But even if a family did not directly invest time in the forest, the forest could still be an important source of consumer goods, e.g. when forest products are bought or bartered. For this reason, we rely on a second criterion for measuring the importance of the forest, namely, the consumption of forest products.

For the empirical analysis we draw on information collected over two-and-a-half years of field research (June 1994 - December 1996) among 33 Tawahka households with different degrees of exposure to the market and wealth. We draw on patterns from cross-sectional analysis to tease out how changes in wealth affect forest use.

2. STUDY SITE AND METHODS

Fieldwork was carried out in north-eastern Honduras (longitude 15°N, latitude 85°W), an isolated area with hilly terrain, covered with tropical rain forest. There are no roads or airstrips; transport is by canoe. After a survey of communities to explore the magnitude of wealth differences in the area, 33 households consisting of 105 adults - defined as people over the age of 16 - and 136 children, were selected from two Tawahka villages, which together comprise 29% of the Honduran Tawahka population. The two communities lie about 20 km apart along

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[2] Data for this paper were collected as part of a broader study on how markets affect the welfare and survival of indigenous people. Fieldwork was conducted through the Harvard Institute for International Development (HIID) under supervision of Dr. Ricardo Godoy and financed by the Cultural Anthropology and Human Dimensions of Global Change Program of the National Science Foundation, USA (NSF Grant # SBR-9417570). The working up of the data in 1998 was supported financially by the Van Melle Corporate Centre B.V., Breda (the Netherlands). The authors are writing their PhD thesis on their own account, under the supervision of Prof.Dr. Ton Dietz (University of Amsterdam), Dr. Annelies Zoomers (CEDLA, University of Amsterdam) and Dr. Mirjam Ros.

the Patuca River. People combine hunting, fishing and plant foraging with slash and burn agriculture. Some earn a cash income by cultivating cacao, others by working occasionally for colonist farmers upriver, selling domesticated animals, panning gold during the dry season, or tending a retail shop.

The relevant variables - the household's wealth level, time spent on forest activities and the value of forest products consumed - are described below.

2.1 Household wealth

A household's wealth refers to its physical and financial assets. We measured the following physical assets for each household: durable goods, domesticated animals, stored crops, mature tree crops, the value of the house, stocks of commercial goods in stores, and cash or gold holdings. Land was not included as an asset, because there is no selling or buying of land among the Tawahka. Neither did we include the future value of annual crops in the field as assets because these goods cannot be sold directly.

A household's wealth level was established by interviewing all adults of the household about the quantity and age of the goods they owned. Since some households - which we defined as the people 'eating from the same stove' - consisted of more than one adult couple, the summed value of all assets of a household was divided by the number of adults in the household.

We used group interviews to collect information on the life span and new value of all items owned by the Tawahka. This allowed us to calculate the value of each item by linear depreciation. For example, a canoe that lasts an average of 10 years loses a tenth of its new value each year; a three year-old canoe was therefore valued at 70% of its new value.

Asset interviews were done three times during the fieldwork in order to capture temporal variations in wealth. The wealth level is based on the average of the three interviews. The 33 households were ranked according to the total value of their assets (US$) and split into five wealth groups, as shown in Table 1.

Table 1 Classification of wealth groups among Tawahka households (n=33)

Wealth group	Total value of assets (US$ per adult)
I (n=5)	< 250
II (n=10)	$250 \leq x < 500$
III (n=8)	$500 \leq x < 750$
IV (n=7)	$750 \leq x < 1{,}500$
V (n=3)	$1{,}500 \leq x < 7{,}500$

2.2 Time investment

We estimated the percentage of daytime that adults spent on forest-related activities. Under forest-related activities we included any activity related to the extraction or manufacture of a forest product, irrespective of whether the item was intended for subsequent sale or for personal use. A few examples will clarify what we mean. Fishing and hunting were included, as was gathering firewood, but gold-panning or clearing forest for agriculture was not. Sawing boards as included (whether the activity took place in the forest or in the village), but building a house with these boards was not considered a forest activity.

Information on time allocation came from scans or spot observation (Gross, 1984). The activities of all subjects were noted on randomly chosen days between 6 a.m. and 6 p.m. We

varied the starting time of the scan systematically to cover all daytime activities of the Tawahka. When monitoring is frequent and continued over an observation period covering at least all seasons once, the observed frequencies per activity may be regarded as the average time that a person spends on this activity (Johnson, 1975; Gross, 1984). We carried out 150 scans during fieldwork. To obtain the time spent on forest activities by a household, the individual percentages of the adult men and women of the household were averaged. The values of households in one wealth group were then averaged to obtain the time spent on forest activities of this wealth group.

2.3 Consumption of forest products

To determine how wealth affected the consumption of forest products, all forest products brought into the households (whether bought or foraged personally) from dawn till dusk were identified, weighed and measured during 70 randomly-selected days. Under forest products we included any biological item produced by the local natural environment. Since the Tawahka almost never forage or hunt before or after dark, or consume forest products in the field, the method provides an accurate estimation of consumption of forest products. We define consumption broadly to include not just edible goods, but also firewood, medicines, thatch leaves, dugout canoes, or any other biological item from the forest.

To estimate consumption we converted physical units into monetary values. For the forest products that were bought, we simply used the price paid for the purchase. For items which were foraged personally or that were obtained through barter, we had to estimate the value indirectly. This was done on the basis of people's willingness to exchange the product during interviews at the end of each month with the same group of people. For every item collected in the previous month with no market price (*i.e.* that was not bought or sold) we asked how many pounds of sugar (or some other item with a known price) they would be willing to give up to obtain the forest product. The value agreed upon after discussion was taken to be the value of the forest product.

3. RESULTS

Tables 2 and 3 contain a summary of the results. The discussion is split into two sections, corresponding to the effects of wealth on (1) time allocated to forest activities and (2) consumption of forest products.

3.1 Time allocation

We first analyse the effect of wealth on all forest-based activities, and then narrow the analysis down to specific activities (*e.g.* hunting and fishing). As the last row in Table 2 suggests, all adults (except for the wealthiest households of group V) spend about the same amount of time on forest-related activities (roughly 10%). The other 90% of the daytime is spent on activities such as agriculture, household activities, social/personal activities, and leisure. The wealthiest households spend only one-third as much time on forest activities as the poorest households do (3.7% vs. 10.6%). The information appears to suggest that the forest absorbs similar shares of adult labour for all groups; the share of time spent in the forest seems to decline only once households have passed – what is for the Tawahka – a very high threshold of wealth.

When forest-related activities are split into more refined categories, the time spent in fishing, hunting and 'other forest activities' is generally lower for wealthier households, and much lower for households at the top end of the wealth scale. 'Other forest activities' include activities such as extraction of non-woody forest products (*e.g.* fruits, honey and medicines) and manufacture

of hunting- and household tools. By contrast, time spent on the extraction of woody products - construction materials, canoes and firewood - is higher (4.1-5.5%) for 'middle class' households (II – IV) compared with the poorest households (3.7%), but again much lower for the richest households (1.9%). Wealthier households seem to concentrate more time on woody products, while for the richest households, the forest appears to have lost most of its importance as a place to work.

Table 2 Percentage of daytime spent by adults on different forest activities, by wealth group

Wealth group	**I**	**II**	**III**	**IV**	**V**
Wealth level (US$)	<250	250-500	500-750	750-1,500	1,500-7,500
No. of households	*n*=5	*n*=10	*n*=8	*n*=7	*n*=3
Fishing	3.7	2.6	2.7	2.8	0.8
Hunting	1.6	1.6	1.0	1.0	0.2
Extraction of woody products	3.7	5.5	4.1	4.3	1.9
Other forest activities	1.6	1.6	2.3	0.9	0.8
Total % time in forest activities	10.6	11.3	10.1	9.0	3.7

3.2 Consumption of forest products

The information in Table 3 appears to suggest an inverted U-shaped curve of forest use. Households at the very bottom and top of the wealth distribution consume less forest products than do households in the middle categories. Consumption rises for group II, declines somewhat for group III, peaks for group IV, and then declines again among households in the top group. The inverted U-shaped curve seems to hold across all types of forest products. This type of curve has been suggested earlier by Panayotou (1992) for the link between household income and dependence on hunting, and has been reported for income and dependence on plant products (Godoy *et al.*, 1995) and annual forest clearing for agriculture by indigenous households (Godoy *et al.*, 1997).

The total value of forest products collected per month by groups II-IV is 1.28-1.55 times higher than that collected by households in group I ($12.0 per month per adult). Households in the wealthiest group consume half as much forest products per month ($ 6.2) as do group I households.

Wealth groups II, III, and IV appear to consume more of all types of forest product compared with the poorest households. By contrast, the richest households consume, except for game, about half as much of all types of forest products as compared with households in group I. There appears to be no category of forest products that is no longer used by the wealthier households.

The consumption data do not appear to correspond with the time investment data of Table 2. While time spent in fishing and hunting by middle groups II-IV is generally lower compared to the poorest households, consumption of the corresponding forest products is much higher for the middle groups. This would suggest that wealthier households are more efficient, possibly through better technology, but another, more likely reason is that wealthier households spend less time on these forest activities and obtain forest products partially by buying or bartering them with other goods. With respect to woody products both consumption and time spent on extraction is highest for the middle groups. The wealthiest group has the lowest level of both consumption and time spent on the extraction of forest products.

Table 3 Monthly consumption of forest products per adult, by wealth levels (US$)

Wealth group	**I**	**II**	**III**	**IV**	**V**
Wealth level (US$)	<250	250-500	500-750	750-1,500	1,500-7,500
No. of households	*n*=5	*n*=10	*n*=8	*n*=7	*n*=3
Fish	1.0	1.9	1.9	2.6	0.4
Game	2.1	3.8	2.9	3.2	1.9
Woody products	6.5	8.2	6.8	8.7	2.6
Other forest products	2.4	2.7	3.8	4.1	1.3
Total value of forest products	12.0	16.6	15.4	18.6	6.2

4. CONCLUSIONS

While sustainable extraction of non-timber forest products has been advocated since the late 1980s as a promising strategy for merging economic development with forest conservation, few researchers have provided empirical estimates of the effects that increased wealth may have on the behaviour and use of forest products by local people. This paper has attempted to quantify differences in the use of forest resources among a range of Tawahka Amerindian households that varied in wealth. The following trends could be observed:

Although adults spend about the same overall share of time in the forest (around 10%), adults of wealthier households appear to focus on extracting woody products, while fishing, hunting and extraction of other goods declines. Only the top three households spend much less time on forest activities, possibly because one of these three households appears to have specialised in farming and animal husbandry, while the other two run small retail shops.
Consumption of forest products seems to resemble an inverted U-shaped parabola, with the people in the middle wealth groups exerting most pressure on the forest. This curve holds for all categories of forest products.

The results of this study suggest that economic development may be most threatening to the forest during the initial stages of wealth accumulation among households in transition from relative autarky to integration into markets. This implies that, even in a situation where non-timber forest products are extracted and marketed in a sustainable manner, the income generated through selling these products may have adverse effects on other forest species that are not being exploited in a sustainable manner. Such a development would be potentially hazardous for biodiversity and forest conservation. Only a substantial lift in wealth appears to be capable of removing the pressure of indigenous households on many forest species. These issues will be further explored in future publications.

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NTFP RESOURCE MANAGEMENT AS AN OPTION FOR MULTIPLE-USE FOREST MANAGEMENT IN SOUTH CAMEROON

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1. INTRODUCTION

It is now generally recognised that non-timber forest products (NTFPs) play an important role for local communities in and around forests. These products may be used for subsistence or for sale, providing a cash income. There is growing awareness that sustainable forest management should include measures for the effective conservation and management of NTFP resources in order to meet the actual and future needs of local people (Peters, 1996). Moreover, developing commercial NTFP extraction is often considered to be a means of improving rural people's living standards, as well as a suitable approach to forest conservation (de Beer and McDermott, 1989; Ros-Tonen *et al.*, 1995). Thus, the further development of NTFP resource management is seen as an important dimension of multiple-use forest management, in which attention is given to local needs, market-oriented production and forest conservation.

These ideas are now being further assessed in several research programmes, including the Tropenbos-Cameroon programme. The resulting research activities should contribute to the development of a NTFP production system that is both ecologically sustainable and socially and economically attractive to the local communities. Most attention is being focused on the options for the sustainable commercial extraction of NTFPs from natural forests and on methods for forest land-use zoning incorporating NTFP production zones.

A broadly oriented NTFP project is being carried out within the framework of the Tropenbos-Cameroon Programme (van Dijk, in press) with the aim of assessing the possible contribution of NTFP production to sustainable and multiple-use forest management. The research project consists of a NTFP reconnaissance identification and utilisation survey, a resources inventory, a harvesting impact study of selected NTFPs, and a socio-economic survey of NTFP users. This paper summarises the results of the reconnaissance survey of the types of NTFPs collected and their main uses. It also presents the main results of the ecological inventory carried out to determine the abundance and distribution of NTFP species. This information will be used as a basis for outlining two options for the development of multiple-use forest management systems incorporating NTFP production.

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2. RESEARCH SETTING

2.1 Research location

The Tropenbos-Cameroon study site covers an area of 200,000 ha of inland forest land in the Bipindi-Akom II region of the Southern Province of Cameroon. The area is geomorphologically diverse, with altitudes ranging from 40 m above sea level (asl) in the western plains to over 1000 m asl in the mountainous eastern part. Yearly rainfall varies from 1,800 to 2,500 mm, with two distinct rainy seasons and two drier seasons. The vegetation changes gradually from Low Altitude Evergreen Forest characterised by the presence of *Lophira alata* to Mid Altitude Evergreen Forest rich in *Caesalpiniaceae* (van Gemerden and Hazeu, 1997). The research site corresponds with the former timber concessions of a Dutch logging company. The area was logged over several times. Timber exploitation was carried out selectively with a low intensity. It is estimated that about 0.7 trees/ha are logged, and that on average 14% of the forest surface is affected by the various logging operations (van Leersum, pers. com.).

Population density in the area is rather low; about 5-10 inhabitants per km^2. Ninety percent of the inhabitants are Bantu; most of them belonging to the Bulu tribe, others to the Fang, Bassa and Ngumba tribes. These Bantu groups are generally referred to as 'villagers' or 'farmers'. They practice shifting cultivation, cocoa cash crop farming and hunting-gathering. About 10% of the population consists of Bagyeli (Pygmy) people. They are often characterised as being engaged mainly in hunting-gathering, although they have recently also adopted food crop and cocoa cultivation. Subsistence production still plays a major role for both Bantu and Bagyeli. The road conditions and public transport in the area are very poor. Consequently, commercial trade plays only a relatively minor role in the livelihood strategies of the local communities.

Figure 1 The study area

2.2 Research methods

The results of two separate surveys will be summarised in this paper, i.e. the NTFP inventory and the ecological survey. These studies are elaborated in van Dijk (in press).

The NTFP inventory aimed at identifying the names, type of products, functions and importance of NTFP species used by the various population groups. Data were collected through interviews with members of 29 households in five communities, ensuring a representation of the main ethnic groups in the area and the participation of both men and women, as well as people of different age classes. The interviews were guided by a questionnaire which included a checklist of potential uses and a number of open-ended questions.

The objective of the ecological survey was to gain an insight into the relative abundance and distribution of NTFP species and to obtain indications of the impact of agriculture, logging and NTFP extraction on resource availability. For the purposes of data collection, 32 one-hectare plots in the form of 1 km long and 10 m wide transects were selected with the aid of an aerial photo-interpretation map indicating the main soil and vegetation types in the research area. The plots selected included undisturbed forests and disturbed vegetation types such as logged-over forests, secondary forests, young fallow lands, food crop fields and cocoa plantations. In each plot, an inventory was made of the presence and diameter of the NTFP species. In order to ascertain the factors influencing the variation in distribution and abundance of the NTFP species, the data were analysed to give a classification of major habitat types, i.e. undisturbed forest of low (under 350 m asl), intermediate (350-500 m asl) and high altitude (over 500 m asl), swamp forests, secondary forests, young fallow lands and fields and cocoa plantations.

3. RESULTS

3.1 The role of NTFPs

During the NTFP inventory 200 animal species and over 500 plant species were recorded, the latter accounting for 1200 different uses. These results demonstrate the great importance of NTFPs. In fact, they form part of almost every aspect of rural life, and also offer a range of possibilities for earning an income. The following categories of NTFPs were distinguished:

- *Wild animal resources* such as bush meat, fish, crustaceans, insects and molluscs. These serve as a major source of protein and are collected mainly for household consumption and local trade. However, there may be temporary rises in hunting to meet increased demands by logging personnel. During a peak period of hunting an average 8.2 kg of bush meat was captured weekly per hunter. During other periods of the year, fishing and the collection of small animals are of most importance. Although the importance of these animal resources is obvious, they will not be further considered in this paper.
- *Vegetable NTFPs used for food and beverages*, such as seeds, fruits, exudates and mushrooms. This NTFP category is the most important class of vegetable NTFPs. The various products are highly appreciated for their taste and they form part of daily consumption. These products are used not only for household consumption, but also for trade. Some are regularly traded, sometimes even to urban markets inside and outside the country.
- *Other vegetable NTFPs used for food, such as vegetables and root crops used as starchy food.* The use of such products is less varied than the earlier category of vegetable NTFPs and the amounts consumed are small. These products are primarily harvested from cultivated species rather than from wild plants.

- *Medicinal NTFPs.* In total, around 300 species are used for medicinal purposes. Their use is common in all households, and knowledge of their use is very well developed amongst all community groups.
- *Material for house construction and for household, agricultural, hunting and fishing equipment.* For each application, there is a clear preference species to be used for specific purposes.
- *Industrial inputs.* At present, only one product is extracted for this purpose, i.e. the seeds of the liana *Strophantus gratus*.

In general, NTFPs are primarily harvested for household consumption. Bush meat, palm wine and 38 vegetable NTFPs are also marketed. The sale of NTFPs is mainly restricted to village markets. These products are subject to a growing demand and they fetch a relatively stable price. Some products, such as palm wine, bush meat and fish, are sold in large quantities. The sale of these products forms an essential part of the income of the local people. The sale of NTFPs to urban markets is restricted to products which yield relatively high prices per unit of volume, such as condiments, spices and flavourers, and, to a lesser extent, fruits. Except for well-favoured kernels such as the Bush mango (*Irvingia gabonensis*) and Njansang (*Ricinodendron heudelotii*) these products are consumed and sold in small quantities (Kempkes, 1995). Overall, the sale to urban markets is relatively unstable and of limited importance. This is mainly due to the poor infrastructure, which results in high transport costs. Only a few products, notably *Strophanthus gratus*, are uniquely collected for sale to international markets. The demand and price of these products are subject to wide fluctuations.

3.2 Distribution and density of NTFP species

The ecological survey indicated that there is considerable variation in the distribution and density of specific NTFP species. Two major variables affect this distribution, i.e. ecological conditions and human impact. With respect to ecological conditions, differences in altitude and drainage conditions cause significant variation in forest types. The various vegetation types which were distinguished, i.e. undisturbed forests at low (less than 350 m asl), intermediate (350-500 m asl), and high altitudes (over 500 m asl); swamp forests in valley bottoms, logged-over forests; late secondary forests; young fallow lands and cocoa plantations, were found to have a distinct configuration of NTFP species. As an example of the variation in distribution and abundance of NTFP species, Table 1 summarises information on various NTFP species with a market value.

In general, the abundance of most important NTFP species is rather low. Most of the species occur at average densities of 0-5 stems/ha, without a clear abundance in certain microhabitats; many species have even less than one producing individual per hectare. Only a few species occur at higher densities (over 10 stems/ha), often in specific microhabitats. These include species such as *Coula edulis*, *Garcinia lucida* and *Scorodophloeus zenkeri*, which are actually extracted for trade. Forty percent of the NTFP species have their maximum densities in man-made habitats such as fallow lands, secondary forests and, especially, cocoa plantations.

Apart from the variation in natural conditions and the impact of agriculture, the abundance and distribution of NTFP species may also be influenced by the impact of either commercial timber exploitation or NTFP extraction itself. In general, the impact of commercial logging was found to be relatively small. Only a few NTFP species, particularly the rare species *Guibourtia tessmannii* and *Baillonella toxisperma*, are threatened, as they are also favoured as timber species. Some NTFP species profit from the enhanced light conditions resulting from enlarged canopy gaps. A few NTFP species reach their maximum densities in logged-over forests, for instance, various rattan species and the herb *Aframomum citratum* which often occurs on

logging roads. Consequently, densities of NTFP species in logged-over forests were found to be intermediate between those of undisturbed forests and secondary forests resulting from shifting cultivation. But, in contrast to the secondary forests, the regeneration of shade-tolerant NTFP species was well developed.

Table 1 Distribution and density of NTFP species with a market value

Category and name of species	Density (stems/ha)		Preferred habitat
	Average	Maximum	
Condiments, barks, nuts, spices			
Baillonella toxisperma	0.2	0.3	undist. forest/high
Cola nitida/C.acuminata	2.4	4.3	undist. forest/high
Coula edulis	4.7	10.1	undist. forest/high
Dacryodes edulis	0.4	3.8	cocoa plantation
Elaeis guineensis	4.6	21.8	cocoa plantation
Garcinia lucida	5.4	22.7	undist. forest/high
Garcinia kola	0.4	1.1	logged-over forest
Irvingia gabonensis	2.1	3.6	undist. forest/low
Panda oleosa	0.7	2.0	undist. forest/low
Poga oleosa	0.3	0.9	undist. forest/interm.
Raphia montbuttorum	0.9	16.5	swamp forest
Ricinodendron heudelotii	2.1	4.1	sec. forest
Scorodophloeus zenkeri	6.6	29.9	undist. forest/high
Aframomum citratum (herb)	5 sites/village	200 clumps/site	fallow lands and logging roads
Condiments, presently not yet commercially exploited			
Monodora spp.	1.3	2.4	undist. forest/interm.
Tetrapleura tetraptera	0.5	1.8	sec. forest and fallow
Xylopia aethiopica	3.0	5.7	sec. forest
Commercialised fresh fruits			
Antrocaryon klaineanum	1.8	3.3	cocoa pl./sec.forest
Cola ricinifolia	0.7	3.2	undist. forest/low
Cola lepidota	4.7	18.9	undist. forest/interm.
Dacryodes macrophylla	0.3	2.7	cocoa pl./swamp for.
Hexalobus crispiflorus	0.3	1.1	cocoa plantation
Trichoscypha acuminata	1.4	3.2	undist. forest/high
Trichoscypha arborea	0.5	1.6	undist. forest/low
(Former) industrial resources			
Alstonia boonei	2.2	5.2	cocoa plantation
Annickia chloranta	2.4	4.9	logged-over forest
Strophanthus gratus	0.2	1.4	cocoa plantation
Rauvolfia vomitoria	1.0	3.3	sec. forest

As far as the effect of the extraction of NTFP products on their availability is concerned, a distinct negative impact was noted for two species - *Garcinia lucida* (Guedje, 1996; de Huu, 1998) and *Coula edulis*. The mortality rates of *Garcinia lucida* populations, from which the bark is mainly harvested, were found to be extremely high, especially in the largest and, therefore, most productive diameter classes. In the case of the multiple-purpose tree *Coula edulis* - exploited for ironwood, nuts and various medicines - smaller trees (10-60 cm dbh) were relatively weakly represented in forests near to villages, which is probably explained by the frequent use of this wood for house construction. For a third species investigated, *Irvingia gabonensis*, no impact of NTFP extraction was detected.

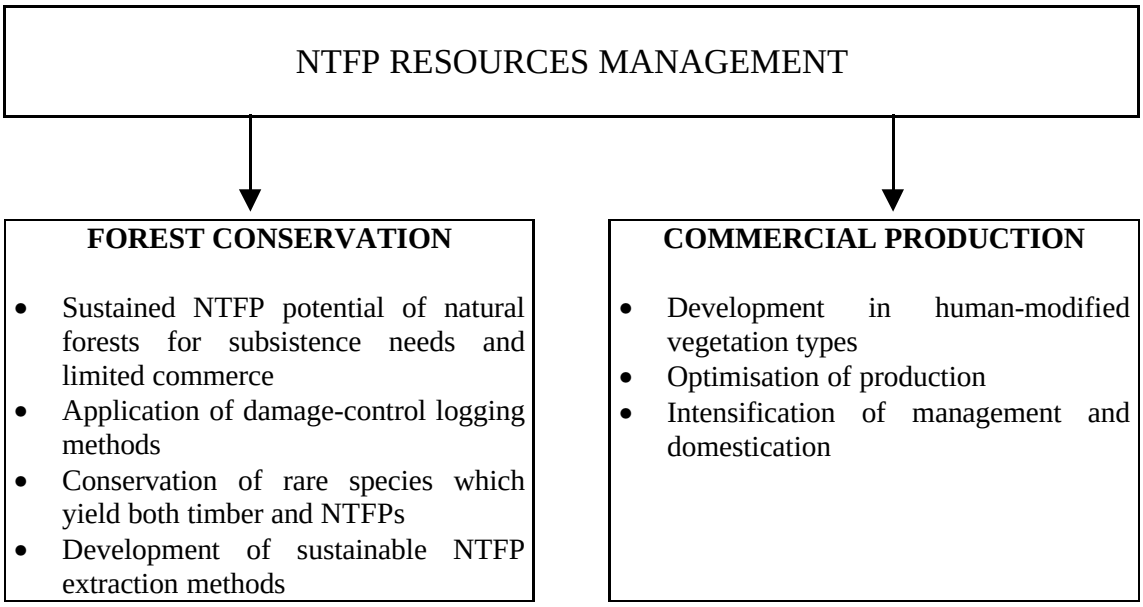

Figure 2 Proposal for a dual approach to NTFP resources management

4. OPTIONS FOR MULTIPLE USE AND SUSTAINABLE FOREST MANAGEMENT

As the above data demonstrate, at the Tropenbos-Cameroon site, NTFP products play an important role in the household economies of local communities. It is therefore relevant to consider how NTFP production can be incorporated into multiple-use forest management systems.

When we consider options for the further stimulation of multiple-use forest management incorporating NTFP species, we should take the following conclusions from the surveys into account:

- Most NTFPs are used mainly for household consumption and only a relatively few products are sold in local or urban markets (*cf.* Ndoye *et al.*, 1998). Consideration should consequently be given to whether the multiple-use forest management systems should be directed at subsistence or commercial products or both. It may be argued that the production of commercial NTFPs offers most scope for development, as it would contribute to raising household incomes and would allow a certain degree of specialisation in production. By its very nature, subsistence production will always be only a part-time household activity; so that the scope for specialised management regimes requiring intensified labour inputs will be limited.
- The density of most NTFP species with a commercial value is low to moderate and many of them have an irregular distribution. Several species have less than one producing individual per hectare, which imposes severe constraints on the availability of resources and the development of efficient extraction in natural forests. Species with a higher density are often restricted to specific microhabitats, while being absent from large parts of the area. This means that, under the local system of land tenure, in which most forest lands are adjudicated to specific clans (Ntamag, 1997; van den Berg, 1998), these NTFPs are not available to

everyone. Moreover, the poor infrastructure limits marketing opportunities. Thus, the scattered distribution and low densities of NTFP species, irregular production, prevailing property rights and limited marketing opportunities result in a low level of commercialisation of NTFPs. Even if the last two constraints are removed, it is still doubtful whether enough NTFPs are available in sufficiently large densities to allow the development of an economically viable specialised extraction system for commercial purposes. This might be feasible only for areas with specific microhabitats in which concentrations of highly valuable NTFP species such as *Garcinia lucida* occur. However, because of this localised character only a selected number of households would be involved.

- A high proportion of the NTFPs are not extracted from natural forests, but from anthropogenic (human-modified) vegetation types such as secondary forests, young fallow vegetation and cocoa plantations. These habitats are generally located near to the villages and cultivated lands, so that the collection of NTFPs can easily be combined with other livelihood practices. The intensification of NTFP cultivation in such anthropogenic land-use types, including the domestication of selected NTFP species, does seem to offer scope for raising household production and income.

Thus, the most limiting factor to the further development of NTFP extraction from natural forests is the relatively low density of NTFP species rather than damage caused by commercial timber logging. Moreover, there seem to be serious limitations to forest management systems which simultaneously aim at raising the incomes of local people through increased NTFP extraction from natural forests and enhancing the conservation of these forests. Rather than aiming at the development of a single generic approach to multiple-use forest management, it seems preferable to aim at a dual approach. From the point of view of conservation, efforts should be undertaken to sustain the NTFP production potential for general household needs and for limited commercial extraction. This could be accomplished by ensuring that appropriate damage-control logging methods are applied, including the conservation of rare species, which produce both valuable NTFPs and timber (i.e. *Guibourtia tessmannii, Baillonella toxisperma)*. In addition, improved extraction methods should be developed for commercial NTFP species, such as *Garcinia lucida*, which occur locally in dense stands.

From the point of view of raising household incomes and reducing the pressure on the natural forests, efforts should be undertaken to develop multipurpose ‘forest gardens’, in which semi-domesticated NTFP species are grown. The presence of mixed cocoa plantations incorporating several NTFP species indicates the feasibility of such a development approach (*cf.* Wiersum, 1997).

5. CONCLUSION

At the Tropenbos-Cameroon programme research site, non-timber forest products play an important role in the household economies of local communities. Many products are used mostly for household consumption, notably food products such as fruits and nuts, exudates, medicinal products, materials for utensils and house construction, and, to a lesser extent, vegetables and starchy foods. A relatively small number of products, such as seeds, fruits and exudates are sold in local and urban markets. Only few products are traded to international markets. The various NTFP products are collected either in the natural forests or in anthropogenic vegetation types such as secondary forests, young fallow and cocoa plantations. Within the natural forests, the distribution and density of most NTFP species is highly variable. The densities, especially of commercial species, are generally low, with only a few species occurring at higher densities in specific micro habitats. In secondary forests, young fallow lands

and cocoa plantations, relatively higher densities of NTFP species occur, and these are in several cases semi-domesticated.

In view of these conditions, the most appropriate approach for developing a sustainable and multiple-use forest management system with the dual aims of conserving natural forests and involving local communities in forest management by raising their incomes, is the development of a dual forest land-use system. Rather than focusing exclusively on the options for a combined production of timber and non-timber forest products in natural forests, consideration should also be given to the development of anthropogenic forest types, such as forest gardens, in which NTFP production can be optimised.

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WHEN THE MONKEY 'GOES BUTCHER': HUNTING, TRADING AND CONSUMPTION OF BUSH MEAT IN THE REGION OF THE TAÏ NATIONAL PARK, SOUTHWEST CÔTE D'IVOIRE

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1. INTRODUCTION

In March 1998, a convention was set up between several partners to carry out research on the exploitation of wildlife in the region of Taï National Park (TNP)[3]. The study focuses on the importance and scale of village hunting and poaching and covers the various stages of game exploitation, ranging from hunting and consumption of bush meat by subsistence hunter households to the local commercialisation of game meat and the region's input to the nationwide bush meat trade. The results of the study will help to answer two key questions about the management of the wildlife resources in the Taï region:

1. How, why and to what extent does the local population exploit game resources?
2. How can the game exploitation and marketing system be transformed into a more sustainable utilisation system?

The recommendations will be addressed to the National Park management. The study results should also contribute to the discussion about the nationwide reopening of hunting, announced by the Ivorian government in 1994 but still not signed and ratified[4].

The research programme started in March 1998 and will continue until March 1999. The study area is located in the southwestern forest zone of Côte d'Ivoire and includes the TNP and N'Zo Game Reserve (Figure 1). These protected areas, which cover 457,000 ha and 79,000 ha, respectively, are located in the centre of the study area and include a large number of endemic flora and fauna species. The unique species composition in the Guinea forest belt had led to its classification by UNESCO as a MAB Reserve in 1978 and as a World Heritage Site in 1981.

The study focuses on the utilisation of 41 species and species groups of mammals which form the largest element of more than 50 species of exploited wildlife. The local consumers of game are

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[3] Partners include the Tropenbos Foundation, the PACPNT project (Autonomous Project for the Conservation of Taï National Park), the German Technical Assistance (GTZ) and the Humboldt University of Berlin. The research group furthermore includes Mr. Prouot Cyr (economist and local consultant to PACPNT), Mr. Koné Inza (PhD student in Biology at the University of Cocody, Abidjan), eleven prospectors in the peripherical zone of the protected areas and two observers covering the urban market sites in the study area.

[4] Hunting in Côte d'Ivoire was forbidden by law in 1974. This prohibition is now under discussion, but game resources in protected areas will continue to be excluded from consumptive utilisation.

the nearby residents of the protected areas, living in the peripheral zones of TNP. They include five different Ivorian tribal groups (Baoulé, Bété, Guéré, Krou, and Wobé) and several non-Ivorian immigrant groups from Burkina Faso, Mali, and Liberia, the latter being refugees from the neighbouring civil war. Their principal source of income is based on agricultural activities, dominated by coffee and cacao plantations and the cultivation of rice.

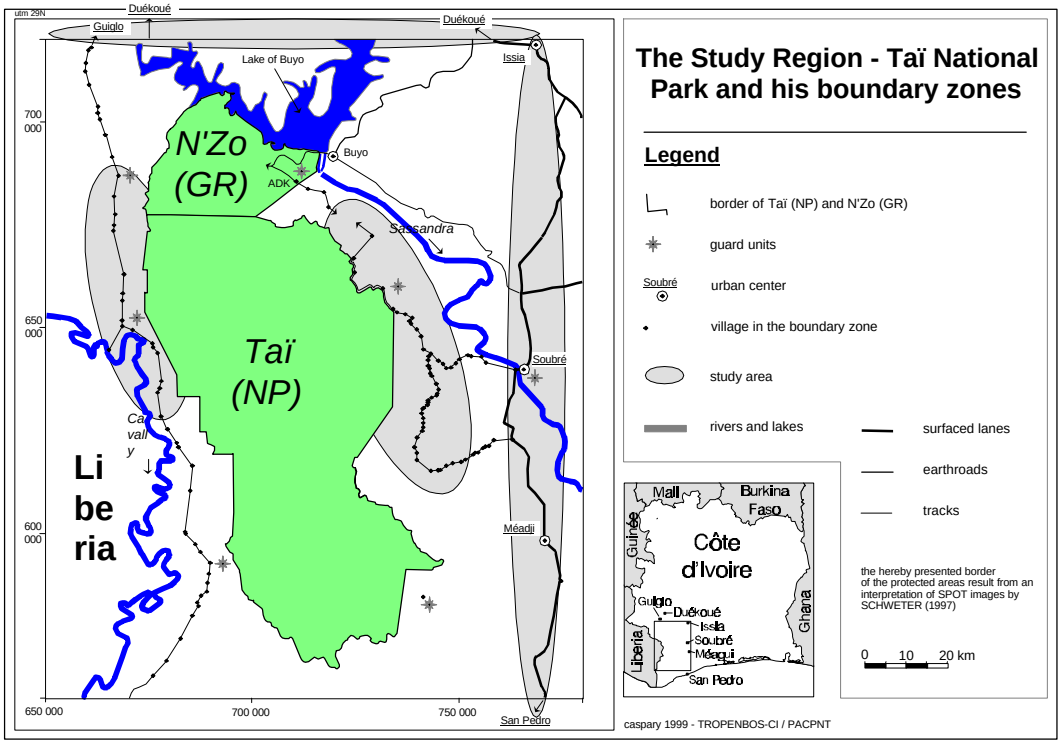

Figure 1 The study area: Taï National Park and peripheral zone

The local population exploits game for its animal protein intake. In addition, they sell hunting products to local and external traders in the informal sector.

Several studies of game exploitation in the tropical African forest zone deal with informal exploitation groups (Fa *et al.*, 1995 in Guinée équatoriale; Falconer and Koppel, 1990 in Ghana; Ziegler, 1996 in Guinée; Steel, 1994 in Gabon). In Côte d'Ivoire, the problem is that hunting and the trade in bush meat and hunting products are actually prohibited. Because of this complex situation, we have used a heterogeneous mixture of quantitative and qualitative research methods in order to obtain information from the local population of the areas surrounding the protected zones. Anonymity of the informants in this context is of utmost importance.

The methodology employed consisted of:

- weekly inventories of game species and the quantities sold in the rural area, including 53 rural bush meat restaurants in eleven different villages and one rural market place in the protected areas peripheral zone;
- weekly inventories of game species and the quantities sold in 70 urban bush meat restaurants located in four urban agglomerations and two urban market places around the protected areas;

- an inventory of the socio-economic characteristics of the market and the parties involved (hunters, restaurant owners, consumers, etc.) in the so-called *filière de viande de brousse* (bush meat marketing chain);
- daily inventories of the number and destination of game species being exploited by ten subsistence hunters from the protected areas peripheral zone;
- examination of local urban and rural people's preferences in bush meat consumption;
- analysis of the game species and the quantities of animals hunted or poached in the protected areas and sold in the peripheral zone (two villages);
- investigation of the ways in which bush meat is transported from the rural to the urban areas and the quantities transferred;
- observation of hunting activities, with a focus on the techniques employed (selective and non-selective), the seasonal characteristics of hunting (calendar of agricultural activities) and the degree of organisation of hunting activities (groups, camps).

Attention was also paid to the role of the different game species in *totem*[5] and to their medicinal uses, as well as to the damage they cause to agriculture. In addition, the available quantities of animal protein from domestic livestock will be compared with those obtained from bush meat.

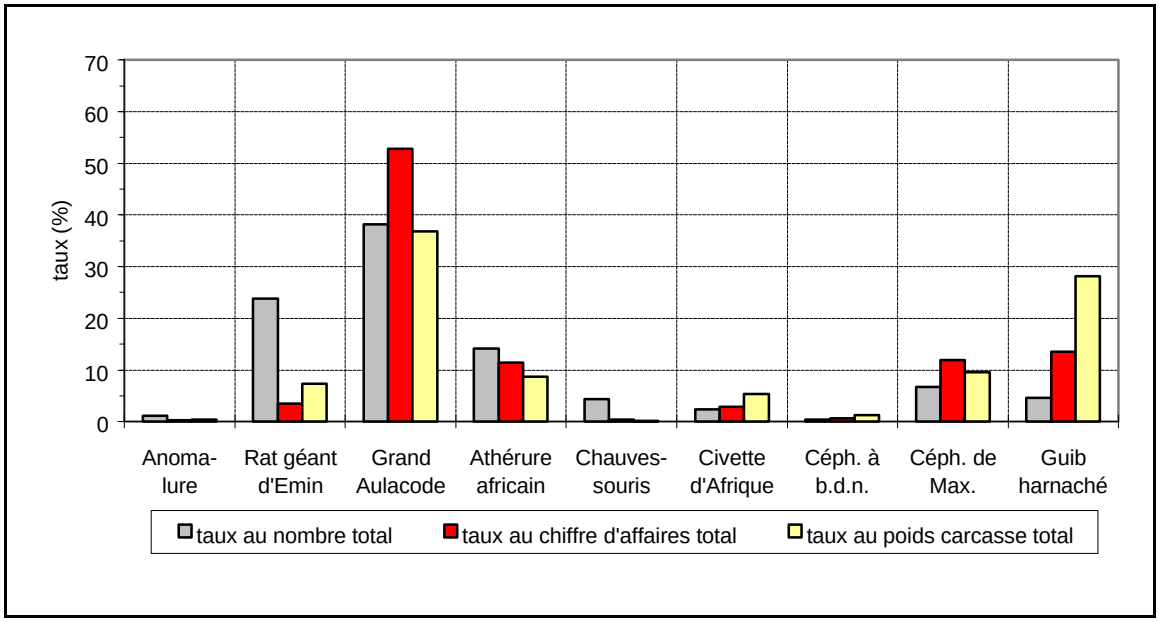

Figure 2 Key species hunted and traded to game meat restaurants in villages neighbouring the Béki Forest Reserve (Southeast Côte d'Ivoire). Source: Caspary (in press).

Anomalure = Pel's flying squirrel; *Rat géant d'Emin* = Emin's giant rat; *Grand Aulacode* = Greater cane rat; *Athérure africain* = African brush-tailed porcupine; *Chauves-souris* = bats; *Civette* = African civet; *Céphalophe à bande dorsale noire* = Bay duiker; *Céphalophe de Maxwell* = Blue Duiker; *Guib harnaché* = Bushbuck.

taux au nombre total = total number; *taux au chiffres d'affaires total* = % of total sales; *taux au poids carcasse total* = % of total slaughter weight.

[5] See Section 3 for more information.

2. INTERIM RESULTS

At the time of writing this article, fieldwork for this study is still going on. The first results will be available by the end of March 1999. We can nevertheless present some major conclusions by reference to a similar study in the more degraded forest zone of southeastern Côte d'Ivoire (Caspary, in press), where we conducted a study into the importance and potential of game utilisation in two forest reserves and their adjacent zones.

The TNP study area is located in the less developed region of Côte d'Ivoire's forest zone. Population density is below the average, the timber industry and agriculture are poorly developed and islands of natural forest do still exist. Species diversity within the group of mammals exploited by subsistence hunters is still high, even outside the protected areas.

In contrast to degraded forest regions (Figure 2), where the range of hunted species is dominated by the greater cane rat, the African brush-tailed porcupine, the blue duiker and the bushbock, hunters in the southwestern region in general trap and shoot all species of primates (including the chimpanzee) and forest antelopes (including the Zebra Antelope and the Jentink's duiker). According to the monthly reports of the *Division Aménagement du Parc National Taï* (PACPNT), the diversity of game meat seized during several anti-poaching controls at TNP (1993 - 1997) is dominated by monkeys (nearly 40 %), followed by all species of the duiker-group (more than 35 %)[6].

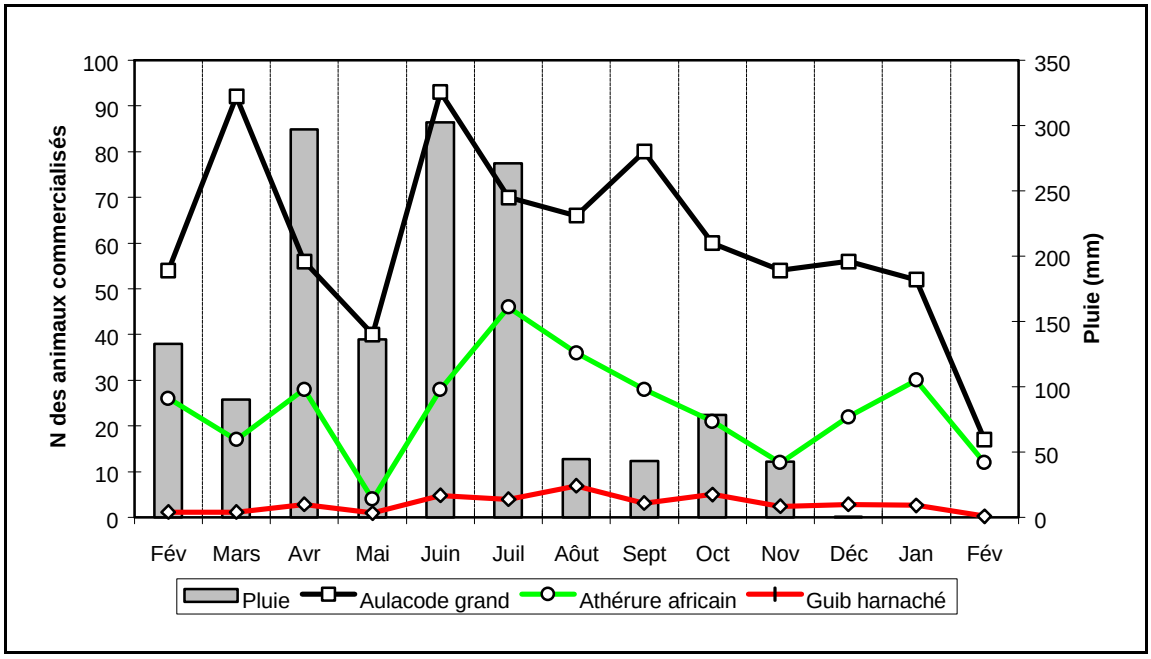

Figure 3 Fluctuations in the intensity of game exploitation – three key species of subsistence hunting in Aniassué (Southeast Côte d'Ivoire) 1996/97. Source: Caspary (in press).

pluie = precipitation*; Grand Aulacode* = Greater cane rat; *Athérure africain* = African brush-tailed porcupine; *Guib harnaché* = Bushbuck

[6] Sources: monthly reports of the *Division d'Aménagement du PN Taï* (PACPNT). The total of the random check (N) is 1,775 individuals.

The exploitation of game resources seems to vary with the intensity of labour input in agriculture, which in turn depends on the region's annual precipitation (Figure 3). Additional factors, like the seasonally increased demand for bush meat in periods of high cash flow (e.g. during the coffee and cocoa harvest), differences in the spatial distribution of tribal groups and the ecological capacity of various habitats, may also determine the output of subsistence hunting and the availability of game for the local population.

3. THE ROLE OF GAME IN FOREST CONSERVATION

For the rural population in the study region and commonly in West Africa, wild game is the main source of meat and supplementary income. The fauna plays an important role in the regeneration of the natural vegetation of both non-exploited and degraded forest habitats. The spatial distribution of a considerable part of the floristic species in tropical forest ecosystems depends on wild animals which feed on forest fruits and thus contribute to the dispersion of seeds. A study on the role of Forest Elephants in the Forest Reserve of Bossematié (Southeastern Côte d'Ivoire) demonstrated their importance as the unique seed distributors of 16 floristic species in this forest reserve (Theuerkauf, 1994). However, the seed dispersal systems rely not only on ungulates and rodents on the forest floor, but also on fruit-eating bats, hornbills and monkeys in the canopy (Martin, 1991).

The inhabitants of West African rain forests have always used game. Their culture is deeply influenced by forest ecosystems and wildlife, and conservation measures are quite common. *Totem*, for example, expresses the prohibition against consuming certain animal species, while the expression *sacred* means that certain areas within the traditional village territory are excluded from utilisation for consumption, such as hunting and slash and burn. These facts should not lead, however, to a romantic view of the local population as the major conservationists of forests and biological diversity. An evaluation of the hunting techniques actually employed in forest zones shows that they are not selective and neglect any idea of a wise use of game resources.

4. THE ROLE OF GAME RESOURCES IN SUSTAINABLE FOREST MANAGEMENT

The question of how the local population perceives the forest resources may shed a light on their potential role in wildlife management. To the rural population, forests are virgin and fertile areas for agriculture. Non-timber forest products like game are considered as cheap and available sources of food. Exploiting these resources is seen as regional rural development. The subsequent ecological degradation is something abstract, becoming real only in the long run. The local population does not at present take it into account.

Sustainable forest management implies controlled utilisation of forest resources according to land-use plans which are useful only if feasible and supported by the local population. The total exclusion of wildlife utilisation for consumption may be a solution for protected areas, but in the peripheral zones of protected areas and on communal lands the utilisation of game resources should be integrated into land-use plans in order to share the potential benefits of the resource with the local population. This may increase the acceptance of measures to prohibit exploitation in protected areas.

Wildlife management which offers an economic benefit to the rural population can therefore contribute not only to sustainable forest management, but also to regional rural development, while disposing people towards the idea of conservation.

5. THE POTENTIAL OF GAME RESOURCES

The economics of wildlife utilisation in the study area are still unknown. In the West African subregion they can be considered at different levels. The macro economic importance of wildlife usage in several sub-Saharan countries is considerable. The annual gross income derived from village hunting (informal sector) in Côte d'Ivoire is estimated at US$ 121 million, whereas the incomes of the formal sector (wildlife tourism) reached only US$ 0.7 million. Similar proportions are known from Burkina Faso, where the formal sector (tourism, breeding, controlled village hunting and trophy hunting) reached a value of US$ 2.9 million, whereas the revenues of the informal sector (poaching and uncontrolled village hunting) were estimated at US$ 33.7 million (Chardonnet, 1995).

A look at the supplementary income derived from the consumption of game resources in small-scale agricultural households in southeastern Côte d'Ivoire shows that the annual income per capita is small. We estimated these incomes at 5,500 F.CFA (US$ 10 or ECU 8) for subsistence hunters and at 185,000 F.CFA (US$ 336 or ECU 308) for professional hunters (Caspary, in press; Dept. of Abengourou; prices in November 1998 values). These estimations should be regarded with caution, as the volume of bush meat consumption in the hunters' households was unknown, so that the true value of game benefits has been underestimated.

Better profits are made by traders and keepers of game meat restaurants. On the basis of a volume of 12,600 animals or 58.33 tons of bush meat sold in 1996, and a total value of 40.33 million F.CFA (US$ 72,018 or ECU 61,106), we estimated that the average annual sales of hunting products in this region averaged 960,000 F.CFA (US$ 1,714 or ECU 1,455) in a typical game meat restaurant. This benefit is comparable to the income of an average agricultural household in the region, which ranges from 600,000 to 900,000 F.CFA when cocoa is the main cash crop and from 450,000 to 1,200,000 F.CFA where coffee is grown (Caspary, in press; Rummel-Shapiro, 1996).

Additional sources of potential income are wildlife tourism, captive breeding, and trophy and recreational hunting, as shown by the experiences in eastern and southern African countries (Swanson and Barbier, 1992). The development of these forms of wildlife utilisation in West Africa is still in an initial phase and offers possibilities to share the benefits of wild game conservation with the local population.

6. CONCLUSIONS AND PERSPECTIVES

An overestimate of the above potentials may lead to excessive utilisation of game resources. The densities of game species are often unknown and determining maximum harvesting rates for controlled village hunting - thus guaranteeing sustainable wildlife use in ecological terms - is therefore hardly possible. The hunting techniques actually employed are not selective, which means that game resources are not being exploited sustainably. Profit-oriented wildlife tourism in

protected areas holds the risk of overestimating the carrying capacity of these often very fragile areas. Profit-oriented trophy hunting can wipe out the large mammals even faster than subsistence hunting. The loss of natural habitats by uncoordinated land use and agricultural expansion is, however, the most common threat to sustainable wildlife management.

These economic utilisation options are out of order in the TNP study area because the region's high protection status.

Both consumptive and non-consumptive utilisation of game resources should nevertheless be discussed for the peripheral zones of protected areas and communal lands. Restrictions have to be imposed when the consumptive utilisation in non-classified areas is in conflict with the regional or national environmental legislation and strategies.

The informal sector's interests in the long-term utilisation of game resources are more significant than is often supposed. Nationwide hunting and trading bans automatically exclude the whole population from the legal benefits of the resource, without consideration of the species hunted and traded. People's sense of responsibility for game resource management is lost if this responsibility is transferred to the national administration. The participation of organised groups (hunters, traders, restaurant keepers) in restricted game utilisation and the transformation of the hidden trade in the informal sector into legalised and transparent marketing simplifies the conditions for a sustainable wildlife management.

Future studies on game utilisation in the region of TNP and the West African subregion should concentrate on:
- the integration of game resource management in land-use and forest management plans;
- the employment of traditional, cheap and selective hunting techniques in order to decrease non-selective hunting;
- captive breeding in order to increase the amount of animal protein available to the local population;
- the dissemination of results of wildlife management research obtained in the more experienced countries of East and Southern Africa; and
- ecological research into the density of game populations and sustainable harvest rates per species.

These aspects should take precedence over aesthetically and romantically motivated biological research, with not only protected areas being taken into consideration, but also degraded habitats and communal lands, which offer a high potential for measures of wildlife management.

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THE POTENTIAL FOR COMMERCIAL NTFP EXTRACTION IN EAST KALIMANTAN

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1. INTRODUCTION

Non-timber forest products (NTFPs) are currently receiving wide attention throughout the tropics. It is increasingly acknowledged that the exploitation of NTFPs can play an important role in the conservation and development of tropical rainforest areas. Sustainable exploitation of NTFPs is thought to be a possible alternative for the non-sustainable forest management currently practised in most of the tropical countries. These products provide food and materials for domestic use, while some of them also provide cash income when traded in local, national or international markets.

The ecological and economic aspects of NTFP exploitation, however, not to mention its social implications, are not well known. A good introduction to the manifold implications of NTFP extraction and study methods can be found in some recent Tropenbos publications (Ros-Tonen *et al.*, 1995; 1998). The present paper focuses on the ecological and economic potential of NTFPs in East Kalimantan.

The study on which this paper is based was undertaken from 1991-1995 as part of the International MOFEC-Tropenbos Kalimantan project based at the Wanariset Research station in Samboja, East Kalimantan. This programme aims to develop appropriate techniques and guidelines for sustainable forest management. It is being implemented by the Indonesian Agency for Forestry Research and Development of the Ministry of Forestry, the Institute for Forestry and Nature Research IBN-DLO, and the Rijksherbarium/Hortus Botanicus, Leiden, in the Netherlands, together with the state forestry enterprises P.T. INHUTANI I and P.T. INHUTANI II.

The aims of the NTFP study can be summarised as follows:
- to provide an inventory of commercially important NTFPs in selected parts of East Kalimantan and to evaluate their economic potential;
- to compare the distribution and abundance of NTFP in various areas in East Kalimantan;
- to study the effects of logging on species composition and NTFP abundance;
- to contribute basic data needed for establishing guidelines for sustainable management of NTFP resources.

[1] The author conducted research from 1991-1995 within the framework of the International MOF-Tropenbos Kalimantan Project when he was attached to the Hortus Botanicus/Rijksherbarium Leiden. He studied the potential of NTFPs in East Kalimantan.

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In order to study the effects of extraction and disturbance on NTFP resources, areas were selected with a traditional land use and unaffected by commercial extraction, as well as areas showing various levels of disturbance and affected by commercial extraction (see Figure 1).

Figure 1 Map of the study area

Remnant forest in the Wanariset area surrounding the research station was studied in detail for soil conditions and tree species composition. A supplementary inventory of rattan was conducted for this study.

The P.T. International Timber Corporation Indonesia (ITCI) concession north west of Balikpapan was selected for a comparison of primary and logged-over forest areas. Research on soil conditions and species composition of trees in permanent plots had already been conducted within the framework of the International MOFEC-Tropenbos Kalimantan project.

The village of Long Sungai Barang in the Apo Kayan 'provided' undisturbed forest in an area with a traditional land use unaffected by market demands. The site was formerly the location of a Man and Biosphere project and social aspects and the ecology of shifting cultivation had already received special attention. For detailed information on the methods used, see van Valkenburg (1997).

2. THE PROBLEM IN A BROAD PERSPECTIVE

The forests of East Kalimantan harbour a great diversity of plant species. The composition of their tree species in general, and of rattan and other NTFP species, in particular, is heterogeneous. Species abundance also varies greatly. This heterogeneity is the cause of regionally differing possibilities for development.

The immense species richness of tropical rainforests may contain a wealth of (potentially) economically important plants, yet at the same time limits the potential of extraction, because of the generally low density of individual species (e.g. Plotkin and Famolare, 1992; LaFrankie, 1994). The economic potential for oligarchic forests, which contain fewer species, may therefore in general be higher (Peters and Hammond, 1990; Nepstad and Schwartzman, 1992). For this reason, virtually all plantation systems, in both temperate and tropical regions, focus on a very limited number of species.

In spite of ecological constraints, NTFP extraction from natural forests was claimed to be the economically most competitive land use for Peru by Peters *et al.* (1989). In Ecuador, too, the Net Present Value (NPV) was found to be much higher for NTFP extraction (US$ 1,257-2,539) than for timber extraction (US$ 180) or agriculture (US$ 500), with a Net Annual Value of US$ 63-136/ha. (Grimes *et al.*, 1994). Under present-day economic conditions, however, the assumption that NTFP extraction leads to forest conservation can hardly be validated (Fearnside, 1989; Lawrence *et al.*, 1995; Siebert, 1991).

Manipulation of the forest results in considerably higher yields. This type of management can be limited to selectively promoting favoured useful plants within the primary forest (Anderson, 1990) or planting rattan in logged-over forest (personal observation). A more intensive management type is enrichment planting in fallow vegetation, resulting in rattan, rubber or fruit gardens. What all these management systems have in common is that they preserve the biotic and physical aspects of the forest environment, with a high species diversity and with trees as a major structural component (e.g. Alcorn, 1984; Padoch and Peters, 1993; Sardjono, 1990; Torquebiau, 1984). The integration of cash crops in the swidden cycle, or as a simultaneous activity of shifting cultivators, with the enriched fallow being maintained as such, has been reported for Kalimantan, Sulawesi and Sumatra from as early as the beginning of the 19th century (Donner, 1987; Dove, 1993; Weinstock, 1983).

NTFP extraction from natural forest is an economically feasible land-use option only if the real environmental costs of development, such as soil erosion and loss of watershed protection are included (Nepstad and Schwartzman, 1992). Economic valuation is often obscured by direct or indirect subsidies and import taxes, as in Indonesia for the timber industry (Nepstad and Schwartzman, 1992) and in Brazil for rubber prices (Fearnside, 1989). The same political instruments of subsidies and import/export taxes may well be used to strategically preserve natural forests.

Social and economic aspects also determine the feasibility of NTFP development. Fluctuating prices influence the management of NTFP resources and have social implications. Rising prices of rattan, for instance, resulted in an influx of 'outsiders' demanding access to the rattan gardens in the middle Mahakam area (Weinstock, 1983). The high prices of gaharu (*Aquilaria* spp.) resulted in an influx of 'outsiders' in the Apo Kayan, thereby jeopardising the resource and depriving local inhabitants of future harvests (van Valkenburg, 1997).

The extraction of NTFP is rarely a full-time occupation. It is only part of a multiple economic strategy of people in rural areas. It provides for both subsistence needs and cash income (e.g. Browder, 1992; Denevan and Padoch, 1987; Pierce-Colfer *et al.*, 1992). People respond to changing needs and possibilities and base their choices on past experiences, choosing what they consider the most profitable option (Vayda *et al.*, 1980; Kartawinata and Vayda, 1984; Pierce-Colfer and Soedjito, 1988). When prices for rubber decrease, a Brazilian rubber tapper family's cultivated land area will increase (Browder, 1992). By contrast, a boom in rubber prices in West Kalimantan does not necessarily result in a change of labour allocation from rice cultivation to rubber tapping, as rice cultivation remains the main priority (Dove, 1993). However, a harvest failure or increased consumption needs may result in increased rubber tapping. In Pasir, East Kalimantan, the time devoted to rice cultivation, rattan gardens and coffee, was influenced by the remaining stock of rice and prices for rattan and coffee (Mayer, 1989). Moreover, as the economic welfare of people rises, the importance of NTFP extraction in providing a cash income in general decreases (Siebert and Belsky, 1983; Godoy and Bawa, 1993). Using NTFP extraction as an instrument for improving the economic welfare of rural people may thus lead to a fall in NTFP extraction in the long term.

The above aspects demonstrate that any development of NTFP extraction needs to be evaluated in environmental as well as in social and economic terms. The choice for a given land use will depend on the local situation.

3. RESULTS

3.1 Present land use in East Kalimantan: some examples

The economic value of NTFP extraction has to be compared with other land-use systems in order to judge its economic potential. Land-use systems that mimic the structure and species diversity of natural forest are judged to be most favourable. In the present study only land-use systems with a low external input and trees as a major structural component have been included.

Various methods have been used to calculate the Net Present Value (NPV) of a given land use and all have their limitations. The calculation of the NPV of NTFP extraction with multiple harvests at irregular intervals, in particular, poses problems. A formula based on a summation of annual returns and costs has to be used[3]. In this formula, R is the gross revenue, C stands for the total costs, t is the time in years, and r is the real discount rate, a factor influenced by the interest rate (see e.g. Filius, 1992). Another formula used in some of the often cited articles on valuation of tropical rainforest is NPV=Net Value/(1-e^{-rt}), where Net Value stands for gross revenue minus total costs, r is the real discount rate, a factor influenced by interest rate, and t is the

[3] $NPV = \sum_{t=o}^{end} (R - C)_t \left(\frac{1}{1+r}\right)^t$ (R: revenue; C: costs; r: real discount rate; t: year of rotation)

rotation length in years (e.g. Peters *et al.*, 1989; Grimes *et al.*, 1994). This method can be used for land-use systems with a single harvest at the end of the rotation and the formula equals NPV=NAV/r for land-use systems with constant annual returns. However, the rotation cycle of the various land-use systems differs. To compare these systems, the NPV is multiplied by a Capital Recovery Factor that is related to the length of the rotation cycle (Gittinger, 1973). This results in a Net Annual Income value.

The direct costs and benefits of the harvesting can be quantified, but the environmental costs of a certain land use are more difficult to quantify. What are the costs of a loss in water retention capacity, soil erosion, decline in downstream fish populations and a loss in subsistence products formerly collected from natural forests? These long-term environmental costs are probably much higher than the present-day financial gain. The logging practices in East Kalimantan changed the forest structure in large areas and made these forests more susceptible to fire (Schindele, 1989). The devastating fires in 1982/1983 seriously affected people's livelihoods, their impact on the environment was immense, and the total costs to the national economy amounted to US$ 9.075 billion (Schindele, 1989). Serious fires again raged through extensive areas of East Kalimantan in 1991 and 1994, the same areas that had also been affected by the 1982/1983 fires. Finally, the 1997/1998 fires raged through large tracts of forest in East Kalimantan and various other provinces of Indonesia. The direct costs and loss of revenue for the Indonesian economy have been estimated at US$ 5-6 billion (CIFOR, 1998).

Table 1 Comparison of the economic aspects of various land-use systems with trees as a major structural component (values in US$; Env. costs = environmental costs, i.e. loss of watershed protection, erosion; increasing from + to +++) (for more details see van Valkenburg, 1997).

	Rotation (years)	**NPV***	**@NPV (r = 10%)**	**Net annual income/ha r = 10% #**	**Env. costs**
Kalimantan					
Timber 1st harvest		4,250	160	(17)	+++
Timber 2nd harvest	35	2,116	80	(8)	+++
Multiple extraction forestry		460	42	(46)	+
Rattan plantation periodically flooded		500		224	++
Rattan plantation Barong Tongkok	30		65-140	(7-15)	+
Traditional home garden		500-1,500	45-35	(50-149)	+
Illipe plantation	60		480	(48)	
Improved home garden	60				+
After 20 years			241-1,081	(28-127)	+
After 60 years			778-1,473	(78-148)	

* For annual yielding systems: Net Present Value = Net Annual Value / r (r = real discount rate; for East Kalimantan r = 10%).

* For non-annual yielding systems: Net Present Value = Net Annual Value / $1\text{-}r^{\text{-}rt}$ (for East Kalimantan r = 10%, t = rotation time in years).

@NPV: for timber, revenue and costs forced to last year.

In parentheses: Net Annual Income = @NPV * CRF (Capital Recovery Factor)

$$@NPV = \sum_{t=o}^{end} (R - C)_t \left(\frac{1}{1+r}\right)^t$$ (R: revenue; C: costs; r: real discount rate; t: year of rotation)

The economic aspects of present land-use systems with low external input and trees as a major structural component are summarised in Table 1. As in Sarawak and South America, besides ecological constraints, the possibilities and costs of transport are key factors in determining the

economic feasibility of a land-use system (Burgers, 1991; Nepstad and Schwartzman, 1992; Denevan and Padoch, 1987). Because of the perishable nature of the products, mixed fruit gardens will be confined to areas at close proximity to the market. Whereas rattan gardens, although less profitable per unit of land, will be a viable option for more remote areas. Subsidies or favourable loans, however, are a decisive economic factor in the establishment of rubber gardens and pulpwood plantations (e.g. *Paraserianthes falcataria*).

3.2 Management options in East Kalimantan

The land-use systems found in East Kalimantan, combined with the economic, ecological and social constraints, were factors in the appraisal of the potential of various NTFPs (Table 2). This potential can be translated into various land-use options, which are presented in order of gradually increasing management input and reduced species diversity. The environmental costs are most favourable for (managed) nature reserves. A common feature of all land-use types is that trees are the major component of the system.

Table 2 Potential for development of various non-timber forest products in East Kalimantan (++ = very good; + = good; - = poor)

	Rattan	**Fresh fruits**	**Illipe**	**Exudates** (excl. *Hevea)*
World market	++	-	++	-
Local market	+	++	-	+/-
Storage	++	-	+	+
Regular (annual) supply	++	+/-	-	++
Large plantations	++	-	++	-
Smallholder management	++	++	++	+/-
Labour allocation	++	+	+	++
Incorporation in swidden cycle	++	+	-	-
Human / livestock consumption	-	++	++	-

Source: van Valkenburg, 1997

3.2.1 Nature reserves

The establishment and preservation of nature reserves in the strict sense (IUCN *et al.*, 1991), excluding any human interference, will be of very limited geographical extent. For historical, social and practical reasons, the participation of the local people in park management is to be preferred. The traditional collection of forest produce often has a long history and has, in general, not severely threatened the forest. Acknowledgement of the controlled traditional harvesting rights of local people will strengthen or maintain their commitment to preserving the resource for future use. If local people do not feel responsible for the forest, protected areas will have little future.

As nature reserves cannot be considered in isolation from local (subsistence) agricultural practices, these should be included in an overall conservation and development plan. Leases or stewardship arrangements between rural communities and the government could serve as a tool. Local communities must clearly receive direct or indirect financial compensation for preserving forest areas that might otherwise be converted into a land use that is financially more profitable in the short-term. Intensification of the present land use may well be a means of reducing the pressure on the remaining forest land (Lawrence *et al.*, 1995; Browder, 1992). Involvement of the local community and strict enforcement of stewardship regulations is essential to prevent

further encroachment on the remaining forest. Besides traditional harvesting rights and security of tenure, reciprocal benefits for indigenous people should also be considered.

The NTFPs of highest economic importance in East Kalimantan are rattan, fresh fruits and exudates. If these were to be included in a combined extraction model for nature reserves, the Net Annual Income would amount to US$ 46/ha in primary forest in the Apo Kayan (van Valkenburg, 1997). The economic feasibility of rattan collection depends on transport costs. Harvesting rattan is ecologically sustainable as long as the vitality of clumps is not damaged and the resource is given sufficient time to recover (van Valkenburg, 1997). Fresh fruit harvesting is an economically realistic option only for areas with markets at close proximity.

This combined extraction can be considered equivalent to the High Diversity Forestry as proposed by LaFrankie (1994). This multiple-product extraction scheme very much resembles the traditional hunter-gatherer system with minimal manipulation of the forest. By combining harvests, the search time for each product can be reduced, thereby avoiding the economic drawback of high diversity and low density of individual species. Whereas LaFrankie assumes the simultaneous extraction of various products in order to reduce the high costs of searching per tree, a combination of fruit and rattan collection is most unlikely. The projected return depends on the species composition of the forest and distance to nearby markets and will therefore vary considerably between areas.

3.2.2 Integration of NTFP production in commercial forest estates

As producing timber is the primary goal of a commercial timber estate, NTFP production should not interfere with timber production. NTFP production might be achieved by using multi-purpose tree species or by combining timber and NTFP-yielding species.

Using multi-purpose tree species for enrichment planting in the present TPI[4] rotation of 35 years is probably most profitable if *Shorea* species yielding illipe fat are used (van Valkenburg, 1997). The trees produce a good quality timber and there is a well-established market for illipe fat. Either the concession holder or a subcontractor could harvest the nuts. A complicating factor is that a concession holder is not officially allowed to fell *Shorea* trees yielding illipe nuts, so he will be disinclined to plant these species if he cannot obtain a permit to fell the trees.

Combining the production of timber and resin or latex is complicated for two reasons. Tapping of resin and latex competes with tree growth as it competes for nutrients and may lead to disfigured trunks (Torqeubiau, 1984). Secondly, extraction would require permanent access by the tapper, thereby causing permanent disturbance and problems with enforcing trespassing regulations.

Combining timber with fruit production would limit the choice of fruit species, as it precludes small and medium-sized species. It also faces problems with both harvesting and marketing of generally perishable fruits. Control of trespassing is difficult. Enrichment planting with trees specifically for fruit production gives a wide variety of species that can be used, but problems with harvesting, marketing and control of trespassing remain.

Mixing timber and large diameter rattan in a 35-year rotation has several management advantages. Extraction of rattan should take place prior to timber harvesting and the same

[4] TPI (Tebang Pilih Indonesia) is selective felling according to Indonesian regulations, based on a 35-year rotation scheme

infrastructure could be used. Harvesting is conducted in strictly defined periods, facilitating control. The quality of the canes should be good, considering the length of rotation and the scheme.abundance of support trees. Each cane can be expected to yield eight three-metre lengths, representing a value of Rp. 4000 (or US$ 2). The large diameter canes are used in furniture making and constitute the basis of the Indonesian rattan industry.

3.2.3 Integration of NTFP production in village or community forestry

At present, logged-over forest areas with no commercial prospects for the concession holder are designated as conversion forest, either as pulpwood plantations or transmigration projects. These areas could be leased or handed over to local communities on the condition that the forest cover is maintained. This would open up prospects for enrichment planting with rattan, fruit trees, illipe species, or other useful trees. This may well be designated as secondary high diversity forestry, the environmental advantages of which are obvious.

Boosting rattan production is good for the national economy, especially for employment. The production of small diameter rattan is to be preferred, in view of the shorter time-span between planting and the first harvest (7-10 years). Success is dependent both on enforcement of the regulations and the creation of markets for the produce. Management and the sale of produce from these communal forests could be organised through the already widely established co-operative system in Indonesia.

Land-use systems incorporating NTFP are already well established in Kalimantan. As stated above, mixed fruit and illipe/tengkawang gardens have a long history in East and West Kalimantan, while rattan gardens are well-developed in areas of South and East Kalimantan. However, there are possibilities for improvement of these existing systems, as will be discussed below.

3.2.4 Optimising NTFP production in a new agroforestry system

An agroforestry system could be created with a canopy of large fruit trees (100 ha^{-1}) and a second layer of medium-sized, shade tolerant fruit trees (100 ha^{-1}). The core of 200 trees per hectare leaves ample space for additional plants.

For the canopy, a selection can be made of illipe species (e.g. *Shorea macrophylla, S. pinanga*) *Artocarpus integer*, *Durio zibethinus*, various *Mangifera* species and *Parkia speciosa*. Suitable shade-tolerant fruit trees include *Baccaurea* spp., *Dimocarpus longan*, *Durio kutejensis*, *Lansium domesticum* and *Nephelium lappaceum.* The balance of species will vary according to market possibilities and ecological and social constraints. The shade-tolerant fruit trees start producing after five years. After ten years the 'canopy' trees will have overtopped the small fruit trees and cempedak (*Artocarpus integer*) and durian (*Durio zibethinus*) trees will start producing. Finally, the first illipe harvest can be expected after twenty years.

The Net Annual Income from just 200 core trees could range from US$ 28-127 after twenty years to US$ 78-148 after sixty years, at present price levels and a real discount rate of 10% (Table 1). After sixty years a decision can be made to fell the canopy trees gradually for timber or maintain the trees for fruit production.

The problem with this proposed man-made forest is, of course, whether people are willing to invest in such a long rotation system. The system reaches its highest production at a time when the person who planted the trees has probably died.

3.2.5 Pitfalls

Promoting the extraction of a NTFP may result in over-harvesting and a drop in prices. This poses a threat to the ecological and economic sustainability and has negative effects for the collectors as well. Diversification to reduce the dependency on a limited number of NTFPs is the solution (Nepstad and Schwartzman, 1992). This applies both to the dependency on rubber and Brazil nut in South America (e.g. Daly, 1990; Kainer and Duryea, 1992) and rattan in Southeast Asia (e.g. Godoy and Tan, 1991). The proposed improved mixed fruit home garden (see above) is an example of such a product diversification strategy.

A further emphasis on species with, at present, a good commercial value may pose a threat to other indigenous fruit species or varieties that will no longer be planted or replaced. The wealth of genetic diversity of indigenous fruit trees that has so far been preserved in traditional Dayak home gardens (Bompard and Kostermans, 1992; Padoch and Peters, 1993; Seibert, 1989) is at stake. This will limit the future potential for crop resistance breeding, an acknowledged problem for cultivated plants and livestock worldwide.

All the possibilities for and constraints on the development of NTFPs described in previous paragraphs depend on one simple issue of paramount importance: who owns the land or its produce? Without vested tenure rights, nothing can be developed. This is a vital issue in the development of sustainable NTFP extraction worldwide.

Traditionally, the ownership of plants in Dayak societies does not necessarily coincide with ownership of the land (Chin, 1985; Weinstock and Vergara, 1987). This clearly contrasts with the western concept of land tenure, under which the ownership of plants cannot be alienated from land tenure rights. The present Indonesian legal system therefore gives rise to conflicts in Borneo. Furthermore, the forest management systems as practised by Dayak people are often deemed to be non-existent, since no agricultural crop has been planted.

Formerly, the harvesting of NTFPs such as rattan, gaharu and damar was regulated by the village community (Chin, 1985; Jessup and Peluso, 1986; Weinstock and Vergara, 1987). Now, however, the granting of harvesting rights has more or less become a function of the state, which complicates matters even more. Coordination between the various departments which grant permits is often lacking and enforcement of the regulations is difficult, because of understaffing (Nepstad and Schwartzman, 1992; Pierce-Colfer *et al.*, 1992).

Problems caused by harvesting regulations play an important role in the proposed combination of timber and NTFP production in timber estates.

4. SOME IMPLICATIONS OF THE FINANCIAL CRISIS AND THE IMF AGREEMENT

The management options and the financial picture presented above are based on the situation up to 1997, but the 1997 and 1998 forest fires and the financial crisis that hit Indonesia in 1998 have greatly altered the picture. The IMF agreement that was negotiated has had a considerable impact on forest policy and regulations.

The export ban on rattan imposed in 1988 will be replaced by an export tax reduction on raw and semi-processed rattan from 30% *ad valorem* to 20% by December 1998, 15% by December 1999 and 10% by December 2000. Simultaneously, an inter-island tax equalling this will be introduced to prevent smuggling from the country. This will most likely induce a rise in prices

for collectors and promote quality control. One problem, however, is that large areas of forest in the Mahakam catchment area and its tributaries - traditional sources of the bulk of rattan from East Kalimantan - have been severely damaged by the recent forest fires, most likely resulting in a severe reduction of the standing stock. This again will give rise to higher prices and over-exploitation of the resource, a problem common to 'free-for-all' resources that gain temporary economic importance.

The export ban on logs has been replaced by an export tax regime similar to rattan. Whether this will encourage sustainable management is doubtful. Another policy change imposed through the IMF loan agreement is the reduction of land conversion targets to environmentally sustainable levels and the implementation of a system of performance bonds for forest concessions. This implicitly contains the admission that present-day practice is non-sustainable. At the same time, restrictions on foreign investment in palm-oil plantations have been removed and the government has replaced the export ban on palm oil with an export tax of 40% as of April 1998, possibly to be reduced in the future to 10%. This may well stimulate the conversion of permanent forest land to oil palm plantations, which is an effect obviously contradictory to the aim of reducing land-conversion rates to sustainable levels.

5. CONCLUSION AND PERSPECTIVES FOR FUTURE RESEARCH

The present-day management of permanent production forest areas of East Kalimantan is far from sustainable. This applies equally to its ecological and its economic and social aspects. The widespread 1997-98 forest fires once again exemplify this, whatever the actual cause of the fires in particular localities.

If short-term economic gain at the local level is a guideline for land-use planning, then the extraction of NTFPs from primary forest areas (at a Net Annual Income of up to US$ 46/ha) in East Kalimantan is not economically the most competitive land use (see Table 1). If, however, watershed protection, erosion control, biodiversity conservation and other environmental services are given a financial value, it is an economically viable option from a national and regional perspective, although not for individual landowners or users.
Leaving forest areas intact for the future may well prove to be more profitable in the long run, as pristine areas will become increasingly scarce. The value of technically irreplaceable assets will be appreciated or felt only when they are no longer there.

As forest concessions have already been granted and vast areas consist of logged-over forest, consideration should be given to the best possible land use for these areas. This would definitely not be a conversion to plantation forests of fast growing tree species such as *Paraserianthes falcataria*. An enormous loss of biodiversity would be the result and these plantations are virtually void of rattan, an NTFP of great importance for employment in Indonesia. Furthermore, the sustainability of this land use is doubtful, in view of the removal of large amounts of nutrients after each rotation and the susceptibility of monocultures to pests. Present-day mechanical logging is too destructive, but can be improved ecologically without negative economic effects (e.g. Hendrison, 1990). These logged-over areas can be preserved as permanent production forest and used to boost the production of large-diameter rattan and illipe (*Shorea* spp.). The high labour input required for harvesting and processing is especially important for employment in rural areas. Apart from these commercial forest estates, the potential for enrichment planting in disturbed habitats involving local populations appears promising. The traditional agroforestry systems could well be improved, or even expanded, by including depleted permanent production forest.

Sound management of the Indonesian permanent forest land plays a pivotal role in poverty alleviation, even in the midst of the present crisis. Forest land is a key source of income for millions of people in remote areas, generating employment for millions of Indonesians working in the forest-related sector. Forest-derived foreign income ranks third behind oil/natural gas and textiles. The importance of maintaining forest for health care should also not be underestimated.

Future research should be geared towards integrated forest management, including both timber and non-timber resources. For optimum management, more knowledge is needed of the ecological requirements of the species involved. On the basis of the species' ecological requirements, economic and social considerations will further shape the management regime. This may well differ considerably between large commercial timber estates and forest areas under participatory forestry. Some form of state control and a more refined forestry law are essential for the viability of such a system.

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TAKING NON-TIMBER FOREST PRODUCTS OUT OF THE FOREST: MANAGEMENT, PRODUCTION AND BIODIVERSITY CONSERVATION

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1. INTRODUCTION

Central to much of the discussion on non-timber forest products (NTFPs) is the proposition that their commercialisation will lead to the conservation of biodiversity. More precisely, this proposition claims that commercialising NTFPs from tropical forests will increase the value of these forests. If sufficient amounts of such products can be sold, the forest will deliver a return value that is higher than the value of alternative land uses. People dependant on the forest, who would otherwise have converted the forest for such alternative land use, will refrain from doing so, as they will be more interested in the returns they can obtain from harvesting forest products.

This proposition poses several questions. Firstly, it is quite a difficult task to generate incomes that are attractive to possible forest product harvesters. Most forest products have a low retail value that often does not compensate for the alternative incomes that have been foregone. Some people have argued that taking a long-term perspective favours the NTFP option, as the net potential value is higher if NTFP incomes are included in the calculations (Peters *et al.*, 1989; Balick and Mendelsohn, 1992). Several of the studies in which this point has been made are seriously flawed, as they use discount rates that are unrealistic for agents that have few other options than, for instance, cutting forest to make fields for crops. They have neither taken into account simple supply and demand interactions nor the effects these have on prices. Commercial dependency on animal species appears to have a higher conservation effect than dependency on plant species, but single species commercialisation has a lower conservation impact than economic activities that depend on entire ecosystems (Salafsky and Wollenberg, 1999). Another problem with the NTFP commercialisation-conservation proposition is the uncertain access to and ownership of forest resources. For instance, Dove (1993; 1994) has argued that, as a rule, economically and politically powerful agents will claim forest products that become economically attractive and take over the trade in these products. The relative benefit to primary forest collectors will be minimised, reducing the incentive to prevent forest conversion for other purposes. Many of the early discussions on forest conservation through income generation from NTFPs were related to safeguarding such forests for benign NTFP users. One example is the case of rubber tappers in Brazil, who claimed the forest for themselves, while keeping away large cattle owners who would have destroyed the forest (Arnold and Ruiz Perez, 1998).

The first problem we have with the commercialisation-conservation proposition is related to the historical cycle of economically successful NTFPs (Homma, 1993; 1996). This historical cycle

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theory predicts that initially, when the product is being discovered, an expansion phase starts because of increasing demand. During the subsequent stabilisation phase, supply and demand balance at the point of maximum extraction capacity. The decline phase that follows is the result of a declining resource and a related increase in extraction costs. When demand surpasses supply and prices increase, there is a strong incentive to increase supply through cultivation or the production of substitutes. Production usually means lower costs to obtain the products through higher returns on land and labour. Otherwise, synthetic substitutes will be developed, where technologically possible. Many examples, such as rubber or, more recently, palm heart, confirm this historical cycle.

The historical cycle proposition may be criticised for being too simplistic and it may be presented more generally. Economic actors will seize the opportunity offered by the booming NTFP, but they will try to minimise their costs and optimise their returns. Often this will include the production of the marketed forest product in managed forests or plantations. In other cases, such as Brazil nut exploitation in Bolivia and Brazil, production in plantations is not cheaper than collecting products from the forests. 'Investments' to take over control over the resource base to the exclusion of local forest dwellers can also be looked upon as an income-optimising action.

The next problem with the commercialisation-conservation thesis, related to the historical cycle theory, lies in the agricultural transformation proposition. In the vast majority of cases where NTFP commercialisation is an option, it is combined with production for household consumption. This kind of low-technology cash cropping allows for limited economic growth in communities, without any drastic change in the organisation of production. Subsequent stages in agricultural transformation may take many different forms. These may be endogenously driven, for instance, when the better-off farmers benefit from new opportunities offered by agricultural extension agencies. These opportunities are in most cases meant to improve overall agricultural production, rather than to equitably raise the welfare of the entire farmer community. Better-off farmers will start competing, or simply appropriate land at the expense of the poorer farmers. The poorer farmers will then have no alternative but to move to the city or move forward to the agriculture-forest frontier areas (e.g. Assies, 1997). In other scenarios, large investors will develop estate agriculture, after acquiring the land on which small farmers operated. The small farmers either become poorly paid labourers or again move on to the city or the agriculture-forest frontier (e.g. Potter and Lee, 1989).

When household consumption is combined with low technology cash-cropping, some NTFPs are usually still collected for household consumption or may still be harvested for commercial purposes (e.g. de Jong, 1998; 1995; Smith *et al.*, 1998; Brookfield and Padoch, 1994). As a rule, NTFPs contribute a smaller part of the household cash income even where important NTFP industries are present. Only if commercial cash cropping is not possible, may NTFPs contribute the larger share of cash incomes (e.g. Wollenberg, 1998). In other examples, NTFPs may have become the important cash crop, for instance, among the many small-scale rubber producers in Indonesia. Once farmers move to the ranks of private commercial producers, they give up collecting NTFPs from the wild. The same holds true for agricultural change that is the result of estate agriculture promoted from outside. On the other hand, the less fortunate farmers who have been pushed to the agriculture-forest frontier will continue to rely heavily on NTFPs. Commercialisation of NTFPs may induce agricultural transformation, but when agricultural transformation takes place, the role of NTFPs will diminish significantly.

It can be argued that the commercialisation-conservation proposition is inadequate in predicting what will happen once NTFP commercialisation occurs, because it fails to take into account

either the historical cycle proposition, or the agricultural transformation proposition. It ignores the fact that successful NTFP commercialisation will cause changes in how the forest products are procured, as well as in who will engage in such procurement and under what circumstances. If we assume that these changes will happen, the conservation effect of NTFP commercialisation may be more or less effective.

This paper argues that there is still reason to maintain the conservation-commercialisation proposition, but that it needs reformulation. The commercialisation of NTFPs from natural forest and the subsequent conservation effects it may have will, in most cases, eventually be replaced by some kind of alternative procurement, whether through local forest or species management or through the planting of species in forest gardens or plantations. Such alternative procurement may follow different pathways with varying conservation effects.

This paper describes Dayak forest management research conducted between 1992 and 1995. It will report on diversity in Dayak-managed forests, the processes of change in forest management and their causes, and the various options for agricultural transformation, including NTFP development schemes, and their implications for the conservation of biodiversity. The paper ends by putting forward a new version of the NTFP commercialisation-conservation proposition.

2. DAYAK FOREST MANAGEMENT RESEARCH IN WEST KALIMANTAN

The study on Dayak forest management was conducted in the sub-district of Noyan, West Kalimantan, Indonesia. Others, e.g. Padoch and Peters (1991), had already reported on extensive local forest management. Based on this, the hypothesis was put forward that such forest management, if adjusted with improved management techniques, could improve people's income and contribute to tropical forest conservation. Research was conducted in collaboration with a number of local partners, including Tanjungpura University in Pontianak (Roslinda, 1994; Rosnani, 1996; Ramadatun, 1996; Sahid, 1995), Dian Tama - a non-governmental organisation that attempts rural development through the elaboration and application of appropriate technology, including NTFP development (de Jong and Utama, 1998; Utama *et al.* 1999) - and the Social Forestry Development Project, a GTZ-funded project in the district of Sanggau (Graefen and Syafrudin, 1996).

The study area, the sub-district of Noyan, is inhabited largely by *Maté-maté* Dayak, a linguistically separate group of what are identified as *Bidayuh* or Land Dayak. *Bidayuh* is a generic term used for the many linguistic groups that inhabit the south of Sarawak and the Indonesian province of West Kalimantan as far south as Ketapang (King, 1995). These groups traditionally grow rice in annually cleared upland swiddens (areas of slash and burn). Many of them have adopted rubber production to obtain cash for buying manufactured goods. Beside rice and rubber production, many West Kalimantan Dayak inhabitants depend on forest products that are obtained from mature natural forests or from several types of managed forests. de Jong (1995) reported six types of managed forests among villagers in the Noyan sub-district, including communally protected areas of mature natural forest, privately-owned plots of the same forest, extensively managed forest garden, or *tembawang*, rubber gardens, and secondary forests.

The area in which the research was conducted, was given out as a forest concession, but was never logged, because of the quite profound impact of local agriculture. An area of about 100,000 ha, including most of Noyan sub-district, has been designated as a Participatory Forest

Management Area (PFMA). The PFMA is a model concession for participatory forest management on state forest land. Less than half of the PFMA is still under mature natural forest. It has a population of 17,000. A Social Forest Management Association is to represent the village inhabitants and eventually will be declared the autonomous ruling body over this area of forest land. The association will be accountable to the Ministry of Forestry (de Jong and Utama, 1998) and manage the area on the basis of an agreed management plan. The main activities of the association in the PFMA are the reforestation of areas under *Imperata* grassland or swidden fallows, the improvement and commercialisation of existing agricultural and agroforestry systems, and the sustainable harvesting and sale of forest products (Yayasan Dian Tama, 1993; de Jong and Utama, 1998).

Figure 1 The study area

3. DIVERSITY IN MANAGED FORESTS

The historical cycle of extractive economies, as proposed by Homma, predicts that when there is a wide demand for NTFPs, they will eventually be produced on plantations or reproduced synthetically. This is a response to the basic economic rule of increasing or sustaining profits while reducing costs and is no different among swidden agriculturists, who have to rely on the forest for much of their livelihood. The yield from products that are economically important can be increased or sustained through various kinds of intervention. An example of such an intervention would be the release of individuals of required species, limiting the number of clumps of stems of species that yield products. This is, for instance, the case with sago (*Erythroxylon sago*, de Beer and Mcdermott, 1989) or some palm heart species (*Euterpe precatoria*, Anderson, 1990). Another measure to sustain desired NTFPs would be to exclude others from the resource through some kind of tenure.

Under some circumstances, a more proactive intervention may be chosen to increase or sustain NTFP supply. Such practices may include a large number of measures. Species may be planted in the forest, as happened with *raicilla* (*Cephaelis ipecacuanha)* in several countries in Central America (e.g. Salick, 1995), or rubber and many other species planted by Dayak farmers in West Kalimantan. More widely known are several examples of managed forests that are to some

extent the result of encouraging the growth of species through tending or planting. In most cases, these are established after previous use of the land as a swidden. Managed swidden fallows from many South American countries are prominent examples (Denevan and Padoch, 1987; de Jong, 1996), as are several types of managed forests to be found among farmers in several countries in Southeast Asia.

Many forests that have experienced human intervention, or that that have developed around the framework of planted trees (van Noordwijk *et al.*, 1997) have a structure and species composition that compare favourably with that of mature natural forest. This can be appreciated, for instance, when one looks at the structure and composition of *tembawang;* a type of managed forest among many Dayak groups in Kalimantan. The concept of *tembawang* is used differently under different circumstances and in different parts of the island. It is a biophysical as well as a socio-cultural phenomenon. Dayak people have the habit of planting trees extensively in the first swiddens they establish when settling in a new area. These tree-planted swiddens eventually turn into full-grown forest gardens, as much of the original vegetation returns together with the planted and tended species. These are called *tembawang*, and this word then refers to the forest, to the location of the long house, as well to the forest as a history marker of the entire village group or individual families. After a closed area of *tembawang* forest emerges, it may expand progressively until, at one point, the village site is abandoned. When that occurs, the area of *tembawang* remains as a reminder of the village in the landscape. A very strong regional respect for tree ownership inhibits anybody who is not the owner of a *tembawang* from slashing any tree species that is known to be a planted species.

Table 1 Structural and floristic characteristics of tembawang and two natural forest plots in the village of Ngira, West Kalimantan. Structure attributes refer to trees dbh $\geq$ 10cm. Number of species all vegetation (adapted from de Jong, 1995).

Attribute	**Tembawang**					**Natural forest**	
	Plot 1	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**	**Plot 6**	**Plot 7**
Number of trees	429	281	443	408	569	562	568
Basal area/ha (m^2)	26.78	22.20	32.46	15.15	23.17	38.17	56.81
Average diameter (cm)	22.82	22.11	23.30	18.46	19.99	23.94	26.01
Number of species	150	122	231	165	183	254	258

In one village, Ngira, where the largest part of the Dayak forest management study was conducted, 1-hectare plots were laid out in five *tembawang* for the purposes of studying their importance for plant biodiversity conservation. In two neighbouring forest plots, densities of 562 and 569 trees/ha (dbh $\geq$ 10 cm) occurred, similar to those in other parts of the island. The five *tembawang* had an average number of 426 trees/ha, with a range of 281-569 trees/ha (see Table 1). The natural forest plots had basal areas of 38 m^2/ha, and 57 m^2/ha. This was lower in the *tembawang* forests, which had an average basal area of 23.8 m^2/ha. The natural forest plots had an average of 256 plant species/ha, while the five *tembawang* had 170 species/ha. On the other hand, of 581 species, 376 occurred in the *tembawang* forests, while 379 were recorded in the two natural forest plots. This means that 174 of the species that occurred in the natural forest plots also occurred in the *tembawang*, while 202 species were found in the *tembawang* forest and not in the mature natural forest plots. This clearly indicates the importance of *tembawang* as *substitute* forests (de Jong, 1995).

4. THE HISTORICAL CYCLE OF NTFPs UNDER SWIDDEN AGRICULTURE SCENARIOS

The examples of Dayak *tembawang* forests clearly demonstrate the importance of such forest for biodiversity preservation. Although there is no data to show this, the structural data sufficiently indicate that other environmental functions like water run off regulation and carbon storage are also provided by such man-made forests. If the original objective of the Dayak forest management research, i.e. the improvement of local forest management in such a way that economic needs are covered and the quality of the forest maintained, could indeed be realised, then vitally important development and forest conservation goals would be met. Several efforts are being conducted in the research area to try to find such forest-based income improvement options (e.g. Graefen and Syafrudin, 1996; de Jong and Utama, 1998). The harvesting of forest products from natural forests is being tried, for instance, with the development of rattan and bamboo-based fashion products (de Jong and Utama, 1998). One of the problems remains the supply of raw material from still shrinking areas of natural forests. Experiments are being carried out with the enrichment of rattan in forest gardens or rubber gardens.

If returns are to be maximised and optimum incomes from forest products under the prevailing opportunity set are to be achieved, there will have to be some kind of intensified production. To what extent this affects the fate of the forest and the latter's biodiversity, remains to be seen. Again, some evidence can be obtained from the studies of Dayak forest management in West Kalimantan, which demonstrate that the impact of such intensified NTFP production on forest cover and the quality of the forest is not necessarily entirely negative.

This evidence comes from the changing forest landscape in Ngira, which has been affected by forest encroachment and expansion of *tembawang* and rubber gardens. As stated in the introduction of this paper, many Dayak swidden agriculturists, like so many other small farmers in Indonesia, grow rubber as their main cash crop. In Ngira, for instance, rubber was first planted in the early 1930s, but the greatest expansion of rubber gardens did not take place until the early 1980s, after road connections to the region had been improved. When this happened, rubber began to be traded to Pontianak via local intermediaries and no longer to Sarawak, as previously. Rubber sales to Sarawak involved walking trips of several days to sell the produce. Now, rubber can be sold in the villages where people live.

When Ngira farmers plant rubber, they seldom maintain a clean plantation of this single crop. Rubber is planted in rice swiddens and usually more than 1,000 seedlings per hectare are planted after, or even before, sowing the rice. Rice is harvested after about seven months and other crops like manioc may be harvested for another year or so. Only minor harvesting of various crops or spontaneous growing species occurs until the rubber trees are large enough to be tapped. Nowadays in Ngira, it is common to plant the site of a future *tembawang* first with rubber and, in the same or following years, with other, more typical, *tembawang* species. In such a field, the rubber can be harvested after only ten years and it will yield latex for a period of about twenty years. When the field is 30 years old, the oldest rubber trees are usually slashed for firewood. By that time, many of the other planted or tended trees yield harvestable products. Several researchers have investigated the plant species (e.g. de Foresta, 1992) and fauna diversity in rubber gardens (Danielsen and Heegaard, 1995). Rosnani (1996) studied the plant species diversity in rubber gardens in Ngira and found results that are compatible with those reported from elsewhere.

Table 2 Land use in Ngira, 1994

Category	Total area	%
Total land area	1,688 ha	100
Swiddens	125 ha	11
Fallows	954 ha	57%
Fallow land planted with rubber	251 ha	15%
Tembawang and rubber gardens	441 ha	26%
Total land under tree cover	692 ha	41%

Ngira, which is located in a region with only 14 people/km^2, had a total area of 1,687.55 ha in 1994. A small part of this was under swidden, and more than half of it under fallow (Table 2). However, 26% was planted with *tembawang* and rubber gardens. The village had 95 ha of full-grown *tembawang* forest, like the plots discussed in the previous section. Another 344 ha of land were reported as rubber gardens, 121 ha of which were planted since 1984. In addition, farmers reported 391 ha of fallow land on which rubber trees were planted. As the rubber trees were still small, this land is reported as fallow rather than as rubber garden. In many instances, the entire area of these fallows was planted with rubber when the survey was undertaken. The total number of rubber trees reported by farmers for these rubber fallows was 250,866. 1,000 rubber trees is a rough estimate for the number of trees planted on one ha of land. Thus, besides the areas of *tembawang* and fully-fledged rubber garden, there were an estimated 251 ha of fields planted with rubber trees.

Of the fields that were planted with trees in the last ten years, 280 ha were actually planted with a mixture of rubber, fruit and other trees, or with only fruit trees and other species. Most of this planting had been done adjacent to the existing *tembawang* area, because it was preferred to have rubber trees as close as possible to the village. This is because rubber is tapped in the morning and the latex has to be collected just before noon. If the tree vegetation had been left to develop in those fields, 280 ha of *tembawang* would have been added in the last ten years.

Table 3 Changes in forest cover in Ngira between 1984 and 1993

Category	Area
Average holding area 1994	25.2 ha
Area cleared from natural forest	0.62 ha/family*year
Area reforested	0.70ha/family*year

The increase in land planted with trees in the last ten years resulted in a reduction of the area per household under fallow vegetation. In 1994, the average size of farm holding in Ngira was about 25.2 ha (Table 3). During the last ten years the total area of forest converted from mature natural forest was 360 ha, resulting in an average area of 0.62 ha per family per year. This is slightly higher than the average of 0.42 ha/family estimated for the three contiguous sub-districts of Noyan, Bonti and Jangkang. The last estimate is lower because it includes villages with little or no natural forest at a short distance, and also because it only includes data since 1989 (Kimman, 1995). The 512 ha of land in Ngira that was reforested between 1994 and 1993 accounted for an average of 0.7 ha per household per year. The total area under fallow or swiddens actually decreased in the period from 1984 to 1993, while the population grew by 2.9% and the number of households by 2.1%.

Data from several neighbouring villages indicate that these may be long-term processes. This is the case in the village of Tae, for example, in the sub-district of Batang Tara, about 150 km southwest of Ngira. In this village, which has a population density of about 80 people/km^2,

people use motorbikes on a well-kept dirt road to take the valuable durian fruits (*Durio zibethinus*) to traders coming from Sarawak (Padoch and Peters, 1991). In Tae unclaimed mature natural forest can be found only on the highest mountain tops. Many farmers have turned to wet rice cultivation in permanent paddy fields, but often still in combination with upland swiddens and rubber gardens. Still significant areas of communally protected mature natural forests and *tembawang* are preserved. A second example is Bagak, a Dayak village close to Singkawang, located along the northern coast of West Kalimantan, an area with a population density of 120 people/km^2. In Bagak it is strictly forbidden to continue encroaching onto the Gunung Raya Pasir nature reserve that borders the village territory (Peluso, 1990). Inhabitants of Bagak have long had no more areas of natural forest from which to reclaim new agricultural fields. In 1990, 11% of the 1,800 ha of the cultivated land in the village was under paddy rice and 19% under swiddens and swidden fallows. Additionally, 16% of the village area consisted of improved rubber plantation, established in 1981 and 1982, while 39% of the land was under *tembawang*- like mixed tree cover and 3% was communally-preserved old secondary forest.

Table 4 Land use in Bagak (adapted from Peluso, 1990)

Attribute	Value
Population density	120 ps/km^2
Total village area	1,800 ha
Area of swidden fallow	19%
Area of paddy rice	11%
Area of improved rubber	16%
Area of tembawang	39%
Area of communal old secondary forest	3%

To summarise, the example of Ngira makes it clear that any form of economic development of NTFPs will most likely lead to some kind of management or production, which will lead in turn to some kind of modified local land use. This will consequently lead to some kind of impact on the forest cover, structure and floristic composition of the forest. In Ngira, mature natural forest has been slashed, but much of this has been replaced with reforested areas. An important part of this area is forest with a significantly higher plant diversity and natural forest-like structure. Whether this is judged as a good or a bad change depends on what it is compared with. However, understanding these processes opens up the possibility for measures that can steer such developments to more preferred outcomes. The next section will demonstrate that this is a potential of NTFP development that is not to be underestimated.

5. TREES VERSUS TREES: THE ULTIMATE CHALLENGE

Ngira is located in an area that has been designated a participatory forest management area. In such an area land use is, in principle, strictly circumscribed. An expensive project has been established to create adequate sources of income, through the harvesting, production, and sale of NTFPs, timber and agricultural products. Once these income opportunities have been set up, they are to be monitored by various local organisations in which people representing the PFMA inhabitants participate. The PFMA achieves a special legal status and forest management plans are to be drawn up. Such a complex institutional set-up, in combination with the processes described in the previous section, provides a good perspective of the forest landscape and its biodiversity.

This is not the case in many other parts of Indonesia, where aggressive estate crop and pulpwood timber plantation programmes have been planned. Currently, the most prominent

estate crop is oil palm, of which currently 2.5 million ha have been planted, while a similar area is planned for approximately the next five years (Potter and Lee, 1998). It is ironical that, what once used to be an NTFP has now advanced that far in its historical cycle that it is becoming the major estate crop in Indonesia. It is also seriously affecting local biodiversity. There are good reasons to favour these developments. At the time of writing, Indonesia is on the verge of bankruptcy. Oil palm can be easily produced with relatively little investment and with the relative certainty that profits will be made within a short time horizon. World demand is expected to continue to increase for still a long time (Potter and Lee, 1998). On the other hand, current privately-funded oil palm development schemes largely ignore the needs of local people, whose land is being acquired for these estates. Both the loss of biodiversity and the social costs of this expansion may be expected to be high, so that it is worthwhile to consider possible alternatives, some of which can be interfered from the research findings presented here.

Two issues should be crucial to the discussion on estate development. How much benefit does it bring to the local people and how much profit does it bring to the national economy? There are certainly alternatives if the first issue is considered. Some of the oldest oil palm schemes that where promoted by the government provided the participating local farmers better monetary incomes than most Ngira inhabitants are currently obtaining. However, those incomes did not allow for the non-monetary incomes that are obtained from forest product collection. This is demonstrated by reports of the faith of local farmers participating in these schemes. In the early government oil palm development schemes, farmers gave up 5 hectares of their land for 2 ha of planted oil palm, the yield of which was to be sold to the central nucleus estate, around which the farmers' plots were located. Although the farmers were informed that these plots would improve their incomes, Potter and Lee (1998) reported how yield levels were disappointing and declined more quickly than predicted. Farmers who signed up for these schemes had to give up some of their land, take out a loan that was to be paid back once their private oil palm lot started yielding fruits, and had constantly to buy fertilisers. Many of them eventually reverted to their previous agricultural strategy, using the oil palm as a secondary cash crop (Potter and Lee, 1998).

We have argued elsewhere (de Jong, 1997) that current forest management among Dayak swidden agriculturists, as described above, may very well provide similar incomes to those obtained by farmers in the oil palm schemes. Improved production of rubber, the manufacture of rattan and bamboo mats as a primary resource for fashion bag production (de Jong and Utama, 1998), and possibly the production of timber from Dayak-managed forest may very well achieve the levels of income currently earned by small farmers who participate in oil palm schemes. Other options based on local forest species are possible alternatives. Yayasan Dian Tama, in collaboration with CIFOR and Tanjungpura University in Pontianak, are developing the smallholder production of *Vitex pubescens* as a pioneer tree species that occurs in many countries in Southeast Asia (de Jong *et al.*, 1998; Sriwardani *et al.*, 1998; Kusmina *et al.*, 1998). Using estimates based on extrapolations of off-site trials, farmers may obtain attractive incomes of about US$ 1,000 per year from only three hectares of plantations of this species (Utama *et al.*, 1999; de Jong *et al.*, 1998). Were such incomes added to current ones in Ngira, they would surpass incomes that oil palm farmers are reported to reach.

The examples of how the forest landscapes fared after the introduction of rubber in villages like Ngira provides evidence that other alternatives like *Vitex pubescens* would lead to a acculturated forest landscape that is more attractive than an oil palm landscape. It can be expected that smallholders will dedicate some of their land and labour to *Vitex pubescens*, while the remaining area will be assigned to a mixture of more or less intensive crops, as well as tree and

forest cultivation. Cases from Tae and Bagak demonstrate that, under an intensified swidden agricultural system, there is still much room for forest cover, much more than on modern oil palm estates like those that are being widely developed in West Kalimantan (Potter and Lee, 1989).

Unfortunately, as we mentioned above, the incomes of the local population is not the decisive argument for decision makers who favour current oil palm development. It is not clear how several of the local forest management-based development schemes will contribute to Indonesia's GDP. Potter and Lee (1998), who also compare several of the small farmer-based tree planting development schemes, are sceptical about their possible impact, mainly because they do not promise the large returns that oil palm plantations have already been shown to provide. We repeat, however, that there is sufficient evidence to seriously consider these alternative options to estate crop development.

6. REVISING THE COMMERCIALISATION-CONSERVATION PROPOSITION

The previous discussion allows for a revision of the commercialisation-conservation proposition put forward in recent years. The new version of this proposition is partly based on the forest management continuum as proposed by Wiersum (1996). The extraction of forest products is only the first stage of a set of forest management technologies that, under a progressively developing economy, will pass through the phases of tending of selected forest resources, protecting forest areas, creating forest gardens, agroforestry plots and plantations. Other social attributes of forests, such as different types of tenure, also evolve with this type of progression through the prevailing forest management technologies. Each of these forest management stages has a direct relationship with biodiversity, leading to a progressive reduction in the species-richness of forest or tree stands.

While there is a clear relation between the prevailing forest management technology and the economic development of a society, this does not mean that all forest land is under only this prevailing forest management technology. In any stage, forest management technologies are applied only to adequate areas of forest land, whether under early or late stages of dominant forest management technologies. Some forests are managed using this technology, while others remain under previous technology regimes or no management at all. The total biodiversity situation differs according to the overall composition of forest land and the overall management technology that is applied.

The new commercialisation-conservation proposition recognises the opportunity to alter the pathway that a forest landscape will undergo from a situation in which only extensive extraction and management and little conversion occurs towards a situation in which there are large areas of plantations and less complex forests. The opportunity for conservation through appropriate NTFP development consists in altering the pathway towards one in which there will be substantially larger areas of forest cover and structurally more complex and more diverse forest than under alternative pathways without appropriate NTFP development. These opportunities will exist, however, only as long as there is a certain demand for forest products.

This does leave room for the original version of the commercialisation-conservation proposition, as many situations can still be found where primary forest product collection makes an important contribution to local or regional economies. However, the effectiveness of the original stage of forest conservation, depends entirely on the speed of economic change. The

largely unknown variable in this argument is the impact of commercialisation of one or more NTFPs on this process of change. When forest product commercialisation is to become the major force of change, it may cause the forest landscape to develop along a pathway that is less favourable from a conservation standpoint than would have resulted from other, more gradual, economic developments. Considering the economic possibilities demonstrated by some of what used to be NTFPs, this concern is not merely rationalising to the extreme. As the case of palm oil demonstrates, efforts to develop NTFPs, whether for the sake of conserving biodiversity or for development, do hold a risk. Development may trigger a historical cycle of such magnitude that the environmental effect may have totally the opposite to what was initially intended.

Crucial to the NTFP commercialisation-conservation proposition appears to be the characteristics of NTFPs to be developed, how they will be procured, and by whom. It can be hypothesised here that the more appropriate NTFPs will have certain features that make them more suitable for management or production by small farmers than other NTFPs, such that the effect of this production on biodiversity and social costs will outweigh other alternatives. Further research might focus on identifying these features.

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UNDERSTANDING DIVERSITY IN NTFP MANAGEMENT: A NEGLECTED ISSUE IN NTFP RESEARCH

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1. DIVERSITY IN NTFP PRODUCTION SYSTEMS

The commercial production of NTFPs has resulted in more deforestation than timber production, as witnessed by the large areas of coffee, tea, oil palm and other estates. Commercial plantations and natural forests form two extreme poles of a continuum in NTFP production systems. The best options for multiple-purpose production systems aimed at combined forest conservation and increased income opportunities are formed by production systems that are intermediary between commercial plantations and natural forests. The scope for such production systems has previously been mostly disregarded in research.

One of the major reasons for the present interest in the scope for NTFP production is the suggestion that such production can effectively contribute to forest conservation. This suggestion is based on the observation that quite a substantial amount of non-timber forest products is collected in natural forests, and that this collection often causes less damage than timber logging. Consequently, much NTFP research focuses on the question of the amount of scope for NTFP production in sustainable natural forest management. It often seems to be assumed that NTFP production takes place either in natural forests or in commercial tree crop plantations. This distinction reflects the often-suggested dichotomy between nature and culture, with NTFP production systems being conceived in terms of either a natural ecosystem or of a man-made cultivation system.

This often-presumed dichotomy of NTFP production systems does not reflect reality. Various studies have indicated that NTFPs are obtained not only from natural forests, but also from a large variety of human-influenced forest types and tree crop plantations (e.g. the Cameroon study reported earlier in this volume). Several of these NTFP production systems still display many of the ecological characteristics of natural forests. This diversity in NTFP production systems has hitherto received relatively scant attention. Nevertheless, their presence illustrates that many local communities are not mere gatherers of NTFPs, but that they are actively managing the forests in order to increase the production of valuable NTFPs.

2. DIVERSITY IN MANAGEMENT CHARACTERISTICS

In considering the development potential of NTFPs, attention should be focused on the assessment of various management characteristics rather than on use characteristics.

The diversity of NTFP production systems is the logical outcome of the diversity in NTFP management systems. Forest management consists of all the conscious efforts to maintain forest

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resources and stimulate increased forest production. Several categories of management practices may be distinguished for the conservation and production of NTFPs (Box 1). Many local communities are actually involved in one or more of such practices. The impact of such indigenous forest management practices on the vegetation depends on their nature and intensity.

Box 1 Different categories of indigenous NTFP management practices (Wiersum, 1996; 1997)

1. Maintenance of the resource through controlled utilisation and protection
   - Only certain species harvested according to stand composition, e.g. size, stand structure, etc.
   -Rotational harvesting regimes
   - Using harvesting techniques which do not cause tree mortality, e.g. limiting harvested amounts, coppicing/pollarding/lopping
   - Control of pests and diseases, e.g. sanitary pruning
   - Fire control practices

2. Stimulation of the production of required products within existing vegetation
   - Selecting coppice shoots, rejuvenation pruning, ringing trees to stimulate fruiting
   - Selection of (high-yielding) cultivars
   - Decreasing water/nutrient/light competition for trees by weeding and thinning non-valuable species
   - Optimisation of soil conditions (e.g. mulching) to favour desired species

3. Stimulating regeneration of valued species
   - Protection of natural regeneration
   - Stimulating of root sprouting
   - Planting of cuttings
   - Transplanting of seedlings obtained from natural forests or plantations
   - Incidental or purposeful seeding

Anderson (1990) distinguished two categories of forest management in relation to the impact of management practices:

1. *Tolerant forest management*: management practices by which the native vegetation is largely conserved or reconstituted through successional stages.
2. *Intrusive forest management*: management practices by which the native vegetation is replaced by (mixed) tree plantations that are manipulated by long-term human activities.

Tolerant forest management results in the modification of forests, while intrusive forest management results in transformed forests (Box 2). The presence of such diverse forest types indicates that local communities exert their own agency in dealing with NTFPs. Forest products are not collected from wilderness areas, but from socially-differentiated forest environments. Various production systems have gradually developed as a result of an evolutionary continuum in interactions between local communities and forests (Wiersum, 1997). During this evolution, the management activities have gradually become intensified and a process of co-domestication of forests and tree species has taken place. During this process there was a concomitant change from wild to domesticated tree species and a change in structure and composition of tree stands occurred (Wienk *et al.*, 1997).

Box 2 Different agroforestry systems incorporating NTFP production (Wiersum, 1997)

A.	**(Modified) forests with prevalently tolerant forest management practices**
	Gathering of non-timber products in natural forests in which NTFPs are protected: specific areas or specific tree species in natural forests that are favoured and protected because of their value for providing useful materials. Example: individually claimed trees
	Resource-enriched natural forests: natural forests, either old-growth or fallow vegetation, whose composition has been altered by selective protection and incidental or purposeful propagule dispersion of food and/or commercial species. Examples: enriched natural forests; enriched fallows
B.	**Transformed forests with prevalently intrusive forest management practices**
	Reconstructed natural forests: (semi-)cultivated forest stands with several planted useful species, tolerated or encouraged wild species of lesser value and non-tree plants (herbs, lianas) composed of mainly wild species. Example: forest gardens
	Mixed arboriculture: cultivated mixed stands, almost exclusively of planted, and often domesticated, tree species. Examples: home gardens; smallholder plantations
	Interstitial trees on croplands: either naturally regenerated or protected trees, or planted and sometimes domesticated trees scattered over agricultural fields. Example: scattered fruit trees cultivation on/along crop fields
	Commercial plantations with associated agroforestry practices: plantations of domesticated tree crops which are (temporarily) inter-cropped with food plants or grazed by livestock. Example: (mixed) tree-crop plantations

At present, many of these indigenously developed forest types have mainly local significance, although some also play an important role in the commercial production of non-timber forest products (Wienk *et al.,* 1997). Most of these human-created forest types have until now been barely acknowledged by forest science. As a recent book on the nature of forests in the West African forest-savannah edge (Fairhead and Leach, 1996) illustrates, the origin of such anthropogenic forest types is often not recognised, as ecologists and foresters have mostly disregarded the positive influences of local communities on forest composition and production. The usual perception is that local communities are mere destroyers of forests (by necessity or ignorance). It is sometimes also considered that they may be preservers of patches of natural forests on ancestral lands, but the possibility that they may be active manipulators of forests is usually not considered. Little attention has been given to the possibility that local communities have enriched forests with tree species they value or have even reconstructed forests to suit their needs for specific forest resources, while maintaining much of their original structure and biodiversity.

3. CONSEQUENCES FOR RESEARCH

The conclusion that local people are not mere gatherers of NTFPs from ‘virgin’ forests, but that they may be more or less intensively managing these resources in human-influenced forest types, has several important consequences for NTFP research:

1. More research should be focused on the identification of different types of indigenously developed forests and of the various factors which influence both their dynamics and sustainability. This means that the concept of sustainable forest management should incorporate the notion that not only the ecological integrity and social functions of forests should be maintained, but also the indigenous ingenuity and creativity in conserving, enriching or even reconstructing forests.
2. For most local communities, managing NTFP resources is only a part-time activity that is combined with other land-use activities. As the utilisation of NTFPs is integrated within the total livelihood system of local people, it cannot be understood in the context of specialised resource utilisation. Research should therefore not focus primarily on the role of NTFP production in contributing to forest conservation, but on the role of NTFP production within integrated land-use systems.

Box 3 Provisional categorisation of NTFPs according to management characteristics

Supply characteristics

1. Production characteristics
   - Degree of ecological sustainability of extraction
   - Ease of vegetative or regenerative propagation
   - Ease of cultivation under different environmental conditions
   - Ease of stimulating production by technological means

2. Organisation of production
   - Access to NTFP resources
   - Gender division of production responsibilities

Demand characteristics

1. Opportunistically collected products for subsistence consumption not related to main household needs (e.g. snack fruits)
2. Occasionally collected products purposively collected in times of emergency (e.g. medicinal products, emergency foods during droughts)
3. Products for regular household consumption
   - Easy to substitute with products of other species (e.g. various fruit products, fodder, fuelwood)
   - Difficult to substitute with products from other species (e.g. preferred forest foods)
4. Products for sale at various market types (local, regional/national, international)
   - High degree of competition with substitutes
   - Low degree of competition with substitutes (e.g. certain medicinal products, gums, resins)
5. Products demanded in manufactured forms, and which can be locally produced giving them added value (e.g. palm sugar, liquors)

Research should be focused on the assessment of various factors influencing NTFP management rather than only on factors influencing their collection and use. Up to the present, most typologies of NTFPs have been based on their use characteristics. Such classifications should be considered as a first step in developing a typology of NTFP management. Little attention has so far been paid to elaborating these typologies and placing NTFPs within a typological framework that explains patterns of NTFPs management. These typologies will have more predictive value in assessing the scope for developing different production systems than the present NTFP classifications (*cf.* Ruiz, 1995; Peters, 1996). Such a framework might possibly be based on an integrated set of supply and demand characteristics (Box 3).

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NTFP RESEARCH NEEDS FROM A VILLAGE PERSPECTIVE: EXAMPLES FROM SOUTHEAST ASIA[1]

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1. NTFP RESEARCH SERVING THE NEEDS OF LOCAL COMMUNITIES

In Asia, and elsewhere in the tropics, there is a widely perceived need for applied NTFP-related research designed for use by local communities. Research into NTFPs should therefore, more than in the past, be guided by the agenda of forest- dwelling people and serve their priorities. It is recommended that research institutes increase their efforts to establish working relations with local/village organisations and to translate scientific results into a form, which fits local needs and skills.

During the last decade a remarkable development has taken place in several Southeast Asian countries, most notably in the Philippines and Indonesia. With the support of local NGOs, forest-dwelling communities are becoming better equipped to articulate their needs and aspirations in the political domain and their voice is being increasingly heard in various fora. It now appears to be more feasible for researchers not only to seek informed consent about their research intervention, but also to establish a genuine working relation with community initiatives in the region. Hopefully, institutes and agencies with a commitment to applied research in forestry, will take up the challenge to have their agenda increasingly guided by priorities set by forest-dwelling communities.

The above development has a direct relevance to the agenda for future NTFP-related research. Firstly, because the subject of NTFPs is very close to the mind of most people living in forest areas and, secondly, because forest-dwelling communities nowadays often seek scientific backing for their efforts to improve or stabilise the economic basis of their lives and to halt the further deterioration of the forest environment (see also Chapter 8 in de Beer and McDermott, 1996).

2. RESEARCH TO SUPPORT FOREST RESOURCE MANAGEMENT

One of the main topics from this perspective is forest resource management. Research activities in this field might include: the collection of data for, and assistance with, the formulation of management plans; the compilation of inventories of best harvesting practices; and the

[1] This contribution builds partly on discussions held in the framework of the newly established NTFP Exchange Programme for South East Asia. The programme is an initiative of the Netherlands Committee for IUCN, ProFound and Both Ends. One of its aims is to provide a platform through which the knowledge, ideas, practices and experiences of forest communities and their representative organisations can enter the international NTFP debate.

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development of techniques for the incorporation of key biological information in community area maps.

Today, one of the main topics from a village perspective is NTFPs in forest resource management. Research activities in this field might include:

- Collecting of data for, and assistance with, the formulation of resource management plans. In the Philippines, for instance, many communities are at present trying to put together management plans for their Ancestral Domains. Assistance with this activity is either lacking or comes in a form that is sophisticated, but expensive and therefore difficult to replicate. Hence, efforts directed at translating scientific results into a form which meets local skills and needs are much asked for by the communities involved.
- Compilation of inventories of best harvesting practices. The NTFP Exchange Programme, for instance, promotes the regional exchange of information about best harvesting practices for various products. The aim of this effort is to enable communities to learn from each other in order to achieve more sustainable NTFP extraction.
- Incorporation of relevant information in community area maps. Community mapping is an activity that has mushroomed in the region over the last few years. It has proven to be a key element in the effort to attain sound forest management. Next, relatively simple techniques should be developed for the incorporation of key biological information relating to NTFPs into these maps.
- NTFPs in village forest rehabilitation initiatives. As many forests are in a poor condition, more and more villages feel themselves obliged to repair the damage as far as possible. Questions that arise here revolve around such issues as what species to include (need of reliable market forecasts for specific products), technical information about enrichment planting, etc..

We may therefore conclude that the role of NTFPs in local forest resource management provides ample opportunities for applied research to serve the interests and priorities of forest communities and to contribute at the local level to the development of more sustainable forest use.

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DYNAMICS AND SUSTAINABILITY OF NON-TIMBER FOREST PRODUCTS EXTRACTION

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1. ECOLOGICAL SUSTAINABILITY

Every extraction system affects - at least temporarily - the biological diversity and hence the structure and functioning of the forest. The results of calculating maximum harvesting levels - e.g. by using matrix modelling – are of limited value for forest management. The data produced for this exercise, however, are relevant for maintaining and enhancing resource availability.

Whether the extraction of non-timber forest products (NTFPs) is ecologically sustainable depends on two parameters (Ros-Tonen *et al.,* 1995):
- *availability*: the use of a harvesting intensity and harvesting techniques which secure the future availability of the resource; and
- *biological diversity*: extraction does not interfere with the structure and functioning of the forest.

These two parameters should be considered independently. It is possible for extraction to deplete the resource, while not having a significant impact on biological diversity. This is the case when the target species has no specific function in the ecosystem or when its function can easily be replaced by another species. The opposite is more common: the harvest is sustainable in terms of resource availability, but extraction does affect the biological diversity.

1.1 Securing resource availability

Any extraction of tree products from the forest affects the population dynamics of the target species. Whether it will finally affect population growth and resource productivity is difficult to analyse for long-living organisms such as trees. One way to overcome this problem is to analyse the population dynamics within distinct size classes and calculate the survival, growth and fecundity per size class. Projections of size class-dependent demographic behaviour within matrix models enables us to simulate the future behaviour of the population from the collected demographic data (Caswell, 1989). With these models we can simulate harvest scenarios and calculate the future availability of resources in these scenarios.

Matrix models have limitations, because they reveal an effect rather than an explanation of why the effect occurs. They require a lot of data collected over a time span of several years. Growth data of adult trees, in particular, require long time spans. The matrix of a population, i.e. the set of demographic data used to calculate transition probabilities from one size class to the next, is specific for each population, time and location of the measurements. The question is whether it can be reproduced for other populations at other places and other time spans. Moreover, extraction simulations are theoretical model experiments, which do not take into account changes in demographic

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behaviour resulting from harvesting itself. This is especially the case when harvesting changes the forest structure, as in the case of timber logging. The increased light levels considerably change regeneration patterns. Matrices are therefore different for disturbed and undisturbed forests (Zagt, 1997; Boot and Gullison, 1995). As the harvesting of NTFPs does not alter the structure of the forest at large, matrix models are probably the most suitable tools for analysing productivity and sustainability of their extraction.

An important output parameter of matrix models is the asymptotic population growth rate (lambda) which is equal to one for stable (non-growing) populations, is less than one for declining populations and greater than one for growing populations. NTFP extraction may decrease the population growth rate and cause populations to decline. To date, the effect of NTFP extraction on population growth rates has been used as an important tool in determining whether extraction is sustainable or not, with extraction leading to a population growth rate of less than 1 being considered as not sustainable (Peters, 1996).

There are two important drawbacks to using only population growth rates for this purpose:
1. Following this line of reasoning, no extraction would be possible in naturally declining populations.
2. Population growth rates are rather variable and often do not significantly differ from 1, which makes the estimated maximum sustainable yield unreliable. In addition, this approach leads to yes-or-no answers to the question of whether exploitation is sustainable.

Rather than focussing on the population growth rate, we propose to employ a methodology of determining the effects of NTFP extraction on resource availability which includes an analysis of the transition probabilities within the matrix that are most critical for population survival. Sensitivity analysis reveals the importance of different stages in a population's life cycle for its growth rate and may indicate what phases should receive special attention in forest management (extraction and silvicultural treatments). An example of this can be found in the growth and survival data of pre-adult individuals of a palm species, the reproductive individuals of which are cut for palm heart. If growth and survival appear to be very important in determining population growth, this already indicates that extraction has a major impact on the population growth and future resource availability (Peña-Claros and Zuidema, *in press).* Such techniques for sensitivity and elasticity analysis are well developed and widely applied in demographic studies (de Kroon *et al.*, 1986, Caswell, 1989).

1.2 Conservation of biological diversity

In contrast with logging, the extraction of most NTFPs does not alter the forest structure. Whether NTFP extraction in the end affects biological diversity depends on the role of the harvested product in the functioning of the forest ecosystem and the degree of disturbance caused by extraction. Studying the effect of harvesting on biological diversity is utopian rather than realistic. Species diversity in tropical rainforest is often extremely high and species interactions within and between different trophic levels are very complex. Harvesting seeds of species A, for example, can reduce seedling competition on the forest floor, allowing less competitive seedlings of species B to establish themselves. The same seeds might be a key resource for animals living in the forest and reduce the quality of the habitat for these animals. Only a few of these species interactions between trophic levels are known, especially those related to pollination and seed dispersal. Whether extraction of NTFPs like seed dispersers, which play a role in the life history of trees, finally affects the regeneration of tree species depends on the probability of replacing these functions by other species. The high species diversity, the complexity of species interaction and the limited knowledge of these interactions mean that the effects of NTFP extraction on biological diversity are hardly understood. It will be very difficult to carry out research

on this issue, as it will touch only a small part of it, even in the most complex model analysing a food web structure.

The best option so far is to study the effects of extraction on the results of some of these species interactions, namely tree regeneration. Tree regeneration is a result of several species-interactions, such as pollination, seed dispersal, seed and seedling survival and growth; processes which are mostly driven by animals. When we observe a change in tree regeneration as a result of extraction - for instance in the number of new seedlings - we still do not know why, as we did not study each of the aforementioned processes. So, although being practical, this approach is not mechanistic and can result in frustrations as systematic patterns can be obscured due to high natural variation. Furthermore, focussing the effect of extraction only on tree regeneration ignores the other species interactions that might be affected and its resulting consequences for biodiversity.

Another option is to simplify and structure the diversity, first by aggregating species into functional groups based on life history characteristics (Condit *et al.*, 1996). Functional groups which share life form, demographic behaviour and reproduction modes might function as indicators for changes in the structure and functioning of the forest. It attempts to help us to look for patterns rather than being diverted by cases. This aggregation of species complexes into functional groups is currently a major research topic for ecologists. It might help us in the near future to analyse the effect of harvesting on biological diversity.

Because of colonisation and the exploitation of forest resources for subsistence, induced by the sedentary nature of NTFP exploitation, densities of one specific functional group - animals - are declining (Redford, 1992; Santivañez, 1998). This harvesting of forest proteins for subsistence might have a much larger effect on the functioning of the ecosystem than the changes in species interactions resulting from the extraction itself.

2. CHANGES IN NON-TIMBER FOREST PRODUCT EXTRACTION

*Research on the sustainability of non-timber forest product extraction has three objects: the **people**, the **products** involved and the **forest** itself. Forest-dependent people use non-timber forest products as a vehicle for earning cash income, to escape from the poverty circle and from forest life. A successful non-timber forest product might evolve into a plantation crop, which grows in an agricultural setting. However, the forest remains an arena for innovations of **new** forest products by **other** people and **other** entrepreneurs. Promoting NTFP extraction therefore remains a viable strategy for forest conservation.*

Extraction of non-timber forest products is often considered as a nature conservation strategy because it reconciles conservation *and* development (Broekhoven, 1996), but colonisation and the accompanying disturbance of the forest is a common and well-known concern. In contrast to timber logging, NTFP exploitation is more often associated with permanent settlement. Employment for forest smallholders in the logging industry is, in general, only temporary, as these operations move from one plot to another, to return to the same plot only after at least 20 years. In the case of NTFP exploitation, however, several products can be harvested annually, and even primary processing in the forest is possible, so that from a development perspective, NTFP extraction does contribute to economic development.

Serious doubts have been expressed, however, about this role of non-timber forest products in

economic development (e.g. de Jong, this volume; Assies, 1997). Extraction and processing of non-timber forest products require high labour inputs and they are economically feasible only at low costs per unit of labour or at a high price per unit of product. Low costs per unit of labour can be achieved in situations of poverty. This is probably the main reason why Bolivia has now replaced Brazil as the main exporter of Brazil nuts and why extraction of non-timber forest products is considered as an establishment of poverty rather than a relief of it (Assies, 1997). This implies that the extraction of non-timber forest products is not a panacea for economic development. Moreover, extraction economies cannot be considered as stable, as successful NTFPs are replaced by plantations or substitutions, providing a higher output per unit of labour (Homma, 1996). For forest dwellers, extraction is part of a transition process. After they have managed to make money from extraction, they might use this money as a vehicle for escaping from the vicious circle of poverty, to move out of the forest and to start investing in other economic activities such as agriculture, trade or industrial activities. Thus, extraction economies are inherently dynamic (Stoian and Henkemans, 1998).

Nevertheless, non-timber forest products in their totality can serve as a viable vehicle in economic development, as the forest remains an arena for innovations of **new** forest products by **other** people and **other** entrepreneurs. Seen from this perspective - and not from that of the individual products - promoting sustainable NTFP extraction remains a viable strategy for forest conservation.

3. RESEARCH PRIORITIES

In order to estimate the future availability of NTFP resources, properties of the population matrix, such as sensitivities, should be evaluated. Such properties are less case-dependent than the population growth rate. These sensitivities reveal which size class in the population life cycle contributes most to the viability of the population. For sustainable extraction and forest management, it is therefore necessary to focus on these size classes. Methods should be developed to enable a rapid assessment to be made of whether extraction is becoming more or less sustainable.

To assess the impact of NTFP extraction on biological diversity, simple models should be developed to quantify the effects of NTFP harvesting on the regeneration of tree species. Another option for the evaluation of the impact of NTFP extraction on biological diversity is to aggregate species diversity and interactions into functional groups and test whether they can reveal patterns of changes in the forest ecosystem.

With regard to the social aspects of NTFP exploitation, it is necessary to place extraction in the wider context of rural and urban development (Dijkman *et al.*, 1998). The social dynamics of NTFP extraction, in particular, and its transitional nature deserve more attention. Ignoring the place and dynamics of NTFP extraction in the livelihood strategies of forest-dependent people will inevitably result in the failure of strategies to promote NTFP extraction as a vehicle for conservation *and* development.

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TOWARDS THE SUSTAINABLE USE OF WILDLIFE IN TROPICAL FORESTS

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1. PAYING MORE ATTENTION TO THE POTENTIAL OF WILDLIFE EXPLOITATION

Studies on NTFPs focus strongly on plant products, even though game and wildlife are by far the most important NTFPs. The problem is that the extraction of wildlife from tropical forests is not sustainable, is illegal, or both. Research should pay more attention to the potential of wildlife exploitation, focusing on the effects of current exploitation systems on the harvested populations and the ecosystem, while an effort should also be made to develop sustainable harvesting models.

Although, according to most definitions, animal products are formally part of NTFPs, the literature on NTFPs is commonly and almost exclusively confined to plant products. Studies dealing with wildlife extraction in tropical forests are usually found under the keyword 'wildlife'. Nevertheless, in most countries wildlife is by far the most important non-timber forest product, both commercially and non-commercially (de Vos, 1973; Fitzgerald, 1989).

Wildlife extraction from tropical forests has increased tremendously in recent decades. The two most important reasons for this are an increasing demand for bush meat for increasing human populations, both rural and urban, and a dramatic increase in the national and international trade in animals and animal products. Extraction for the local market and for 'feeding the cities' is mainly focused on bush meat from abundant non-protected species and can thus generally be viewed as legal. However, subsistence hunting of species listed on Appendix I or II of CITES[2] does occur and has to be considered in a different way. Examples of such species are gorilla (*Gorilla gorilla*), chimpanzee (*Pan troglodytes*) and bush elephant (*Loxodonta africana cyclotis*). It is suspected that most of the extraction of animals and animal products for trade is directed towards protected species and hence is illegal. The national and international trade in wild animals and wild animal products is currently estimated to be at least $5 billion per year (Roth and Mertz, 1997).

In most areas, the levels of extraction for many species have already been unsustainable for some time and this has led to a sharp decrease in numbers per species and in overall wildlife biodiversity: the forest has become 'empty' (Redford, 1992). Although it can be said that the most important reason for the global loss of animal biodiversity is the loss of habitats (Pickett *et al.*, 1997)), if we restrict ourselves to the still existing tropical forests - be they primary or secondary forests - the most important factor is direct hunting by man. Some other types of

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[2] The Convention on International Trade in Endangered Species of Wild Fauna and Flora is a global treaty which has been in effect since 1975 to protect plant and animal species from unregulated trade. Appendix I of CITES protects threatened species from all international trade. Appendix II regulates the trade in species not threatened with extinction, but which may become threatened if trade goes unregulated. Appendix III allows countries to list native species already protected within their own borders.

activities, like selective logging or less intensive slash-and-burn, might even, in principle, promote conditions for wildlife because of an increase in plant biomass at the lower levels.

2. THE NEED TO DEVELOP USER-FRIENDLY EXPLOITATION MODELS

It is important that ecologically suitable and economically promising animal species are identified and that easily accessible and user-friendly models are developed for these species, so that local communities can apply them effectively.

It will be clear that all illegal activities affecting protected species and wildlife in protected areas have to be stopped. Although the implementation of protective measures is by far the most important activity that has to be undertaken, there is little to do here for the scientist. What science can contribute is to help develop optimal and sustainable harvest models of selected species, mainly - but not exclusively - focussed on species that can serve as a source of protein for the local population (bush meat).

A very simple harvest model can be used to identify some basic rules for enabling suitable species for sustainable economic use to be identified (Figure 1). In Figure 1 the sustained yield is related to population size, with populations growing in a density-dependent way to carrying capacity K, beyond which their net growth rate is zero (logistic growth). Yield curves are drawn for two species with different densities, where species 1 (S1) - the largest in number - has a higher density than species 2 (S2). MSY is the maximum sustained yield.

Figure 1 Relationship between sustained yield and population size, assuming density-dependent growth. S1 represents a fast-growing species reaching high densities, while S2 is a slower growing species reaching lower densities.

The basic rules to be stressed here are:
1. Any yield higher than the sustained yield drives the population towards extinction.
2. For any level of sustained harvest, the population has to be reduced below carrying capacity. The MSY is at ½K.
3. Slow-growing species like species S1 (which generally have a larger body weight and occur at lower densities) can sustain lower harvest levels than fast-growing species like S2.
4. For slower growing species, similar harvest rates are reached at a lower absolute density than for faster growing species.

It can be deduced from these 'rules' that large species which occur at low densities are more vulnerable to any harvest regime than small species. This is even more relevant in tropical forests, where the density of vertebrates is reputedly low. It is not surprising that many threatened and already extinct species belong to this category, and their scarcity is directly related to their economic value. Harvesting 'low density species' is therefore ecologically risky and should not be encouraged. It would be best from an ecological point of view to select species with relatively high growth rates, while reaching rather high densities (in numbers and/or biomass). Examples are bush pig (*Potamochoerus porcus*), cane rat (*Thryonomys swinderianus*), guineafowl (*Numida meleagris galeata* Pallas), capybara (*Hydrochaeris hydrochaeris*) and peccary (*Tayassu* spp.). It may also be economically worthwhile to focus on rare species the hunting of which is permitted, but this strategy is more dangerous ecologically and needs more careful study to determine sustainable harvest levels.

Furthermore, it may be relevant to note that some species play a more important role in the forest ecosystem than others. This may especially be the case when tree species are dependent on animals for the dispersal of their seeds. In this way, frugivores like bats, monkeys and large rodents can play a key role within the forest ecosystem and the system will thus be more affected when the population densities of these species are reduced as a consequence of harvesting.

3. CONSEQUENCES FOR RESEARCH

It should be possible using the above rules of thumb to identify species which are potentially suitable for sustained harvesting and which can provide ample food in the form of protein for local populations. This will enable research to focus on a few selected species. Both the role of these species within the functioning of the system and the consequences of a systematic lowering of population densities have to be clarified. This will enable optimal harvest models to be developed on the basis of detailed knowledge of the relevant life history parameters that determine the dynamics of the populations. Ideally, the harvest models should be constructed in such a way that local hunters can easily use them. This means that, ultimately, an optimal harvest rate can be determined using only a few parameters that are easy to estimate in the field. A very good example of this approach is the work of Njiforti (1997) on guinea fowl (*Numida meleagris galeata* Pallas) in Cameroon. Only when carefully designed optimal harvest levels are designed and implemented, will it be possible to guarantee the wise use of wildlife.

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REFINING CONCEPTS, OBJECTIVES AND RESEARCH QUESTIONS FOR NTFP RESEARCH[1]

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1. REFINING THE CONCEPT OF NON-TIMBER FOREST PRODUCTS

It is important from the perspective of designing sustainable forest management systems to distinguish between NTFPs from natural forests and those from human-influenced systems. Criteria should be defined for drawing a line between forest and agriculture systems (cf. NTFP certification workshop held in Oaxaca, Mexico from 30 November to 2 December 1998). For this reason, the term NTFP should be refined, in order to distinguish between forest products collected from the 'wild' and domesticated products of forest origin.

In 1995, we defined non-timber forest products as "all tangible animal and plant products from the forest, other than industrial wood" (Ros-Tonen *et al.*, 1995). In 1998, we slightly modified this definition in "all tangible animal and plant forest products other than industrial wood, coming from natural forests, including managed secondary forests and enriched forests (Ros-Tonen *et al.*, 1998). In both instances, we excluded products of forest origin which were cultivated in home gardens and agroforestry systems, although we pointed out that "in practice, the distinction between 'wild' and (semi-)cultivated products is often difficult to make."

The fact is that many items that are being marketed as NTFPs originate both from natural forests and from man-made vegetation types, since economically successful NTFPs, in particular, tend to be domesticated (e.g. Homma, 1992). Black pepper, bananas and coffee, for example, were once non-timber forest products. Van Dijk and Wiersum (this volume) have already noted that a high proportion of the NTFPs exploited in Southern Cameroon are not collected from natural forests, but harvested from vegetation types modified by man, such as secondary forests, young fallow vegetation and cocoa plantations. In the transition from 'wild' to cultivated products, several NTFPs may come from both natural forests and home gardens or plantations. The best known example is that of rubber from *Hevea brasiliensis*, which is collected from natural forests in Brazil, while in Indonesia it comes from plantations. The same occurs within one and the same country with gum Arabic from *Acacia senegal* in Sudan and rosin and turpentine made of the oleoresin of *Pinus merkusi* in Indonesia (Coppen, 1999). When such products appear on the market, they bear no label to clarify their origin. Several authors – including some in this book - therefore apply the term 'non-timber forest product' to 'wild' as well as to (semi-)domesticated products of forest origin.

The controversy about whether or not to include cultivated products of forest origin into the definition of NTFPs is as old as the term itself. To quote de Beer and McDermott (1989), who were among the pioneers writing on the subject:

> "The term 'non-timber forest product' encompasses all biological materials other than timber which are extracted from forests for human use. (...) By 'forest' is meant a natural ecosystem in which trees are a significant component. However,

[1] The views expressed in this paper do not necessarily reflect the official standpoints of the Tropenbos Foundation.

> forest products are derived not only from trees, but also from all plants, fungi and animals (including fish) for which the forest ecosystem provides habitat. Human intervention *per se* does not make an ecosystem 'unnatural', although human origination does. Hence, whereas managed, secondary or degraded forests are sources of non-timber forest products, plantations are not." (de Beer and McDermott, 1989: 17-18).

The problem lies in the fact that the distinction between natural and human-modified forest ecosystems cannot always be easily drawn. There is often a gradual transition from the collection of 'wild' products in natural forests to enrichment planting in secondary forest and intensively managed home gardens (Ros-Tonen *et al.*, 1995). Reviewing the history of forest manipulation by indigenous people and various types of indigenous forest management, Wiersum (1997, 1998) concludes that there is an evolutionary continuum in forest-people interactions, during which a process of co-domestication of forests and trees takes place. As a result, the natural ecosystem is gradually transformed into an agro-ecosystem. This evolution is characterised by increasing input of human labour per unit of forest land and intensified human intervention in the reproductive biology of desired species (see also Wiersum's contribution to this volume).

Various Tropenbos studies confirm this evolution. Van der Hammen and Rodríguez (1996), for example, illustrate how indigenous people in the Colombian Amazon region manipulate forest succession in order to promote the growth of such useful species as the chontaduro palm (*Bactris gasipaes)* and the guamo fruit tree (*Inga* spp.).

De Jong (this volume) provides an example of the evolution of a man-made vegetation type in West Kalimantan, which appears to be a match for natural forest in biological diversity. The Dayak's habitat of planting trees in the first swiddens they establish eventually results in full-grown forest gardens with species numbers, densities and basal areas that are comparable to many natural forest plots. In addition to the original vegetation, of which much returns after slashing the original forest, these tree-planted swiddens or *tembawang* also contain the planted and tended species, which makes them important sources of NTFPs.

If the transitions are so gradual and the products remain the same, why should we bother about the terminology? The point is that the research questions and recommendations for the sustainable management of NTFP resources will differ according to the context in which the products are exploited. This issue clearly came to the fore during a recent workshop on NTFP certification in Oaxaca, Mexico. Some participants perceived a clarified concept of NTFPs as necessary for the formulation of clear and transparent recommendations for NTFP management and, consequently, of the criteria for the certification of NTFPs. The main question was where to draw the line between agroforests as *forest* ecosystems and agroforests as *agricultural* systems (Mallet, 1999). Both have their own dynamic and, as Wiersum has made clear (this volume), their own management regimes.

Many authors prefer to restrict the use of the term NTFPs to products from natural forest systems, whether they are modified by human intervention or not. The reason for doing so lies in the fact that the term was coined in relation to strategies for the conservation of biodiversity in natural forests. Several alternative terms have been suggested for products from man-made vegetation types, such as forest garden products (Senanayake, 1999), non-timber plantation products (Melvani, 1999) or agroforestry products (Ottens, 1999).

If we take the perspective of forest-dwelling people, we might even consider replacing the term NTFPs with "community-exploited forest products", even if this might be confusing in relation to FAO statistics, in which forest products mostly refer to wood products. The term NTFPs, besides being an awful acronym, suggests that we are dealing with products that, in the first place, are *not* something else. This is not in line with the perception of local people, who consider these products as important sources of food (*cf.* Caspary, this volume), medicines and construction material. From a local perspective (*cf.* de Beer, this volume), the real issue is not whether these locally exploited products are timber or non-timber, but how they can be managed so that they contribute optimally to people's livelihoods and can be harvested with minimal damage to the forest. It is through the small-scale extraction of timber *and* non-timber forest products that local people can be given a secure place in the sustainable management of tropical rainforests.

2. REFINING THE OBJECTIVES

On order to define research needs more sharply, it would be helpful to be more specific about the different objectives of NTFP development, as criteria for successful NTFP development differ according to the aim pursued (forest conservation, (participatory) sustainable forest management, improved livelihoods). Although it would be desirable to reconcile these objectives, research has made it clear that this is "wishful thinking" in most cases.

What this book has made clear is that the different objectives pursued through NTFP development are difficult to reconcile (see also the introductory chapter). If we accept this as a fact, I suggest that we should specify the objective to be pursued and define the research questions accordingly.

Reviewing the studies reported on in this book, we can distinguish two main approaches: a forest-oriented approach and a people-oriented one[2]. It is NTFP research - or better, research on the local use and exploitation of timber and non-timber forest products - that links the two approaches. At the interface of the two fields of research (see Figure 1), the challenge is to find models for the integrated and participatory management of natural forest resources.

As Figure 1 makes clear, this challenge may lie both within and outside the forest, in man-made ecosystems. The latter is the case, for example, if the possibilities are studied for the captive breeding of animals or the cultivation of valuable forest products in forest gardening or agroforestry systems with a view to improving the livelihoods of local people and reducing the pressure on the natural forest. By the same token, efforts to conserve the forest and forest biodiversity may be incompatible with forest use. If the final objective for a species-rich area is the conservation of the full range of biodiversity, from a forest-oriented point of view, protection rather than NTFP extraction might be the most appropriate strategy (Ros-Tonen *et al.*, 1995).

While the broad perspective of participatory and integrated natural resource management could function as an umbrella framework for all NTFP research, it is the perspective chosen and the objective pursued which will determine what research questions are relevant (Figure 2). From a

[2] The statement made by Dijkman *et al.* in this volume that research on the sustainability of non-timber forest product extraction has a threefold object – the people, the products and the forest itself – would suggest a third, product-oriented, approach. However, as most studies that focus on products are usually undertaken with a view to improving either the sustainability of their extraction or the economic feasibility of their production and marketing, I think that also the product-oriented studies fit into either the forest- or the people-oriented approach.

forest-oriented perspective, research will be primarily geared towards forest conservation and sustainable resource management. If a people-oriented approach is chosen, research will primarily aim to contribute to participatory management and improved livelihoods. Specifying the approach and objective will help to be more specific about the research questions that need to be answered.

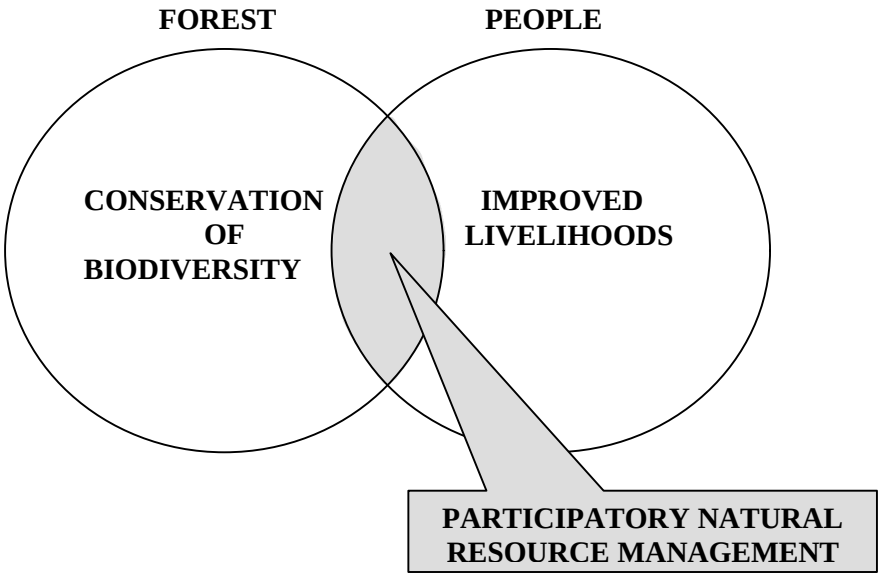

Figure 1 Linking people and the forest: participatory natural resource management

3. REFINING THE RESEARCH QUESTIONS

On the basis of their specific experiences, all the authors have made suggestions for further research. The diversity of recommendations confirms that these suggestions have been formulated in line with the approach adopted (forest or people-oriented) and the objective pursued (biodiversity conservation, participatory forest management or improved livelihoods). Figure 2 attempts to synthesise the various options that have been put forward in this volume.

If the forest is taken as a starting point of research, the primary objective of NTFP research is to contribute to the conservation and sustainable management of the forest and its biological diversity. In this case, NTFP research focuses on the development of an ecologically sustainable extraction system. Research questions requiring an answer are:

- What are suitable animal and vegetable species for sustainable harvesting (van Andel and Reinders; de Jong; van Wieren)?[3]
- What forest types are most suitable for extraction (Duivenvoorden)?
- What is the key ecological information we need for the sustainable extraction of plant and animal species (van Andel and Reinders; Caspary; van Valkenburg; Dijkman *et al.*; van Wieren)?
- What is the effect of extraction on the future availability of NTFP resources and its impact on biodiversity (Rodríguez and van der Hammen; Dijkman *et al.*; van Wieren)?

[3] The author's names are given in the same order as their contributions. Their name is given where they explicitly recommend to dealing with the respective research questions or where their paper gives rise to such a recommendation.

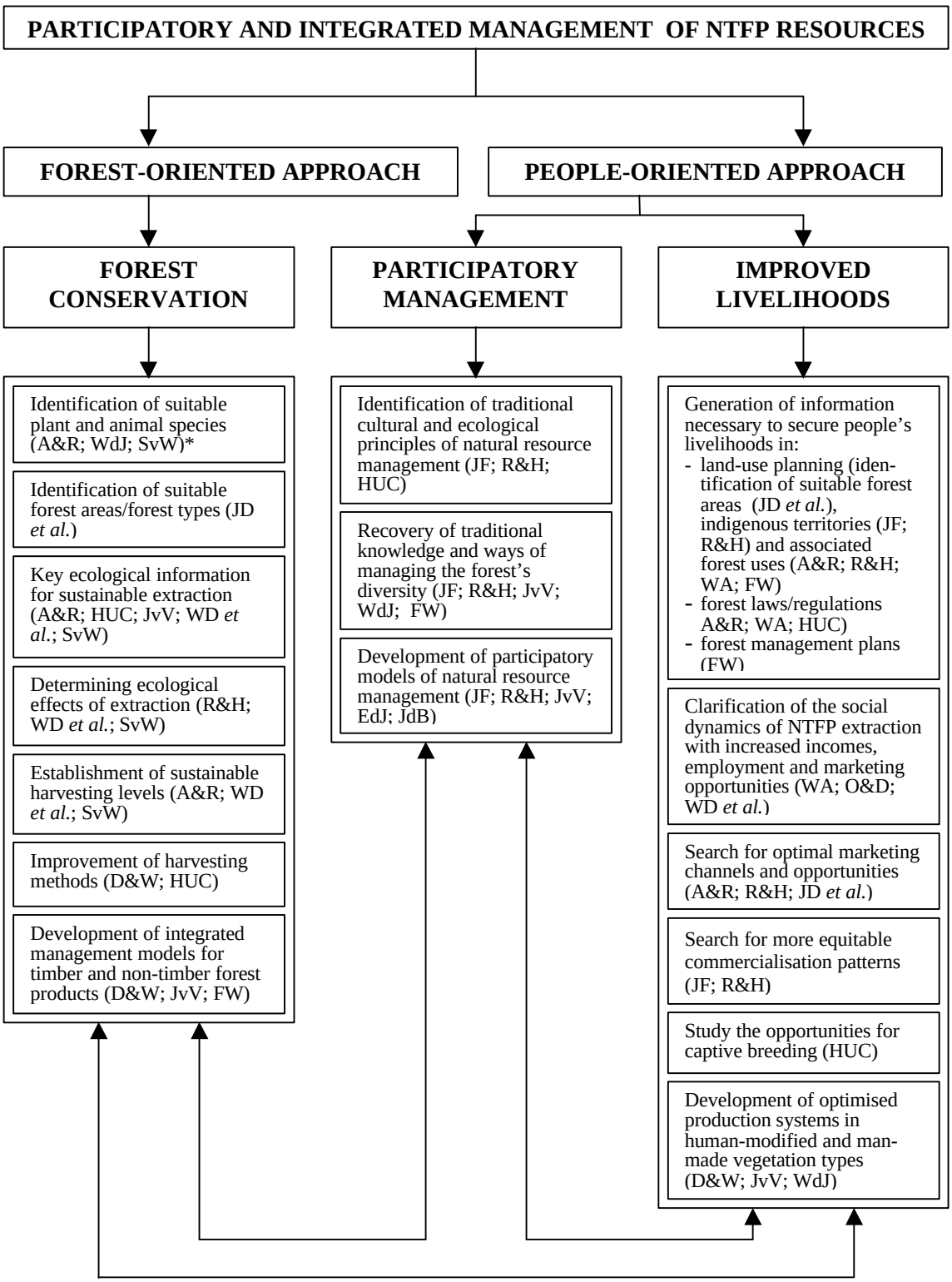

Figure 2 Options for objective-oriented NTFP research

* A&R = van Andel and Reinders; D&W = van Dijk and Wiersum; FW = Wiersum; HUC = Caspary; JD *et al.* = Duivenvoorden *et al.;* JdB = de Beer; JF = Forte; JvV = van Valkenburg; O&D = Overman and Demmer; R&H = Rodríguez and van der Hammen; SvW = van Wieren; WA = Assies; WD *et al.* = Dijkman *et al.*; WdJ = de Jong.

- What harvesting levels can be regarded as sustainable (van Andel and Reinders; van Wieren)?
- How can extraction methods be improved (van Dijk and Wiersum; Caspary)?
- How can the production of timber and non-timber products be integrated into a sustainable management system (van Dijk and Wiersum; van Valkenburg; Wiersum)?

Taking a people-oriented approach, research may focus either on the development of participatory management models or the improvement of forest-dependent people's livelihoods. If the former, NTFP research will focus on the recovery of traditional knowledge of managing the forest's biodiversity and its application in participatory models of natural resource management. Relevant research questions here are:
- What cultural and ecological principles guide local models of natural resource management (Forte; Rodríguez and van der Hammen; Caspary)?
- What can we learn from indigenous knowledge and ways of managing the forest's biodiversity (Forte; Rodríguez and van der Hammen; van Valkenburg; de Jong; Wiersum; de Beer)?
- How can these traditional principles, knowledge and management models be integrated in participatory and integrated models for natural resource management (Forte; Rodríguez and van der Hammen; van Valkenburg; de Jong; de Beer)?

If the objective is to improve people's livelihoods through NTFP development, research can be supportive in securing forest people's livelihoods by generating the information necessary to include forest-based livelihoods in land-use planning, forest laws and regulations and forest management plans. Important research questions here are:
- What forest types are the most suitable for NTFP use (Duivenvoorden)?
- Which parts of the forest form the territory of local communities and constitute their source of livelihood (Forte; van Andel and Reinders)?
- What other forms of land and forest use are being combined with NTFP extraction to make a living (van Andel and Reinders; Rodríguez and van der Hammen; Assies; Wiersum)?
- How do forest law and regulations affect forest-based livelihoods and what adaptations are needed to secure people's access to land and resources (van Andel and Reinders; Assies; Caspary)?
- What management characteristics of NTFP production systems need to be known in order to optimally integrate these systems into sustainable management plans (Wiersum)?

In order to assess the viability of NTFP-based livelihoods, we also need to understand the social dynamics of NTFP extraction. Some important research questions here are:
- How does forest use change with increased incomes (Overman and Demmer; Dijkman *et al.*)?
- How does forest use change with increased employment opportunities (van Andel and Reinders)?
- How do actors change with increased marketing opportunities (Assies; Dijkman *et al.*)?

Last, but not least, research could provide insight into the options for optimised production systems in human-modified and man-made vegetation types, as well as into the marketing opportunities for NTFPs. In the case of animal NTFPs this implies that the opportunities for captive breeding need further study. This suggests the following research questions:
- How can NTFP production systems be optimised in human-modified and man-made vegetation types (de Jong; van Dijk and Wiersum; van Valkenburg; Wiersum)?
- What are the possibilities for domestication and captive breeding (Caspary)?
- How can new marketing opportunities be developed (Forte; van Andel and Reinders; Rodríguez and van der Hammen; Duivenvoorden)?
- What are the possibilities for realising more equitable commercialisation patterns (Forte; Rodríguez and van der Hammen)?

It will be clear that the several research options are mutually reinforcing. Participatory forest management cannot be realised without the ecological information that is gathered from a forest-oriented approach, nor can it be separated from proposals to optimise production in human-modified or man-made vegetation types. This objective-oriented framework makes clear that there is a challenge ahead for continued collaborative NTFP research for the benefit of tropical rainforests and the people who depend on them for their livelihoods.

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