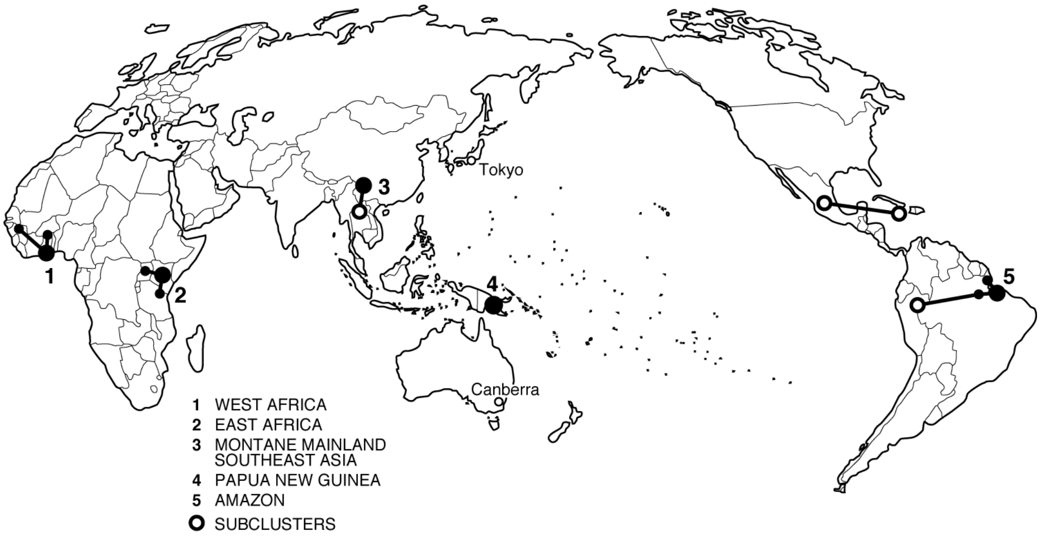
THE UNITED NATIONS UNIVERSITY Project
on People, Land Management and
Environmental Change (PLEC)

PLEC NEWS AND VIEWS

No. 12 April 1999



The Clusters of PLEC

ISSN 1020 0843

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PRINCIPAL SCIENTIFIC COORDINATOR'S REPORT

PAPERS BY PROJECT MEMBERS

P L E C N E W S A N D V I E W S

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PRINCIPAL SCIENTIFIC COORDINATOR'S REPORT

Harold Brookfield

The start of the Second Year

The second year of the GEF-funded project began on 1 March, 1999. This is a year of the greatest importance to PLEC, as it is during 1999 that the field work of PLEC must be on its way to a major success. Within another twelve months, we have to face a mid-term review: there can be no falling behind schedule. Progress in the first year was very good, as the basic summary from the Report to UNEP, printed on p.7, makes clear. The emergent need for guidelines on assessment of biodiversity and agrodiversity was addressed, and in March 1999 guidelines were sent by electronic means to all Clusters. They are printed in a special 'methodology issue' of *PLEC News and Views* (#13), which is distributed together with this issue.

PLEC's second year corresponds very closely to the Chinese Year of the Rabbit, just as our first year corresponded with the Year of the Tiger. In this second year, we need to combine all the cleverness of the rabbit with all the fierceness of the tiger if we are going to be successful.

DEPARTURE OF PLEC'S TOKYO SUPREMO, JUHA UITTO

There is about to be a major change in the PLEC coordination office at UNU. Juha Uitto, who has been part of the PLEC team since the beginning of the project, is moving to the GEF Secretariat at the World Bank. The GEF Council decided to strengthen the Monitoring and Evaluation Unit of the Secretariat by creating a new post of M&E Specialist. Juha will start his new duties in this position from the beginning of May. We hope that PLEC can benefit from his presence in Washington, DC, in the future. We all owe a lot to Juha for his support and hard work over the years. We will miss his presence at our meetings. We wish him, and his lovely wife Yoko Takahashi, all success in their new life in Washington. Juha's place in general charge of the Project will until further notice be taken by Prof. Motoyuki Suzuki, Vice-Rector.

This is what Juha has to say:

'After almost nine years at UNU in Tokyo, it is time for me to move on. PLEC has been an important part of my life since 1992 when we started the development of the project together with Harold Brookfield. A few grey hairs were added in pushing the innovative PLEC concept, but it has been marvellous to see the project's growth from the modest beginnings to the thriving global network it is today. I have thoroughly enjoyed working together with PLEC coordinators and scientists, and have experienced some of my most cherished moments visiting the clusters in Africa, Amazonia and Asia. In my new job at the GEF Secretariat, I will not be far away, but looking at matters from the other side. I am also confident that, with Luohui Liang and Audrey Yuse firmly in charge, the UNU coordination office will continue its efficient work managing the project. I would like to thank all of you for your cooperation and look forward to keeping in touch with all of my friends in PLEC'.

PROGRESS IN THE CLUSTERS

This report concentrates on three of the five GEF Clusters, West Africa, China and Amazonia. Detail on progress in East Africa will be given in *PLEC News and Views* 14, later in the year. An update on the situation in the Papua New Guinea Cluster is given on p. 5. The following are extracts from Cluster reports, edited by Harold Brookfield.

West Africa: Ghana

In southern Ghana, three demonstration sites (Gyamfiase-Adenya, Amanase-Whanabenya; Sekesua-Osonson) are now developed; functional PLEC farmers' associations have been formed in each. Home garden surveys with farmers, and survey of plants and soils in Gyamfiase forest grove were concluded. Work proceeded on: collection of data on agrodiversity; identification of trees that, reputedly, combine effectively with crops; studies of climatic change; demographic conditions, and gender and land tenure, as they relate to bio-physical conditions and/or agrodiversity. On-farm conservation of trees, nurseries of rare endemic and popular exotic plants, and tree planting, were encouraged in all sites. Experiments were initiated in Gyamfiase-Adenya, all with farmers, on the use of stones, grass and *Chromolaena odorata* to check soil erosion, and on use of *Cassia* in fallow management.

In central Ghana, Jachie developed further as a principal demonstration site, unusual in that it is female-led and most members are women farmers. Tano-Odumase emerged as a second major site. Work focused on participatory inventory of agrodiversity, of butterflies and flora in a sacred grove, and on watershed management including restoration of diversity in aquatic life. There are plans to establish a rare food crops arboretum at one or both sites. Other activities included establishment of an arboretum of rare medicinal plants and community plant nurseries, a survey of home gardens, support for livestock industry and non-traditional forms of farming, and studies of food security, and indigenous wild food hunting and gathering.

The major general activity was the second WAPLEC Regional Workshop on **Conserving Agricultural and Biological Diversity for Food Security: Participatory Approaches in West Africa,** which brought together more than 60 farmers, scientists and government and non-governmental officials from Ghana, Guinea and East Africa. Graduate and undergraduate students were encouraged to base their theses on aspects of PLEC basic concern; and training sessions were organized for farmers in areas of tree-planting, stone-lining along hill contours, and raising of small ruminants and poultry.

A major cross-site development was the exchange of plant species and resource conservation knowledge through a visit to farmers in the central sector by farmers from the south, and the interchange of farmer-visits among sites in the southern sector. Six members from the Gyamfiase PLEC farmers' association visited the Jachie association in central Ghana. They stayed four days, exchanging information and experiences, and especially compared mixed-crop farming methods between the two regions. Each side offered advice to the other, and they suggested that the growing network of PLEC farmers' associations should develop into a national NGO.

West Africa: Guinea

The Pita demonstration site on the Fouta Djallon now focuses on the villages of Hadjia, Missidé-Héïré, Dianguel, and Kollangui. Plant species, and threatened animals, were inventoried and their uses identified. Sampling plots were selected across a variety of habitats. Some plant species indicating soil fertility were recorded. In collaboration with farmers, data collection and analysis continue on physical and social-economic conditions, population movement, main economic activities, land tenure and agricultural production systems. Work has begun on the re-introduction and elaboration of old systems of composting, collaborating with farmers who are specialists in compost making, at Missidé Héïré and with an NGO which is experimenting with a modern method at Kollangui. Stone cordons were introduced with three farmers at Dianguel to control soil erosion. Potato and onion were experimented with within farmers' fields to enhance food self-sufficiency. Research was initiated at Missidé Héïré to develop methods of *in situ* conservation of flora resources, including endangered species. A women dyers' group was formed at Missidé Héïré to boost conservation of threatened animal and plant species. Moussaya village near Kouroussa, in semi-arid northern Guinea, close to the Niger river, was initiated as a secondary site.

A training workshop was organized from 7 to 8 October 1998 at Bantignel to explain the PLEC objectives, and what has been achieved, to the people. The prefecture and local authorites as well as the farmers of all districts attended the workshop. The second national workshop was organized from 12 to 13 February, 1999 in order to give full information on project progress to a range of participants from Pita and Kouroussa prefectures, the National *Directions* of Agriculture, Water and Forestry, Livestock, Environment, Rural Engineering and Meteorology and the national NGO Guinée-Ecologie. This was reported by the radio and television. Three Waplec-Guinea researchers attended an English training course for 45 days in Accra (Ghana), and a fourth will join the course in future. Five postgraduate students attended training in PLEC methodology at the demonstration sites in Pita and Kouroussa, and in soil sample analysis in the laboratory at Conakry. Two associated researchers in Kouroussa and three in Pita have gained research experience in data collecting on agro-biodiversity through working with PLEC.

Yunnan, China

In **Xishuangbanna** Prefecture, both the Baka site (Hani nationality) and the Daka site (Jinuo nationality) were confirmed and characterized. A four year plan for sustainable community development was completed for each site. Different types and sub-types of land use have been identified in Baka and Daka, and mapped with computer-mapping software. Sample plots across these types of land use have been marked for long-term monitoring. In Daka, 25 sample plots have been surveyed, and 296 plant species inventoried within them. At Baka, 20 varieties of upland rice and 55 wild vegetables together with their features have been recorded. Preferred timber tree species have been inventoried and assessed, 30 by Baka people and 35 by Daka people. The spatial and temporal differences of species and varieties composition have been analysed. Statistical data on the population have been collected and sketch maps of the villages have been drawn for Baka and Daka sites. A socio-economic survey has been conducted in Baka village. Household survey has been conducted in Daka. On-farm design, land and seedling preparation for home garden elaboration, and a preferred tree species plantation have been completed at the Daka site. At the Baka site, on-farm design, land and seedling preparation of agroforestry have been initiated for reducing reliance on shifting cultivation: a preferred tree species plantation, a firewood plantation and butterfly farming have also been undertaken.

In **Baoshan** Prefecture there are two sites, respectively on the eastern and western sides of Gaoligong mountain. The Hanlong site (Lisu nationality) and the Sabadi (Han and Lisu nationalities) site were confirmed and characterized. Different land-use systems at Hanlong have been identified and mapped with computer-mapping software; 15 sample plots have been marked for long term monitoring. Home garden systems have been surveyed at Sabadi. Aerial photogrammetric survey of forest resources and land use was conducted around the Sabadi and Hanlong sites, and a ground pre-survey was carried out in the target villages. A land-use map was drawn and ground indicators identified. Research on firewood resource and consumption in Gaoligong Mountain has been done by analysis of statistical data and results from sample interviews. It has been found that firewood resources within the community territory can meet only 47.5% of the total demand. Indigenous fuel wood systems (e.g. oak, alder, *Lindera* and *Cassia*) were identified as potential systems for demonstration and experiment to solve firewood shortage in the area.

Household surveys were conducted at both Hanlong and Sabadi, recording family size, land resources, economic resources, and agricultural production. A monitoring card for each interviewed household has been set up for long term monitoring. Based on traditional successful practices in the regions, agroforestry systems are being further tested on degraded sloping farm-land; and community forests are being regenerated through proper management. On-farm design, land and seedling preparation was commenced for home garden elaboration and firewood plantation establishment.

Farmers' associations on biodiversity conservation have been established in three sites. The farmers' associations will become the main organizers for community conservation and development of project activities, as well as running training workshops at the demonstration sites. Three training workshops were held for farmers. For researchers and local officials, a field-oriented workshop on Methods of Participatory Planning on Sustainable Community Development was held in Xishuangbanna. A methodology training workshop was organized for young researchers and local officials from 31 January–4 February 1999. Two graduate students have joined PLEC, and a joint graduate student training programme with Yunnan University is under discussion. Two young researchers are in place in Xishuangbanna and one in Gaoligongshan as liaison persons between researchers and community people.

A Cluster working group and advisory group meeting was held in Kunming, 9–10 June, 1998. In the same month, three Cluster members conducted two short informal workshops with Baoshan Prefecture foresters and Tengchong County foresters. A policy recommendation workshop was conducted on 21 December 1998 to present UNU/PLEC work on sustainable models, for provincial level policy makers, and other academic researchers in Kunming. The PLEC model was recognized as an important approach for sustainable rural development by the policy makers. An annual Cluster meeting was held in Baoshan, 29–30 January 1999. 53 participants attended. 21 reports were presented to summarize project activities undertaken during 1998.

Amazonia

On **Ituqui** island, near Santarém, two types of demonstration sites for habitat restoration projects and smallholder agroforestry systems have been selected and evaluated. An ethnohistorical study of landscape change in the Ituqui region, including a survey of local knowledge of plants species and their uses, has continued. It has identified 101 species that are used by the Ituqui population for seven different types of uses. The present and historical status of major habitats and resources on the island were mapped by members of local communities. The first phase of a study of the ecology and management of water buffalo has been concluded. The household economy was surveyed to obtain economic data on the principal resource-use activities of the household, and the role each activity plays in the household economy.

For the study of várzea land tenure systems, data from the earlier household survey was analysed to determine the distribution of farm sizes on the várzea, and the manner in which residents acquired the land upon which they are living. In addition to the survey, a map has been prepared as part of the GIS of the Ituqui region now being constructed which shows the boundaries of all Ituqui properties. Community reforestation of lake margins has made solid progress. Seedling production and planting has proceeded well, including introduction of *Pau mulato*, a fast growing timber species, to increase the direct economic potential of reforestation, in addition to the indirect benefits via the contribution to the productivity of lake fisheries.

At **Amapá**, near the mouth of the Amazon, two demonstration site villages, Mazagão and Ipixuna have been further developed in association with the farmers' organization. Using farmers' classification of fallow, plant species under different types of fallow were inventoried by sample survey. Data from the inventory were evaluated to identify difference in species composition between the inventoried associations and the natural regeneration. Information about the social and environmental changes that affected the sources of household income and the status of biodiversity in the landholdings of smallholders were collected by interviewing 25 families and by visiting their fields, fallows, house gardens and forests.

A course on the ecology and management of floodplain lake fisheries was organized, and the fifth of a planned nine modules has recently been completed. The course has 40 participants representing six Ituquí communities and grassroots organizations from three other major regions of the municipality. In mid-1998 the pilot phase of the project to develop an environmental education program for várzea schools was concluded and an agreement was signed with the municipal secretary of education to expand the program to all the várzea schools of the municipal school system. In addition, a training course for primary school teachers of the municipality on the várzea is being developed. Two inter-village meetings, eight visits to demonstration sites (2 in Ipixuna and 6 in Mazagão) and 2 training courses (*encontros*) for farmers were conducted. The integration of the 10 expert farmer families has facilitated the execution of training and extension activities. Two NAEA graduate students, one at the master's level and the other at the doctoral level are participating in PLEC. Students involved in PLEC activities are also studying at other Amazonian universitities. A field trip to Ituqui was organized for the first year doctoral students under the NAEA Doctoral Programme.

OVERCOMING PROBLEMS IN PAPUA NEW GUINEA

The Papua New Guinea Cluster had more than its fair share of problems in 1998. At the beginning of the year, the national Cluster leader, Mr Tom Nen, was appointed Managing Director of the PNG National Forest Authority, and had to leave PLEC just as development of a national group was to have commenced. For a period, Dr Beno Boeha, Director of the National Research Institute, acted as Cluster leader with the support of Dr Colin Filer, head of Social and Environmental Studies in NRI. A junior researcher in the Institute, Mr Rodney Kameata, attended the general Project workshop in Uganda in April 1998. PLEC was adopted as a major NRI project, and a replacement for Tom Nen was sought. In June, Mr John Sowei was appointed, and almost immediately attended the Management Group meeting in Tokyo. This was followed by a meeting of most members of the Cluster in Port Moresby, on 14 July.

The July meeting set up a work-plan for the project, settling the choice of demonstration site areas, of which there are three, two of them developed mainly by the Japanese and Australian groups who have a long record of work in Papua New Guinea. The third was selected by the National Research Institute. The sites are:

1. Two villages in the Dreikikir-Wosera area of East Sepik Province, to be known as the 'Dreikikir site', and to be the main responsibility of the Australian National University team;
2. Two villages in the Kilimeri Census Division, south of Vanimo town in West Sepik Province, to be known as the 'Kilimeri site', and to be the main responsibility of the National Research Institute team;
3. Two Huli-speaking parishes in the Tari Basin in Southern Highlands Province, to be known as the 'Tari site', and to be the main responsibility of the University of Tokyo team.

One of the reasons for selecting the Kilimeri site was that NRI already had a research project on the Social Context and Impact of the Vanimo Timber Project which was funded by the European Union into 1999. National and foreign researchers working on this project had already assembled data on population, land use, and indigenous environmental knowledge which was obviously relevant to the aims of the PLEC project. Good relations were already established with officials of the Sandaun Provincial Government, and with local villagers.

The three sites are strongly contrasted. Tari is a high-altitude basin in the Southern Highlands Province, and one of the most densely-peopled parts of the country. An intensive farming system is based on the sweet potato. The other two are both in the northwestern Sepik Province, and sago is important in both areas. Many people refer to sago as 'the backbone' of the Sepik people. Sago is nutritionally very poor, but is a high-energy food rich in carbohydrates. The labour distribution among males and females involved in sago processing varies between tribes in the Sepik. It is usually the women who process sago starch. This can be processed from harvested palms all year round and provides food security when garden crops are in short supply. Its extraction demands a high level of manual labour, for it involves pounding the pith, transporting the pounded pith to the water source, washing the pounded pith and transporting the wet starch to be prepared for consumption. At Kilimeri, sago is more important than farming, and hunting remains a major male activity. The Tumam people at Dreikikir are more dependent on gardening, mainly for yams, than on sago as a food resource.

Substantial basic work has now been done in each area, in preparation for moving into the demonstration activities with the villagers during 1999. However, NRI plans have been put at risk by the decision of the Papua New Guinea government to end funding of the Institute, at a date not yet determined. Thus Project staff can only be appointed on PLEC funds, and planned NRI counterpart funds cannot any longer be relied upon. This was the context in which a March 1999 meeting decided to establish a stronger national presence in the Dreikikir and Tari areas. Use of training funds in the budget makes possible engagement of nationals as junior Research Officers and Assistants, and these people will reside permanently at or near the sites. They will also move around between sites from time to time, so as to enhance national familiarity with all parts of the Project. Some promising young graduates have been appointed. To publicize the Project, a feature article by the Cluster leader was written for the Port Moresby *Independent* newspaper, and published on 8 January 1999.

OVERALL SUMMARY OF THE 1998 GEF WORK: REPORT TO UNEP

Liang Luohui, Managing Coordinator

The four-year project UNU/PLEC under funding from the GEF formally started on 1 March 1998. The first half-yearly contribution of US$1,286,349.00 from GEF and the second of US$681,699.00 were received on 13 April and on 10 November 1998 respectively. Implementation at project level and Cluster level has commenced according to the Project Document, although with some delays due to late receipt of funds. Under annual contracts from the UNU, the Clusters in all participating countries (Kenya, Tanzania, Uganda, Ghana, Guinea, Brazil, China, Papua New Guinea) have completed their first year work by the end of February 1999, and have begun to implement the second year work. The implementation of the first year work was difficult, but successful due to the dedication of all participating institutions and people

Major work at project level

While the first year work at project level was carried out on schedule, special attention was paid to planning and assisting the work, providing work guidelines, establishing the PLEC organization, and formulating the framework for project management.

The PLEC General Meeting, and the PLEC Field Meeting for the Americas were held, and coordination visits to Clusters made to plan and assist work implementation. In addition, a short-term scientific adviser was hired to assist the East Africa work

The PLEC General Meeting was hosted by the East Africa Cluster and the Uganda sub-Cluster in Mbarara, Uganda, 29 March–4 April 1998. The main theme of the workshop was planning the future course of PLEC, especially in view of the purpose and methodologies pertaining to demonstration sites.

The PLEC Field Meeting for the Americas was held in Portland, Jamaica, 6-8 November 1998. The Jamaica sub-Cluster, based at the University of the West Indies, were the local organizers. The Field Meeting brought together PLEC researchers in the Americas in order to compare experiences and disseminate ideas; to assist the 'cluster-in-formation' (Meso-America, consisting of Jamaica and Mexico) in developing a viable work programme and choosing appropriate methodologies; to test agrodiversity methodologies in a field situation; and to monitor progress to date, and develop consistent workplans for all Americas groups.

The PLEC Biodiversity Advisory Group (PLEC-BAG) was formed and met to produce guidelines on collection and analysis of agro-biodiversity data. Two methodology papers on biodiversity and agrodiversity description and analysis, were prepared to guide the work at demonstration sites. Lastly, a scientific adviser was hired to give a talk on intellectual property rights in biodiversity databases.

The PLEC Biodiversity Advisory Group (PLEC-BAG) was established by the PLEC Management Group to ensure the quality of and develop the methodology of the collection and analysis of agro-biodiversity data. It consists of Cluster personnel with expertise in this field. The PLEC-BAG Field Meeting was held from 21–28 January 1999, in Yunnan, China, hosted by the PLEC China Cluster. Through formal and informal discussion, comparison and exchange on existing approaches to agro-biodiversity assessment during the largely field meeting, PLEC-BAG developed common views on method. Subsequently, a methodology paper has been through several drafts, and was distributed to all PLEC Clusters on 15 March 1999.

Guidelines on Agrodiversity were drafted by Scientific Coordinators Brookfield and Stocking, and made available to Clusters in July 1998. Following completion of the BAG report, these have been revised in order to match the BAG classifications and recommendations. Copies of the revised Agrodiversity Guidelines were distributed to Clusters on 23 March 1999. Both the BAG and Agrodiversity Guideline papers are now printed together in a special 'methodology' issue of *PLEC News and Views* No. 13.

Concerning PLEC organization and management, both the Management Group and the Advisory Group formed and met. The primary guidelines and procedures for project management and reporting format were formulated. The Scientific Coordinators met fully and made strategic decisions on emerging issues. In addition, facilities for communication, research and transportation for Ghana, Guinea and Tanzania were arranged to improve working conditions.

The PLEC Management Group met in connection with the General Meeting at Mbarara. The PLEC Expanded Management Group Meeting was held at the UNU Headquarters, Tokyo, Japan, 2-4 July 1998. The objective of this important meeting was to discuss and resolve emerging issues of future management of UNU/PLEC. These included terms of the conduct and reporting of project work, reporting format, rules of financial management of project funds, forward financial planning, guidelines for creation of an agrodiversity database, dissemination, and training. The record of the meeting sets a framework for future management of PLEC.

The PLEC Advisory Group Meeting was hosted by the UNU Office in Europe at UNESCO premises in Paris, 11 September 1998. Because of the difficulty in coordinating the timing, the meeting was held 6 weeks behind the schedule stipulated in the PLEC-GEF Project Document. All institutions indicated in the Project Document were invited to the meeting at their own cost. Most of the UN agencies, including FAO, UNDP and the World Bank, nonetheless, were not be able to attend. In attendance were UNEP, UNESCO, several relevant international research institutions and initiatives (ICARDA/FCP, ICRISAT/DMP, ISNAR, TSBF), as well as two bilateral donors (DFID, SDC) who have taken a specific interest in PLEC. At the meeting, valuable suggestions were made and informative contact with other relevant projects established. One of the suggestions was that GEF should establish a joint advisory group that would cover all of the four initiatives, i.e. PLEC, DMP (the Desert Margins Programme), FCP (the Fertile Crescent Programme), and TSBFP (the Tropical Soils Biodiversity and Fertility Programme) in order to assure maximum impact and coordination.

The PLEC Scientific Coordinators Meeting was held in London, 13-16 February, 1999. At the meeting strategic decisions were made on emerging issues around forward financial planning, mid-term review, coordination, publication, and publicity.

PLEC has been disseminated to a wide international community through setting up the provisional PLEC Homepage on the Internet (http://202.253.138.133/plec.htm). PLEC was presented at the Fourth Conference of Parties (COP4) of the Convention on Biological Diversity, Bratislava, Slovakia, 4-8 May 1998, and at the second Conference of Parties of the Desertification Convention (COP2/CCD), in Dakar, Senegal, 30 November–11 December 1998.

Major work at Cluster level

The important achievement at Cluster level is that 23 PLEC demonstration sites in eight countries were confirmed. At selected sites, partnership between scientists, local officials and farmers is being built up. Inventory of agrodiversity, analysis of socio-economic and demographic conditions, and outreach and experimental work have started and continue. On the basis of traditional knowledge, different models of agroforestry, soil conservation, and agro-biodiversity conservation are being experimented with by farmers with assistance from local officials and scientists.

Planning is essential to smooth project implementation at Cluster level. All Clusters and sub-Clusters held formal or informal planning meetings, detailed their work plans and had annual contracts issued with assistance from the Scientific Coordinators. Some of them formulated relevant guidelines for project management. In addition, the West Africa Cluster and China Cluster held successful Annual General Meetings to review the work, exchange experience and to plan forward.

To build local capacity and institutions, farmers' associations with various interests, such as biodiversity conservation/ environment/ agriculture/ special skills were formed. They play an important role in PLEC outreach and experimental work. Training courses on sustainable agriculture, ecology, income-generating techniques, etc. have been organized for farmers and grassroots organizations: some courses on research methods were for local officials, students and young researchers. Other courses were organized by farmers' associations themselves, and taught by expert farmers. Training programmes are being developed to involve students from universities. 21 postgraduates and junior researchers joined PLEC under training. Moreover, PLEC membership of professionals almost doubled from 106 to 197 over the year 1998, and members from developing countries accounted for 90 %.

FORTHCOMING PLEC MEETINGS

1) The 3rd PLEC Management Group Meeting, 15-18 May 1999, Toluca, Mexico.
2) A 4th Meeting of the Joint UNESCO-UNU-TWAS Programme on 'South-South Cooperation on Environmentally Sound Socio-Economic Development in the Humid Tropics', 19–24 May 1999, Xalapa, Mexico.
3) The 2nd Meeting of PLEC-BAG, 20-24 May, 1999, New Hampshire, USA.
4) The 2nd General PLEC Meeting is now planned to take place in February, 2000, at Macapá, Brazil.

PAPERS BY PROJECT MEMBERS

CLAIM THAT TENANT–FARMERS DO NOT CONSERVE LAND RESOURCES: COUNTER EVIDENCE FROM A PLEC DEMONSTRATION SITE IN GHANA[1]

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Introduction

Tenants form a pivot of farming in tropical African countries. In Ghana, through share-cropping and land renting, tenants play a central role in food crop farming, just as they did in the cocoa-farming revolution in the first half of this century (Hill 1963; Gyasi 1994).

Because tenant-farmers do not own the land, but operate it on rental or share-cropping basis, it is often argued that they lack the motivation to conserve and regenerate the land resources, especially the soils and natural biota. Sometimes the tenant-farmers are accused of exploiting land to the point of destruction.

A telling example of this negative view of farming by tenancy is the Ghana Ministry of Agriculture's description of renting of farm land as 'the most destructive of all arrangements for holding land since the cultivator aims at obtaining a maximum of returns in the shortest possible time; and this objective transcends the need to adhere to good husbandry practices' (Division of Agricultural Economics, Ministry of Agriculture 1962). Based on observations in the margins of the southern sector of the forest-savanna mosaic zone near Nsawam, immediately north of Accra, Ghana's national capital, Varley and White had similarly concluded that 'as a long-term policy this system [of transient migrant-tenant-farming on rented land] is bad' (Varley and White 1958: 92), because the tenants cut down most of the forest trees, carried out intensive monocropping, 'moving on when the land is exhausted' (Varley and White 1958: 120). In this way, the tenants had rendered much of the area 'completely useless for farming for many years to come' (Varley and White 1958: 93). A similar adverse situation appears to be developing in an adjacent area, in Yensiso, an approximately 100 sq. km PLEC pilot study site which is in development into a demonstration site under the new name Gyamfiase-Adenya, in the same forest-savanna ecotone. There, PLEC studies carried out in 1995 suggested less favourable bio-physical conditions in localities farmed by tenants than in those farmed by non-tenant, owner-occupier farmers. In the tenant-farmed localities, there appeared to be: a dominance of grass and non-floral species; fewer trees; greater erosion and exhaustion of soils; less crop diversity; and other symptoms of greater bio-physical deterioration (Gyasi 1996).

However, whilst moving recently among villages in a major PLEC survey of home gardens we unexpectedly encountered situations in the Gyamfiase-Adenya demonstration site which appear to contradict the claim that tenants do not

[1] Mr Daniel K. Abbiw, Research Associate, Mr George Larbi, Senior Technician, and Mr J.Y. Amponsah, Technician, all of the Department of Botany, University of Ghana, were instrumental in the identification of the plants presented in this paper. Their help is gratefully acknowledged.

conserve land and its related bio-physical resources. The survey is being carried out in a participatory manner with farmers in Ghana to generate information for enhancing the role of home gardens as germplasm banks and a source of food. Among the food-crop farms invariably operated by migrant Ayigbe settler-tenants [including home gardeners] through land rotation in the bush away from the compound house, we noticed a sizeable number in which the food crops grew alongside conserved trees, especially young ones, a practice encouraged by PLEC.

We probed this unexpected situation further by closer study of the floral composition of four of the tenant-farms in which trees are conserved *in situ*, and by discussions with the operators of the farms who may own the trees either exclusively, or jointly with the landlord. The preliminary findings are presented below, case-by-case, as a possible basis for a more informed planned conservation of agrobiodiversity.

Findings

Case 1: Yaw Apeti's farm at Otwetiri

The farm of Yaw Apeti, a married tenant with children, is operated on a parcel of land leased at Otwetiri by the landowner, Madam Akosua Botwe of Akropong, seat of the paramount Chief or Stool of Akuapem people, the predominant owners of the Otwetiri lands. It, like the others, measures less than half an acre estimated, as in the other cases, by pacing around the perimeter of the farm.

The plants are summarized in Table 1. They include nine varieties of crops involving different cultivars. The crops are dominated by cassava/manioc, which is shared in the ratio of 1:1 (*abunu*) between the tenant and landowner, and by maize/corn, shared in the ratio of 2:1 (*abusa*) with the higher fraction going to the tenant.

Table 1 Plants in Yaw Apeti's farm

Crop				***Other plant (sapling\tree)***			
Local Name in Twi	*Common English Name*	*Botanical Name*	*Use*	*Local Name in Twi*	*Common English Name*	*Botanical Name*	*Use*
Bankye	Cassava/ Manioc	*Manihot esculenta*	F	Odwen	Camwood	*Baphia nitida*	M/Fu
Aburow	Maize/Corn	*Zea mays*	F	Akakapenpen	?	*Rauvolfia vomitoria*	M/Fu
Afasew	Wateryam	*Discorea alata*	F	Onyankyren	Sandpaper tree	*Ficus exasperata*	O
Amankani	Cocoyam	*Xanthosoma maffafa*	F	Osena/Yooye	Velvet tamarind	*Dialium guineense*	F/O
Brode	Plantain	*Musa paradisiaca*	F	Ankye	Akee apple	*Blighia sapida*	F/Fu/O
Brofere	Pawpaw	*Carica papaya*	F	Abrewa-aninsu	?	*Hoslundia opposita*	M/Fu
Abrobe	Pineapple	*Ananas comosus*	F	Osisriw	?	*Newbouldia laevis*	M/Fu
Mmofra morewa		*Solanum torvum*	F/M	?	Resurrection plant	*Bryophyllum pinnatum*	M/Fu
Mako	Pepper	*Capsicum annuum*	F				

F: food M: medicinal Fu: fuelwood O: other uses ?: not known

Ten varieties of other plants, including those used for medicines and firewood, were identified. As in the other cases, there were weeds, dominated by *Chromolaena odorata* which, although regarded as an obnoxious weed, has reported soil enriching capability and medicinal and other uses.

Case 2: C.K. Avume's farm at Otwetiri

C.K. Avume and his wife operate farms both jointly and separately on parcels of land rented, as in the case of Yaw Apeti, from an Akuapem landowner originating from Akropong.

Made up of crops and saplings/trees, the relevant plants in Avume's farm are shown in Table 2. The crops are dominated by cassava and maize, which are raised on share-cropping basis. The 15 species of sapling/tree encountered are used variously as firewood, food, medicine, and constructional material.

Table 2 Plants in C.K. Avume's farm

Crop				***Other plant (sapling\tree)***			
Local Name in Twi	*Common English Name*	*Botanical Name*	*Use*	*Local Name in Twi*	*Common English Name*	*Botanical Name*	*Use*
Bankye	Cassava/ Manioc	*Manihot esculenta*	F	Pepea	?	*Phylanthus discordens*	Fu
Aburow	Maize/Corn	*Zea mays*	F	Emire	?	*Terminalia ivorensis*	T
Abe	Oil palm	*Elaeis guineensis*	F	Ofosow	?		Fu
Mako	Pepper	*Capsicum annuum*	F	Osese	?	*Holarrhena floribunda*	F/C
Aso	Cowpea	*Vigna unguiculata*	F	Osisriw	?	*Newbouldia laevis*	M
Mango	Mango	*Mangifera indica*	F	Owudifo akele	?	*Anthocleista vogelii*	M
				Okronoo	Red-flowered silk-cotton tree	*Bombax buonopozense*	M
				Awonwee	?	*Olax subscorpioidea*	M
				Opanpan	?	*?*	Fu
				Osena/Yooye	Velvet tamarind	*Dialium guineense*	F/O
				Nyamedoa	Pagoda tree	*Alstonia boonei*	M
				Akakapenpen	?	*Rauvolfia vomitoria*	M/Fu
				Agyama	Christmas bush	*Alchornea cordifolia*	M
				Odwen	?Camwood	*Baphia nitida*	M
				Bronyadue	Brimstone tree	*Morinda lucida*	M

F: food M: medicinal Fu: fuelwood O: other uses ?: not known T: timber C: carving

Case 3: Madam Avume's farm at Otwetiri

The relevant plants in the farm of Madam Avume, C.K. Avume's wife, are summarized in Table 3. The crops and other plants are similar to those found in the husband's farm. However, the husband's shows greater diversity.

Table 3 Plants in Madam Avume's farm

Crop				***Other plant (sapling\tree)***			
Local Name in Twi	*Common English Name*	*Botanical Name*	*Use*	*Local Name in Twi*	*Common English Name*	*Botanical Name*	*Use*
Bankye	Cassava/ Manioc	*Manihot esculenta*	F	Osese	?	*Holarrhena floribunda*	M
Aburow	Maize/Corn	*Zea mays*	F	Akakapenpen	?	*Rauvolfia vomitoria*	M
Afasew	Wateryam	*Discorea alata*	F	Ankyo	Akee apple	*Blighia sapida*	M
Mango	Mango	*Mangifera indica*	F	Agyama	?	*Alchornea cordifolia*	M
				Odwen	Camwood	*Baphia nitida*	M
				Emire		*Terminalia ivorensis*	T
				Osena/Yooye	?	*Dialium guineense*	F/O
				Adurubrafo	?	*Maraya micrantha*	M
				Bronyadua	Brimstone tree	*Morinda lucida*	M
				Odwen-dwenua	?	*Lecaniodiscus cupanioides*	O
				Atwere	?		O
				Atuaa	Hog plum	*Spondias mombin*	M

Case 4: Goha's farm at Mampong-Nkwanta

Goha is a 29-year-old graduate of a polytechnic institute, who took to farming for want of what he described as a better alternative job opportunity. His biodiverse farm is operated on a share-cropping basis on land leased out by one of the citizens of Akuapem-Mampong who own the lands of Mampong-Nkwanta and adjoining villages.

Table 4 Plants in C.Y. Goha's farm

Crop				***Other plant (sapling\tree)***			
Local Name in Twi	*Common English Name*	*Botanical Name*	*Use*	*Local Name in Twi*	*Common English Name*	*Botanical Name*	*Use*
Bankye	Cassava/ Manioc	*Manihot esculenta*	F	Osese	?	*Holarrhena floribunda*	C/Fu
Aburow	Maize/Corn	*Zea mays*	F	Osena/Yooye		*Dialium guineense*	F/O
Amankani	Cocoyam	*Xanthosoma maffafa*	F	Odwen	Camwood	*Baphia nitida*	M
Abo	Oil Palm	*Elaeis guineensis*	F	Osisriw		*Newbouldia laevis*	M
?	Cowpea	*Vigna unguiculata*	F	Kyonkyen	Bark cloth tree	*Antiaris*	F/O
				Ankye	Akee apple	*Blighia sapida*	F/Fu
				Odum		*Milicia excelsa*	T

F: food M: medicinal Fu: fuelwood O: other uses ?: not known T: timber C: carving

The five varieties of crop are interplanted with seven species of tree/sapling having various uses (Table 4). The crops include cowpea, which is not found in any of the first three cases presented above but which occurs on two farms here, and cocoyam which is rare in tenant farms.

Reasons for the conservation of trees

In all four cases, the tenants cited growing scarcity of fuelwood associated with deforestation as the principal reason for the practice of tree conservation. Trees are harvested regularly for fuelwood. Other reasons were that the trees serve the useful purposes of providing the following: medicine; supplementary food; wood for carving, fencing and house construction; and mortar and pestle for pounding *fufu*, a popular local meal.

Contrary to expectation, the tenants reportedly started conserving trees spontaneously, independently of the nearly two year-old PLEC campaign of tree conservation in the Gyamfiase-Adenya demonstration site. This finding would seem to suggest that there is, inherent among tenants, environmental consciousness, which PLEC should recognize and use as a basis for its bio-physical conservation drive.

Conclusion

This paper shows that, contrary to popular belief, tenant-farmers do not in all cases exploit land resources: some of them do, in fact, consciously conserve and regenerate such resources. The paper also underscores a need for PLEC field workers to remain alert for the unexpected. It is essential not to operate solely on the basis of preconceived notions or hypotheses, which may betray individual prejudices and turn out to be fallacies.

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DIVERSITY OF UPLAND RICE, AND OF WILD VEGETABLES, IN BAKA, XISHUANGBANNA, YUNNAN[1]

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Introduction and methods

This article reports two background studies in the Xishuangbanna village of Baka, one of the four demonstration sites of the China Cluster. Baka people are mostly Jinuo, members of an indigenous group numbering 18,000 people. In former times they practised shifting agriculture only, but many villages, including Baka, were relocated closer to rivers and roads during the period 1950–80; most now cultivate some irrigated lowland rice. The main upland crops include upland rice, maize and beans. Jinuo used to grow about 100 types of upland rice. They still grow about 70 types to meet requirements of households with different economic conditions, using lands with varied natural conditions.

In the past they also extensively collected roots, stems, leaves, flowers and fruits of wild plants. Jinuo still collect more than 200 species of plants for food, medicine and other uses. Among them, more than 100 species are wild vegetables, accounting for a major part of collected wild plants. Most vegetables are from forests, except for a few that are planted. Some of the latter are common on the market, and include Choucai (*Acacia insia*), Baihua (*Bauhinia variegata*), Xiangchun (*Toona sinensis*), Ciyuantuo (*Eryngium foetidum*), Shuiqin (*Oenanthe javanica*), Citianqie (*Solanum indicum*) and Yuxingcao (*Houttuynia cordata*).

Little has been reported on assessment of variety diversity at natural village level although there are some research reports on variety diversity of the fallow system at the higher administrative village level. This study began with inventory. In the field, in company with the householders, researchers recorded the local name of different varieties of upland rice, and later obtained information about their sowing time, type, shape, and other characteristics. They moved through different altitudes from lowland to highland within the village. By discussion and observation they recorded land-use history, and soil fertility, and found out existing problems and opportunities for development.

They also noted local names of wild vegetables, and by interview obtained information about their collecting time, frequency, tools used and the parts of plants that are collected. A structured questionnaire survey was designed to find out specific items such as quantities collected, home consumption, and sale. A statistical analysis on results was then carried out. The researchers also visited the local market and recorded types, quantities and prices of wild vegetables on sale.

Diversity of upland rice

The 48 natural villages of Jinuo Township grow about 70 varieties of upland rice. Baka grows 20, as shown in Table 1. According to different standards, these varieties can be classified into a few large groups:

a) By sowing time, three groups, i.e. early-sown, middle-sown, and late-sown;

b) By variety, two groups, i.e. non-glutinous and glutinous;

c) By colour, three groups, i.e. red, white and mixed colour groups;

[1] This article is drawn from two separate articles by the authors, put together by the editors. Translation is by Liang Luohui, Managing Coordinator of PLEC.

Table 1 List of upland rice varieties in Baka

No	*Local name*	*Sowing time*	*Type**	*Shape***	*Shell colour[cc]*	*Grain colour[cc]*	*Taste*	*Yield*	*Temper-ature (resistant to) †*	*Fertility of soil*	*Fre-quency*
1	landigu	middle	G	s and t	r	w	b, h	low	c	poor	few
2	luoli	early	G	m, r	r	r	g	high	h	fertile	many
3	hejieba	middle	G	m, r	w	r	b	high	c and h	poor	more
4	liajdaogu	early	G	t and lo	w	w	g, s and f	middle	c	fertile	few
5	diancui	early	G	m, r	w	w	h	middle	c	fertile	few
6	bailuogu	late	Ng	lo and L	w	w	g	high	c and h	fertile	many
7	maogu	late	G	r, s	p	r	be, f	middle	c+	poor	fewer
8	huagu	late	G	r, s	p with w	r	be, f	middle	c+	poor	fewer
9	mowanggu	early	G	r, L	w	w	be, f and s	high	h	fertile	few
10	changgu	late	G	t and lo; m	w	w	g, f	low	c	fertile	fewest
11	sequoluo	early	G	t and lo	w	w	g, s and f	low	c	fertile	few
12	manyagu	late	G	L and lo	p with y	w	b, h	high	c	fertile	many
13	hebeng	middle	G	L*, r	p with y	w	g, f	middle	c	fertile	many
14	gulala	the last	Ng	t, lo	p	p	g, s and f	lowest	c	fertile	few
15	xiahong	middle	G	lo, m	w	r	b, h	high	c	poor	few
16	dahong	middle	G	lo, L with short awn	w	r	b, c	high	c	poor	few
17	xihong	middle	G	lo, s	w	r	b, h and c	high	c and h	poor	more
18	anene	late	Ng	lo, L	y	r	g	high	h	fertile	many
19	langu	late	G	lo, L	r	w	g, s and f	high	c	fertile	few
20	ximongu	late	G	L, r	p with w	w	g, h and f	high	c	fertile	few

Key:

* G: glutinous; Ng: non-glutinous

** s: small; m: medium; L: large; r: round; t: thin; lo: long; L*: largest.

cc r: red; w: white; p: purple; y: yellow.

tt b: bad; g: good; h: hard; s: soft; f: fragrant; be: best; c: coarse.

† c: cold; c+: colder; h: hot.

d) By the temperature most suitable for the varieties, which are respectively cold-resistant, heat-resistant and broadly tolerant. There are two reasons for the co-existence of three groups. One is that the village altitude ranges from 600 metres to 1250 metres above sea level. Second is that new varieties are easily introduced as this village is now near the road.

Difference in planting frequency among varieties

Variation in planting frequency has three causes:

a) Differences in natural conditions. This is mainly due to difference in temperature at different altitudes. At high altitude, varieties resistant to cold are planted. Baka village has moved down from the heights to the existing site. Therefore, the planting area of some traditional cold-resistant varieties has decreased gradually. In addition, households with relatively more lowland wet-rice land tend not to go to the uplands for shifting agriculture. This tendency further reduces frequency of planting of some cold-resistant varieties.

As for two varieties, *xiahong* and *dahong* (15 and 16 Table 1), local people have found that it is difficult to thresh them in the hot lowland, and consequently they are planted less than before. They have almost stopped planting *changgu* (10), which used to be planted at the old village site, since it is not suitable to the temperature at the new village site. *Landigu* (1), that produces a relatively high yield on low quality soil in the highlands, yields less well in the lowland, so it is now planted less than formerly.

(b) Difference in the economic situations of households. Some types of upland rice taste good, but yield poorly. Only rich households plant them. Poor households prefer the varieties of upland rice which yield well but taste poorly. Thus, they have enough rice to eat or sell to the local market.

c) Difference in soil fertility. At the old site, per capita fallow land of Baka village was 25 *mu* according to national regulations. Fallow period was 8-15 years since Baka was sparsely populated. As a result, soil fertility could recover with a long fallow period. Soil quality was high at the old site. After the community had moved down from the old site to the new site, 3000 *mu* of fallow land was classified as part of Nature Reserve in 1978. Per capita fallow land was reduced to 8 *mu*. The fallow period has to be shortened to maintain grain production. Soil fertility is degraded as the fallow period is not long enough for it to recover. Thus, some varieties such as *ximongu* (20), which require high soil fertility, were not planted as often as they used to be at the old site. Their sowing area has decreased in recent years as soil fertility is depleted.

Use of wild vegetables

Due to continuing uncertainties of land tenure, local people collect what they can find in the mountains, and there is little attempt to conserve species and varieties. Some people cut canes or trees, even dig out plant roots. Wild vegetables of economic value or seasonal ones, in particular, are not sustainably collected. This leads to degradation of wild vegetables and influences sustainable use of resources. For instance, the top shoots of *Citongcao* (*Trevesia palmata*) have almost all been cut and collected.

Through a long history of collecting wild vegetables, all nationalities in Xishaungbanna have acquired knowledge of how to collect wild vegetables regularly and seasonally according to different periods of growth, blossom and seeding. Similarly, they have developed different ways of cooking wild vegetables, such as toasting, frying, making soup or jam; some are eaten raw. They also have various ways of processing them, including fermentation and drying. However, little has been recorded on the assessment of species diversity of wild vegetables at village level.

Results are shown in Table 2, which lists 55 species of wild vegetables used at Baka. The fresh stems and leaves of plants are mostly collected. The village is very rich in natural resources of seasonal bamboo shoots and mushrooms. Their sales on the market are large. Both of these two wild vegetables have big potential for further development. Through the sale of wild vegetables in the market, the Jinuo have increased considerably their involvement in business.

Table 2 Ethnobotanical Inventory of wild vegetables in Baka, Xishuangbanna

No	Chinese Name	Latin Name	Jinuo Name	Edible Part *	Cooking Method †	Collection Season	Habitat §	Frequency
1	Jiahaitong	Pittosporopsis kerri	Buokuoluo	Fr	b	Jul-Aug	pf	Often
2	Caijie	Callipteris	Duokuolu	fs, L	b, f	Apr-May	sh or s	Often
3	Jia		Pege	L	f, b	Mar-May	sh or s	Often
4	Huoshaohua	Mayodendron igneum	Leduolo	fo, fL	f, t	Apr	sh or s	Sometimes
5	Hongpao		Miabosele	fo, fL	r	Nov-Jan	sh or r	Occasionally
6	Lidoujian	Typhonium diversifolium	Yeduo	fs	f, s	Nov-May	w	Often
7	Shutiejie	Brainea insignis	Duoche	fs	f, df	Sept-Jun	sh or s	Sometimes
8	Ciwujia	Acanthopanax trifoliatus	Mame		t, s, f	Nov-May	sh, s, or r	Often
9	Manji	Dicranopteris dichotoma	Duo ki a		t, s, f	Sept-May	d or u	Often
10	Diannanhujiao	Piper spirei	Sagang	c	s	Mar-Apr	sh, s, or r	Often
11			Gegeili		s	Dec-May	sh or s	Often
12	Yeqingcai	Oenanthe javanica	Palienei	L	f, b	Apr-May	sh, we, or s	Often
13	Xintongzhi		Chituoluo	L	t, f	Nov-Apr	d or we	Often
14	Jieleiyizhong	Pteridium sp.	Duoge		so	Jan-Dec	s or w	Sometimes
15	Beifenteng	Cissus repens	Kemo	Fr	r	Jun-Aug	d or we	Often
16	Zhonghuaqiuhaitang	Begonia cathayana	Pachele	L	f, t	Sept-Jun	s or w	Sometimes
17	Fengyanlian	Eichhornia crassipes	Paga	L	t, f, b	Apr	wa	Occasionally
18	Yeqingcai	Brassica chinensis	Letugemo	W	so, f	Apr-May	sh or s	Often
19			Seche		f, b	Aug-Sept	s or sh	Often
20	Neijiangjun		Muzhi	W	f, b	Jul-Oct	sf	Often
21	Shaozhoujun		Mubo	W	f	Jul-Oct	sf	Often
22			Mupoluo		b, so	Jul-Oct	sf	Often
23	Dahongjun		Mulele	W	so	Jul-Oct	sf	Often
24	Lajun		Mupili	W	df	Jul-Oct	sf	Often
25	Muer		Laokulu	W	f, t	Jul-Aug	s, f	Often
26	Beisheng		Munie	W	so, f, t	Jul-Aug	s, f	
27	Likeyizhong		Digeye	W	t	Nov-Apr	ri	Often
28	Muguarong	Carica papaya	Sepu	fs, L	b	Feb-Mar	s or f	Often
29	Ciyu	Lasia spinosa	Tai	L, Fr	b	Jan-Dec	s or f	Sometimes
30	Nuomiye	Serobilanthus sp	Ejieena	fs, L	b	Jul-Aug	s	Often
31	Houpirong	Ficus callosa	Palin	fs, L	b	Mar-Apr	fm or w	Sometimes
32	Cijiancai	Amaranthus spinosus	Yamogeye	fL	b, f	Nov-Apr	ri, fi	Often
33	Shuimiqi	? Cardamine sp	Geginie	W	so	Jan-Dec	ri	Often
34	Qicai	Cardamine sp	Geginie	W	b	Jan-Dec	ri	Often
35	Qianjinteng	? Stephania forsteri	Pabu	fs, L	b	Apr-May	ri	Often
36	Shuiqin	Oenanthe javanica	Paniene	fs, L	f	Jul-Aug	ri	Often

No	*Chinese Name*	*Latin Name*	*Jinuo Name*	*Edible Part* *	*Cooking Method* †	*Collection Season*	*Habitat* §	*Frequency*
37	Zhongyelu	Thysanolaena	Lebulu	fco	r, f, df	Nov	s or f	Often
38	Biba	Piper longum	Geye	fs, L	r, f, b	Apr-May	ri	Often
39	Huangjiangyizhong	Alpinia sp	Meibu	fs, L	f, b	Apr-May	ri, sh	Sometimes
40	Yutou	Colocasia fallax	mibiabuleduo	fs, L	b	Jun-Nov	ri or sh	Sometimes
41	Choumudan	? Clerodendrum philippinum	Shuonie	fs, L	t, s	Nov-Dec	ri, sh	Sometimes
42	Yeqie	Solanum coagulens	Sekuole	fFr	f, df, b	Mar-May	ri, r	Often
43	Shuijiecai	Callipteris esculenta	Duokuoluo	fs, L	f	Jun-Jul	ri	Often
44	Huabancai	Parabaena sagittata	Padele	fs, L	f, b	Mar-Dec	ri or r	Often
45	Shuixiangcai		Bohuo	fs, L	f, r	Jan-Dec	ri or r	Sometimes
46	Kuliangcai	Solanum nigrum var.	Geli	fs, L	f, b	Jun-Jul	ri or fi	Often
47	Nansheteng	Celastrus paniculata	Cuopuliualie	fs, L	b	Apr-May	m	Often
48	Malan	Baphicacanthus cusia	Biaobu	fo	b	Mar-Apr	s	Often
49	Cipao	Thladiantha sp	Pakuoluo	fFr, L	f, b	Mar-Jun	f	Often
50	Dayuantuo	Eryngium foetidum	Pabuoma	W	r, f, b	Jan-Dec	f	Often
51	Chouyunshi	Caesalpinia mimosoides	Pala	fs, L	b	Mar-Aug	s or r	Often
52	Duanbanhua	Brachystemma calycinum	Kaneipabuluo	fs, L	t	Feb-May	ro	Sometimes
53	Rouhuihujiao	Piper semiimmersum	Piuge	fL	t	Jan-Dec	s	Often
54	Liangmianzhen	Zanthoxylum nitidum	Akiubutu	fL	t	Nov-Mar	shw	
55	Shanyo	Dioscorea alata	Memo	R		Apr-May		

Key:

* Fr: fruit; L: leaf; s: stem; c: cane; f: fresh; fo: flower; w: whole plant; co: core; R: root.

† b: boil; f: fry; df: deep fry; t: toast; r: eat raw; s: steam; so: soup.

§ m: mountain; ri: near river; fm: forest margin; pf: primary forest; sf: secondary forest; sh: shady; shw: shady and wet; s: near stream; f: fallow; r: near road; w: near water; du: dry or upland; dw: dry or wet; wa: water; we: wetland; fi: field; ro: near rock

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SUSTAINABLE MANAGEMENT OF AN AMAZONIAN FOREST FOR TIMBER PRODUCTION: A MYTH OR REALITY?

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Background

Several researchers have exposed the limits of forest management for timber production as a means of protecting biodiversity and reducing deforestation rates in Amazonia (Rice, Gullison and Reid 1997; Robinson 1993). The uncontrolled or liquidation logging practised by loggers is mentioned as one of the reasons why in Amazonia sustainable timber management is a myth. The low density of valuable species such as mahogany (*Swietenia macrophylla*) and cedro (*Cedrela odorata*) were found to be correlated to this kind of logging (Dickinson, Dickinson and Putz 1996; Putz and Viana 1996).

Most conservationists use the argument of high biodiversity as an ecological reason why timber cannot be sustainably produced in Amazonia (Robinson 1993). Researchers also believe that timber activities, regardless of where and at what scale they are conducted and who is conducting them, produce loss of biodiversity, fragmentation of habitat, and other ecological and economic problems. Recently, some conservationists pointed out that the dependency of mahogany and other valuable timber species on forest openings for regeneration, and their poor growth performance in mature stands, are other important reasons why timber management is not an alternative land use system that can reduce deforestation and biodiversity loss in Amazonia (Rice, Gullison and Reid 1997).

Most ecologists argue against forest management for timber production in Amazonia under the assumption that selective logging erodes seed banks and greatly reduces the capacity of valuable timber species to regenerate naturally (Putz and Viana 1996; O'Connell 1996). Timber extraction is believed to be one of the main causes of forest fragmentation in Amazonia. This fragmentation is cited by foresters to have negative effects on the structure, density and distribution of the vegetation, with adverse impact on habitat diversity for wildlife (Roberts and Gilliam 1995).

Researchers also argue that sustainable forest management for timber production cannot be practised in Amazonia because of economic and political factors. The market for Amazonian wood is very selective, and depends on mahogany and a few other slow-growing species (Plumptre 1996). Investing time and money in the management of valuable slow-growing hardwood species is believed to be unattractive because it requires a long term investment in a very unstable and risky political environment (Rice, Gullison and Reid 1997). The majority of governments are believed to be lacking land and resource tenure policies that are necessary to practise sustainable forest management for timber production (Barbier 1995). Experts also mention the lack of tax and other economic incentives for loggers and timber enterprises as another important reason why sustainable timber production in Amazonia is a myth (Uhl et al. 1997).

Although the economic, political and ecological factors are indeed limiting the sustainable production of timber in Amazonia, a close look at the way people who are engaged in timber activities are confronting these limitations presents a very different picture from that presented by the majority of experts. The question is not if sustainable forest management for timber production can or cannot be practised in Amazonia, but rather who can conduct it, and where, and under what economic, political and ecological conditions: and, most importantly, who can produce timber while protecting biodiversity. To answer these questions we look beyond timber extraction practised by loggers in unmanaged forest, and into timber activities implemented in their landholdings by smallholders living in várzea environments. Despite the common belief of most experts, timber activities in Amazonia are not practised only in unmanaged forests: the majority of peasants plant, protect and extract timber from managed forests (Pinedo-Vásquez 1995).

In this article we examine timber activities of smallholders in two regions of the estuarine várzea located in the state of Amapá, Brazilian Amazonia. We look not only at how they manage timber but also why they are engaged in timber activities. To answer these questions and measure sustainability, data on current and past economic and political conditions that favour or limit timber production are analysed and discussed. We look at how the *caboclo* system of timber production can help to protect biodiversity and whether it can be used as a model for sustainable resource use in Amazonia.

Ecological sustainability of the *caboclos'* model is measured by quantifying the impact of management techniques and extraction on species, habitat diversity, natural regeneration patterns and availability of seed banks. The economic, market and political conditions that favour or limit timber production by smallholders are also identified and discussed. Inputs and outputs from timber activities are quantified and analysed in order to determine if smallholder timber management can be promoted in the region.

Site and household selection

Data reported in this paper were collected from 1991 to 1997 by members of the PLEC sub-Cluster Amapá within the Amazonia Cluster. All information was collected from demonstration sites located in the estuarine várzea areas formed by the Amazon, Mazagao, Ajudante and Mutuaca Rivers (Figure 1). In 1991, preliminary plant surveys were conducted in the fields, house gardens, fallows and forests owned by 140 households of the total 185 families that live in the area. Members of each household were interviewed about their production and management activities, including timber. Data collected on the inputs and outputs of timber activities began in 1992 in 35 households which were self-selected to 12 at the end of the five-year period of the study (December 1997).

Impact of the methods and techniques of timber management and extraction were monitored on the properties of the 12 sampled households. Plant inventories and the evaluation of natural regeneration were conducted every two years. Changes in log prices and the amount of timber sold by each selected household were also recorded. Trees selected and protected by each family as seed producers were counted, measured and species identified. Past timber activities in the region were recorded from the archives of the municipalities of Macapá and Santana and by interviewing selected long-term residents at the site.

Why smallholder households are engaged in timber activities

We found ecological, economic, social and historical information that explains why

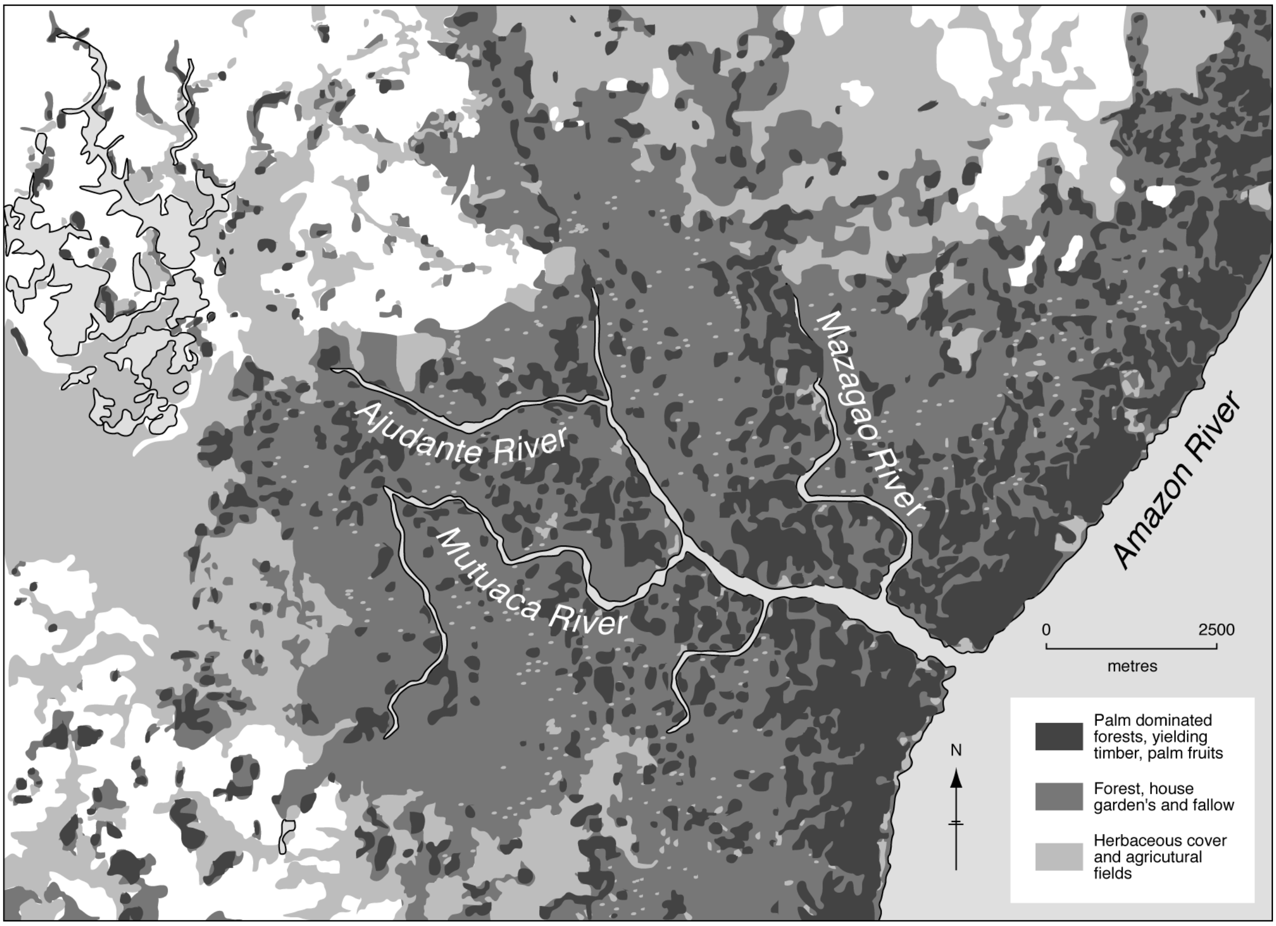

Figure 1 Study Sites

várzea peasants are engaged in forest management for timber production. The rural inhabitants of Amapá identify several ecological and environmental factors that make the estuarine várzea an ideal place for practising timber activities. Among these is the proximity of forest areas to river channels. In addition, most várzea land-forms are easy to reach during high tides. Although the estuarine várzea contains rich soils, crop production is very limited because most of the land is exposed to daily tidal freshwater floods. While tidal floods limit crop production, they are important natural factors that favour the establishment and growth of forests. Floods provide the main vehicle for seed dispersal and source of new sediments whose high nutrient content facilitates the rapid natural regeneration of tree species. The availability of nutrients in sediments and water, the adaptability of most timber species to flood and other environmental and ecological conditions, make the estuarine várzea one of the most suitable environments for timber management in Amazonia.

In the past, based on historical records, the high stock of commercial volume of cedro (*Cedrela odorata*), samauma (*Ceiba pentandra*), virola (*Virola surinamensis*) and muratinga (*Maquira coriaceae*) allowed a very important timber industry to flourish in the region. From the beginning of this century until 1970 seven large sawmills (daily production of 20,000 m^3) and four plywood factories were operating in or near the demonstration sites. These industries closed down or moved to other regions during the 1970s and early 1980s, mainly because the stocks of the four dominant commercial species were exhausted in Amapá and neighbouring várzea regions.

The departing timber enterprises left behind unemployed people with high skills of wood processing techniques, sawmill operation and other timber processing activities. Although most of these experts moved to the cities of Santana and Macapá, those who remained in the area built small family-run sawmills and other timber processing plants using mainly recycled materials from the abandoned facilities. Because the stocks of the most valuable timber species were exhausted, the owners of these small sawmills began to buy and process species that smallholders already managed in their forests, fallows, house gardens and forests for firewood, medicine and fruit production.

The majority of smallholders were already managing *Cedrela odorata* and other valuable species on their land. The family-run small sawmills then created a market for several fast-growing species such as pau mulato *(Calycophyllum spruceanum*). The demand for these has made forest management for timber production economically attractive to peasant families. In addition, the market created by the family-run small industries produced a change from the traditional dependency of the timber market on a few slow-growing species such as *Swietenia macrophylla* and *Cedrela odorata*.

Two other important factors have provided new impetus for farmers to engage in timber activities. Most regions of Brazilian Amazonia are connected to the developed regions of the South of Brazil: consequently smallholders cannot compete with the high quality and low prices of rice, corn, beans and other crops that are produced in the south and sold in the urban markets of Amazonia. Várzea farmers therefore began producing bananas as a source of household cash income. During the last 15 years, however, the region has suffered from an epidemic of mokko disease that practically eliminated banana plantations from the region and has left farmers with very few sources of household income. Under these conditions, smallholders depend greatly on their ability to produce timber on their own land. How are these rural Amazonians doing this under these ecological, economic and social conditions? In this project we have focused on understanding the strategies and management techniques that are used by them to answer this and other questions.

Timber management and extraction as practised by smallholders

Farmers manage timber by maintaining a patchy landscape on their properties, where forests, fallows, house gardens and fields provide a diversity of habitats and environmental gradients suitable for a range of regeneration, growth and production of fast- as well as slow-growing timber species. They have diversified their traditional land-use systems by combining agriculture, agroforestry and natural forest management techniques for the production of timber. By practising multiple use management, rather than converting their property to a single use such as cattle ranching, smallholders not only reduce the ecological risks but also maintain several economic options. They manage a range of size, location and succession of forests, fallows, house gardens and fields in order to produce both slow- and fast-growing timber species.

While the size and location of house gardens tend to remain more stable, the size and location of fields, fallows and forests vary. The average size of house garden per household was 2.7 ha. An average of two fields per family, covering an area of 1.4 ha, were made every year from 1992 to 1997. The average area of fields maintained per year by each family was 3.2 ha during the five years of the study. Corn, watermelon, vegetables and sugar cane are cultivated in fields for two years.

Farmers cannot produce banana in their fields, but they manage to produce this important cash crop in fallows by using a sophisticated and complex agroforestry system and techniques that control the damage produced by the mokko disease. The average area of fallows was 6.5 ha under different ages (from one to five years). Smallholders manage their fallows for an average of five years, after which production of banana declines. Such patterns of fallow management have led to the establishment of multi-aged forests where fast- and slow-growing species are found. The average size of multi-aged forest within the properties of the sampled households was 15.6 ha. The average total area of each property was 28 ha. Despite the opinion of most experts, the maintenance of a patchy landscape and fragmented forest favours rather than limits the practice of timber management by smallholder families.

In order to maintain available seed banks to help regenerate timber species, farmers select and maintain seed producer trees in all four categories of land use areas. Seed producer trees were of DBH=45 cm and showed no or very few signs of insect or disease damage. Each sampled household keeps as seed producers an average of nine trees of eight species in their house gardens, seven individuals of five species in their fields, 26 trees of 12 species in fallows, and 32 trees of 14 species in forests. Among these seed producer trees are included individuals of *Cedrela odorata*, *Ceiba pentandra*, *Maquira coriaceae*, *Virola surinamensis*, *Carapa guianensis* and other species that were over-exploited by loggers in the region.

The number of seed producers and species protected in forests is greater than in fields and fallows, because seed producers of most fast-growing species are selected and protected in forests. Seed producing trees of over-exploited species are mostly kept in house gardens because in the past loggers working for the timber industries claimed ownership of trees with merchantable volume of these species in smallholder forests and fallows.

Timber management in fields focuses on the protection of seed producer trees and seedlings that are either naturally regenerated, transplanted or planted. Fallow management for timber production focuses on the management of juveniles, and removal of selected individuals of vines, shrubs and pioneer trees to facilitate the maintenance of diverse gradients of light and humidity for natural regeneration. Small farmers focus management on adult trees in forested areas for high growth and diameter increment. Trees in forest areas are managed mainly by eliminating selected emergent trees from the stands, using girdling techniques.

Each of the 12 sampled households are protecting, planting and managing an average of 40 timber species on their properties. Of these, 24 are fast-growing and 16 slow-growing species: the majority of them (26) produce hardwood and 14 produce light wood. Among the slow-growing species are included the over-exploited *Cedrela odorata*, *Ceiba pentandra*, *Virola surinamensis* and *Maquira coriaceae*. Most fast-growing species are extracted on a average rotation of eight years, while the slow-growing are on a rotation of 30 years.

Although smallholders occasionally plant or transplant seedlings, they depend mainly on the natural regeneration of the 40 species. Data on natural regeneration collected from fields, fallows and forests of the 12 sampled households shows that the majority of timber species do not regenerate in either open or closed canopy conditions, but under the different light and humidity conditions of fallows.

Most of the 40 timber species managed by smallholders regenerate in fallows (18) and most species (19) have natural regeneration equal to or less than 100 seedlings per hectare. Two of the over-exploited species (*Cedrela odorata* and *Ceiba pentandra*) have the lowest density of seedlings per area (15/ha). Only four species seedlings have a density of more than 500 per hectare: pracaxi—*Pentachlethra macrolloba* (3066/ha), *Calycophyllum spruceanum* (2110/ha), goiabarana—*Bellucia glossularioide* (1077 per ha) and pracuuba—*Mora paraensis* (600/ha). Of these four species, *Bellucia glossularioide* is the only one with low commercial value. While *Pentachlethra macrolloba* and *Mora paraensis* regenerate in low densities in fallows, *Calycophyllum spruceanum* regenerates only in fields. Because of the quality, operability and durability of the wood (0.78gr/cm^3) and the capacity to naturally regenerate and reach commercial size on average in eight years, *Calycophyllum spruceanum* is considered the eucalyptus of Amazonia.

Smallholders are maintaining high stocks of commercial volume of timber on their properties. Each of the 12 sampled properties contained an average of 525 trees/ha (DBH=26 cm) with an average of 1103.88m^3/ha of standing commercial volume. Each farm was estimated to contain approximately 14,700 trees with an average of 30,908.64 m^3 standing commercial volume.

While trees with commercial volume of most species (36) were found in forest areas as well as in house gardens, fallows and fields, all individuals with commercial volume of four over-exploited species: *Cedrela odorata, Maquira coreaceae, Ceiba pentandra* and *Virola surinamensis*, were found only in house gardens and fields. An average of 24 trees/ha with an average of 53.98m^3/ha standing commercial volume of these four species were found in the house gardens and fields. Over the five-year study none of these trees were extracted by the sampled households, but were protected as seed producers or kept as a security source of cash for a time of economic crisis.

The abundance of commercial standing volume of fast-growing species helps farmers keep trees with commercial volume of over-exploited species on their properties. Two fast-growing species alone contain the highest number of trees/ha and standing commercial volume: *Calycophyllum spruceanum* and macucu (*Licania heteromorpha*). Each property in the sample contains an average of 111 trees/ha with 253.31m^3/ha, and 92 trees/ha with 352.02 m^3/ha of standing commercial volume, of *Calycophyllum spruceanum* and *Licania heteromorpha,* respectively. These two species comprise 39% (5,684) of trees and 55% (16,949.24 m^3) of the standing commercial volume estimate on the average property.

An average of 2,324 m^3/yr (83 m^3/ha) of timber was extracted per household during the five-year study. From these an average of 37% (860 m^3) came from *Calycophyllum spruceanum*, 23% (534 m^3) from andiroba (*Carapa guianensis*), 12% (279 m^3) from macacauba (*Platymiscum huberi*) and the other 28% (651 m^3) from 26 other species. Farmers did not extract logs of 11 species which include the four most over-exploited species in the region. All logs extracted by the 12 sampled households during the five years were sold to the owners of small family-run sawmills.

The price per cubic metre of logs paid by the owners of small sawmills increased three times from January 1992 (R$ 4/m^3) to January 1996 (R$ 12/m^3). Although the management of timber in a patchy landscape and fragmented forests includes direct and indirect costs, all sampled households calculate profits from timber extraction discounting only direct costs. Most of the indirect cost such as making fields, is discounted from agriculture or agroforestry production. The most common direct management costs of timber production cited by the 12 sampled households are related to the management of seed producer trees, natural regeneration, juveniles and mature trees.

The annual net revenue average made by each household from selling 2,324 m^3/yr of logs during the five-year study was $13,981/year. Since most management and extraction costs are covered by the labour of family members, the household income is greater than the estimated net revenue. In addition, because the owners of small sawmills pay yield tax, the state of Amapá provides tax incentives to farmers to manage timber on their properties. While a more conventional economic analysis is needed, the results from the standard cost-benefit analysis shows that timber management is a viable source of household income for the impoverished *caboclo* families living in the várzeas of Amapá.

Discussion

The search for answers on how to produce timber in a sustainable way in tropical rainforest has produced a large body of varied and important ecological, socio-economic and political information. Although such information is extremely valuable for understanding the issues of sustainability, researchers tend to use it to make irresponsible conclusions. Most of these researchers do not see the difference between protecting or conserving tropical rainforest and sustainable forest management, yet most social groups that are using forest resources can clearly see the differences. Generalizations made by experts limit rather than help to integrate site-specific experience that can help to find solutions to deforestation and the decline of biodiversity in Amazonia.

Most experts are well informed on the activities of loggers and timber companies, but their knowledge of smallholders' timber activities is very limited. They tend to represent smallholder forest use and management as essentially, if not exclusively, oriented toward non-timber products. While non-timber goods are indeed important to many tropical dwellers, results from our study show that timber is a very important output from forest areas that are managed for multiple-uses by rural Amazonians.

The ways in which smallholders manage forest for timber production, however, differ greatly from methods used by professional foresters and industrial timber companies. Management implemented by timber companies is based on a single system to yield a single product while smallholders manage forests for multiple products using a variety of management systems. Industrial timber management focuses on species exclusion while peasants manage timber by focusing on the exclusion of selected individual trees. By removing selected trees rather than species, biodiversity is preserved in smallholders' forests. These and other critical differences between the two systems of management and industrial timber management are usually not considered by those experts who argue about why or why not timber can be sustainably produced in Amazonia. The lack of attention given to timber management by smallholders has led to considerable misinterpretation and overgeneralization and in turn to the formulation of inappropriate policies. Greater attention to this important body of knowledge and practice is encouraged.

Conclusion

Several ecological studies have proved that Amazonian forests tend to recover after timber extraction. In both the short- and long-term, valuable tree species can regenerate in areas where timber was extracted if seed banks are left (Boyle and Sayer 1995; Heinrich 1995). Although most researchers agree that forest openings made during timber extraction can indeed produce short-term ecological damage such as habitat fragmentation, the main damage is the removal of all productive adult individuals of valuable species to a degree that they can not regenerate (Roberts and Gilliam 1995). The adverse impact of the current practices of timber extraction by loggers, particularly of mahogany and tropical cedar, is not in the openings that are created, but rather in the removal of all adult individuals without leaving some trees which are in reproductive state. Such destructive-extractive methods have reduced the capacity of these and other valuable species to naturally regenerate. Although most timber is extracted using destructive-extractive methods, there are extractive methods that are not destructive. For instance, the method of selective weeding used by smallholders helps them to eliminate vines and reduce damage by tree fall.

Research conducted on small-scale timber management practised by smallholders in Amazonia and Indonesia shows that biodiversity and habitat diversity increases in areas of forests that are managed for timber production (Pinedo-Vásquez and Padoch 1996). Smallholders use diverse and complex techniques to produce timber using ecosystem management where regeneration materials are abundant, and different gradients of light environments for the establishment and dynamic function of the vegetation: diversity of habitat is created for seed dispersal (Pinedo-Vásquez 1995). Several important conservation applications can indeed be found by understanding the diversity, scale and intensity of timber management that is practised by smallholders and other groups in Amazonia and other tropical regions (Lugo 1995; Franklin 1993, Bodmer et al. 1992).

Several studies report how smallholders manage forest for timber production: but most of this information is still not used by the experts who argue in favour of sustainable timber production in Amazonia. The technical and scientific information produced by researchers who do study timber management by rural Amazonians shows that sustainable management of tropical rainforest for timber production is not just a matter of knowing how. There is also a need to identify and understand the historical, ecological, economic and social factors that create conditions in which timber can be sustainably produced. Several authors suggest that experts should look beyond the ecological factors (Putz and Viana 1996).

While there are many ecological factors that make it difficult to practise sustainable forest management, socio-economic and cultural factors are mainly responsible for limiting the practice of sustainable forest management in the estuarine várzea environments of Amapá. For instance, we found that most rural inhabitants of the várzeas of Amapá are able to practise sustainable forest management for timber production because of the demand for high numbers of fast-growing timber species created by small-scale sawmills. Ironically, these family-run timber industries were established after timber enterprises moved from the region, having depleted the stock of the most valuable timber species from the Amapá forests.

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PLEC NEWS AND VIEWS **is published for the United Nations University in the Department of Anthropology, Division of Society and Environment, Research School of Pacific and Asian Studies, The Australian National University. Production work has been undertaken by Ann Howarth, PLEC Administrator. Artwork is by Neville Minch.**

PLEC NEWS AND VIEWS

- Published about twice yearly
- Edited by Muriel Brookfield and Harold Brookfield

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