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

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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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[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.

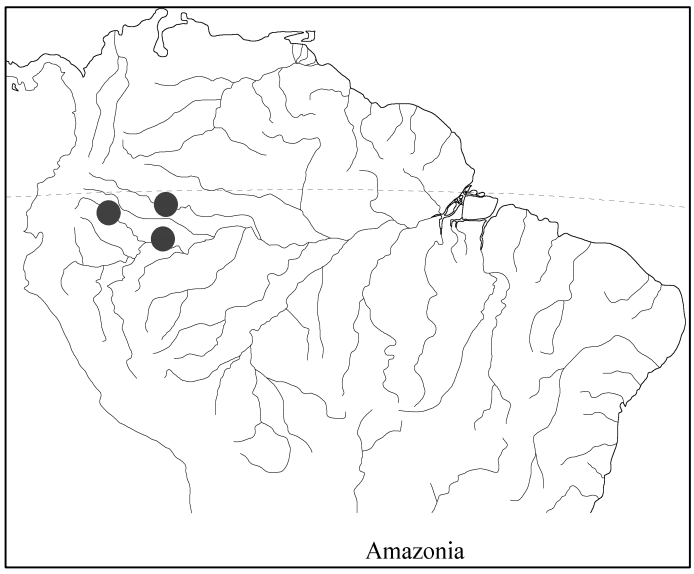


Figure 1 Location of NW Amazonian sites with well-established records of a high forest diversity. The pilot areas of the project (see detailed maps in Fig. 2-4) are located at these same sites

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.

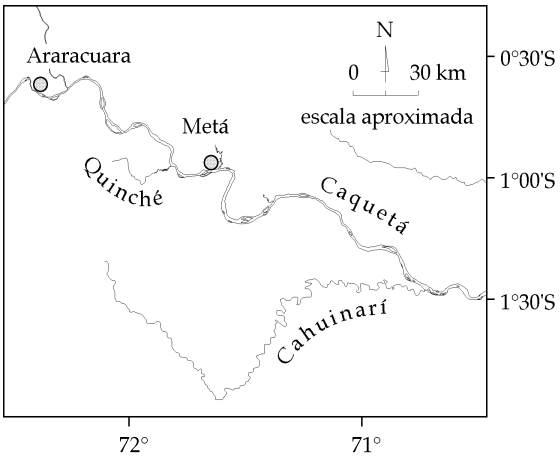


Figure 2 Location of pilot area in Colombia

[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 (

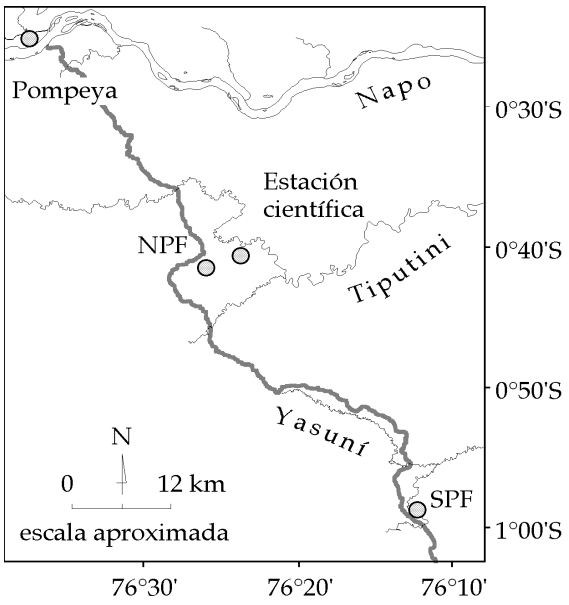
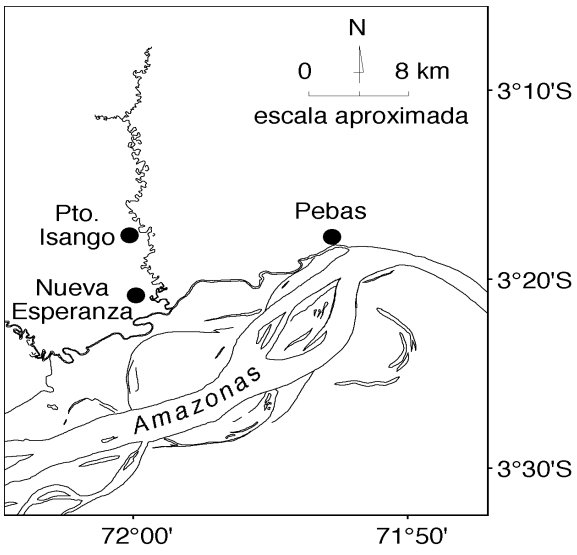


Figure 3 Location of pilot area in Ecuador



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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