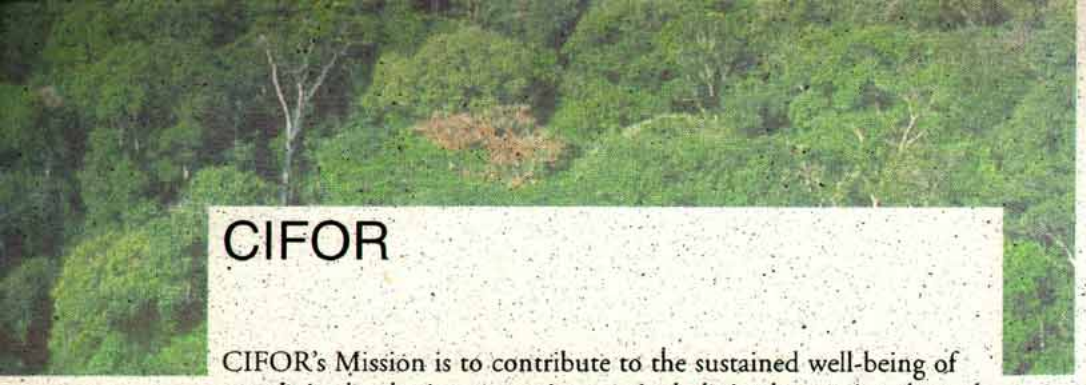
# ANNUAL REPORT

CIFOR
CENTER FOR INTERNATIONAL FORESTRY RESEARCH

1995



# CIFOR

CIFOR's Mission is to contribute to the sustained well-being of people in developing countries, particularly in the tropics, through collaborative strategic and applied research and related activities in forest systems and forestry, and by promoting the transfer of appropriate new technologies and the adoption of new methods of social organisation, for national development.

## CIFOR's Objectives

- To improve the scientific basis for ensuring the balanced management of forests and forest lands.
- To develop policies and technologies for sustainable use and management of forest goods and services.
- To strengthen national capacities for research to support the development of policies and technologies for the optimal use of forests and forest lands.

## What is CIFOR?

CIFOR was established under the CGIAR system in response to global concerns about the social, environmental and economic consequences of loss and degradation of forests. It will operate through a series of highly decentralised partnerships with key institutions and/or individuals throughout the developing and industrialised worlds. The nature and duration of these partnerships will be determined by the specific research problems being addressed. This research agenda is under constant review and is subject to change as the partners recognise new opportunities and problems.

CIFOR has collaborative links with other CGIAR Centers, particularly ICRAF, IFPRI and IPGRI, in development and implementation of research. CIFOR and ICRAF are the principal organisations active in implementing the forestry-agroforestry agenda developed by Technical Advisory Committee for the CGIAR. CIFOR concentrates its research on the conservation, rehabilitation and sustainable utilisation of forests, while ICRAF focuses on improved agroforestry systems on deforested and degraded farmland. CIFOR's philosophy emphasises the role of research carried out through partnerships with NARS to seek policies and technologies to ensure that the full value of forests accrues to poor people in the tropics.

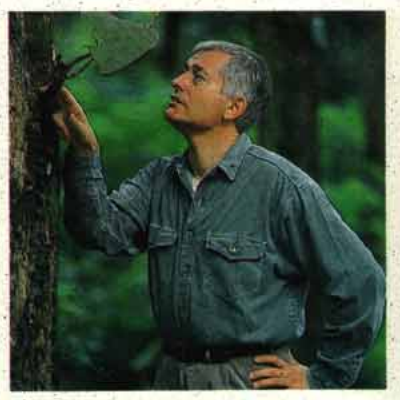
*Rafflesia pricei, Sabah (Plinio Sist)*

# Table of Contents



# DIRECTOR GENERAL'S REPORT





*Jeffrey A. Sayer, Director General*

CIFOR consolidated structures and procedures at our headquarters in Bogor during 1995 and invested heavily in developing collaborative relationships with research partners throughout the tropics. It was our first year of operation with a full complement of scientists present in Bogor. Staff and the Board of Trustees continued to work throughout the year on developing our longer-term strategy and at year's end the formal strategic plan was nearing completion. The question of how to operationalise our "Center without Walls" philosophy was the subject of particularly intense debate. It became clear that this required a flexible approach to collaboration with a wide diversity of partners. Memoranda of Understanding were signed with a number of such partners in the course of the year and efficient and mutually satisfactory research relationships are now emerging.

In the early weeks of 1995 we completed the reports from the Government of Indonesia/CIFOR initiative to develop a vision of research needed to address UNCED/CSD concerns relating to forests. This *Vision of Forestry Research for the Twenty-first Century* which was produced at what has come to be known as the "Bali Dialogue", is a major element of CIFOR's strategy and has also become an important reference document for the CSD. Its major conclusions were presented at the FAO Committee on Forestry ministerial session in Rome in March. Participants in this meeting and many subsequent inter-governmental gatherings during the year were receptive to the idea that the international debate on forests needs to be much more science driven. The CSD meeting in April in New York established an Inter-governmental Panel on Forests (IPF) and research was given high priority in its work plan.

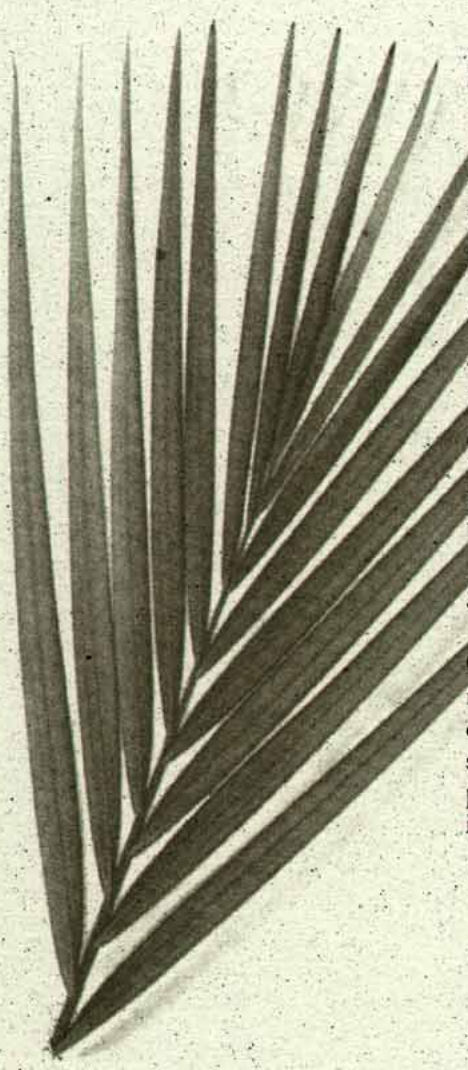
Scientific research, forest assessment and development of criteria and indicators for sustainable forest management.
*IPF Mandate, Point 3*

At the first meeting of the IPF in September, CIFOR was granted observer status. The Panel agreed to focus its future work around eleven study areas, in most of which CIFOR is undertaking research. An inter-agency task force composed of FAO, UNEP, ITTO and UNDP, together with a number of governments, is preparing issue papers on each subject and CIFOR scientists are contributing to this work. Our involvement in this process has greatly benefited our thinking on our own strategic priorities. We are now in a position where our research agenda matches closely the scientific concerns of the international forestry community.

An Internally Commissioned External Review in September helped focus and advance our strategic thinking. Four prominent scientists and a management consultant spent two weeks interacting intensively with CIFOR staff and reviewing our procedures and operations. A major issue addressed by the external team was how to minimise the impediments to inter-disciplinarity which seem to have characterised much forestry research in the past. The external review report, together with expert advice sought from other research centres and management specialists, led us to modify CIFOR's internal management structure at year's end. A Deputy Director General for Research was appointed and he, together with a Chief Scientist, was given the task of ensuring coherence and quality in the entire research programme. The external review also made valuable comments on

various aspects of project management which have been incorporated into CIFOR's procedures. All CIFOR research activities were consolidated into eight research projects, the leaders of which will report to the Deputy Director General Research.

Considerable progress was made in developing CIFOR's facilities in Indonesia. The Phase I building programme neared completion and we hope to occupy the building before the CGIAR Mid-Term Meeting which will take place in Indonesia in May 1996. Work on construction of Phase II of the headquarters facility began towards the end of the year. Progress was also made on developing plans for CIFOR's research forest in Indonesia. The Minister of Forestry, Djamaludin Suryohadikusumo and his senior staff joined CIFOR's management team in East Kalimantan in June to examine on the ground the possibility of establishing this research forest, adjacent to the Kayan Mentarang National Park. As a result of this visit and subsequent studies, a 300,000 hectare research area has now been allocated to CIFOR by ministerial decree. This and progress on the buildings are illustrative of the excellent relations that CIFOR has continued to enjoy with the Indonesian authorities.



There were a number of opportunities during the year for CIFOR to develop its profile internationally. The five-yearly congress of the International Union of Forest Research Organizations took place in Tampere, Finland, in August. CIFOR was well represented by staff and by sponsored participants from our collaborating organisations in the tropics. Several CIFOR scientists are now involved in IUFRO working groups and two have been appointed to the International Board. CIFOR's Board of Trustees also took the decision to invite the President of IUFRO to attend future CIFOR Board meetings as an observer.

The Conference of the Parties to the Convention on Biological Diversity took place in Jakarta in November and this also provided an opportunity for CIFOR to contribute to the convention's work. We hosted a workshop immediately preceding the Conference of the Parties to develop a paper on research needs for conserving forest biodiversity. This paper was presented at a satellite meeting during the Conference in the presence of CGIAR chairman, Ismail Serageldin.

CIFOR continues to enjoy excellent relations with FAO under the new leadership of its Forestry Department. There was useful collaboration on reduced impact logging, criteria and indicators for sustainable forest management, the development of non-timber forest products, the conservation of forest genetic resources and forest policy in Africa and Central America.

CIFOR's programmes in Africa developed satisfactorily during the year. Studies of incentives and technologies for sustainable management in the high forests of West Africa and of research capacity in eastern and southern Africa were completed. A CIFOR office was established in Libreville, Gabon, to develop our activities in Francophone west and central Africa. A full-time CIFOR scientist is now attached to the IITA/ICRAF research site at Mbalmayo in Cameroon. A review of research issues in the Miombo woodlands region of south-east Africa is nearing completion.

There was expansion of activities in Central America and relations with CATIE and IICA were further developed. Our work with CATIE will focus on secondary forest management and tropical forest silviculture and at IICA on forest policy in Central America. Progress in South America has been slower but late in the year extra-sectoral policy work began in Bolivia along with work on biodiversity at the forest margin in association with ICRAF's Alternatives to Slash and Burn sites in the Western Amazon.

We enjoyed particularly good collaboration with the Forestry Research Institute in Malaysia and the Chinese Academy of Forestry. In addition, CIFOR scientists were active in India, Thailand and Vietnam, while research was initiated in various parts of Indonesia in collaboration with a number of organisations. The ICRAF/ASB site in Jambi, Sumatra, and CIFOR's own research area at Kayan Mentarang in East Kalimantan were particular foci of activity. Collaborators came from the Agency for Forest Research and Development of the Ministry of Forestry, the Universities of Indonesia (Jakarta), Gadjah Mada (Yogjakarta), Mulawarman (Samarinda), the SEAMEO BIOTROP Centre in Bogor, World Wide Fund for Nature and a number of local NGOs.

At year's end CIFOR staff in Bogor consisted of 25 internationally recruited scientists and 50 local staff and plans were well advanced for the move to the new headquarters early in 1996.

*Jeffrey A. Sayer*
*Director General*

*Forest survey in Central Kalimantan (Christian Cossalter)*

*A section of the Bahau River and view of village (Lini Wollenberg)*

# KAYAN MENTARANG RESEARCH FOREST

In Bulungan district, East Kalimantan, lies one of the largest remaining expanses of tropical forest outside of the Amazon. A quick glimpse of this forest reveals clear rushing rivers, sacred hornbills and mountain peaks crowned by cloud forests. The forest is a source of livelihood to local Kenyah and Lun Daye farmers, Punan hunters and gatherers, and indirectly to the Chinese traders and other coastal groups that periodically ply the rivers and search the forests for the valuable incense wood *(Aquilaria* spp), birds' nests or bezoar stones. The forest is also a source of revenue to the timber concessions that build roads and log the lower-elevation sites. Isolated and yet not, the villagers living in this forest may own a satellite dish for their TV, but also require five days by difficult boat travel to reach the nearest hospital.

Although distinct in its expanse, the forest in Bulungan shares many of the same challenges facing forests and forest-dependent people anywhere in the world: resource availability, simultaneous pressures for conservation and economic development, and increasing competition for forest use among different interests. CIFOR is addressing these global challenges through its research programmes world-wide but, until recently, has not had the opportunity to begin long-term investigation of the dynamics and complexity of such issues in any one place.

Ba'i'é Ca juta téga e
Ba'i'é Ca ibu bobo e

This forest of mine,
one million beauties,
This forest of mine,
one thousand challenges

Kenyah Badeng song

The Government of Indonesia made such long-term research possible by creating the 300,000-hectare Kayan Mentarang Research Forest in Bulungan and granting CIFOR permission and support to conduct long-term research there. The creation of the research forest – the first ever in Indonesia – and the agreement with CIFOR grew out of a provision in the host-country agreement granting access to a long-term research site. CIFOR began the search for an appropriate site in 1994 and, in October 1995, submitted a recommendation to the Indonesian Department of Forestry for an area in Bulungan located between the Kayan and Mentarang rivers. The Minister of Forestry approved the designation in December 1995.

A major factor in selecting the Kayan Mentarang site was the presence of diverse groups of forest-dependent people and diverse demands for use of forest resources. The Forest currently includes land used for local settlements, industrial timber concessions, shifting cultivation and collection of forest products. The Forest is also adjacent to the Kayan Mentarang Nature Reserve, where the World Wide Fund for Nature – Indonesia Programme, in partnership with the Indonesian Directorate of Forest Protection and Conservation (PHPA), is preparing a management plan to enable the Reserve to become a national park, where local people would be allowed to reside.

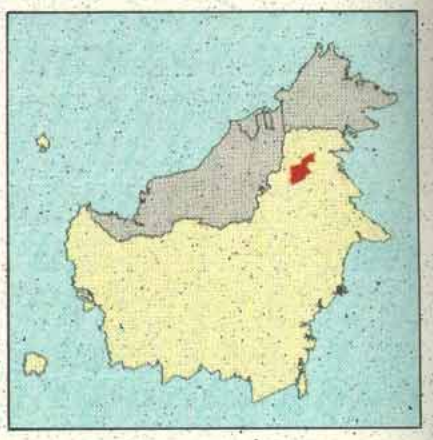
Importantly, the creation of the Kayan Mentarang Research Forest does not change existing land-use zone designations or rights to land and forest products. The agreement gives CIFOR *permission to conduct research* in the area in partnership with local government, forest users and other researchers. One example of a partnership CIFOR hopes to develop is to join WWF and PHPA in facilitating the creation of a "model forest", which would be an umbrella arrangement covering both the Kayan Mentarang Research Forest and Nature Reserve. Together the two areas constitute an expanse of more than 1.7 million hectares. Under the model forest arrangement, a steering group representing diverse government, community, research, educational and private commercial interests would help guide the development of management practices and programmes for improving local peoples' well-being. The steering committee would also guide research and provide an outlet for implementing research findings.

As the Research Forest was established at the end of 1995, CIFOR is spending the first several months of 1996 planning a research programme for the area. Activities will begin with the establishment of local partnerships and institutional arrangements, including further exploration of the model forest concept. Later in the year, research will be initiated with a focus on three of CIFOR's current activities: local livelihoods and community-based forest management; low-impact harvesting; and biodiversity assessment.

*Lini Wollenberg*

## CIFOR Research Area Map

Kab. Bulungan, Province of East Kalimantan,
Republic of Indonesia
Area 303000 Ha.



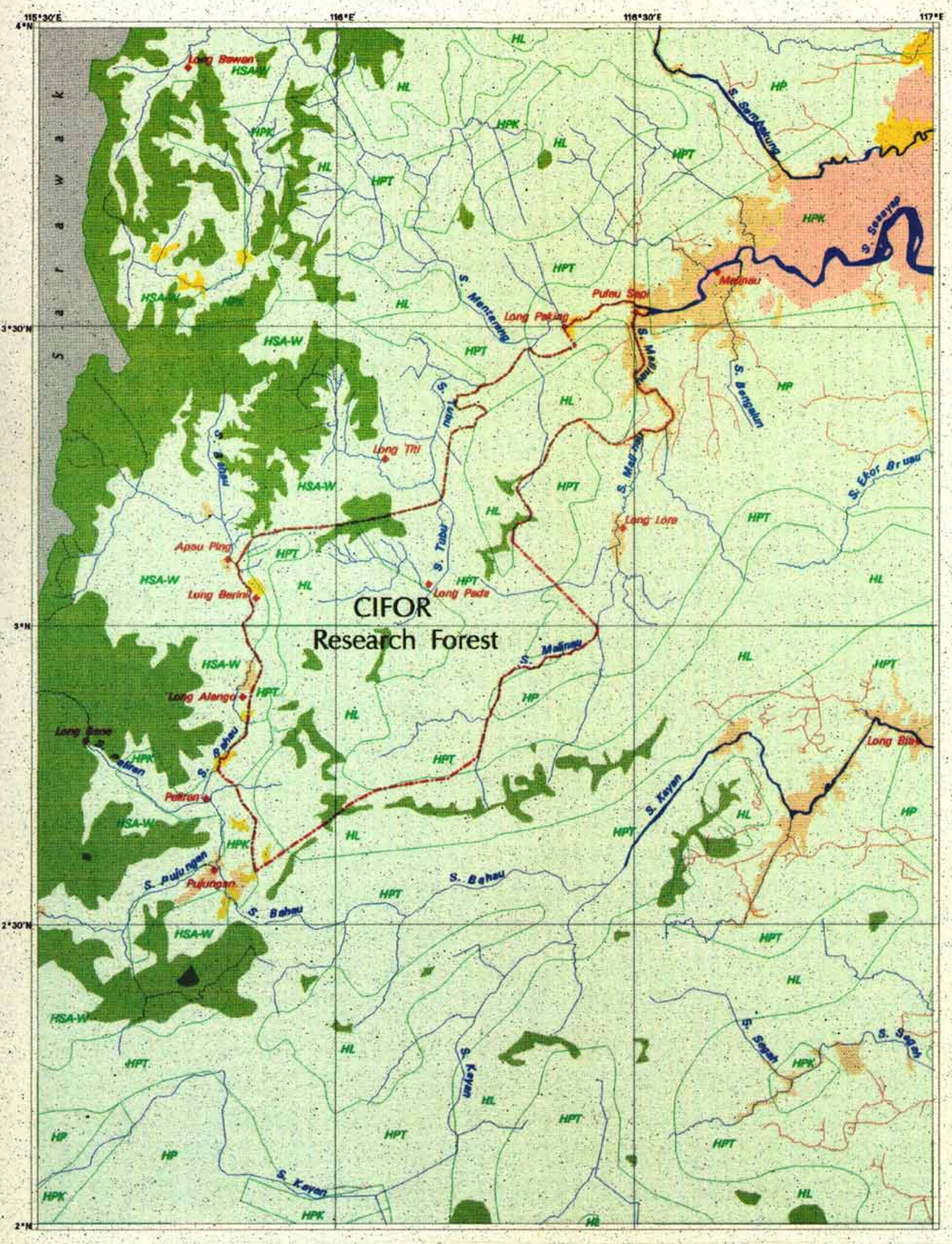

Legends:

- CIFOR Research Site
- Rivers
- Logging road
- Lowland forest
- Submontane forest
- Montane forest
- Mangrove forest
- Swamp forest
- Manmade forest
- Unproductive dryland
- Unproductive wetland
- Agriculture
- Estate
- Other Land Use
- HL Protection forest
- HSAW Nature Conservation and Recreational forest
- HP Production forest
- HPT Limited Production forest
- HPK Conversion forest

Sources:

1. Ministry of Forestry Decree No. 35/Kpts-II/96 dated 29 January 1996 regarding the given permit for CIFOR to conduct research in the forests at Kec. Long Pujungan and Kec. Malinau, Kab. Bulungan, Province of East Kalimantan
2. Forest Vegetation and Land Use Map, Ditjen INTAG, Sheet no 1818 and 1819, scale 1:250000

*Hut modified for rice drying, Malinau, East Kalimantan, near CIFOR Research Forest (Andy Gillison)*




*CIFOR Research Forest, East Kalimantan (map generated by Atie Puntodewo)*

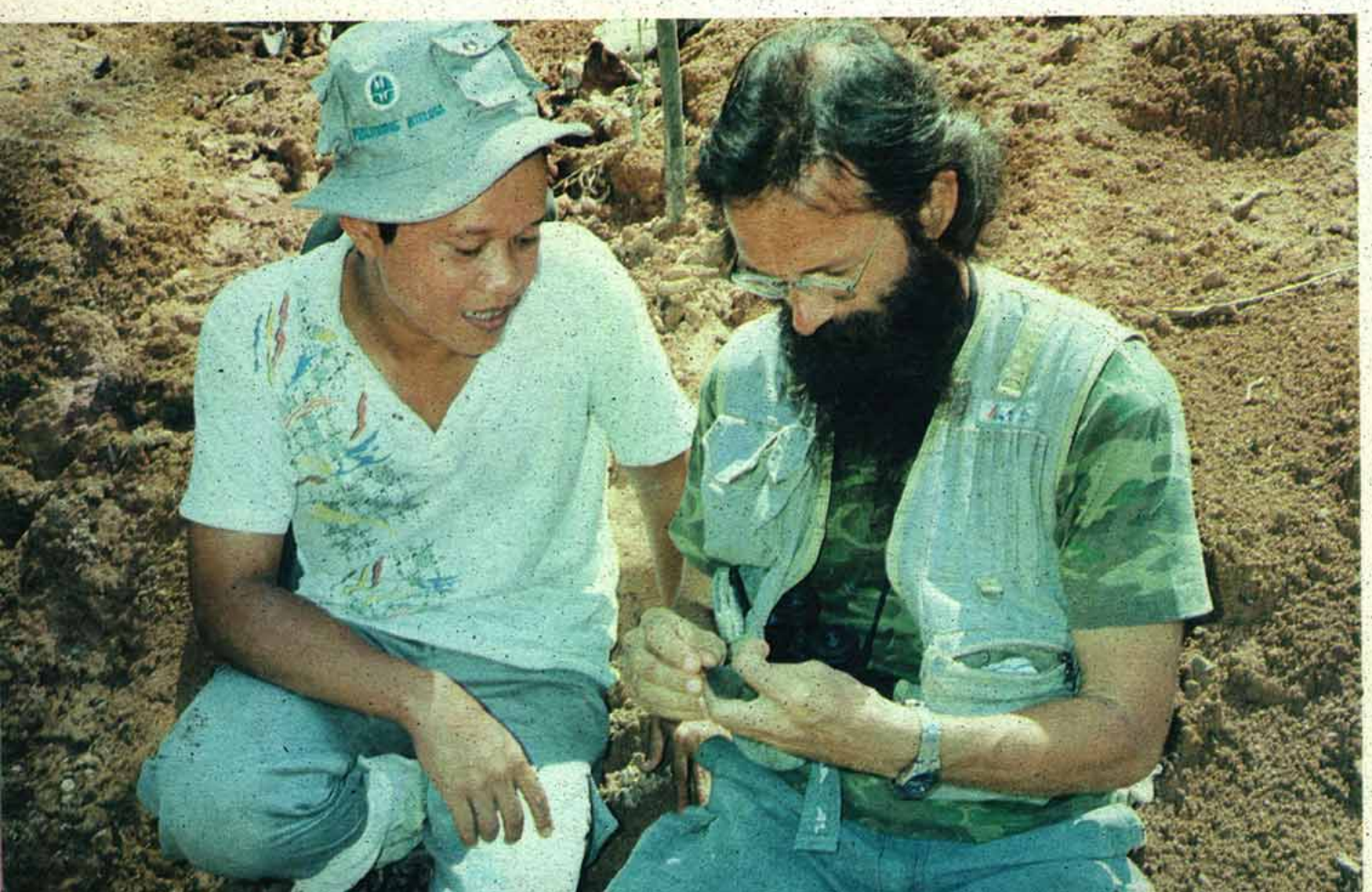
# CIFOR's Partnerships



CIFOR has publicised widely its intention of working through partnership arrangements with developing-country scientists. This has led to a large number of scientists writing to CIFOR to express interest in working with us. This positive response has been very welcome and encouraging to CIFOR, but it has also put us in the difficult position of having to decline quite a large number of offers.

The situation is that CIFOR works to a research agenda which is developed and approved by our Board of Trustees and is then reviewed and approved by the Technical Advisory Committee of the CGIAR. It is this Approved Research Agenda (ARA) which forms the basis of CIFOR's funding arrangements with donors. CIFOR is only authorised to conduct research on subjects which form part of the ARA. It is central to CIFOR's mandate that we implement our ARA in such a way as to maximise our capacity building impact on developing-country forest research institutions. But CIFOR's Board and donors also require that we achieve the ARA in the most cost-effective manner possible.

This means that we have to work with those partners in developing countries who are willing and able to help us carry out the ARA most efficiently and effectively – potential collaborators who meet our dual objectives of capacity building and achieving specific research products or outcomes. In making our choices we have to look at a number of factors. Partners who are located where the problems being addressed are most pertinent have an advantage. The potential of the partners to disseminate the work in important geographical areas is an added bonus. But the fundamental criterion has to be the ability of the partner to contribute to obtaining the best possible research results at minimum cost.



*CIFOR partners from Birdlife International involved in biodiversity baseline study, Jambi (Andy Gillison)*

Some potential partners inevitably are excluded by these processes. CIFOR can still try to involve them in our work in some way. For instance we can provide documents or facilitate participation in training courses. There are also occasions when potential partners can solicit outside funding to enable them to collaborate with CIFOR. Several aid agencies are prepared to fund this sort of collaboration directly to developing-country scientists or institutions.

One thing that CIFOR cannot do is provide support for research projects which fall outside our ARA. This has led to some disappointment in the past as numerous developing-country scientists have written to CIFOR seeking support for their projects. In some cases the projects were of high merit, but because they were not part of our ARA the answer had to be "no".

A more detailed explanation of how CIFOR works with its partners is in our strategic plan. This also gives an outline of the ARA for the current five-year period. Copies of the plan will be available for distribution in May 1996 and can be obtained by writing to CIFOR headquarters in Bogor.

*Jeffrey A. Sayer*

# Natural Forest Ecology and Management

*Suspension bridge of natural fibres, south-east Guinea (Michael Ibach)*

Research on natural forest ecology and management has included four broad areas of inquiry in 1995: forest ecosystem management; management of forests for the sustainable production of multiple goods and services; testing criteria and indicators for sustainable forest management; and tropical silviculture.

In addition to scientists in Bogor, CIFOR has one post-doctoral researcher located at CATIE in Turrialba, Costa Rica; and three half-time senior research associates, one in Brazil and two in the United States, working in this area. In addition to the activities described below, scientists contributed to numerous collaborative initiatives and publications. A comprehensive research proposal was submitted to the Inter-American Development Bank for significant funding to support collaborative research on the management of secondary forests in the American tropics with particular emphasis on forest margins.

**Forest Ecosystem Management**

At the landscape level, forests are an important component in many tropical developing countries, co-existing with other land uses such as tree plantations, shifting agriculture, settled agriculture and urban areas. An emerging theory of forest management holds that forests and the people who influence them should be regarded as a single, integrated ecosystem. To apply this theory, which CIFOR refers to as "forest ecosystem management" (FEM), it is necessary to recognise and understand the functional linkages between forests and other land uses (especially agriculture). These linkages emphasise the importance of human activities generally in determining whether forests can be sustained at all and, if so, the characteristics that sustainable forests will exhibit. This means that policies and technologies for landscape-level forest management must be firmly grounded in ecology, forestry and the social sciences.

CIFOR's efforts in this area are to develop the base data needed for landscape-level forest management decisions and then to use these data in comparative case studies, replicated among CIFOR's eco-regional foci, to develop assessment tools and comprehensive planning and management models which can be used to formulate and evaluate policies to promote effective landscape-level decisions. The magnitude of the problem demands both the identification of appropriate modelling parameters and the acquisition of data from representative tropical forest eco-regions. Initial benchmark sites are being developed in Indonesia, the western Amazon and the Congo basin. FEM research actively involves other CGIAR Centers such as ICRAF, CIAT and IITA, as well as numerous NARS and NGOs.

Three benchmark sites have been established in Jambi Province, in Sumatra, Indonesia; in the western Amazon (covering eastern Peru, northern Bolivia and western Brazil); and in the Congo basin, focusing initially on Cameroon. Most emphasis during the year was on Jambi, with a less significant but still important effort in the western Amazon and a lower level of attention on the Congo basin benchmark site. At each of these sites extensive collaboration with national, international and local groups has been initiated, led by **Dr Andy Gillison**.

A spatial-data cataloguing system has been established for the benchmark sites and a spatial-referencing protocol developed for integration of FEM spatial data with those provided by WCMC and UNEP GRID. Spatial datasets from various local and international agencies on Indonesian soils and climate, road systems and stream networks have been collected along with maps of forest concession boundaries, land-use patterns and 1:50,000 scale topography for target study sites within Jambi Province. Survey design and framework for data collection and analysis for a rapid ecological assessment of the Kerinci Seblat buffer zones were developed for implementation in early 1996 with funding from the World Bank and in collaboration with WWF–Indonesia. Training workshops were held in Jambi for WWF and National Park staff on vegetation survey methods, and a training session on PATN (a software package for exploratory data analysis) was held in Bogor with participants from partner NGOs.

*CIFOR partners from LIPI involved in biodiversity baseline study, Jambi (Andy Gillison)*

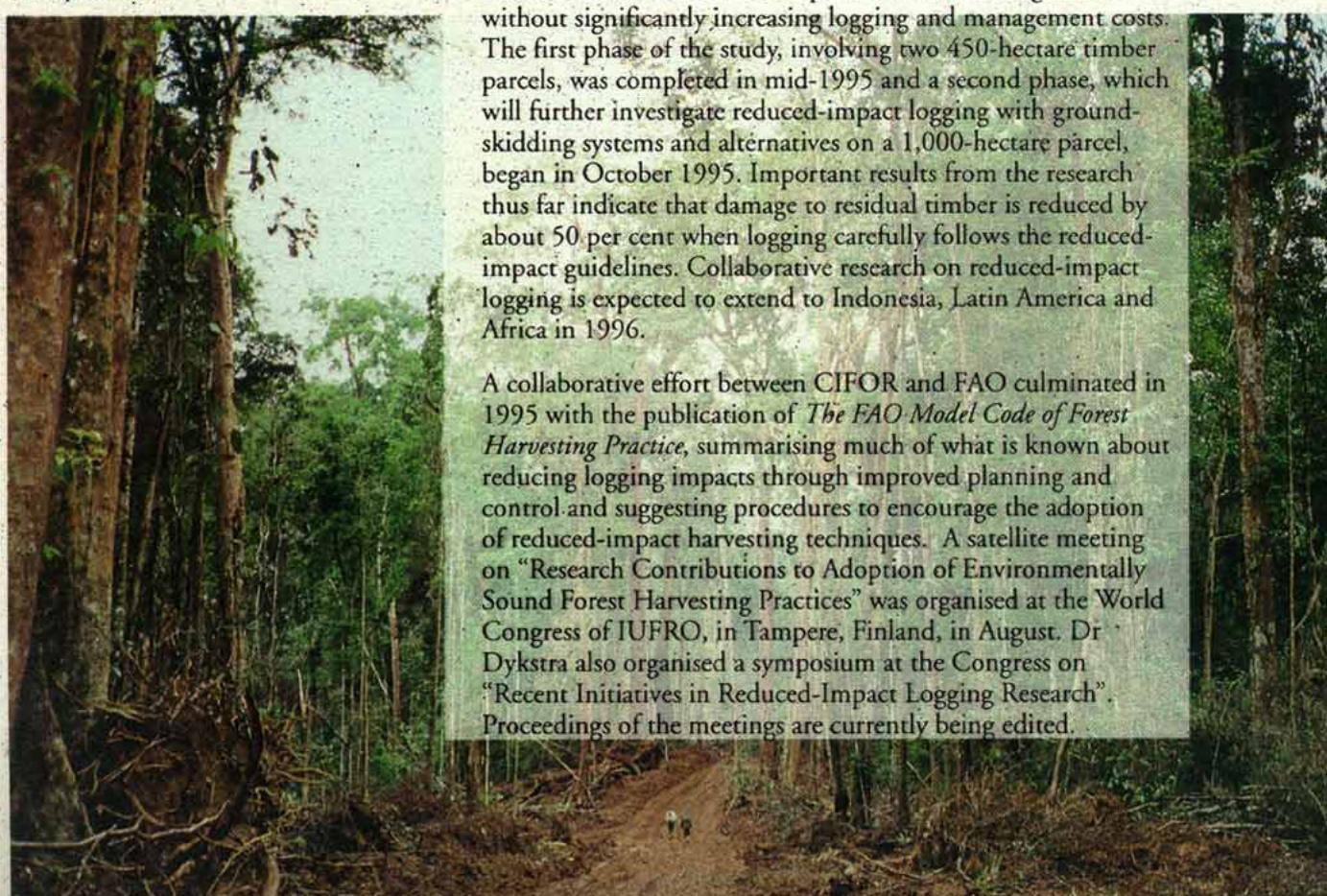
**Management of Forests for the Sustainable Production of Multiple Goods and Services**

At the level of the individual forest management unit, it must be recognised that forests are much more than factories for producing wood. Multiple-resource planning and management models are needed which reflect the complex interactions among commodity and non-commodity forest resources, and which can be used to evaluate multiple criteria in order to explore equitable and participatory ways of managing forests. The objective of such evaluations is to determine optimal combinations of products and services that will provide for both industrial use and local needs while maintaining environmental quality and ensuring that the forest itself, and its essential character, can be retained. CIFOR is undertaking comparative case studies on technologies for reducing environmental and social impacts associated with harvesting operations. We are also developing base data and multiple-resource management models to permit comprehensive analyses of trade-offs inherent in forest management decision making. Work in this project during 1995 focused on reduced-impact logging as a vehicle for improving prospects for sustainable forest management.

Much of this research was in a collaborative project in Sabah, Malaysia, on reduced-impact logging as a strategy for increased carbon sequestration. The collaboration involves Innoprise Corporation, a timber concessionaire in Sabah; the New England Power Company of Massachusetts, USA; the Forest Research Institute of Malaysia; the Sabah Forestry Department; and **Dr Dennis Dykstra** and **Prof Jack Putz** from CIFOR. The principal aims of the research are (a) to measure increased carbon sequestration associated with improved post-logging vegetation viability; and (b) to develop guidelines on logging methods which will reduce impacts on soils and vegetation without significantly increasing logging and management costs. The first phase of the study, involving two 450-hectare timber parcels, was completed in mid-1995 and a second phase, which will further investigate reduced-impact logging with ground-skidding systems and alternatives on a 1,000-hectare parcel, began in October 1995. Important results from the research thus far indicate that damage to residual timber is reduced by about 50 per cent when logging carefully follows the reduced-impact guidelines. Collaborative research on reduced-impact logging is expected to extend to Indonesia, Latin America and Africa in 1996.

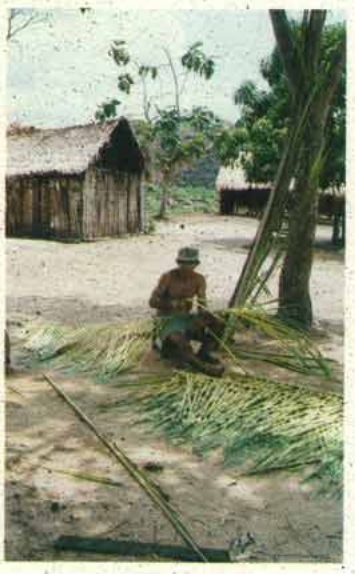
A collaborative effort between CIFOR and FAO culminated in 1995 with the publication of *The FAO Model Code of Forest Harvesting Practice*, summarising much of what is known about reducing logging impacts through improved planning and control and suggesting procedures to encourage the adoption of reduced-impact harvesting techniques. A satellite meeting on "Research Contributions to Adoption of Environmentally Sound Forest Harvesting Practices" was organised at the World Congress of IUFRO, in Tampere, Finland, in August. Dr Dykstra also organised a symposium at the Congress on "Recent Initiatives in Reduced-Impact Logging Research". Proceedings of the meetings are currently being edited.

*New logging road, upland Jambi (Andy Gillison)*





A project on *Sustainable Forest Management in West and Central Africa*, initiated in 1994 with UNEP funding, was completed in 1995 with a series of symposia in Ghana and Nigeria under the leadership of the Forest Research Institute of Ghana. For the Francophone countries, a more ambitious, longer-term study was initiated in the last quarter of 1995 with funding from the Government of France. For the latter study a project office has been established in Libreville, Gabon, staffed by **Dr Robert Nasi**, seconded to CIFOR from CIRAD-Forêt.



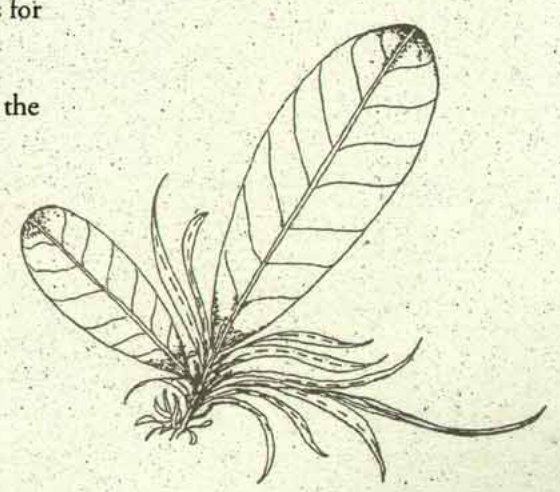
*Magueri man, Tapajos river, Para, Brazil (Carol Colfer)*

**Testing Criteria and Indicators for Assessing the Sustainability of Forest Management**

Over the past several years a world-wide debate has developed over proposals to "certify" that forests from which commercial products have been harvested, especially those products entering international trade, are being managed on a sustainable basis. Much of the debate has focused on criteria and indicators which might be used to assess sustainability at the national level, but increasingly it is recognised that if certification is to be feasible, criteria and indicators must be developed which can be applied by forest managers at the level of the individual forest management unit. CIFOR's principal contribution to this debate at present is on the development of criteria and indicators for application at the forest-management unit level. The initial emphasis of the research is to conduct field tests utilising criteria and indicators from published catalogues which have been proposed or are actually being used by certification agencies. (See page 15 for a more detailed report by **Dr Ravindra Prabhu**.)

After its first full year the project has developed an iterative, process-oriented approach to assessing and developing criteria and indicators based on the inputs of twenty experts who were involved in the field evaluations.

An analysis of the independently derived sets of criteria and indicators is now under way with the objective of identifying both common and site-specific elements. Preliminary analysis shows that the criteria and indicators used in the field tests, although generally relevant for the assessment of sustainability, vary significantly as to their objectivity. The cost-effectiveness of criteria and indicators needs to be improved. It is not the intention of the project to identify a "universally" applicable set of criteria and indicators. Rather, the recommendations developed by the project team will ultimately serve as tools for those wishing to develop or improve their own criteria and indicators. The project's main focus therefore is on the development of an unbiased and objective system to assess the sustainability of forest management.



*Shifting cultivation near Kribi, Cameroon (Carol Colfer)*

Substantial areas remain under-developed. These include criteria and indicators in the fields of biodiversity, environmental services, landscape-level interactions and social sustainability (see pages 18). There is a need to address the problem of reaching decisions in a transparent, acceptable manner when confronted with incomplete information and conflicting interests, as will frequently be the case when assessing the sustainability of forest management units. Another important element which is to be addressed by **Dr Carol Pierce Colfer and Dr Lini Wollenberg** in 1996, is the development of criteria and indicators in forests managed by local communities.

**Tropical Silviculture**

Silviculture is potentially a critical element for sustainable forest management in the tropics, although it has seldom been applied consistently over a long period, usually because of financial constraints. On the other hand, quite a lot is known about the effects on forests of silvicultural treatments, but these results have not been satisfactorily brought together for large regions. In addition, silvicultural research has tended to focus on logged-over forests, ignoring the potentially important economic contribution of secondary forests which have re-grown on land previously cleared for pastures and crops. The main aim of CIFOR's research on tropical silviculture is to contribute to improved resource management by integrating production from secondary and logged-over forests into the overall context of land use, especially for resource-poor people on the forest margins. The research, led by **Dr César Sabogal**, includes socio-economic, biological, silvicultural and managerial aspects, and concentrates initially on sites in the Amazon basin and Central America.

Activities in this project involved four main areas:

(a) Preparation of a CIFOR monograph synthesising silvicultural research and practice for natural forest management in the American tropics. This involved considerable effort to develop collaboration within Latin America. More than fifty potential contributors were contacted, and about twenty were eventually selected to provide chapters for the monograph.

(b) Initiation of a CIFOR/CATIE electronic bibliography on both published and "grey" literature on natural forest management in the American tropics from many documentation centres throughout Latin America, plus several private collections.

(c) Research on silvicultural techniques to improve economic returns to farmers from secondary forests. This research was undertaken by **Dr Manuel Guariguata**, the post-doctoral fellow located at CATIE. It focuses on abandoned pastures and crop fields that have re-grown into secondary forest and represent potentially valuable assets to farmers if their economic value can be increased through inexpensive silvicultural interventions.

(d) Organisation of a forestry NARS consultation for Latin America which will be sponsored by CIFOR and held during the first quarter of 1996 in Manaus, Brazil.

# Testing Criteria and Indicators for Sustainable Forest Management

World-wide interest in sustainability indicators has grown dramatically over recent years as concern with the state of the world's forests has deepened. The Inter-governmental Panel on Forests (IPF) has listed criteria and indicators for sustainable forest management as an area for priority action. The Forest Stewardship Council (FSC) has taken the responsibility for accrediting certifiers. Many national initiatives are currently under way to address improved forest management. Global comparisons of criteria and indicators will improve the process of identifying adequate and appropriate measures.

CIFOR perceived a particular need to distinguish clearly between generic and site-specific criteria and indicators, determine their relevance, scientific basis, feasibility and cost-effectiveness, and identify relevant research needs. Improved forest management can be achieved either directly through technical or financial assistance to forest management units or indirectly through improvement of the policy framework for forest management. Incentives could be provided to trade in forest products from sustainable sources.

The first phase of CIFOR's project on *Testing Criteria and Indicators for the Sustainable Management of Forests* attempted to field test selected sets of existing criteria and indicators in a variety of locations. Inter-disciplinary teams of foresters, social scientists and ecologists selected and evaluated criteria and indicators developed by SmartWood (Rainforest Alliance, USA), ITW (Germany), Woodmark (Responsible Forestry Standards, Soil Association, UK), DDB (Netherlands) and LEI (Indonesia) at sites in Germany, Indonesia, Côte d'Ivoire and Brazil. The last two were not included in the first test in Germany, but a parallel test in Austria provided additional results from a temperate-zone site. Testing involved national collaborators and each field exercise concluded with a workshop involving representatives from government, industry, academia and NGOs to discuss the criteria and indicators selected.

Objectives of this phase of the project were to:

- develop a methodology to evaluate and generate criteria and indicators;
- generate a minimum number of cost-effective and reliable criteria and indicators for each test site, based on iterative and comparative field evaluations of selected sets; and
- initiate work on a system to evaluate the sustainability of forest management as a whole, based on the recommended criteria and indicators.

A conceptual framework was developed to organise principles, criteria and indicators into a hierarchical structure, particularly social attributes. The underlying concepts in the sets of criteria and indicators examined were found to be unclear and confusing. During field work, team members combined inductive and deductive approaches as they applied their

*Top: Log extraction in Sarawak (John Turnbull)*

*Bottom: Log yarding in Inhutani I concession area, East Kalimantan (Andy Gillison)*

existing knowledge to the criteria and indicators then tested conclusions against field realities. Then followed a return to broader experiences to assess each selected criterion and indicator. The conclusions of team members were then compared at the closing workshops and evaluated, both qualitatively and quantitatively.

Initial analysis of the German test generated nine important attributes in assessing criteria and indicators:

- Summary or integrative measure
- Closely and unambiguously related to the assessment goal
- Adequate response range to stress (sensitive)
- Diagnostically specific
- Appealing to users
- Easy to detect, record and interpret (feasible)
- Precisely defined (clear)
- Produces replicable results (reliable)
- Relevant

Using the base sets, the teams proposed criteria and indicators relevant to the specific sites. These of course varied between sites and across disciplines. Whereas for the set of criteria and indicators proposed by the Indonesian team, roughly 85 per cent of all criteria and indicators (not counting principles and verifiers) owed their origin to the base sets, this figure dropped to 69 per cent in Brazil and 55 per cent in Côte d'Ivoire. The ecology criteria and indicators across all three tropical sites showed the highest proportion of references to the base sets (again not including principles and verifiers) with 87 per cent. Between 62 per cent and 64 per cent of the policy, forest management and social criteria were developed directly out of the base sets.

The selected sets of criteria and indicators varied as bases for proposals made by experts across the social, environmental and forestry fields. A set of principles, criteria, indicators and verifiers was identified that was common to each site. The percentage of criteria and indicators held in common among teams varied from 32 per cent for Brazil's social criteria and indicators to 79 per cent for the policy set in Côte d'Ivoire. The social dimensions understandably showed a significantly lower level of commonality than existed in other areas. The high was 68 per cent for ecology, with 63 per cent for policy, 58 per cent for forest management and only 40 per cent for social criteria and indicators.

While there was considerable commonality in selection of fundamental concepts, team members often assigned the same concept to different hierarchical levels. This occurred with the forestry and social criteria and indicators that were considered least defined. This suggests the need for flexible conceptualisation of hierarchies in assessing sustainable forest management.

**POLICY**

**Principle: Maintenance of ecosystem integrity**

Criterion: Ecosystem function is maintained

*Indicators:*

* *no chemical contamination to food chains and ecosystem*
* *ecologically sensitive areas, especially buffer zones along water courses, are protected*
* *no inadvertent ponding or water-logging as a result of forest management*

**SOCIAL SCIENCE**

**Principle (Implied): Forest management maintains fair inter-generational access to resources and economic benefits**

Criterion: Stakeholders'/forest actors' tenure and use rights are secure

*Indicators:*

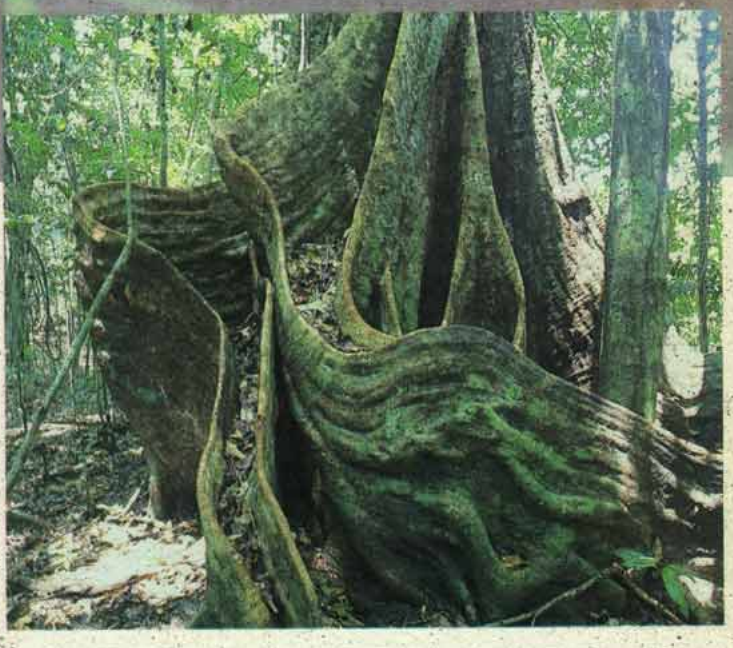
* *tenure/use rights are well-defined and upheld*
* *opportunities exist for local people/forest-dependent people to get employment and training from forest companies*

Criteria and indicators emerged that were a mix of those based on performance standards and those based on a more process-oriented environmental-management system approach. The variation between teams was attributed to three factors. The composition of the base sets of criteria and indicators was the most fundamental source with the composition of team members also important. A series of site-specific factors such as resource ownership and access, history of forest management, forest system ecology, demography and culture were also key variables. This points to a need to modify appropriate criteria and indicators for given regions or locales in co-operation with various stakeholders.

Identification of the most relevant stakeholders in sustainable forest management must take account of several important dimensions.

During the second phase of the project, work will be more focused on the key issues identified over the past 18 months. Criteria and indicators will be fine-tuned and the causal links among issues more closely examined. In the social sphere, for example, the relationship among people's participation in forest management, inter-generational access to resources and sustainable forest management will be investigated. In ecology, efforts will be made to define biodiversity more clearly. The process of decision making, in an environment of incomplete and conflicting information resulting from field assessment of sustainable forest management, will also be examined.

*Ravindra Prabhu*



*Mora excelsa tree, Iwokrama rain forest, Guyana (Andy Gillison)*

*Woman collecting wood in Appoisso, Côte d'Ivoire (Carol Colfer)*

# Social Sustainability in the Forest

Social criteria and indicators have been often criticised by forest certifiers as being the least well-developed, the most difficult to assess in the field, and the most ambiguous to interpret of all the proposed criteria and indicators of sustainable forest management.

It is difficult to establish absolute standards for desirable social conditions such as "human well-being". Comparable conditions can be interpreted differently, with different implications for forest management, across both social context and time. The variation among social systems and their constant change further complicate the development of global methods for measuring social criteria and indicators. CIFOR's social science team has developed a set of special activities in this field as part of the project *Testing Criteria and Indicators for Sustainable Management of Forests*. We developed an initial definition of sustainability that contained three distinct social elements to be considered.

## The Social Aspects of Forest Sustainability

The *well-being of people* living in and near forest areas encompasses several dimensions:

- Security and sufficiency of access to resources – both now and in the future;
- Economic opportunity – activities should maintain or enhance livelihood opportunities;
- Decision-making opportunity – right to meaningfully participate in decisions affecting their lives;
- Justice – fair resolution of conflict and distribution of benefits, rights, responsibilities and incentives;
- Heritage and identity – respect for people's cultural values, behaviour, land use and material goods, both at present and for future enculturation of the young; and
- Safety and health – both physical and mental.

The *actions of people can affect the quality of forest management.* Ostrom (1994) refers to the capacity of a group to co-operate effectively as "social capital". By assessing this social capital, or potential for co-operation, and the incentives for use of the forest, it is possible to predict the likelihood of good forest management. Building on Ostrom's ideas and those of others on common property resource management, we identified at least eight social conditions necessary for effective resource management by a group:

- Clear boundaries;
- Capacity to protect the forest resource;
- Effective decision-making and conflict resolution mechanisms;
- Capacity to monitor the quality of the forest resource;
- Organisational efficiency to promote effective and frequent communications;
- Incentives and benefits for good forest management;
- Inputs – people have the labour, technology, information, capital and other inputs necessary for sustainable management; and
- Shared value of conservation or commitment to maintaining the forest.

*Inter-generational distribution of benefits* focuses on the persistence or improvement of social equity over time. Indicators for assessing inter-generational benefits include the stability of people's well-being; the maintenance of social capital; equitable inheritance systems; tenurial security; and values of, and opportunities available to, the younger generation.

*Road in Bebou, Côte d'Ivoire (Carol Colfer)*



The CIFOR social science team took this definition into consideration in addressing three key objectives: development of a conceptual framework for the analysis of the social dimensions of forest sustainability; development of methods and field procedures for testing the social science criteria; and the field testing of specific criteria and indicators. Our intention was to test the conceptual framework against our findings in the field and to revise our concepts accordingly.

**Project Work**

Field tests and workshops on social science criteria were conducted in Indonesia, Côte d'Ivoire and Brazil in conjunction with the tests of the larger project. In East Kalimantan (Borneo), **P.M. Laksono**, an Indonesian anthropologist, joined the team. In Cote d'Ivoire, social scientists **Heleen van Haaften** (Dutch) and **Ahui Anvo** (Ivoirean) participated in the tests. **Jan Kressin**, a German sociologist, joined the Brazil team. The field tests drew attention to criteria such as the maintenance of cultural integrity, human physical and mental health, and the significance of a "conservation ethic". From a methodological standpoint, there was much discussion during all tests about the definition of stakeholders and on which stakeholders to focus attention.

Two working papers were prepared to promote discussion on these issues. Colfer with Prabhu and Wollenberg (1995) provide a synthesis of social criteria and indicators examined in the project and a discussion of related issues. Colfer (1995) proposes a simple method for scoring stakeholders along six dimensions: proximity to the forest, pre-existing rights, forest dependency, indigenous knowledge, forest/culture link and power deficit, in order to determine their relative importance in the forest management process.

*Punan man, East Kalimantan (Andy Gillison)*

Plinio Sist

## Lessons Learned

By identifying key questions and points of debate, we hope to clarify thinking about the social dimensions of sustainability and accelerate the development of methods for assessment. Issues concerning the social criteria and indicators included:

1. Whether social concerns belong in sustainability assessments at all. Some felt it would be clearer to create a separate category of social sustainability.
2. If the standards for social conditions are specific to a particular cultural and locational context can social standards can be set at all? Should criteria be designed to measure processes, such as capacities to adapt to new conditions, or absolute thresholds, such as well-being?
3. Should criteria measured at the forest management level include factors beyond the control of the forest managers, e.g., national land tenure policies or population settlement programmes? Should we develop assessment systems that distinguish between the responsibilities of the forest manager and larger entities? Where does accountability and control for such influences ultimately lie?
4. How far should the boundaries of assessment extend? If social impacts are rarely confined to the limits of the forest management boundary and it is thought necessary to assess these impacts in a larger area defined as a social management unit, how should this larger, more permeable social boundary be defined and how can we best assess the "social spillover" effects?
5. How can good-quality information about social conditions be acquired quickly? Where assessors are working under schedules and in many sites, it may not be possible to develop the rapport and understanding necessary to acquire quality information.

One of the most interesting, and in some ways surprising, lessons we learned was the reasonable degree of agreement – among social scientists of varying nationalities, disciplines, orientations and personalities, both on and off our teams – about which social principles, criteria and indicators were considered to be most important. Less surprising, was the difficulty of finding indicators of social sustainability that are simple, cost-effective, transparent and replicable.

## Next Steps

Over the next two years (1996-97) CIFOR will initiate research to empirically test many of the links postulated in our conceptual framework. Does participatory decision-making among stakeholders contribute significantly to sustainable forest management? Is inter-generational security of access to resources critical? Other important issues we would like to address include further refinement of the six dimensions proposed for identifying "who counts" in sustainable forest management; the effects of economic incentives on people's use of forests; and further development of our "working concept" of human well-being.

We also plan to extend the tests to forests managed by local communities. Aside from the interest in certification, many of these forests are still considered policy experiments, and policy makers are anxious to know more about their social and environmental outcomes. Since few assessment techniques have been developed explicitly for this type of forest, CIFOR plans to identify, generate and test criteria for assessing the sustainable management of forests by local communities, again using an inter-disciplinary approach.

Through the community forest field tests, workshops and participation of our in-country collaborators, we hope to constructively advance the debates on sustainability so national institutions and certifying organisations can better pursue their own initiatives related to sustainability.

*Lini Wollenberg and Carol Pierce Colfer*

**References**

Colfer, C.J.P. 1995. *Who Counts Most in Sustainable Forest Management?* CIFOR Working Paper No. 7.

Colfer, C.J.P., with Ravi Prabhu and Eva Wollenberg 1995. *Principles, Criteria and Indicators: Applying Ockham's Razor to the People – Forestry Link.* CIFOR Working Paper No. 8.

Ostrom, E. 1994. *Neither Market Nor State: Governance of Common-Pool Resources in the Twenty-first Century.* Washington, DC, International Food Policy Research Institute.

*Women and child between logging trucks, east of Kribi, Cameroon (Carol Colfer)*

# POLICY AND SOCIAL SCIENCES

CIFOR's collaborative programme in policy and social sciences focused on research needs to identify better policy options for the alleviation of rural poverty of forest-dependent people, together with the improved conservation and management of forests. Three main research areas are emerging: extra-sectoral policies; community-based management and non-timber forest products (NTFPs).

It is widely recognised that certain macro-economic policies, national demographic and social trends, and the policies and actions of other sectors can overwhelm decisions and actions taken within the conventionally defined forestry sector, especially in tropical developing countries. During 1995, methodologies and protocols for a series of comparative case studies in Bolivia, Cameroon and Indonesia were finalised with government and NGO partners in each country. **Dr David Kaimowitz** and **Dr William Sunderlin** are leading this research on "extra-sectoral influences", ably supported by **Dr Ousseynou Ndoye** in Cameroon and **Dr Godwin Kowero** in eastern and southern Africa.

*Upland rice farming near CIFOR Research Forest, East Kalimantan (Andy Gillison)*

Another priority theme is the quest for new institutional arrangements for the management of forests at the local level, by those whose livelihoods are directly at stake. **Dr Lini Wollenberg** has been leading this field of research at CIFOR, and representing CIFOR in the Inter-Center consortium on Property Rights and Collective Action. She has undertaken detailed field work herself in Kayan Mentarang Nature Reserve in East Kalimantan, Indonesia, examining the opportunities for income generation among forest villagers. She is also testing the conditions under which such incomes are compatible with conservation aims especially the inter-relationships among households' changing livelihood strategies, competition for forest use, and institutional arrangements for securing property rights, resolving conflict and distributing benefits associated with forest use. She also expects to provide simple methodologies for rapid assessment of income needs and opportunities compatible with conservation aims. **Louise Buck** has also been an active member of an international group investigating devolution and local organisations for resource management, specifically in the context of local management of protected forest areas. Her work on the institutional and socio-economic aspects of people and protected area management, is currently concentrated on "Integrated Conservation and Development Projects", particularly in Madagascar. Her collaborators there include CARE and the University of Antananariva.

The research on production and marketing of Non-Timber Forest Products (NTFPs) is led by **Dr Manuel Ruiz Pérez**, with field work under way in China, Brazil, Sri Lanka, Indonesia and Cameroon in collaboration with local research partners. A major two-year study on sustainable use and management for NTFPs, with partners in Germany, Zimbabwe and Bolivia, is

being co-ordinated by **Dr Wil de Jong. Dr Ndoye** has undertaken a comprehensive analysis of the markets and marketing of NTFPs in and around Cameroon. This has highlighted the importance of forests and contribution of NTFPs to local livelihoods, in the context of the local institutions for managing forests (see page 34).

Although CIFOR staff, associates and partners approach these three themes from their specific areas of interest and competence, the inter-connections are becoming increasingly apparent to all concerned. It seems that whichever entry point we take, whether starting from an interest in:

- the small-holders' forest products (e.g., NTFPs) physically;
- the forest resource from which the products come;
- the markets in which they are traded;
- the people who collect and trade them;
- the impacts of these activities on biodiversity;
- the incomes that people derive from protecting, using or destroying forests;
- the effects of local institutions, tenure and markets on how these people do what they do in or to the forests, and how these change over time; or even
- the effects of national policies on those local processes which influence people's use and/or management of the forests (such as for NTFPs);

we find a very similar set of related, inter-connected issues and questions, and very similar research methods are required.

*Village market near Ubud, Bali (Andy Gillison)*

A striking example of this is CIFOR's research focused on Miombo woodlands, led by **Dr Godwin Kowero** in Bogor and **Prof Bruce Campbell** of the Institute of Environmental Science in Harare. With collaborators throughout the region, Prof Campbell has almost completed a comprehensive, inter-disciplinary synthesis of knowledge about Miombo woodlands: their ecology and management, the production and marketing of NTFPs from the Miombo; the impacts (both positive and negative) of such use or management on the woodlands; the institutional arrangements for local community management of the woodlands; and the impact of national economic policies (such as Structural Adjustment programmes) on sustainable management and use of Miombo woodlands. This research is conducted in conjunction with the University of Zimbabwe and the Forest Research Centre of Zimbabwe, and an informal Research Working Group from all the SADC countries (see page 24).

Just as policy reforms have influenced household behaviour in bamboo production and marketing in China (see page 25), the impact of past policy reforms and the need to develop new socio-economic and institutional structures to facilitate rehabilitation of degraded lands, is the subject of ongoing collaboration with the Chinese Academy of Forestry and IDRC. There are close parallels (but also some interesting contrasts) with other CIFOR research on the conditions under which small-scale tree farming on previously degraded lands has developed in Vietnam and India.

*Spices, Appoisso market, Côte d'Ivoire (Carol Colfer)*

*Debarking of baobab trees for bark cloth, Zimbabwe (Manuel Ruiz Pérez)*

A topic identified as high priority by the Inter-governmental Panel on Forests (IPF) is "techniques and methods for the comprehensive economic valuation of forests". This is pre-requisite to discussions of possible compensations to tropical countries for their incremental costs in setting aside forests for biodiversity conservation or carbon sequestration. The Convention on Biological Diversity also calls for equitable sharing of the benefits and costs of conservation, which requires robust objective valuation techniques. Throughout 1995, CIFOR staff and partners in Thailand and the Philippines collaborated with researchers from the World Bank Environment Department on forest valuation. Other forest valuation research was conducted with IUCN in Sri Lanka and ACIAR in Vanuatu, and with FAO's Andre Meyer Fellow who is specialising on this question.

## The Miombo in transition: woodlands and welfare in Africa

Miombo woodlands are the most extensive vegetation type in Africa south of the equator. These dry tropical woodlands cover some 2.5 million hectares and are home to over 40 million people. Miombo products are also very important to the livelihoods and basic needs of an additional 15 million urban Africans.

The extent to which livelihood strategies of rural communities depend on Miombo goods and services, and the strong differentiation of uses within communities, in space and time, has now been comprehensively documented for the first time. The ecological constraints to human activity in the region range from nutrient-poor soils to the presence of the tse-tse fly. Numerous policies (both deliberately and unintentionally) have influenced Miombo woodlands and their uses and, of course, their users and residents, from pre-colonial times to the present. The current importance of Miombo products in markets, both locally and globally, and how these are evolving, are also now being analysed rigorously for the first time. Options for management, including silvicultural treatment, fire management and grazing regimes and new institutional arrangements, both local and state, for the management of the woodlands have emerged from this review, but now have to be more fully investigated. How can local communities be empowered to manage and benefit from the woodlands?

*The Miombo in transition* develops a conceptual framework of how all the diverse social, economic, political and ecological processes interact to shape how the household livelihoods and woodland ecosystems are changing. This model is then used to identify key issues for research, which will reduce gaps in current understanding and facilitate the formulation of alternative management strategies, policies and institutions.

*A book with this title, edited by Bruce Campbell, will be available from CIFOR in July 1996.*

# A Mixed Economy: Bamboo Shoots Ahead*

## Introduction

In 1978, just two years after the death of Chairman Mao, China initiated ambitious economic reforms spearheaded by three mutually reinforcing steps: decentralisation of production and investment decisions shifted the focus of control from central planning authorities to provincial governments and local enterprises; markets were increasingly used as the resource-allocating mechanism, through a "Socialist Market System"; and an "Open Door" policy permitted, and even encouraged, the import of foreign capital and technology and the establishment of foreign enterprises.

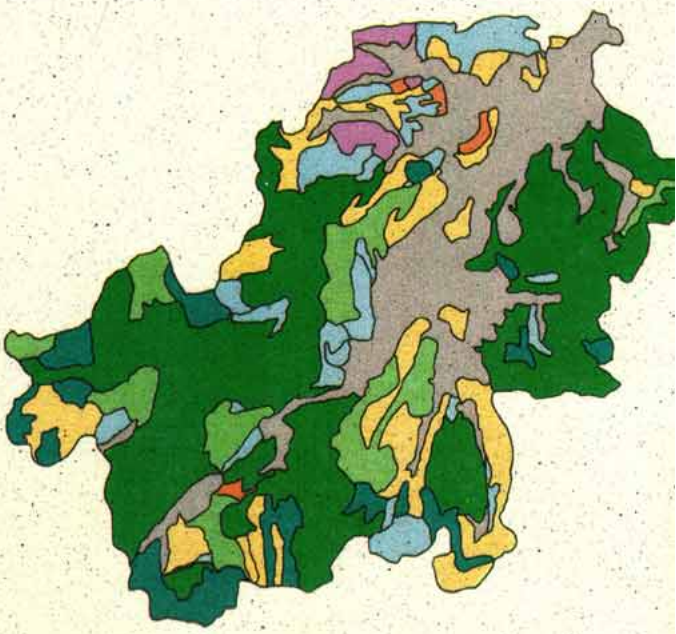
These reforms had major impacts on forests, particularly in the bamboo sector which is economically and socially important. It employs over 700,000 people and generated exports worth US $271.8 million in 1993 (Zhong *et al.* 1995). A recent CAF/CIFOR/INBAR study examined the impacts of these national policy changes on the bamboo sector in Anji County, Zhejiang Province, where bamboo has a long tradition and is important in the local economy. The purpose was to investigate the potential contribution of bamboo cultivation, harvesting and processing to rural development, given an appropriate policy and economic environment.

Because of the strong competition with other land uses, changes in the area of bamboo cultivation have not been as dramatic as harvest figures alone may suggest. Intensification and diversification of management have been the major factors in the growth of the bamboo sector.

## Bamboo production in Anji County

China's policy reforms grew out of various "policy experiments". One of these was the successful experience of Anhui Province, where a "household responsibility system" policy allowed households to enter into contracts with production units (normally village-level teams), taking full financial responsibility for their production of agricultural and related products. This shift of responsibility levels had an immediate effect on primary production and fostered widespread introduction of the new system.

The new household responsibility system was almost instantly adopted in Anji's bamboo production sector. By 1984, one year after implementation, it had been introduced in all villages and 90.9 per cent of the moso bamboo (*Phyllostachys pubescens*, that accounts for 78 per cent of the county's bamboo) area was under private management (Table 1). The collective farms were decimated, while the minor State-farm contribution remained practically unchanged.




*Land-use map showing importance of bamboo, Anji County, China (map generated by Atie Puntodewo and Ana Cuenca Fernandez)*

* A detailed report of this study can be found in the Journal of Forest Economics, 2(2).

Table 1. Moso bamboo management systems in Anji County.

| Year | State farm | | Collective (village) | | Individual | | Total |
|---|---|---|---|---|---|---|---|
| | area (ha) | % | area (ha) | % | area (ha) | % | area (ha) |
| 1975 | 617 | 1.4 | 42,183.0 | 98.6 | 0 | 0 | 42,800.0 |
| 1982 | 617 | 1.4 | 42,993.0 | 98.6 | 0 | 0 | 43,610.0 |
| 1984 | 617 | 1.4 | 3,376.9 | 7.7 | 39,773 | 90.9 | 43,766.9 |
| 1989 | 617 | 1.4 | 3,377.1 | 7.7 | 40,025 | 90.9 | 44,019.1 |
| 1994 | 630 | 1.4 | 3,377.9 | 7.6 | 40,512 | 91.0 | 44,519.9 |

Source: Yearbook of Anji Forest Bureau.

Collective operation and its more egalitarian characteristics have not been totally abandoned in this shift to private management. Most farmers pay the commune a fee or rent equivalent of the current market value of the average number of culms produced at the time of the initial agreement. The total income from renting the commune's land is then distributed back to farmers (after deducting general services and government taxes) based on work and family size, as in former commune practices. The farmer can keep any culm production beyond the amount established in the contract, plus all the bamboo shoot, branch and leaf production, thus providing the incentive for improved management. After ten years the land rent is increased by 10 per cent allowing the commune to capitalise part of the improvement in productivity and profitability.

The reforms have been accompanied by improved bamboo harvests since 1975 (Figure 1). Most of this increase can be attributed to intensified management as measured by stand density and output per hectare (Figure 2), as increase in area under production has been moderate. Culm production per hectare has increased by 79.3 per cent since 1975. The most important inputs have been fertilisers, pesticides and labour. This has resulted in a better standing culm ratio, and cutting cycles have been reduced from eight to six years. Many farmers have moved to a mixed culm–shoot production regime because of the high profitability of producing bamboo shoots, which has also been noted in other areas of China (Zhong 1994).

*Bamboo forest in Anji County, China (Christian Cossalter)*

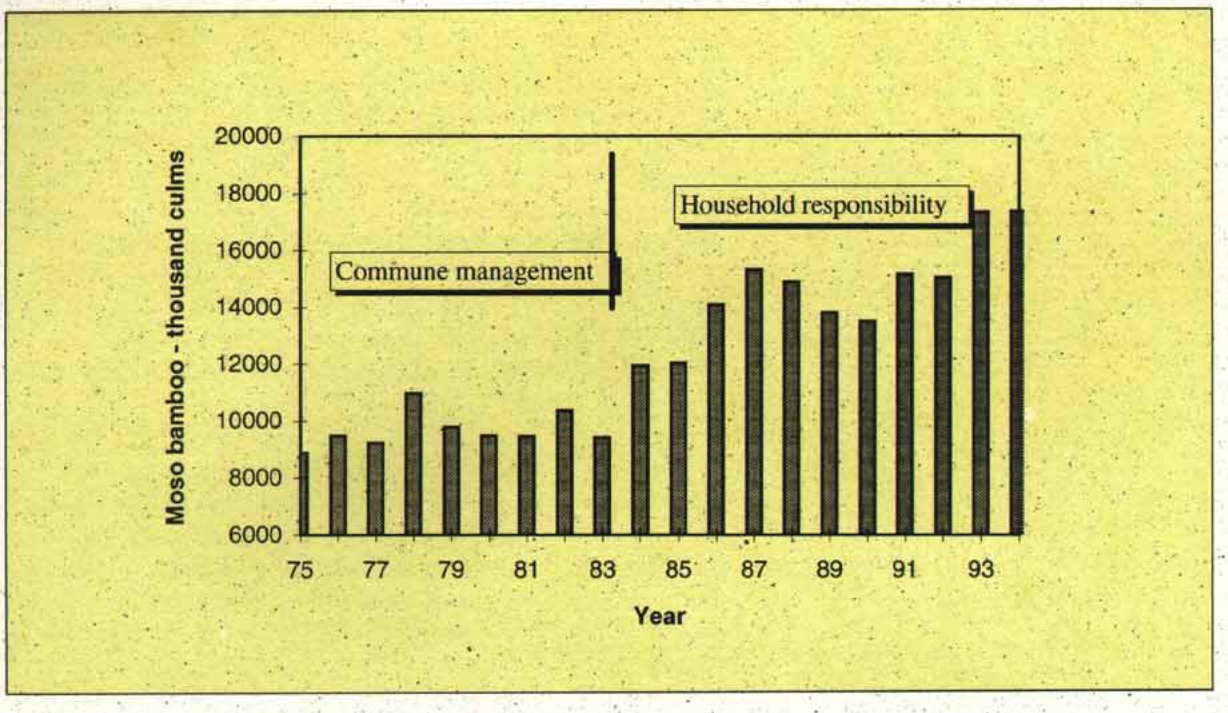



**Figure 1.** Evolution of the moso bamboo harvest in Anji.

**Sources:** Field work and Anji Forest Bureau Statistics

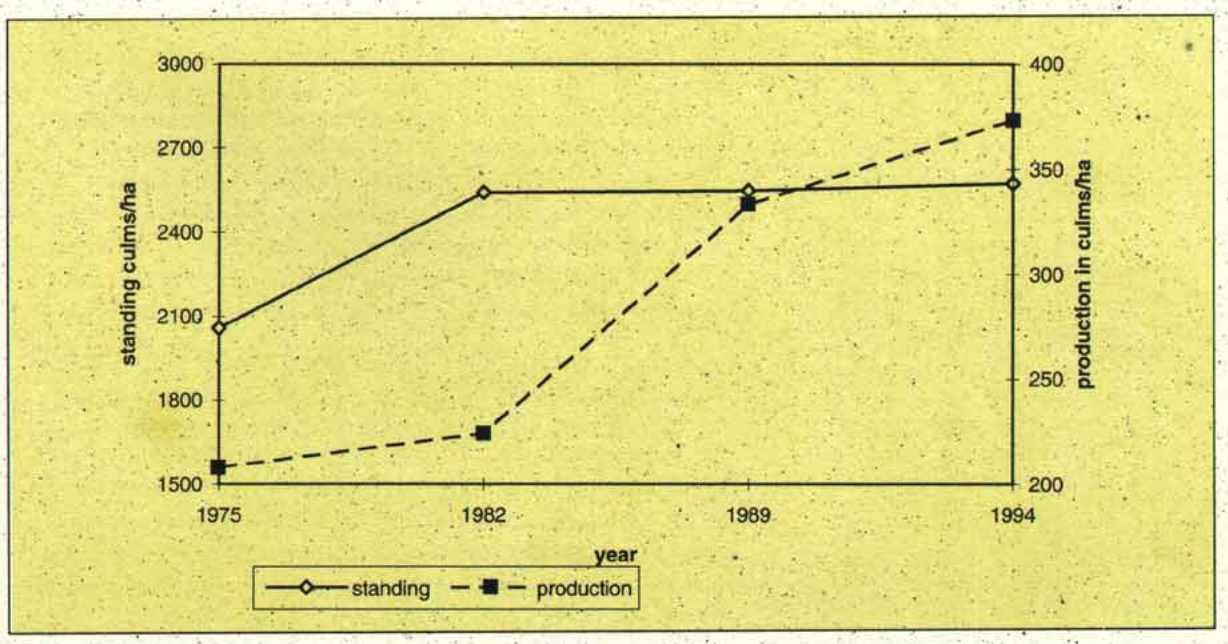



**Figure 2.** Moso bamboo production and stand density, 1975 to 1994.

**Sources:** Field work and Anji Forest Bureau Statistics

### The reform of the marketing system

Until 1980 all bamboo produced was sold at a fixed price through the State-run Supply and Marketing Cooperative. The new policy allowed the sale of above-quota production directly by villages, creating a market for surplus production and encouraging increased productivity by the villages, who were also authorised to establish their own enterprises for semi-processed products.

With market pressure on prices, the government was forced to eliminate the quota system in 1985, moving bamboo production to a fully open market situation. The Supply and Marketing Cooperative negotiated prices with individual farmers. Consequently, 1986 brought the highest rate of increase in the private market, 71.5 per cent above the previous year. Private marketing channels overtook the State for the first time since 1949. Gradually, intermediaries appeared in the County, specialising in and facilitating trade relations. About 200 traders, most from Anji County, controlled 91.7 per cent of the total moso bamboo sales in 1994. The remainder was produced by State or village farms that sell directly to their own enterprises.

In 1978, 95.7 per cent of Anji County's moso bamboo production was exported in unprocessed form to other counties or provinces in China; only 4.3 per cent was sold in Anji. By 1994 the local market absorbed 42.6 per cent of production for processing by factories recently established in Anji. Purchase of bamboo from other counties or provinces started in 1990 in response to increasing demand, and was 13.2 per cent of total trade in 1994.

Increased production and opening of trade and free markets have not been sufficient to deal with growing scarcity caused by increased demand from the newly established enterprises. Consequently, prices have increased much faster than the general retail or exchange rate indices. A moso culm that sold for 0.95 yuan in 1980 would fetch 2.64 yuan in 1994 (in constant 1980 yuan). Bamboo culm production has emerged as a stable, core activity for households: reliable and reasonably profitable. The shoot-production activity is much more dynamic: recent, more profitable and, as a biennial crop, capable of expanding or contracting more quickly in response to changing market demands.

**Bamboo processing**

Until 1978, there were 19 factories for all bamboo products in Anji County, employing 460 workers and generating a gross output of 940,000 yuan ($670,000). Most bamboo was processed outside the county. The first marketing reform in 1980 permitted new village and township enterprises, as well as some private enterprises (mostly family-based), despite the quotas and restrictive marketing channels. By 1985, when the quotas were abandoned and the market opened, there were 154 enterprises, with 3,370 workers and a gross output of 12.31 million yuan ($4.16 million). Since 1990 the industry has grown exponentially, in step with the rapid expansion of the Chinese economy. In 1994, 505 private factories with a gross output of 412.32 million yuan ($49.68 million), employed 10,292 workers, of whom about 80 per cent were women. However, the number of farmers growing bamboo increased by just 1 per cent from 1985 to 1994.

*Processing bamboo in China (Christian Cossalter)*

Two factors have converged to encourage growth. The change in the production and marketing system, coupled with more flexible facilities for rural industries (Martin 1993), have allowed a channelling of domestic savings. This was the driving force from 1980 to 1988 when the "Open Door" policy and incentives attracted foreign enterprises which sustained the expansion. Since 1988, 19 joint ventures have located in the county, with a peak in 1992 when 8 new factories opened. Total investment was 36.31 million yuan and the 3,274 workers represent about one-third of the total labour force in the processing sector. Taiwan and Japan have been the main investors.

**Bamboo exports in Anji**

With the approval for foreign industries to establish in the County and the reform of foreign trade in 1988, the Anji Foreign Trade Company was authorised to negotiate direct exports and to keep part of the foreign currency, thus eliminating the provincial channels. Exports soared to 131.5 per cent above those of the previous year.

In 1989/1990, the expansion of the sector was interrupted, especially in the bamboo shoot industry. Deterioration of foreign relations and boycotts on Chinese goods after the Tiananmen Square events particularly affected export goods like bamboo shoots to Japan. The bamboo shoot industry in Thailand, from plantations of *Dendrocalamus asper*, had just reached full production (Thammincha 1995). This sudden reduction of exports led to a general decline in the sector.

Growth resumed after 1991, with exports increasing by 172.8 per cent over the next four years, mainly bamboo mats and flooring. Bamboo shoots have not recovered the level reached in 1988 despite the re-normalisation of relations and the establishment of two bamboo shoot joint ventures with Japanese firms. The entry of Thailand as a main competitor played a greater role than the economic sanctions in the course of development.

At present the Anji bamboo sector is strongly export-oriented – from zero in 1978 to 75.3 per cent of industrial production in 1990. However, the importance of the internal market must not be overlooked. Sales within the county and to other regions of China have been growing faster than exports since 1990 and accounted for 52.8 per cent of the industrial bamboo output in 1994. This also partly explains the ineffectiveness of the boycott.

Diversification and quality improvement and control are the main challenges to the sector. Foreign enterprises and markets have stimulated development; export-oriented enterprises have devised new products such as special bamboo mats and vacuum-packed fresh bamboo shoots that have increased production and sales.

*Research on bamboo shoot preservation, China (Christian Cossalter)*

*Bamboo in China (Christian Cossalter)*

## Conclusions

Since China's political shift towards a more efficient, market-related economy, the bamboo sector in Anji County, Zhejiang Province, has changed radically in production, marketing, processing and international trade. Production has moved from village co-operatives to a farmer responsibility system with the effect of intensification of production and increased output, and diversification to include highly profitable bamboo-shoot production. The total area planted to bamboo has only increased slightly because of the strong competition for land.

All indications are that the sector was ready for change. Bamboo production has a long tradition in Anji County, but technical capacity resulting from farmers' innovations and a strong research base seems to have been well ahead of practice. A series of policy changes have cleared the main bottlenecks in the sector, providing the incentives and opportunities to intensify production of raw material with little increase in land area, and to diversify production towards increased shoot output. Because the changes were implemented gradually, and frequently tested on a small scale first, major disruptions have been avoided. Success and a smooth transition have been facilitated by a sequence that has moved initially from reforming the production of raw material to subsequent changes in marketing, processing and foreign trade.

The increased efficiency and enormous release of production capability has been achieved within the context of a State land-tenure system with strong communal involvement where distribution of land rents is still based on a combination of need and merit. This is consistent with the conclusions of Sicular (1988) that a mixed system can be sustainable and can have desirable efficiency and distribution effects. The case of bamboo in Anji also shows how the State may no longer directly influence production and consumption behaviour in the presence of markets.

*M. Ruiz Pérez, Fu Maoyi, Xie Jinzhong, B. Belcher, Zhong Maogong and Xie Chen*

**References**


Changjing, S. 1992. Community forestry in southern China. *Journal of Forestry* 90 (6): 35-40.

Martin, W. 1993. Modeling the post-reform Chinese economy. *Journal of Policy Modeling* 15 (5&6): 545-579.

Ministry of Forestry. 1993. *Forest Resource Inventory.*

Prosterman, R.L. & T.M. Hanstad. 1990. China: a fieldwork-based appraisal of the household responsibility system. *In:* Prosterman, M.N. Temple & T.M. Hanstad (eds), *Agrarian Reform and Grassroots Development. Ten Case Studies.* Lynne Rienner Publishers. London, pp. 101-136.

Qiu, F.Q. 1992. The recent development of bamboo food. *In:* Zhu, S.; Li, W.; Zhang, X. Wang, Z. (eds), *Bamboo and its Uses. International Symposium on Industrial Use of Bamboo. Beijing, December 1992.* ITTO-CAF, pp. 333-337.

Sicular, T. 1988. Plan and market in China's agricultural commerce. *Journal of Political Economy* 96: 283-307.

Thammincha, S. 1995. The bamboo shoot industry and development in Thailand: The physio-socio economic implications. INBAR Vth International Bamboo Workshop. Bali (Indonesia), June 1995.

World Bank. 1988. *China. External Trade and Capital.* World Bank Country Study. World bank. Washington.

Zhong, M. 1994. Analysis of the economic benefits and development of agroforestry for bamboo shoot forests [Chinese]. *Forestry Economics* 1994 -1: 56-61.

Zhong, M., Xie C, Fu and Xie, J. 1995. *Bamboo and Rattan Socio-Economic Database; People Republic of China.* INBAR Socio-Economic Database. INBAR. New Delhi.


# Modelling Land-use Patterns at the Forest Edge



A weakness of much forest policy research is the difficulty of testing propositions. One way to allow more robust tests is to model social and ecological factors then compare model predictions with empirical data. Although such models seem feasible, no spatially explicit models of this kind appear to have been implemented to date. Models are not the only way to test propositions, but a major attraction of formal modelling is that ideas must be expressed completely, concisely and explicitly, and implemented in an integrated and testable way. In particular, models excel at exposing counter-intuitive consequences of simple assumptions. They also offer new insights and pose new problems for research.

The basic concepts in this work are not new; what is new is the way concepts are integrated and applied to give spatially-explicit predictions, an important aspect for model testing. The danger of confabulation (i.e., a plausible but irrelevant explanation) is increased in the more general models, and this may be minimised by working at the largest practicable scale.

The proposed model relies on five basic assumptions, namely that:

1. Land-use patterns are ultimately shaped by individuals and groups of individuals;
2. These individuals make rational decisions based on available information, obligations and expectations;
3. Individuals explore all options available to them, within the constraints imposed by resources, finances, skills and knowledge;
4. Individuals tend to maximise expected benefits or to minimise anticipated risks to themselves, their families and their clans; and
5. Both benefit seeking and risk avoidance can be modelled by maximising the risk-adjusted benefits.

Decisions affecting land-use patterns may typically involve the production of one or more outputs to achieve the maximum benefit subject to some social and economic constraints. This benefit may be adjusted to account for risk avoidance by introducing a suitable discount factor (see below). Thus the benefit to an individual $k$ may be estimated by choosing activities $i$ and sites $j$ so as to maximise

$$\Sigma_j \{Max_i [Yield_{ij} ( Price_{ij} \times Risk_{ijk} \times Share_{ijk} - Input_{ij} - Sell_{ij}]\}$$

subject to the constraints imposed by available resources. In non-mathematical terms, choose the "best" combination of activities for each of the sites available to the individual, so that the overall benefit to the individual is maximised. Note that "best" depends on many things: the anticipated yield for that activity (e.g., crop, handicraft item, wage-based employment) at that site, the anticipated price, any reduction for real or imagined risks (e.g., pests, disease, fire, theft, loss of tenure, spoiling during transport to market, viability of an employer), an allowance for shares that others may have in the activity

*Valley in Bali (Andy Gillison)*

*Shorea smithiana (Plinio Sist)*

(e.g., clan obligations as well as landlords who may share revenues but not costs). For efficiency, the prototype model assumes that yields and prices are the same for all individuals (ignoring production and negotiating skills), but recognises that individuals may differ in their willingness to accept risks and in their social obligations. Notice that the correction for risk ($Risk_{ijk}$ in the equation) may reflect the long-run expectation for individuals who are not risk-averse, but may be substantially less for those who are unable or unwilling to contemplate a risky venture. The gross return to the individual is adjusted for the costs of production ($Input_{ij}$) and the costs of marketing ($Sell_{ij}$). Note that these also depend on the product and the site. Production costs may include labour (own or paid), rent (formal or informal obligations) and other inputs (fertilisers, pesticides, etc.). The inclusion of some estimate of the value of an individual's own labour may not influence the outcome of the model greatly, but may be a useful way to discriminate "enjoyable" and "unpleasant" work. Individuals may undertake activities because of the status conferred, so the production cost may need to be adjusted for this perceived status. Marketing costs may include transport and packing and, in some situations, advertising.

The terms in the equation can all be quantified in some sense, so it should be possible to construct and evaluate this model, provided that we can quantify them all in similar units (e.g., dollars or other local currency). Note that history does not enter this equation, except in that it influences the choice of activities $i$ entertained by each individual. This could be formulated as a mathematical programming exercise, but it is probably sufficient (at least initially) to solve it heuristically (i.e., trial and error with a simple set of guidelines). This is not a typical linear-programming problem formulation which maximises overall benefits, as each individual may attempt to find an optimal solution for the family or clan, even if it leads to a sub-optimal outcome for the village as a whole. However, in common with classical linear programming, it shares the need to recognise constraints such as the time, land and assets available to each individual.

The decision made for any particular site $j$ is not independent of decisions made for other sites, since price and risk may depend on total production across all sites and many land use options may have off-site impacts (e.g., pollution, erosion). Over-production of staple goods may saturate local markets and, conversely, under-production of export-oriented goods may encounter problems with economies of scale in marketing and handling. For goods produced and consumed locally, it is appropriate that the model should ultimately account for total demand and price elasticity, but this introduces several complexities and will be omitted from initial prototypes. It is also desirable to include lagged adjustments to take into account the time taken to learn and implement new technologies (and meet transition costs). However, in the initial prototype of the model, we could avoid this complexity by making the prevailing market prices exogenous to the model, getting the user to provide the prices and assuming that they remain constant. This avoids many complexities, since the actual prices paid may depend on elasticity, the number of

*Soliga homestead, Biligiriranganabetta (B.R.) Hills (Tim Boyle)*



producers and buyers and local wealth (individuals tend to substitute luxury for inferior goods as their personal wealth increases). It also simplifies the model since we can then assume decisions on any site are independent of other sites, so that the equation can be solved without taking topology into account.

Some further simplification allows the model to be implemented as a static spatial model; static in the sense that parameters do not change over time, and spatial since predictions will be spatially explicit and thus able to be mapped and checked on the ground. One attraction of a spatial model is the rigorous testing that is possible when spatial predictions are provided.

The model should provide a range of outputs to suit different user requirements. One visible output would be a map that responds to changes in input parameters, allowing users to gain a visual impression of land-use changes occurring in response to changes in policies and other instruments. Under some scenarios, predicted land uses may remain relatively static, despite moderate perturbations in input variables and model parameters. We want to identify the "sensitive" areas, where comparatively small perturbations in inputs and assumptions give rise to large changes in predictions. In particular, we want to know where these areas are, what parameters trigger shifts in dominant land use, and how these shifts occur. One useful way to emphasise such changes is to compare predictions under two (or more) scenarios, and to map the difference in outcomes. Another possibility is to plot isolines showing the price change in the product of interest that is likely to result in land-use change (e.g., degradation or deforestation as a result of lower transport costs or higher prices for cash crops). Preconceptions suggest that these sensitive areas may be near the forest edge, and may include *imperata* grasslands. However, to establish or refute this, we need sensitivity analyses on all input parameters. While this sensitivity testing is critical to both understand and check the model, it is also an important outcome of the modelling exercise.

The initial prototype of the model is currently being calibrated with existing data from Thailand, and after fine-tuning of the model and refining of the concepts, subsequent versions will be constructed for Indonesia and for CIFOR's other priority areas.

*Jerry Vanclay*

*Land Use 1994 Map Nam Lang Project Area Pang Ma Pha Sub-district Mae Hong Son Province (map generated by Atie Puntodewo and Thomas Enters)*



# Non-timber Forest Products Sustain Women in the Humid Forest Zone around Cameroon

Between January and July 1995 more than one thousand tons of non-timber forest products (NTFPs) were marketed in the Humid Forest Zone of Cameroon. These figures were derived from a CIFOR study investigating the performance of NTFP markets in the Humid Forest Zone in and around Cameroon. The study relied on data collected from farmers, transporters and traders of NTFPs in 31 markets located in 5 provinces of Cameroon. It has demonstrated clearly that NTFPs are the source of employment for many rural people in the region, and suggests how policy makers should explore market research and develop new policies to expand opportunities for resource-poor farmers and improved forest management.

Table 1: Trade in selected non-timber forest products in the Humid Forest Zone of Cameroon, January to July 1995

| Common Name | Scientific Name | Value of trade (tons) | Volume of trade ($US 000) |
|---|---|---|---|
| African pear | *Dacryodes edulis* | 587 | 244 |
| Palm nut | *Elaeis guineensis* | 246 | 51 |
| Abata cola | *Cola acuminata* | 212 | 212 |
| Njansan | *Ricinodendron heudelotii* | 172 | 460 |
| Dika nut | *Irvingia gabonensis* | 140 | 302 |

### Who is engaged in NTFP marketing?

In the Humid Forest Zone of Cameroon women are much more active in the marketing of NTFPs than men. Of all sampled farmers who market NTFPs, 93 per cent were women; 50 per cent had only received primary education and 25 per cent had no schooling at all. Improvement in the markets and in the marketing of NTFPs should increase the level of employment of women. Expanded employment opportunities in collection, processing and sale of NTFPs have the potential to enhance the welfare of women and their families. The processing of NTFPs is mostly done by women and absorbs much of their labour time. Similarly, introduction of efficient technology and methods could improve their return for the labour they expend on NTFP collection and processing.

### How do NTFP markets operate?

Prices for NTFPs are determined by the usual supply and demand conditions operating in any market. In times of abundant supply prices are lower. A more even supply to the market will reduce the fluctuations in price. However, due to the seasonal nature of NTFP production, storage of the

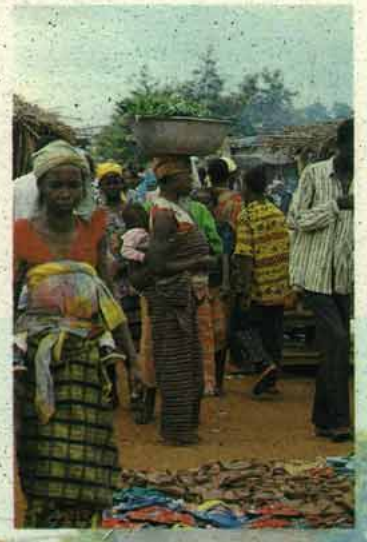
product becomes important in guaranteeing availability throughout the year. Many NTFPs are perishable and therefore cannot be stored for long periods. Efficient storage facilities would be needed to allow for a more continuous supply throughout the year.

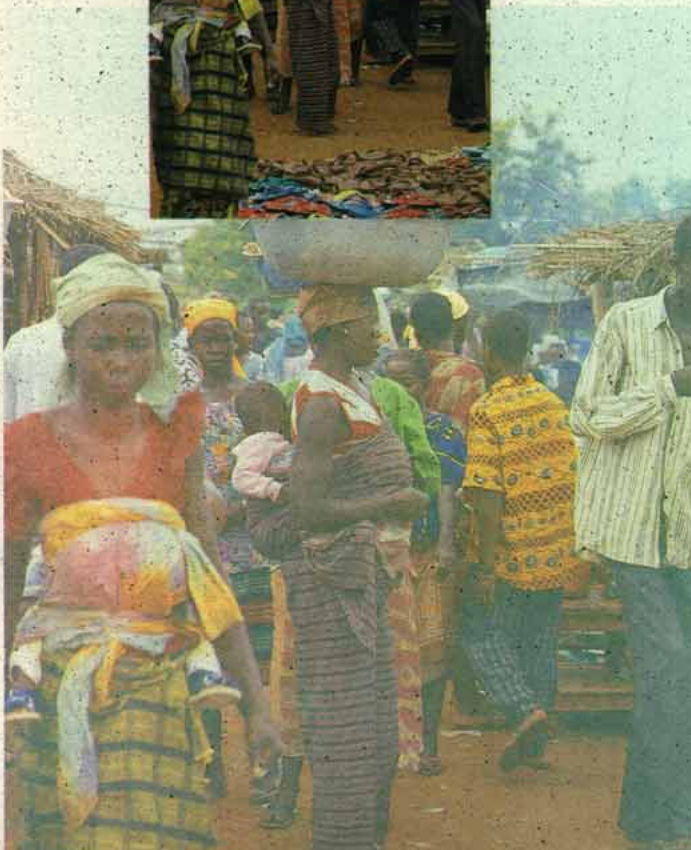
Demand within NTFP markets is determined partly by the capital available to local traders as well as demand for NTFPs from foreign traders and consumers in Gabon, Equatorial Guinea, Nigeria and the Central African Republic. A signal of scarcity in urban markets of the Zone will also have a significant impact on demand.

Farmers and traders in Cameroon bargain to establish a price acceptable to both. The bargaining power of farmers depends on types of NTFPs offered (perishability), quantity on the market, individual financial pressures and the number of traders. The price paid by a trader will also be determined by expected prices in urban and border markets, costs of marketing and acceptable margins on the sale of the product. Collusion between NTFP traders to buy at a single price will affect the ability of the farmer to bargain. However, collusion does break down because of ethnic differences as well as market conditions in traders' home zones.

During periods of scarcity, many traders will buy at the village, thereby increasing farmers' bargaining powers and reducing the costs of transportation to markets in time and money. Conversely, during the period of peak production, many traders prefer just to purchase NTFPs at the market rather than going to villages.

*Appoisso market, Côte d'Ivoire (Carol Colfer)*





### NTFP financing

Informal financial markets play an important role for NTFP traders. They increase their cash flows by placing savings in rotating credit schemes, known as "tontines". Fifty-four per cent of traders interviewed are involved in these associations. In each tontine, the contribution is set by the association and is regulated by the "chieftaine" or woman head. If the tontine is on a weekly basis, at the end of each week, the total amount of money contributed is given to one member of the association and this continues until all members have had their turn. NTFP traders who participate in tontines contribute an average of 3,800 CFA F per week. The money received from the rotating credit provides additional funds to buy NTFPs. The role and operation of these tontines are key elements to be understood before policy to influence financing can be formulated.

### Cross-border trade of NTFPs

Cross-border trade is an important part of the NTFP economy in Cameroon. For example, the volume of *Irvingia gabonensis* marketed to traders and consumers from Gabon and Equatorial Guinea can be estimated conservatively at 38 tons, or 27 per cent of the volume of *Irvingia gabonensis* marketed in the Humid Forest Zone, with an estimated value of $US 87,000.

*Rattan, Central Sumatra (Andy Gillison)*

The prices foreign traders are willing to pay depends on conditions in their home country and the quality of the product offered. For some NTFPs prices higher are paid for better-quality products.Development of improved quality products may greatly benefit the farmer.

### Marketing costs and margins for NTFPs

Perceived profit margins for NTFPs are higher in border markets than in more in-country markets. The margins received are greater for the less perishable items because quality does not diminish with transportation to the market. As the figure shows, traders' marketing margins are reduced during seasons of low production (selling prices at these times increase by less than the increase in prices paid to farmers-collectors). Transport costs too are significant determinants of price. The establishment of a regional market serviced by an improved transport infrastructure is likely to expand the opportunities for growth in the NTFP economy. If supply to the market can be sustained and regional trade policies harmonised, NTFPs could become a more reliable source of income for farmers, and for the women who trade in them.

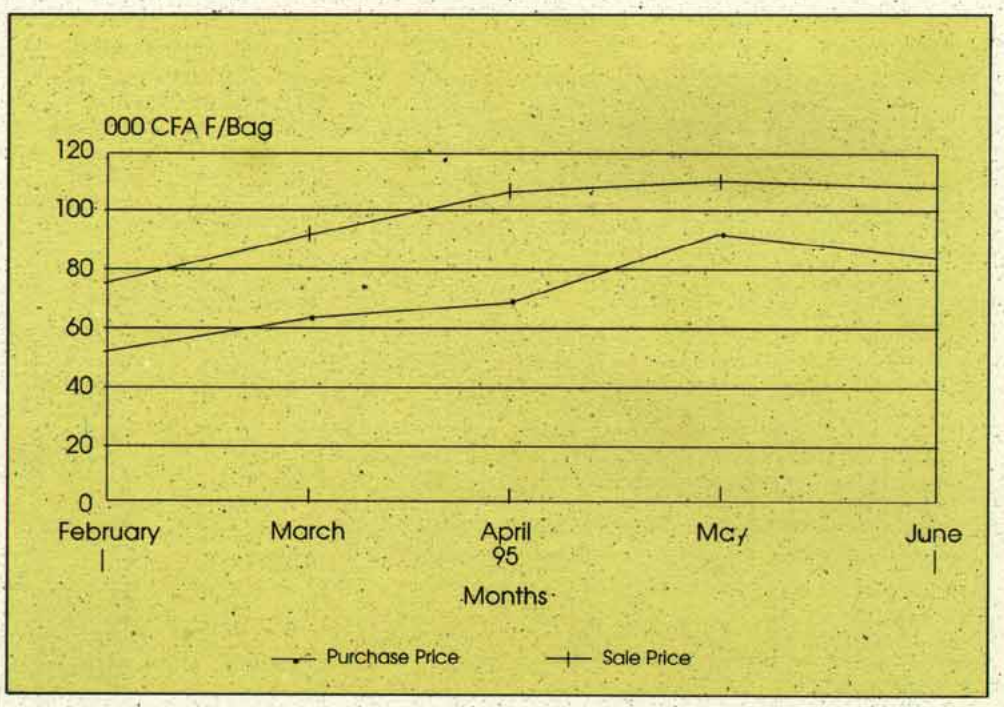



**Figure 1.** Price Variation of *Ricinodendendron* in the Humid Forest Zone

**Sources:** CIFOR NTFP Surveys in Cameroon, 1995

### Opportunities for development

This preliminary research has shown the very significant contribution to incomes and subsistance of rural households in Cameroon, from the production, collection and marketing of NTFPs. Yet, still very little is known about the sources of supply, the marketing chain and final demand for these products.

*Ousseynou Ndoye*

# PLANTATION FORESTRY AND GENETIC RESOURCES

In plantation forestry, the focus has been on the management of trees to maintain or enhance the productivity of forest lands, particularly those which have been degraded or are of inherently low fertility. CIFOR's research aims to identify priority problems which constrain sustainable and productive tree planting and to develop improved technological and incentive options. We emphasise research which will ultimately benefit small-scale forestry enterprises and conservation of forest resources. It is recognised however, that large-scale industrial plantations can create employment, enhance economic growth and thus assist in poverty alleviation.

Industrial forestry has made great progress using monocultures and applying intensive management with high inputs to give high productivity and uniform products. However, they offer limited social and environmental benefits. As large areas of land not subject to tenurial problems become increasingly difficult to locate for large-scale plantations, there is good potential for a more complex model of plantation forestry in which trees are grown in smaller blocks, more integrated with other land uses, with direct involvement of local people and providing a diverse range of products and services. Complex plantation forestry requires an inter-disciplinary approach to define the economic, social and environmental contexts in which it is appropriate, as there are likely to be biophysical, socio-economic and policy constraints to be overcome. CIFOR is using comparative case studies to determine key processes influencing productivity and socio-economic and environmental sustainability. Such an approach could be difficult for a national forestry organisation but in partnership with CIFOR national research organisations become part of a co-ordinated inter-disciplinary effort.

**Socio-economics of Reforestation of Degraded Lands**

*Imperata Grasslands*

A 3-year project in collaboration with scientists in Australia, Indonesia and the Philippines, and with support from ACIAR, *Improving Smallholder Farming Systems in Imperata Areas of South-east Asia* began in February 1995. The research aims to improve productivity of *Imperata* grassland by testing proposed policies and technologies via computer modelling. A bio-economic model was used to analyse the economic feasibility of growing pulpwood trees by smallholders. The necessity and value of *Imperata* control has been demonstrated, least-cost control methods elucidated and the critical period, the first two years, for *Imperata* control was defined. The most significant result is the dramatic value of improved planting material for shading and controlling *Imperata.*

Analyses of the economic value of trees planted for timber and pulpwood on *Imperata* areas in Kalimantan by smallholders assessed resource constraints faced by smallholders and how trees might best be integrated with other smallholder priorities,

*Acacia mangium planting by smallholders is one of the options for using Imperata grassland (John Turnbull)*

*Severely degraded forest land in Jiangxi Province, China (John Turnbull)*

*Farmer participation in tree planting in China is increasing (John Turnbull)*

such as food production. It was found that, under all but the lowest interest rates, trees are likely to be grown with food crops, although not necessarily on the same plot of land. The land-labour ratio was also an important determinant of the potential value of growing trees.

### *Degraded lands in China*

A new activity, *Alternative Socio-economic Approaches to Reclaiming Degraded Lands*, co-ordinated by **Dr John Turnbull**, involves collaboration with the Chinese Academy of Forestry and several other institutions in China. Towards the end of the 1970s, a fundamental change took place in rural areas with the system of collective land management being replaced by a family contract system. While these rapid reforms of land tenure, market access and institutional structures appear to have greatly facilitated reforestation in parts of China (see page 25), a number of problems remain including ambiguous land tenure arrangements, limited incentives for farmer participation, and conflicts between immediate economic gains and long-term social benefits. Developing social forestry and making effective use of forest resources are important in the national programme of poverty relief.

Survey and evaluation of existing rural socio-economic and production systems in selected marginal ecosystems in Yunnan, Guangdong, Hunan and Zhejiang provinces of southern China is under way. The aim is to use an integrated participatory approach to design options for small-scale forest management in the areas. The results of this research will be used with similar studies in other countries to provide insights for countries where there have been serious problems in small-scale plantations or where this form of forestry is in its infancy.

### Diseases of Tropical Acacias

Tropical acacias, native to northern Australia, Papua New Guinea and eastern Indonesia, have attracted a high level of interest for plantation programmes and agro-forestry in the Asia-Pacific region as well as in parts of Africa and Latin America. Acacias are among the most widely planted trees in the humid tropics, being used for protection of degraded lands, in agro-forestry systems, community plantings and in industrial plantations.

Scientists from Australia, Indonesia, Malaysia, Thailand and India have been undertaking a survey of diseases of the tropical acacias, *A. mangium, A. auriculiformis, A. crassicarpa* and *A. aulacocarpa*, which threaten planting programmes in tropical countries. While some of these species are planted extensively, the research strategy set by **Christian Cossalter** has been to focus on provenance and species trials to maximise the range of species-provenance-pathogen combinations.

The highest incidence and variety of diseases have been found in the native stands in northern Australia with *A. crassicarpa* appearing to be more susceptible to foliar pathogens than *A. mangium* or *A. aulacocarpa.* Rust diseases which are common in native stands have not yet been observed in plantations in the countries surveyed. A number of diseases have been found on planted acacias, but with the exception of heart rot, few foliar and stem diseases have been found to have major impacts on tree health.

**Site Management and Productivity in Tropical Forest Plantations**

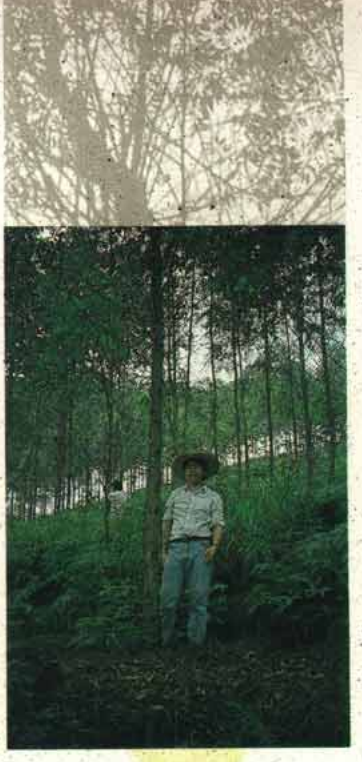
Developing a man-made forest resource that will be biologically and economically sustainable, and socially acceptable, is one of the important challenges that many tropical countries will have to face in the immediate future. Fast-growing species make up a large part of tropical forest plantations. Little is known about the potential capabilities for increasing plantation productivity or potential problems that may limit yields. Some sites cannot support reasonable wood production even with proper management. Many plantations are on soils that are low in nutrients and susceptible to degradation. Often, the land available to forestry is where other land uses have failed. Although plantations can be very productive, they might degrade a site if managed poorly. Good management can increase productivity and maintain or improve soil properties in the long term.

CIFOR has been developing a network of collaborators to conduct co-ordinated research to develop management practices that ensure the trend in plantation productivity is non-declining, or positive, over successive rotations and harvests while maintaining or enhancing the quality of the soil resource base, and with due care for environmental values. Partners from Australia, China, Congo, Indonesia, India and Malaysia met in Kuala Lumpur, Malaysia, in November 1995 to finalise the research protocols.

**Genetic Resources**

*The impact of disturbance on genetic diversity of tropical forest species.*

On undisturbed and associated sites, where local use/extractivism or logging has caused disturbance, the genetic diversity of a suite of species having different life history strategies is being assessed. Losses (or increases) in genetic diversity are related to intensity of different types of disturbance. This task will investigate the socio-economic causes and consequences of forest degradation and fragmentation, and the narrowing of intra-specific genetic diversity. The processes by which genetic diversity may be lost are being investigated through studies co-ordinated by **Dr Tim Boyle** on invertebrates which control key genetic processes. Laboratory protocols have been developed, and sites and species selected in India and Thailand. Initial data on the effects of disturbance on the reproductive biology of two tree species have been obtained in Thailand. At three sites, with different levels of disturbance from fire and logging, the impact



*CIFOR collaborator Dr Xu Daping involved in site management and productivity of tropical plantations in China (John Turnbull)*

of the disturbance on the pollination biology of *Dipterocarpus obtusifolius* was that the flowers are not as effective in attracting pollinators as they are in the undisturbed site, where there are fewer under-storey flowers upon which the butterflies and moths may feed.
This study revealed that in addition to causing the reduction of some plant and animal species, forest disturbance may also cause the long-term decline and eventual elimination of other species including the dominant trees of the forest canopy. *D. obtusifolius* trees in the disturbed site are unlikely to set many fruit due to the decline in numbers of its pollinators which are small insects that are frequently overlooked. Without these insects the largest forest trees cannot survive beyond one or two generations.

In a second study, the impact of fire on the reproductive biology of *Sindora siamensis*, a common legume canopy tree in the deciduous forest in Thailand, was investigated. In this case there was little evidence to suggest that increasing fire frequency has an important impact on reproductive outputs of *S. siamensis*, which may be buffered from indirect effects of fire by having a wide range of pollinators and nitrogen fixing ability.

*The impact of logging and silvicultural treatments on genetic diversity of tree species.*
The impact of selective logging is being investigated by comparing genetic diversity in mature trees and in-breeding rates for embryos and seedlings for three commercial dipterocarp species, in unlogged and logged plots in Central and East Kalimantan, Indonesia. Field trials of seedlings and rooted cuttings, to assess adaptive traits, will also be established. For non-commercial species, genetic diversity in control and poisoned plots will be assessed and compared with growth rates and reproductive biology. Up-scaling of the results to develop management prescriptions at operational scales will be undertaken using GIS.

*Attacus atlas moth (Plinio Sist)*

*Fast-growing plantations of Eucalyptus grandis in Fujian Province, China. Are they sustainable? (John Turnbull)*

# Conservation and Utilisation of Forest Genetic Resources

Effective conservation of tropical forests requires accurate assessment of their current status and ways to monitor changes over time. Levels of biodiversity provide one criterion by which to judge the status of land that has been forested for a considerable time and sustainability of forest management, including logging and extraction of non-timber forest products. Variations in genetic diversity are potentially useful early-warning indicators of changes in biodiversity as a whole. In the hierarchy of biological organisation (Figure 1), genes operate at the smallest scale, but often at the most rapid rate. Changes to ecosystems usually occur over many years, decades, or even centuries. Changes in species composition of ecosystems also commonly occur over a period of years. Species extinction is the final step in a long process of declining stocks and population viability. The addition of species diversity occurs through speciation or, more frequently, through migration. While the arrival of a migrant is an instantaneous event, the establishment of a viable population takes much longer. Changes at the genetic level, however, can be much more rapid.

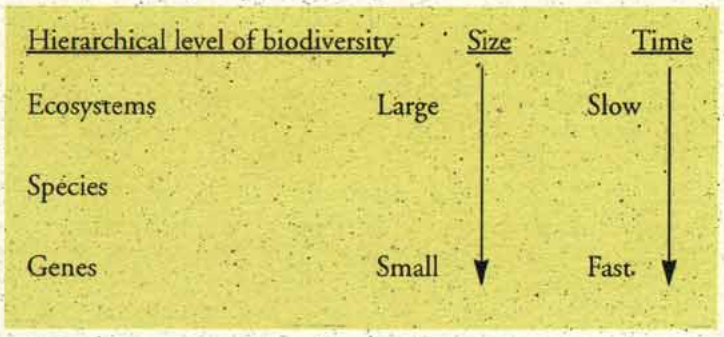
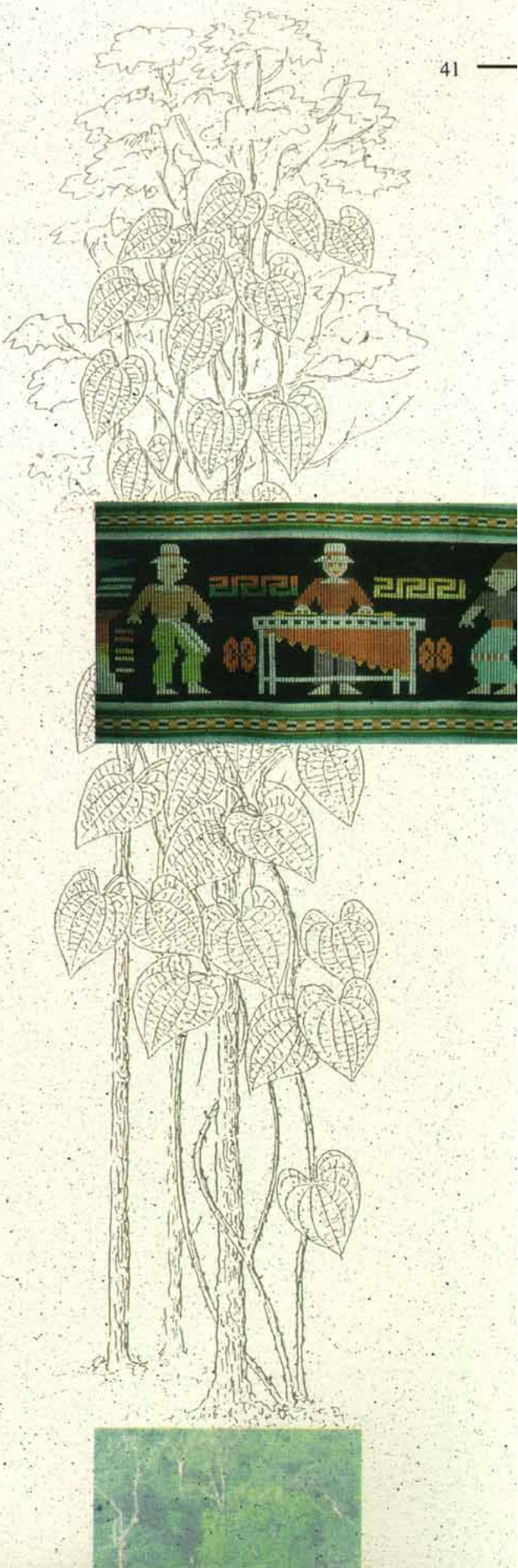



**Figure 1.** Relationship between hierarchical levels of biological organisation and scales of space and time.

It is possible to detect changes at the genetic level very quickly, while less sensitive techniques such as demographic monitoring may not identify biodiversity erosion until much later. Population sizes can be stable or increasing while genetic diversity is declining. Population censuses or monitoring extinctions are therefore very poor methods of assessing loss of biodiversity. The effects are only evident at a very late stage, when most of the damage has already been done. Change may be much simpler and faster to detect by means of genetic diversity assessment. This is particularly true when the forest is not undergoing major modifications caused by widespread clearance over short periods of time.



*Floating home in Chao Sot N.P., southern Thailand (Tim Boyle)*

Thus, research on the conservation of genetic diversity of tropical forest ecosystems can contribute both directly to conservation of genetic resources and to methods for early-warning monitoring of biodiversity changes in managed forests. Genetic resource conservation was the first subject area in the CGIAR system to be organised into a Systemwide Programme, placing CIFOR's work on forest genetic resources in the context of work in other CGIAR Centers, in particular, IPGRI. While the programmes of CIFOR and IPGRI differ in many respects, the two share common goals in the area of *in situ* conservation. To avoid duplication of activities in achieving these aims, CIFOR is taking the regional lead in South-east Asia, and IPGRI in Africa, with both working in Latin America. Links with other CGIAR Centers are also being strengthened through participation in the Inter-Center Working Group on Genetic Resources.

The enormous numbers of species in tropical forests present a great challenge when developing a programme of strategic research on conservation of genetic diversity. Principles governing the conservation of genetic diversity in tropical forests are more likely to be revealed through the study of *processes,* rather than by the monitoring of specific, economically important species. Research is focusing on interaction at two levels: the landscape-scale processes that reduce genetic diversity, especially degradation (disturbance) and deforestation (fragmentation); and the genetic-scale processes such as gene flow, inbreeding and genetic drift. The interaction of processes at both scales will depend on the biological and ecological characteristics of the organisms on which they act. Therefore, studies will include "model" species, not necessarily trees, which represent contrasting ecological approaches (or "life history strategies") to maintaining genetic diversity. For example, model species may include those pollinated by small, less-mobile insects (e.g., thrips), small mobile insects (small bees/wasps), large insects, bats and possibly wind. Model species also exhibit a variety of seed dispersal mechanisms , and are characterised by differences in distribution (widespread versus clumped) and canopy position.

Research on genetic diversity of tropical forests has suffered in the past from a lack of suitable techniques. It is only recently that many of the advanced molecular marker techniques have been applied to tropical forest species. There remains a shortage of well-equipped laboratories and trained scientists in the tropics capable of conducting studies involving such techniques. Similarly, analysis of genetic data is relatively complex, requiring access to computers and specialised software. Both are difficult to procure for many tropical institutions. CIFOR is also conducting research on new, and more readily available tools, such as molecular marker techniques, improved computer programs and GIS, to improve the ability to analyse genetic diversity. Research on tools for measuring genetic diversity provides a link between CIFOR's research efforts on conservation and on utilisation of genetic resources.

CIFOR's research on genetic conservation focuses on the two landscape-scale processes that cause loss of biodiversity, namely forest degradation and deforestation. By forest degradation we mean any "disturbance" resulting from human activities within the forest, including felling of trees, harvesting of non-timber forest products, grazing and burning. Of these, commercial logging is a disturbance that has a high intensity of impact, over broad areas and long time periods (and also high public and political profiles). For these reasons logging receives particular attention in CIFOR studies. Total deforestation is rare, but a landscape containing fragments of the original forest cover in an agricultural, secondary forest or forest plantation matrix may result from disturbance. The impact of fragmentation therefore constitutes another significant research focus.

*Prescribed burn with regenerating cycads, Huay Kha Khaeng, Thailand (Thomas Enters)*

To increase the effectiveness of conservation, we need to understand the impacts of various activities on the biological resource as well as on the livelihoods of local people and industries. Only through multi-disciplinary research can a complete understanding of the relationship between disturbance and genetic diversity be gained. This requires that the response of "model" species, representing different reproductive ecologies and economic uses, be studied over a gradient of different human activities, and that the economic significance of these activities be understood. It should be emphasised that the actual impacts of disturbance will vary from species to species; the consequences will not be felt equally by all species.

Only if the relationship between human use and the resultant impacts on biodiversity is understood can effective conservation strategies be designed. Realistic incentives (financial and otherwise) will need to be provided to forest users in order to promote conservation. CIFOR has initiated projects in Malaysia, Thailand and India to investigate these questions.

*Dipterocarp seedlings from logging concession, upland Jambi (Andy Gillison)*

While our research on genetic variation focuses on the constituent plant species of the ecosystem, the impact of disturbance on insect species which control key ecosystem processes, such as pollination and seed predation, is also being investigated. Preliminary results from study sites in a wildlife sanctuary, in the buffer zone, and outside the buffer zone, clearly show that butterfly pollination activity is drastically reduced on the site outside the buffer zone. This is expected to have severe consequences for the reproductive success of the model species.

The Malaysian research activities will also include a component on disturbance caused by logging. Additional studies in East and Central Kalimantan will investigate both the direct impact of logging on genetic diversity and possible indirect impacts due to increased levels of post-logging inbreeding.

**Development of Tools**

The development of molecular markers, conducted in collaboration with OFI, has included a strong training component, involving three trainees from Brazil, Malaysia and Mexico during 1995. Some of the results obtained with their newly acquired skills have included new information on the taxonomy and phylogeny of Mexican pines, the characterisation of populations of Swietenia, and the assessment of the impact of over-exploitation on populations of *Aquilaria malaccensis*, important in the perfume industry.

*Effects of drought, Senegal (Christian Cossalter)*

A project conducted in partnership with the University of Alberta, Canada, is developing new, user-friendly, Windows-driven computer programs to facilitate the analysis of population genetics data. The package will analyse isozyme, RFLP and RAPD data, and will also calculate population genetic parameters from quantitative data. A first version of this package has been produced and distributed to various laboratories for testing. Preliminary feedback indicates that this will be a significant contribution to tools available for analysing genetic diversity. The final product is due to be produced by August 1996, followed by a training programme.

The utility of physiological testing as an aid to early selection and matching of provenances to site is being tested on drought tolerance of *Pterocarpus macrocarpus*, an important tree legume in Thailand. The physiological responses of seedlings to various intensities of artificially induced drought stress in the nursery have been assessed, and the material has now been out-planted for testing under field conditions. Preliminary results from the nursery test indicate that variation in photosynthesis, transpiration, water use efficiency and water potential were not significantly different among the eight provenances, though several were apparently well-adapted to drought.

The research already undertaken by CIFOR on conservation of forest genetic resources provides some initial indications of how genetic diversity changes under the influence of disturbance. As more studies are added on habitat fragmentation and the improved analytical techniques arising from CIFOR's research are applied, a more comprehensive model of the effects of human activities on genetic diversity of tropical forests will emerge.

*Tim Boyle*

# RESEARCH SUPPORT SERVICES



CIFOR's research activities receive general scientific and logistical support in three broad areas: training and capacity building; publication services (including the library and document delivery service); and information services (including computing services, GIS laboratory, database management, and electronic networking). Our ability to provide such support was strengthened by the appointment of a Statistician, a Computer Systems specialist, a Systems Modeller and an Impact Assessment specialist early in the year.

**Training and Capacity Building**

CIFOR co-hosted with FORSPA (FAO's Forestry Research and Support Programme for Asia and the Pacific) and AFRD (Indonesia's Agency for Forestry Research and Development) a meeting of heads of forestry research institutions of the Asia-Pacific region in Bogor in February. At that meeting, the Asia-Pacific Association of Forestry Research Institutions (APAFRI) was formed, with Dr Suree Bhumiphamon as its first President.

In July 1995; CIFOR organised an intensive two-week Training Workshop for Forestry Editors, with financial support from USAID and staff support from the US Forest Service. Fourteen forestry editors from developing countries came to Bogor to participate. A Forestry Editors' network was initiated as a direct outcome of the interaction between regional editors at this workshop.

Two further training courses were held for librarians and information officers in the use of TREE-CD, in collaboration with CAB International, in Bogor and in Pretoria, South Africa, with financial support from the ODA (UK).

**Publication Services**

*CIFOR News* continues to be the chief vehicle for communication of information about CIFOR's activities world-wide. Four issues were completed in 1995 and the list of recipients has expanded greatly (now in excess of 4000). Translation into French and Spanish has meant that CIFOR can reach a broad range of interested individuals and institutions. CIRAD-Fôret and IICA assist with translation and distribution of the French and Spanish versions respectively.

The *Occasional Papers* and *Working Papers* series have provided a forum for CIFOR staff and collaborators to circulate their work for discussion and further development. During 1995, three additional papers in each series were published and over 500 copies of each of the *Occasional Papers* have been distributed.

*Fruits of Dillenia suffruticosa (Francis Ng)*

CIFOR published the first in its *Monograph Series* in August. The volume *Measuring and Monitoring Biodiversity in Tropical and Temperate Forests* contained the proceedings of a symposium sponsored by CIFOR, IUFRO and the Royal Forest Department of Thailand and was edited by Tim Boyle and Boonchoob Boontawee.

Other publications produced during the year included the *1994 Annual Report* (also in Bahasa Indonesia) and two special papers arising from the "Bali Dialogue" organised by CIFOR in December 1994. A second printing of *Forest Research: A Way Forward to Sustainable Development* and *A Vision for Forest Science in the Twenty-first Century* was necessary to meet demand.

Work was started on CIFOR's first multi-media CD. The pilot project chosen was FRIM's *Malayan Forest Record No 34: Manual of Forest Fruits Seeds and Seedlings.* This two-volume, 1,000-page book containing hundreds of photographs, line drawings, text and tables was considered ideal for re-organising and publishing as a multi-media CD.

**Information and other Support Services**

CIFOR's entry into the Internet was established through the IPTekNET towards the end of the year. This enabled CIFOR to create its World Wide Web home page for disseminating information electronically. It is planned to make CIFOR News and other publications available through this media. In the first 4 months of operation, over 5,000 people accessed the home page.

A photo library was begun with 100 colour slides representing the work of CIFOR world-wide.

The GIS library was expanded with a number of newly digitised maps. These included a vegetation map of Central Sumatra, to which was added information on soil and geology. Other maps have been produced to support specific CIFOR research projects in different regions.

The LAN was expanded to meet the growing needs of staff, and the backup and archiving system was strengthened to provide better security for data.

Services in biometrics, research assessment and systems modelling were added to the range of services in support of CIFOR's research programmes. One of the major accomplishments of the research-assessment and capacity-building efforts has been in southern Africa, financially supported by ODA (see page 47).

# Developing Forestry Research Capacity in the SADC Region



The Southern African Development Community (SADC) is an economic grouping of the eastern and southern African countries of South Africa, Namibia, Angola, Botswana, Lesotho, Swaziland, Mauritius, Mozambique, Malawi, Zimbabwe, Zambia and Tanzania. All have significant and varied forest resources, but differ widely in their abilities to develop and manage these resources. Forestry research institutions in the SADC face problems in developing their capacity for research and technology transfer which could be powerful tools for achieving sustainable management of forests.

Despite elaborate regional arrangements, institutions suffer because of the vulnerability of agricultural research systems typical of small countries (see Gilbert *et al.* 1994 on West Africa). The obstacles faced include lack of critical mass, limited resources and an unfocussed research agenda. Many forestry research institutions are small, under-staffed and lack financial and other resources to implement research plans. Research has been largely unco-ordinated, at both national and regional levels, thus precluding effective application of resources and results. In an effort to overcome these problems, the Forestry Sector Technical Coordination Unit (SADC-FSTCU) and the Southern African Centre for Cooperation in Agricultural and Natural Resources Research and Training (SACCAR) collaborate in matters of forestry research for sustainable resource management in the region (SADC-FSTCU, 1992). SACCAR has the specific task of co-ordinating regional research in natural resource utilisation and conservation, and establishment of mechanisms for integrated research in all disciplines related to food, agriculture and natural resources (SADC, 1992).

*Forest Research Institute, Malawi (Christian Cossalter)*

With the exception of South Africa, institutions in the other SADC countries have for many years been supported by donors, and therefore partly insulated from adverse economic conditions. With declining resources, these institutions are being forced to re-examine their survival strategies for research and development. One possible avenue is through collaborative research with organisations both within the region and internationally. In an initiative to develop such co-operation, CIFOR and the Division of Science and Technology (FORESTEK) of the Council for Scientific and Industrial Research (CSIR) of South Africa have conducted a study on the capacity for forestry research in the region. The overall objective is to evaluate research capacity which supports forest and woodland resource management, with emphasis on institutions' capabilities to address both resource and socio-economic issues.

In the study, forestry research capacity of SADC forestry research institutions was compared to that of other research institutions in countries at a similar level of economic development. This technique is similar to that adopted by Bengston *et al.* (1988) in the Asia-Pacific region. Capacity is

related to established norms, which can provide information on a wide range of capacities, but does not determine optimum or absolute levels of capacity. Senior research managers were surveyed by questionnaire and/or interview about institutional organisation, resources and interactions with internal and external environments. Indicators were used to provide measures of such relationships. At this level of the study it is possible to identify the relative strengths and weaknesses of each institution using institutional profiles which simultaneously combine all parameters. A wide range of evaluation criteria have been constructed from indicators supplied in the survey questionnaire.

Country profiles were prepared by aggregation of institutional information, which will indicate the relative position of the various research capacity elements, as well as comparative advantages of the various countries/institutions in terms of available research capacity. A regional leadership role can be adopted by institutions/countries in those research areas in which they have a comparative strength. Another key outcome from the study will be to indicate appropriate strategies for the development of research capacity in the region. Co-ordination of research and resource sharing are other means of promoting regional approaches to mutual research problems.

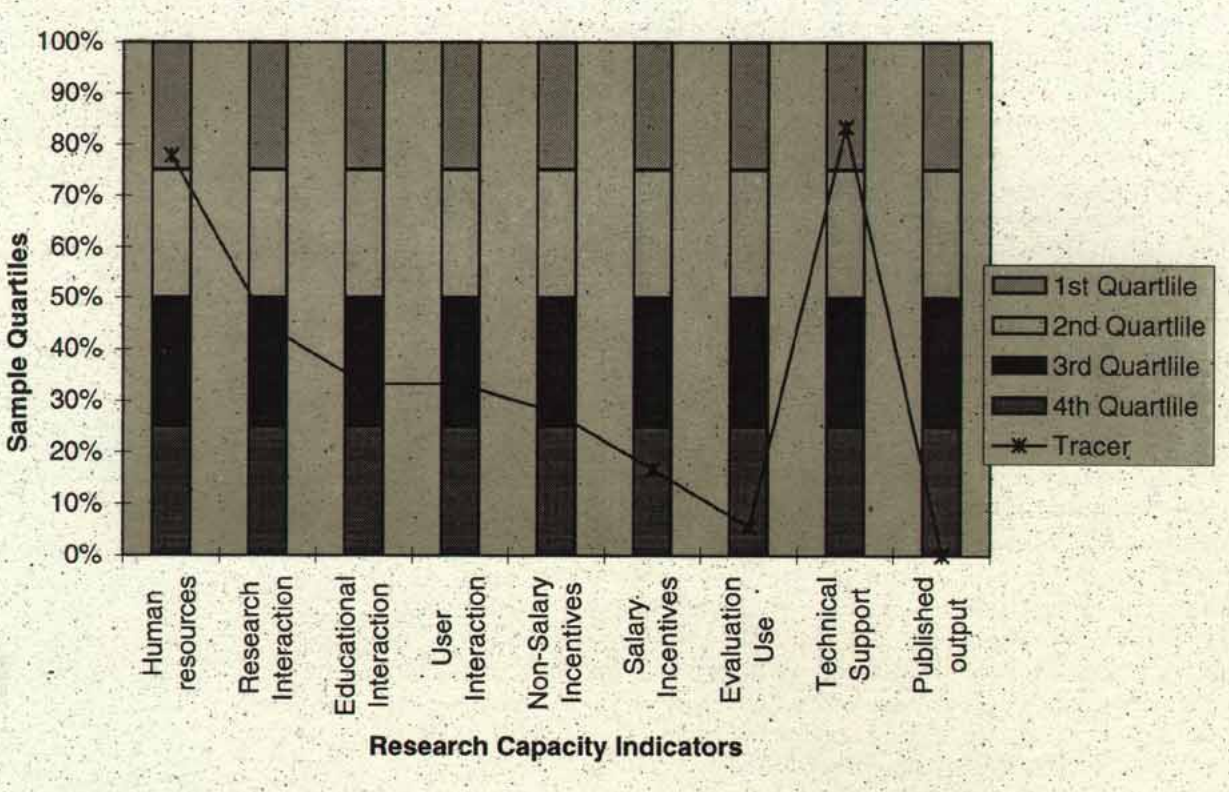



**Figure 1.** Example of a research capacity 'profile' for a research institution.

Various research cap[acity indicators are presented along the x-axis, whilst the y axis defines quartiles for the study sample. The points show the ranking of the Institute for indicator within the sample. Since the indicators are sets of independent observations, the line merely aids visual location of the data points.



In the accompanying figure, various research capacity indicators are presented along the x-axis, whilst the y-axis defines quartiles for the study sample. The points show the ranking of the institute for the indicator within the sample. Since the indicators are sets of independent observations, the line merely aids visual location of the data points.

A regional workshop with the following specific objectives will be convened to discuss and develop options for improvement in the deployment of forestry research capacity:

- to consider the potential of the forest sector in the eastern and southern African region;
- to review and evaluate the outcomes of the CIFOR/CSIR and other studies on forestry research capacity in the region;
- to develop a forward view on necessary capacity in forestry research in the region, including the appropriate institutional arrangements for such capacity; and
- to lay out the options for improved forest research capacity and in so doing give guidance to national and international institutions in this respect.

**Benefits to the SADC region**

It is expected that the results of the study together with the deliberations of the workshop will help the region in:

- mobilising present skills and information through improved institutional arrangements in forestry research;
- aligning research and technology transfer with current and anticipated future needs, and ensuring that institutions remain responsive;
- improving the mutually reinforcing dimensions of the relationships between national and international institutions;
- improving the flow of information and skills throughout the region; and
- finding models for sustainable forestry research and development institutions in the region.

*Researcher in Tropenbos research site, south-west Cameroon (Carol Colfer)*

**References**

Bengston D.N., H.M. Gregersen, A.L. Lundgren and L.S. Hamilton. 1988. *Forestry Research Capacity in the Asia Pacific Region.* Occasional Papers of the East West Environment and Policy Institute. Paper No. 6.

Gilbert, E., P. Matlon and P. Eyzaguire 1994. New perspectives for vulnerable institutions: agricultural research systems in the small countries of west Africa. Briefing Paper No.14. ISNAR.

SADC 1992. *Regional Policy and Strategy for Food, Agriculture and Natural Resources.* SADC.

SADC-FSTCU 1992. *Forestry Research Plan for the SADC Region.* SADC Project AAA.5.23. FSCTU, Lilongwe.



## BUILDING RESEARCH CAPACITY

A university chemistry professor in a developing country once complained to his chancellor:

> The resources of the laboratory have been too small from the beginning. I was given four bare walls instead of a laboratory; and despite my solicitations, nobody thought of a definite sum for its outfitting (and) for the purchase of supplies. I needed instruments and (chemical) preparations and was obliged to use 300-400 florins per year of my meagre salary for the purchase of preparations; I have needed, in addition to the attendant paid by the state, an assistant, who costs me 320 fl; if you subtract these two expenditures from my stipend (800 fl) not much remains to clothe my children. (Quoted by William H. Brock, 1992. *The Fontana History of Chemistry.* Fontana Press, London).

The scientist was Justus von Liebig, of the University of Giessen, and the developing country was Germany in the year 1833. Liebig complained a lot, but he also personally contributed enormously to the uplifting of science in his country. His work on chemical fertilisers became the starting point of modern agricultural science. Almost single-handedly, he established Germany as a world power in chemistry, by creating resources, attracting resources and building a capacity that lasted beyond his own lifetime.

The central issue in capacity building is identifying such "champions" to invest in. Experience has shown that capacity cannot be sustained without champions. Training funds have produced PhDs who benefit personally but do not provide scientific leadership in their countries. Research grants have produced results too weak to publish. Travel grants have been used for thinly disguised holidays. Equipment has been left to rot. Capacity built at high cost has collapsed as soon as donor support tapered off.

True champions lead by personal example and are willing to make sacrifices in support of a cause. They get results in spite of difficulties. They deserve support. One of the great rewards in international development work is to discover such champions, and to see a small amount of development aid go a long way in producing worthwhile results. When this happens, it makes up for the frustration of investments gone wrong.

*Francis S.P. Ng*

# STATEMENT OF FINANCIAL POSITION

AS AT 31 DECEMBER 1994 AND 1995
(US $000)

| | 1995 | 1994 |
|---|---|---|
| **ASSETS** | | |
| **Current Assets** | | |
| Cash on hand and in banks | 7,361 | 6,594 |
| Accounts receivable: | | |
| Donors | 961 | 628 |
| Employees | 112 | 71 |
| Others | 304 | 192 |
| Prepaid expenses | 387 | 427 |
| Funds in trust | 21 | – |
| Total current assets | 9,146 | 7,912 |
| **Fixed Assets** | | |
| Property, plant and equipment | 1,257 | 1,100 |
| Less: Accumulated depreciation | 469 | 229 |
| Total fixed assets - net | 788 | 871 |
| **TOTAL ASSETS** | 9,934 | 8,783 |
| **LIABILITIES AND NET ASSETS** | | |
| **Current Liabilities** | | |
| Accounts payable: | | |
| Donors | 779 | 954 |
| Others | 42 | 28 |
| Accruals and provisions | 1,418 | 655 |
| Total current liabilities | 2,239 | 1,637 |
| **Net Assets** | | |
| Capital invested in fixed assets | 788 | 871 |
| Capital fund | 2,215 | 2,132 |
| Operating fund | 4,692 | 4,143 |
| Total net assets | 7,695 | 7,146 |
| **TOTAL LIABILITIES AND NET ASSETS** | 9,934 | 8,783 |

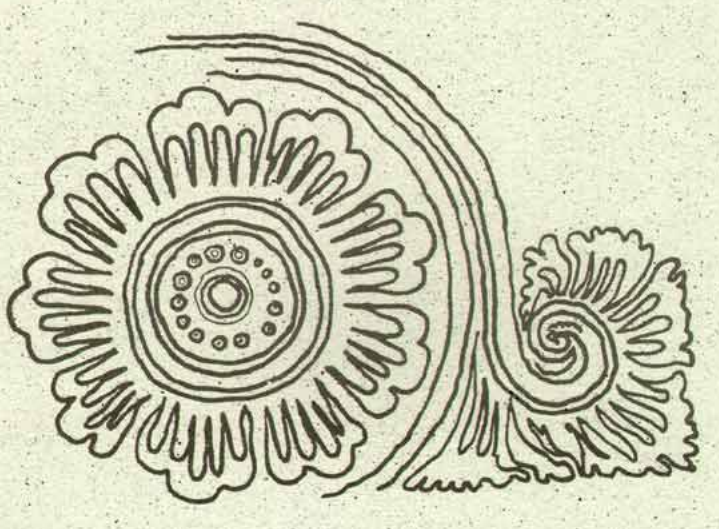
# STATEMENT OF ACTIVITIES AND OPERATING FUND

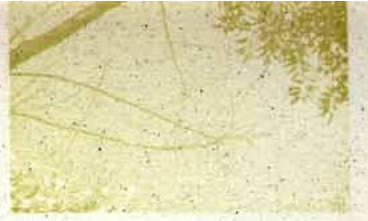
FOR THE YEARS ENDED 31 DECEMBER 1994 AND 1995

(US $ 000)



| | 1995 | | | | 1994 |
|---|---|---|---|---|---|
| | Core | | | | |
| | Unrestricted | Restricted | Complementary | Total | Total |
| **Revenue** | | | | | |
| Grants | 7,300 | 439 | 1,283 | 9,022 | 6,078 |
| Other revenues | 369 | – | – | 369 | 88 |
| Total revenue | 7,699 | 439 | 1,283 | 9,391 | 6,166 |
| **Operating expenses** | | | | | |
| Research programmes | 3,486 | 439 | 712 | 4,637 | 2,317 |
| Research support | 1,447 | – | 571 | 2,018 | 1,024 |
| General administration | 2,187 | – | – | 2,187 | 1,474 |
| Total operating expenses | 7,120 | 439 | 1,283 | 8,842 | 4,815 |
| **Excess of revenue over expenditure** | 549 | – | – | 549 | 1,351 |
| **Operating fund - beginning** | 4,143 | – | – | 4,143 | 2,792 |
| Excess of revenue over expenditure | 549 | – | – | 549 | 1,351 |
| **Operating fund - ending** | 4,692 | – | – | 4,692 | 4,143 |
| **MEMO ITEM** | | | | | |
| Operating expenses – by natural classification: | | | | | |
| Personnel costs | 3,459 | – | 265 | 3,724 | 1,904 |
| Supplies and services | 2,819 | 399 | 943 | 4,161 | 2,049 |
| Operational travel | 530 | 40 | 75 | 645 | 640 |
| Depreciation of fixed assets | 312 | – | – | 312 | 222 |
| **Total operating expenses** | 7,120 | 439 | 1,283 | 8,842 | 4,815 |





# SCHEDULE OF GRANT REVENUE

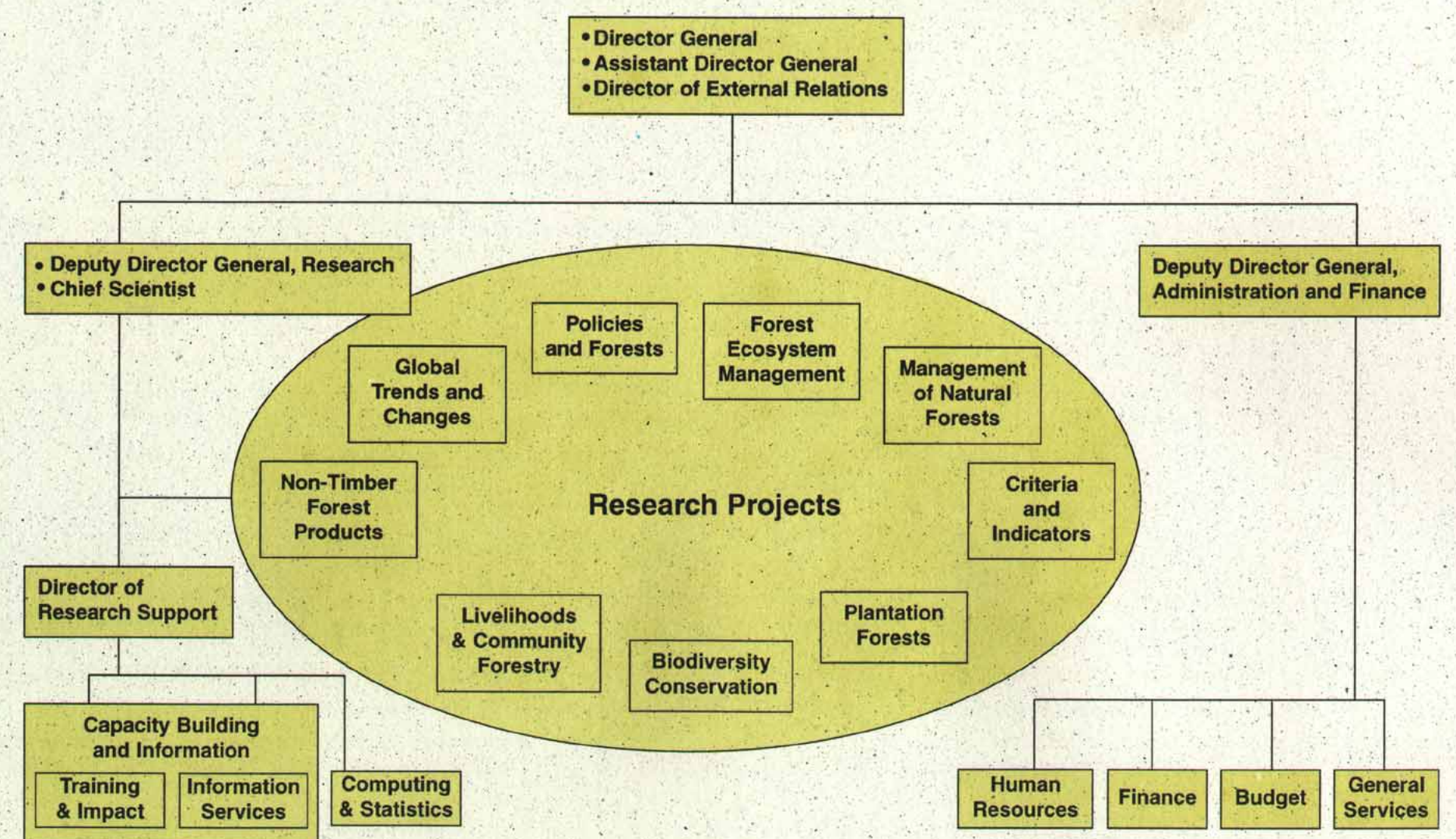
FOR THE YEARS ENDED 31 DECEMBER 1994 AND 1995
(US $ 000)



| Donors | 1995 | 1994 |
|---|---|---|
| **Core Unrestricted** | | |
| Australia | 336 | 309 |
| Austria | 80 | 70 |
| Canada | 245 | 217 |
| European Union | 323 | 303 |
| Finland | 421 | 206 |
| France | 104 | 76 |
| Germany | 349 | 183 |
| Indonesia * | 75 | 75 |
| Japan | 1,635 | 1,822 |
| Netherlands | 617 | 589 |
| Norway | 222 | 191 |
| Spain | 25 | 25 |
| Sweden | 191 | 177 |
| Switzerland | 257 | 168 |
| USAID | 350 | 250 |
| World Bank | 2,070 | 1,106 |
| Sub total | 7,300 | 5,767 |
| **Core Restricted** | | |
| Australian Centre for International Agricultural Research | 49 | – |
| Overseas Development Administration (UK) | 137 | 5 |
| UN EnvironmentProgramme | 253 | 25 |
| Sub total | 439 | 30 |
| **Total Core** | 7,739 | 5,797 |
| **Complementary** | | |
| BMZ/GTZ (Germany) | 285 | 65 |
| European Union | 404 | – |
| Ford Foundation | 21 | – |
| United States Department of Agriculture/Forest Service | 43 | – |
| Japan | 1 | – |
| Netherlands | 0 | – |
| Overseas Development Administration (UK) | 529 | 216 |
| Sub-total | 1,283 | 281 |
| **Total Grants** | 9,022 | 6,078 |

* Additional to the above grants received, Indonesia directly funded construction of CIFOR's new Headquarters building at Darmaga, Bogor.

# CIFOR Organization Chart



# CIFOR STAFF 1995*

| | |
|---|---|
| **Director General's Office** | |
| Jeffrey A. Sayer (UK) | Director General |
| Soli Prijono | Executive Officer |
| Ninta Karina Bangun | Personal Assistant |
| Bambang Soekartiko | Director, External Relations |
| Indah Susilanasari | Secretary |
| **Finance and Administration** | |
| Norman Macdonald (Canada) | Director |
| Henny Saragih | Executive Assistant |
| Hudayanti | Receptionist |
| Robert Bourquein (USA) | Consultant, Headquarters Development |
| Marielle Paiement (Canada) | Human Resources Officer |
| Tania Hendjan-Langitan | Human Resources Assistant |
| Lia Octari Wan | Travel/Conference Coordinator |
| Susan Kabiling (Philippines) | Budget Officer |
| Betty Ramli | Finance Manager |
| Edward Martin | Accountant |
| Nur Kambaruddin | Cashier |
| Imas Kurniati | Accounts Clerk |
| Henny Linawati | Accounts Clerk |
| Elfy Joelijarty | Accounts Clerk |
| Ramsey Omar | Administration Manager |
| Murniati Sono | Administrative Assistant |
| Ismed Mahmud | Administrative Assistant |
| Kustiani Suharsono | Administrative Support |
| **Policy and Social Sciences** | |
| Neil Byron (Australia) | Director |
| Manuel Ruiz-Pérez (Spain) | Principal Scientist |
| David Kaimowitz (USA) | Principal Scientist |
| Lini Wollenberg (USA) | Senior Scientist |
| William Sunderlin (USA) | Senior Scientist |
| Godwin Kowero (Tanzania) | Senior Scientist |
| Wil de Jong (Netherlands) | Senior Scientist |
| Ousseynou Ndoye (Senegal) | Scientist (IITAH) |
| Thomas Enters (Germany) | Research Fellow |
| Lay Cheng Tan (Malaysia) | Research Assistant |
| Ani Septiani Nawir | Research Assistant |
| Ambar Liano | Secretary |
| Lucya Yamin | Secretary |

* Indonesian unless otherwise specified

*Orchid, Singapore Botanical Garden (Plinio Sist)*

**Natural Forest Ecology and Management**

| | |
|---|---|
| Dennis Dykstra (USA) | Director |
| Andrew Gillison (Australia) | Principal Scientist |
| César Sabogal (Peru) | Senior Scientist, Silviculture |
| Ravindra Prabhu (India) | Scientist, Sustainability Assessment |
| Manuel Guariguata (Venezuela) | Research Fellow (Unidad de Manejo de Bosques Naturales, Costa Rica) |
| Nining Liswanti | Research Assistant |
| Sri Rita Mustikasari | IUFRO Liaison Officer |
| Nani Herawati | Secretary |
| Patricia Radjiman | Division Assistant |

**Plantation Forestry and Genetic Resources**

| | |
|---|---|
| John Turnbull (Australia) | Director |
| Christian Cossalter (France) | Principal Scientist |
| Timothy Boyle (Canada) | Principal Scientist |
| Rosita Go | Secretary |

**Research Associates**

| | |
|---|---|
| Louise Buck (USA) | Senior Associate (CIIFAD) |
| Bruce Campbell (Zimbabwe) | Senior Associate (U. of Zimbabwe) |
| Alex S. Moad (USA) | Senior Associate (USDA Forest Service) |
| Francis E. Putz (USA) | Senior Associate (U. of Florida) |
| Allan Tiarks (USA) | Senior Associate (USDA Forest Service) |
| Virgilio M.VIANA (Brazil) | Senior Associate (U. of Sao Paulo) |

**Research Support**

| | |
|---|---|
| Francis Ng (Malaysia) | Director |
| Jerome Vanclay (Australia) | Senior Scientist, Systems Modeller |
| Michael Spilsbury (UK) | Scientist, Impact Assesment |
| Michael Ibach (Germany) | Information Scientist |
| Venkateswarlu Perugupalli (India) | Statistics And Computer Science |
| Yvonne Byron (Australia) | Editor |
| Steve Lee (UK) | Network Administrator |
| Hindra Irawan | Computer Systems Specialist |
| Atie Puntodewo | GIS Specialist |
| Yuni Soeripto | Librarian |
| Dina A. Satrio | Information Services Assistant |
| Rahayu Koesnadi | Secretary |
| Cut Fathiah Gathom | Secretary |

| Office Support | Other | Motor Pool |
|---|---|---|
| Ukat Sanusi | Endang Kosasih | Didi Maruddin |
| Pendi | Ani Tentrem | Uken Sukender |
| Supandi | Tina Turtinawati | Tonny Syafei |
| Atang Sanjaya | Ali Bin Maud | Suratman |
| | Siti Nadhiroh | Tatang Hasan |
| | Komar | Ata Sukanta |
| | Suhendar | Iie Suwarna |

# APPENDIX 1: CIFOR 1995 PUBLICATIONS



**Monographs**

T.J. Boyle and Boonchoob Boontawee (editors) Measuring and Monitoring Biodiversity in Tropical and Temperate Forests. CIFOR Monograph No. 1.

**Occasional Papers**

No. 4, March: J.A. Sayer. Science and International Nature Conservation (Inaugural lecture for the Prince Benhard Chair at the University of Utrecht, The Netherlands).
No. 5, April: C.T.S. Nair, T. Enters and B. Payne. Barriers to the Application of Forestry Research Results: A Report of an International Workshop.
No. 6, October: Shen Zhaobang. Production and Standards for Chemical Non-Wood Forest Products in China.

**Working Papers**

No. 6, January: Manuel Ruiz-Pérez. A Conceptual Framework for CIFOR's Research on Non-Wood Forest Products
No. 7, October: Colfer, C.J. Pierce. Who Counts in Sustainable Forest Management?
No. 8, October: Colfer, C.J. Pierce. (with Ravi Prabhu and Eva Wollenberg) Principles, Criteria and Indicators: Applying Ockham's Razor to the People-Forestry Link.

**CIFOR News** (in English, French and Spanish) Numbers 6 (March); 7 (July), 8 (September), 9 (December).

**Other Publications**

Annual Report 1994 (in English and Bahasa Indonesia)
Forest Research: A Way Forward to Sustainable Development
A Vision for Forest Science in the Twenty-first Century
Strategic Plan (drafts) (August and October)

*Montane forest, 2200 metres, Gunung Tujuh, Kerinci, Sumatra (Alain Compost)*

# APPENDIX 2: PUBLICATIONS BY CIFOR STAFF, 1995 *



**Books, Chapters and Refereed Journal Articles**


**Boyle, T.J.B.** and B. Boontawee (eds). *Measuring and Monitoring Biodiversity in Tropical and Temperate Forests.* CIFOR, Bogor, Indonesia.

**Boyle, T.J.B.** and **J.A. Sayer**. Measuring , monitoring and conserving biodiversity in managed tropical forests. *Commonwealth Forestry Review* 74: 20-25.

*__Buck, L.E.__ Agroforestry policy issues and research directions in the US and less developed countries: insights and challenges from recent experience. *Agroforestry Systems* 30: 57-73. (Special issue on Agroforestry Science, Policy and Practice.)

*Brookfield, H., L. Potter and **Y. Byron**. *In Place of the Forest: Environmental and Socio-economic Transformation in Borneo and the Eastern Malay Peninsula.* UNU Press, Tokyo.

**Colfer, C.J. Pierce**. Beyond slash and burn: a searching look at Uma' Jalan forest knowledge. *In* Kusnaka Admihardja, Ade M. Kramadibrata, Oekan S. Abdullah, and Haryo S. Martodirdjo (eds.), *Adaptation and Development.* UPT Indonesian Resource Centre for Indigenous Knowledge, Padjadjaran University, Bandung, Indonesia, pp. 116-168.

**Dykstra, D.P.** and R.Heinrich. *FAO Model Code of Forest Harvesting Practice.* Food and Agriculture Organization of the United Nations, Rome, Italy. Publication V5855.

**Enters, T.** The economics of land degradation and resource conservation in Northern Thailand: challenging the assumptions. In J. Rigg (ed.), *Counting the Costs: Economic Growth and Environmental Change in Thailand.* ISEAS Environment and Development Series. Institute of Southeast Asian Studies, Singapore, pp. 90-110.

**Guariguata, M. R.**, R. Rheingans and F. Montagnini. Early woody invasion under tree plantations in Costa Rica: implications for forest restoration. *Restoration Ecology* 3(4): 252-260.

Holbrook, N.M. and **F.E. Putz**. Physiology of tropical vines and hemiepiphytes: plants that climb up and plants that climb down. *In* S. Mulkey, P.L. Chazdon and A.P. Smith (eds), *Tropical Plant Ecophysiology.* Chapman and Hall, New York, pp. 363-393.

*__Kaimowitz, D.__ La transferencia de tecnologia para promover un desarrollo sostenible de la agricultura. *In* R. Radulovich (ed.), *Los Elementos para el Cambio.* Escuela Agricola Panamericana, Zamorano, pp. 15-26.

*Kvist, L.P., M. Andersen, M. Hesselsøe and **J.K. Vanclay** Estimating use-values and relative importance of Amazonian flood plain trees and forests to local inhabitants. *Commonwealth Forestry Review* 74: 293-300.

Liengsiri, C., F.C.H. Yeh and **T.J.B. Boyle**. Isozyme analysis of a tropical forest tree, *Pterocarpus macrocarpus* Kurz. in Thailand. *Forest Ecology and Management* 74: 13-22.

Pinard, M.A., **F.E. Putz**, J. Tay and T.E. Sullivan. Creating timber harvest guidelines for a reduced-impact logging project in Malaysia. *Journal of Forestry* 93: 41-45.

*Potter, L., H Brookfield and **Y. Byron**. The eastern Sundaland region of South-East Asia. *In* J.X. Kasperson, R.E. Kasperson and B.L. Turner II (eds), *Regions at Risk: Comparisons of Threatened Environments.* UNU Press, Tokyo, pp. 460-518.

*__Putz, F.E.__ Relay ascension of big trees by vines in Rock Creek Park, District of Columbia. *Castanea* 60: 175-178.

**Putz, F.E.** Vines in treetops: consequences of mechanical dependence. *In* M.D. Lowman and N. Nadkarni (eds), *Forest Canopies.* Academic Press, Orlando, Florida, pp. 311-323.

**Putz, F.E.** and M.A. Pinard. La contribucion de los investigadores botanicos a la mejora del manejo forestal en Bolivia. *Boletin BOLFOR* 5: 9-10.

*__Putz, F.E.__, G.B. Romano and N.M. Holbrook. Phenology of epiphytic and tree-phase strangler figs in a Venezuelan palm savanna. *Biotropica* 27: 183-189.

**Sayer J.A.**, P.A. Zuidema and Meta H. Rijks. Managing for biodiversity in humid tropical forests. *Commonwealth Forestry Review* 74: 282-287.

*Silva, J.N.M., J.O.P. de Carvalho, J. do C.A. Lopes, B.F. de Almeida, D.H.M. Costa, L.C. de Oliveira, **J.K. Vanclay** and J.P. Skovsgaard. Growth and yield of a tropical rainforest in the Brazilian Amazon 13 years after logging. *Forest Ecology and Management* 71: 267-274.

Soares P., M. Tome, J.P. Skovsgaard and **J.K. Vanclay**. Evaluating a growth model for forest management using continuous forest inventory data. *Forest Ecology and Management* 71: 251-265.

*__Sunderlin, W.D.__ Global environmental change, sociology, and paradigm isolation. *Global Environmental Change* 5: 211-220.

**Sunderlin, W.D.** Managerialism and the conceptual limits of sustainable development. *Society and Natural Resources* 8: 481-492.

*__Sunderlin, W.D.__ Resource decline and adaptation through time: fishers in San Miguel Bay, Philippines. *Ocean and Coastal Management* 25: 217-232.

*Tan, W.-X., T.J. Blake and **T.J.B. Boyle**. Early selection for drought tolerance and relationships to dry weight partitioning in black spruce families. *Forest Science* 41: 168-180.

*Usoltsev, V.A. and **J.K. Vanclay**. Stand biomass dynamics of pine plantations and natural forests on dry steppe in Kazakhstan. *Scandinavian Journal of Forest Research* 10: 305-312.

**Vanclay, J.K.** Growth models for tropical forests: a synthesis of models and methods. *Forest Science* 41: 1-42.

**Vanclay, J.K.** Operator bias with optical wedges in point sampling. *Commonwealth Forestry Review* 74: 158.

*__Vanclay, J.K.__ Sustainable silvicultural systems: lessons from Queensland, Australia. *In Ø.* Sandbukt (ed.), *Management of Tropical Forests: Towards an Integrated Perspective.* Occasional Papers from SUM No. 1/95. Centre for Development and the Environment, University of Oslo, pp. 169-181.

*__Vanclay, J.K.__, J.P. Skovsgaard and C. Pilegaard Hansen Assessing the quality of permanent sample plot databases for growth modelling in forest plantations. *Forest Ecology and Management* 71: 177-186.


**Proceedings**


**Dykstra, D.P.** Technology and the practice of forestry. Keynote presentation. In L. Bren and C. Greenwood (eds), *Proceedings, Institute of Foresters of Australia 16th Biennial Conference.* Institute of Foresters of Australia, Canberra, pp. 3-8.

**Ibach, M.**, Electronic publishing of forestry information for developing countries. In A. Kempf and V. Brown (eds), *Forestry Information and Knowledge Exchange.* Proceedings of IUFRO Subject Group S6.03-00 Information Systems and Terminology, held at the XX IUFRO World Congress, 6-12 August 1995, Tampere, Finland. Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), Birmensdorf, pp. 43-49.

*__Kaimowitz, D.__ The end of the hamburger connection? Livestock and deforestation in Central America in the 1980s and 1990s. In H. Cortes-Salas, R. de Camino and A. Contreras (eds), *Readings of the Workshop on Government Policy Reform for Forestry Conservation and Development in Latin America.* Inter-american Institute for Cooperation in Agriculture, San Jose, pp. 155-176.

**Kowero, G.S.** Forestry development planning: the case of Mozambique. In D.G. Brand (ed.),. *Forestry Sector Planning: Proceedings of a Meeting held 18-22 September 1994 in Anchorage, Alaska.* Canadian Forest Service/Food and Agriculture Organization of the United Nations, Ottawa, Canada, pp. 192-205.

Päivinen, R. and **J.K. Vanclay**. Proceedings of the *Sessions S4.02 and S4.12 of the IUFRO XX World Congress, Tampere, August 1995.* IUFRO/CIFOR/EFI, Joensuu, Finland.

Scherr, S., **L. Buck** and R. Meinzen-Dick. *Proceedings of a Workshop on Policies for Local Organizations in Natural Resources Management: Toward an Interdisciplinary Research Agenda,* IFPRI and CIFOR. Washington, DC.


* Based on work completed before joining CIFOR

Skovsgaard, J.P., V.K. Johannsen and **J.K. Vanclay**. Laser dendrometers in forestry: tools or toys? In L. Bren and C. Greenwood (eds), *Applications of New Technologies in Forestry*. Proceedings of the Institute of Foresters of Australia Conference, Ballarat, Australia, 18-21 April 1995. Institute of Foresters of Australia, Canberra, Australia, pp. 289-298.

**Vanclay, J.K.** Growth models for complex tropical forests: design, construction and extrapolation. In Y. Konohira (ed.), *Growth and Yield of Tropical Forests*. Proceedings of IUFRO Symposium, 26 Sept-1 Oct. 1994, Tokyo University Of Agriculture and Technology, Fuchu, Japan, pp. 10-18

**Vanclay, J.K.** Introduction to forest yield forecasting. *In Yield Forecasting*. Seminar organised by FAO, CEC-DG VI Agriculture, CEC-JRC Ispra and CEC-Eurostat, 24-27 Oct 1994, Villefranche sur Mer, France. CESD Communautaire, Senningerberg, Luxembourg, pp. 401-408.

**Vanclay, J.K.** Modelling land use patterns at the forest edge: feasibility of a static spatial model. *In: Ecological Economics Conference*, Coffs Harbour NSW 19-23 November 1995. CARE, UNE, Armidale, pp. 79-84.

**Vanclay, J.K.** Modelling to explore land use patterns at the forest edge: objectives and model design. In P. Binning, H. Bridgman and B. Williams (eds), *Proceedings, International Congress on Modelling and Simulation (MODSIM'95)*, 27-30 November, University of Newcastle, NSW, pp. 1:113-116.

***Vanclay, J.K.** A simple density-dependent growth model implemented as a spreadsheet. *In* Y. Konohira (ed.), *Growth and Yield of Tropical Forests*. Proceedings of IUFRO Symposium, 26 Sept-1 Oct. 1994, Tokyo University Of Agriculture and Technology, Fuchu, Japan, pp. 98-109.

***Vanclay, J.K.**, J.P. Skovsgaard and G.Z. Gertner (eds.) *Growth and Yield Estimation from Successive Forest Inventories*. Selected papers from an IUFRO Conference in Copenhagen, 14-17 June 1993. Special issue of *Forest Ecology and Management* 71: 171-276.

**Other Publications**

**Byron, R.N.** CIFOR's policy research. *ITTO Tropical Forest Update* 5(4): 13.

**Byron, R.N.** Rehabilitating Imperata grasslands. Report of an International Workshop on Agroforestry Innovation on Imperata Grasslands. Banjarmasin, South Kalimantan, Indonesia. January 1995. *ITTO Tropical Forest Update* 5(2):24-25.

**Byron, R.N.** Tree farming by small farmers on degraded lands in Central Vietnam. *Forestry Chronicle* 71(2): 183.

***Kaimowitz, D.** Livestock and deforestation in Central America in the 1980s and 1990s: A policy perspective. EPDT Discussion Paper #9. IFPRI, Washington D.C.

***Kvist, L.P., S. Gram and **J.K. Vanclay**. Estimating the importance of Amazonian flood plain forests for Peruvian flood plain inhabitants (Abstract only). In E. Korpilahti, T. Salonen and S. Oja (eds.), *Caring for the Forest: Research in a Changing World*. Abstracts of Invited Papers at IUFRO XX World Congress 6-12 August 1995, Tampere, Finland, pp. 67-68.

Skovsgaard, J.P., **J.K. Vanclay** and O. García. An overview of approaches to evaluating forest growth models (Abstract only). *In* E. Korpilahti, T. Salonen and S. Oja (eds), *Caring for the Forest: Research in a Changing World*. Abstracts of Invited Papers at IUFRO XX World Congress 6-12 August 1995, Tampere, Finland, p. 293.

**Turnbull, J.T.** CIFOR's research on reforestation. *ITTO Tropical Forest Update* 5(1): 12.

**Vanclay, J.K.** Minimum data requirements for sustainable forest management. *IUFRO News* 24(1):11-13.

***Vanclay, J.K.** E. Williams and A.C. Matheson, 1994. *Experimental Design and Analysis for Use in Tree Improvement*. CSIRO, Melbourne. 174 pp. ACIAR News, March 1995.



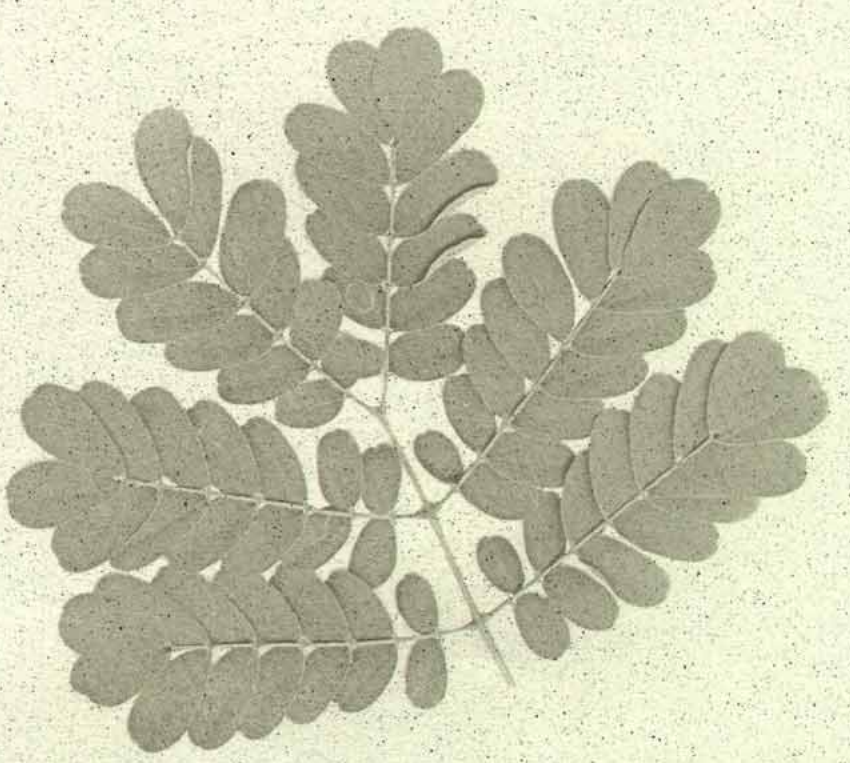
# APPENDIX 3: CIFOR BOARD OF TRUSTEES, 1995



Professor Bo Bengtsson (Sweden), Swedish University of Agricultural Sciences, Uppsala, Sweden (Chairman).

Dr. Yves Birot (France), Institut National de la Recherche Agronomique, Department of Forestry Research, Avignon, France (Vice-chairman).

Dr Suree Bhumibhamon (Thailand), Kasetsart University, Faculty of Forestry, Bangkok, Thailand.
Mr Alan Brown (Australia), Commonwealth Scientific and Industrial Research Organization, Division of Forestry, Canberra, Australia.
Dr Ronnie de Camino Velozo (Chile), Precious Woods, San José, Costa Rica.
Dr Stanley Heckadon Moreno (Panama), Smithsonian Tropical Research Institute, Balboa, Panama.
Professor Yoriko Meguro (Japan), University of Sophia, Tokyo, Japan.
Dr Jeff Odera (Kenya), Kenya Forest Research Institute, Nairobi, Kenya.
Professor Dianne Rocheleau (USA), Clark University, Worcester, USA
Professor Jeffrey Sayer (UK), Center for International Forestry Research, Bogor, Indonesia.
Mr El Hadji Sène (Senegal), Foood and Agriculture Organization, Rome, Italy.
Dr Toga Silitonga (Indonesia), Agency for Forestry Research and Development, Jakarta, Indonesia (Host Country Representative).
Dr David B. Thorud, University of Washington, Seattle, USA (Chairman, ICRAF Board of Trustees)
Dr Cornelis Baron van Tuyll van Serooskerken (Netherlands), GTZ Deutsche Gesellschaft für Technische Zusammenarbeit, Forest Resources Management and Conservation of Nature, Frankfurt, Germany.



# APPENDIX 4: ABBREVIATIONS AND ACRONYMS

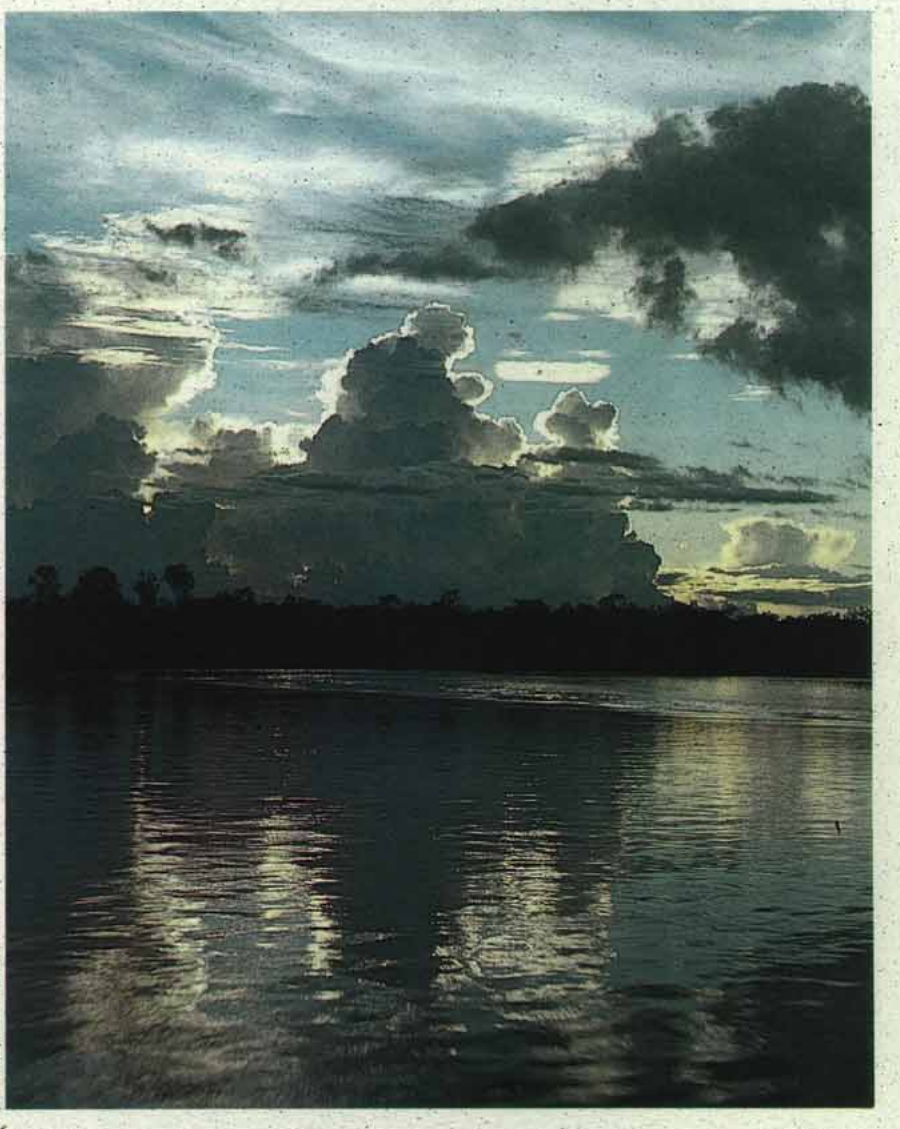


| | |
|---|---|
| ACIAR | Australian Centre for International Agricultural Research, Australia |
| AFRD | Agency for Forestry Research and Development, Indonesia |
| APAFRI | Asia-Pacific Association of Forestry Research Institutes |
| ARA | Agreed Research Agenda |
| ASB | Alternatives to Slash and Burn |
| BIOTROP | SEAMEO Regional Centre for Tropical Biology, Indonesia |
| BMZ | Bundesministerium für Wirtschaftliche Zusammenarbeit, Federal Republic of Germany |
| CAB International | Centre for Agriculture and Bioscience International, UK |
| CAF | Chinese Academy of Forestry, People's Republic of China |
| CARE | Cooperative for American Relief Everywhere, USA |
| CATIE | Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica |
| CD-ROM | compact disk - read only memory |
| CFA F | CFA Franc; unit of currency used in certain African states (US$1 ≅ 506 CFA Francs) |
| CGIAR | Consultative Group on International Agricultural Research, Washington DC, USA |
| CIAT | Centro Internacional de Agricultura Tropical, Colombia |
| CIFOR | Center for International Forestry Research, Indonesia |
| CIRAD | Centre de Coopération International en Recherche Agronomique pour le Développement, France |
| CIRAD-Forêt | Forestry division of CIRAD |
| CSD | Commission on Sustainable Development |
| CSIR | Council for Scientific and Industrial Research, South Africa |
| DDB | Deskundigenwerkgroep Duurzaam Bosbeheer, Netherlands |
| EU | European Union |
| FAO | Food and Agriculture Organization of the United Nations, Rome, Italy |
| FEM | Forest Ecosystem Management |
| FORESTEK | Division of Science and Technology of CSIR, South Africa |
| FORSPA | Forestry Research Support Programme for Asia and the Pacific, Thailand |
| FRIM | Forestry Research Institute Malaysia |
| FSC | Forest Stewardship Council, USA |
| FUNTAC | Fundaçao de Tecnológia do Acre, Brazil |
| GIS | geographic information system |
| GTZ | Deutsche Gesellschaft für Technische Zusammenarbeit, Federal Republic of Germany |
| ICRAF | International Centre for Research in Agroforestry, Nairobi |
| IDRC | International Development Research Centre, Canada |
| IICA | Instituto Interamericano de Cooperación para la Agricultura, Costa Rica |
| IITA | International Institute for Tropical Agriculture, Nigeria |
| IPF | Inter-governmental Panel on Forests |
| IPGRI | International Plant Genetic Resources Institute, Italy |
| ITTO | International Tropical Timber Organization |
| ITW | Initiative Tropenwald, Germany |
| IUCN | The World Conservation Union (formerly the International Union for Conservation of Nature and Natural Resources), Switzerland |
| IUFRO | International Union of Forest Research Organizations, Austria |
| LAN | local area network |
| LEI | Lembaga Ekolabel Indonesia, Indonesia |
| NARS | National Agricultural Research Service/System(s) |
| NGO | non-governmental organisation |
| NTFP | non-timber forest product |
| ODA | Overseas Development Administration, UK |
| OFI | Oxford Forestry Institute, UK |

Plinio Sist

| | |
|---|---|
| PATN | a software package for exploratory data analysis |
| PHPA | Perlindungan Hutan dan Pelestarian Alam, Forest Protection and Forest Conservation, Ministry of Forestry, Indonesia |
| RAPD | random amplified polymorphic DNA |
| RFLP | restriction fragment length polymorphism |
| SACCAR | Southern African Centre for Cooperation in Agricultural and Natural Resources Research and Training |
| SADC | Southern Africa Development Community, Malawi |
| SADC-FSTCU | Forestry Sector Technical Coordination Unit of SADC |
| SEAMEO | South East Asian Ministers of Education Organization, Thailand |
| TREE-CD | Forestry on CD-ROM – Abstracts |
| UNCED | United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, 1-12 June 1992 |
| UNDP | United Nations Development Programme, New York, USA |
| UNEP | United Nations Environment Programme, Kenya |
| UNEP GRID | UNEP Global Resource Information Database |
| UNESCO | United Nations Educational, Scientific and Cultural Organization, France |
| USAID | United States Agency for International Development |
| WCMC | World Conservation Monitoring Centre (IUCN), UK |
| WWF-I | Worldwide Fund for Nature – Indonesia |





Christian Cossalter

# CGIAR

## The CGIAR System

The Consultative Group on International Agricultural Research (CGIAR) is an informal association of public and private sector donors that supports a network of sixteen international agricultural research institutes, CIFOR being the newest of these centres. The Group was established in 1971. The CGIAR Centers are part of a global agricultural research system which endeavour to apply international scientific capacity to solution of the problems of the world's disadvantaged people.

## The CGIAR Mission

Through international research and related activities, and in partnership with national research systems, to contribute to sustainable improvements in the productivity of agriculture, forestry, and fisheries in developing countries in ways that enhance nutrition and sell-being, especially among low-income people.

Acknowledgements

Text edited by Yvonne Byron

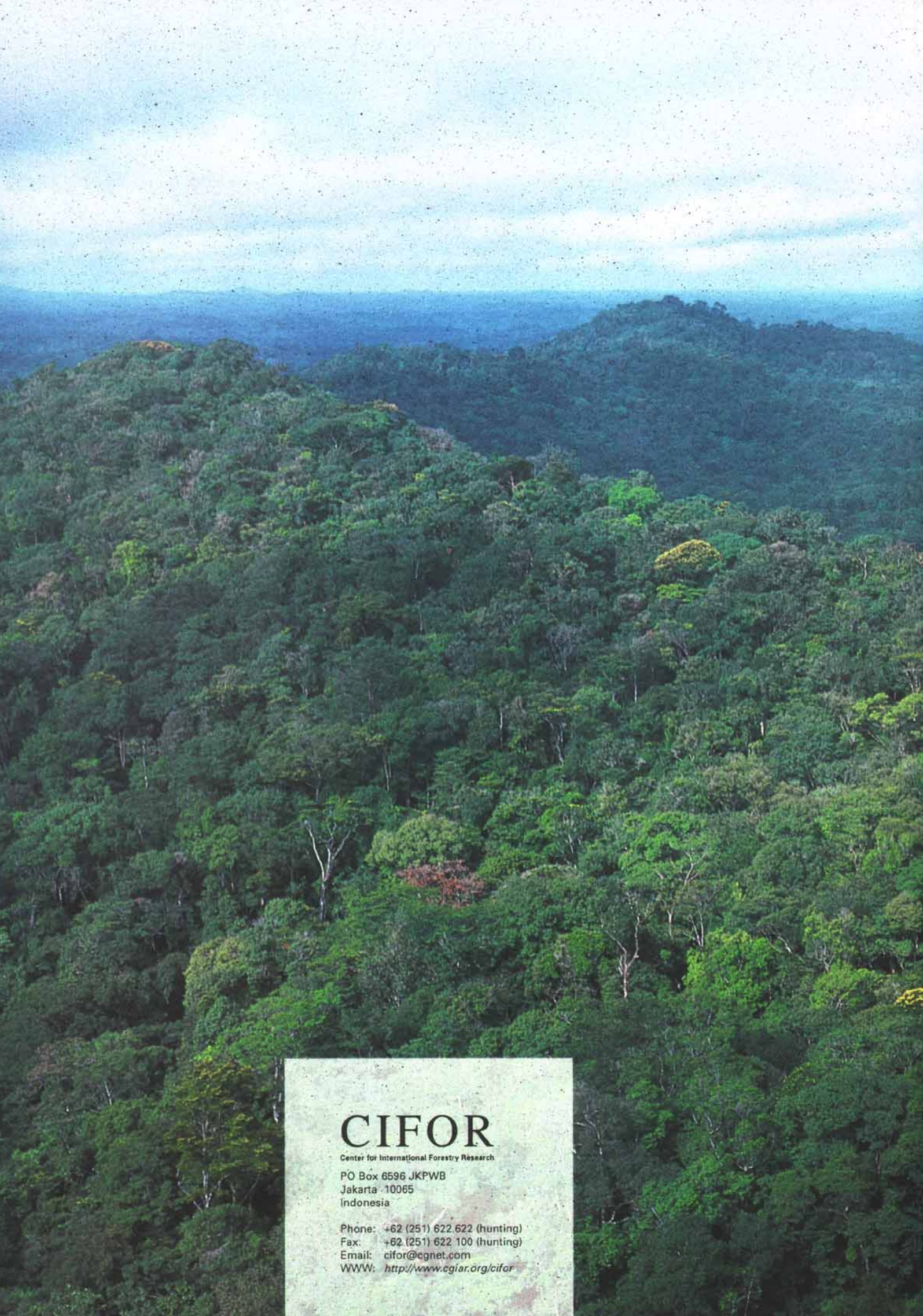
Design by Patrick Virolle,
Reflet Artwork for Business
Switzerland

Printed by SMT Grafika Desa
Putera, Indonesia

Cover photos:
*Background* - French Guyana
(WWF/Fred Hoogervorst)
*Inset* - Kayapo Indian, Amazonia, Brazil
(WWF/Mauri Rautkari)

Illustrations by Iskak Syamsudin,
Evi Sopian and Baby Ahnan

Printed on recycled paper




# CIFOR

**Center for International Forestry Research**

PO Box 6596 JKPWB
Jakarta 10065
Indonesia

Phone: +62 (251) 622 622 (hunting)
Fax: +62 (251) 622 100 (hunting)
Email: cifor@cgnet.com
WWW: *http://www.cgiar.org/cifor*