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Royal Academy
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The Man and Biosphere
Programme

TROPICAL FORESTS IN A CHANGING GLOBAL CONTEXT

Guest Editor: Morgan De Dapper

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THE MAN AND BIOSPHERE
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International Symposium

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Brussels, 8-9 November, 2004

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CONTENTS

Foreword 5

Official Opening

D. DE LAME. — Welcome 9
W. ERDELEN. — Address 11
J. P. KOYO. — L'aménagement durable des forêts tropicales face à la multiplicité des fonctions attendues des arbres et des écosystèmes forestiers. Le cas du Bassin du Congo 19
P. METTENS. — Contribution of Belgian Science to the Tropical Forests 39

State of the Art in the Continents Concerned

J.-L. DOUCET. — African Rain Forests: Evolution and Threats . . . 45
R. PURI & D. DONOVAN. — Asia's Tropical Forests in a Changing Global Context: Can Expert-led Policy-making Cope with Change? . 61
M. PAOLETTI. — Biodiversity Management and Loss of Traditional Knowledge in the Largest Forest of the Amazon. Examples from Amazonas, Venezuela and Ecuador 93

Governance

S. MANKOTO & M. MALDAGUE. — Stratégie systémique appliquée à la gestion de la biodiversité. Cas de la Réserve de biosphère de Luki (RDC) 115
J.-C. NGUINGUIRI. — Gouvernance des aires protégées dans le Bassin du Congo: principes et pratiques 127
P. LIMAN. — Development of Conservation Areas. An Effort towards Biological Diversity Conservation in Indonesia 139
P. BIGOMBE LOGO *et al.* — Forest Management Decentralization in Cameroon. Which Impact on Local Development? 149
M. KHAN. — Governance in the Forestry Sector in the North-West Frontier Province, Pakistan. Managing Forests — Is Deterioration Inexorable? 175

T. TREFON & S. COGELS. — A Stakeholder Approach to Natural Resource Management in Peri-urban Central Africa 197

Commercial Exploitation

J.-J. LANDROT. — The Problem of Sustainable Forestry Management in Humid Tropical Forests. The African Example 225
L. MATHOT & J.-L. DOUCET. — Wildlife Surveys in Rain Forest Concessions in order to Identify Protected Areas 241

Local Exploitation

L. ARAGON. — Building Regional Capacity for Sustainable Use of Tropical Rainforest in Latin America: Experience and Challenges of the South-South Cooperation 257
C. VERMEULEN & J.-L. DOUCET. — Conservation and Sustainable Use of Non-Timber Forest Products in Favour of Local Communities within Integrated Forest Management in Central Africa 267
J. C. MONSEMBULA *et al.* — Gestion de la faune sauvage et commerce du gibier en Afrique centrale 281
H. BEECKMAN *et al.* — Knowledge Generation on Tropical Forest Products: a Model from Nepal 293
A. CISSE *et al.* — Systèmes de croyances Niominka et gestion des ressources naturelles de mangrove 307
A. VERHEYDEN *et al.* — Potential of High-resolution Wood Anatomy and Stable Isotope Measurements for Tropical Dendrochronology: a Case Study on a Kenyan Mangrove Tree Species 333

Round Table

M. DE DAPPER. — Tropical Forests in a Changing Global Context. Round Table Conclusions 349

Foreword

This volume brings together the papers presented at the International Symposium "Tropical Forests in a Changing Global Context" which took place at the Palais des Académies in Brussels in November 2004.

The present publication is in the continuation of the proceedings of three workshops and of a common session of the three Sections of the Academy "Tropical Forests. A State of the Art at the Turn of the Century" which came out in 2004 (under the editorship of Prof. Dr M. De Dapper).

We are most grateful to UNESCO for its highly appreciated collaboration in the framework of the Memorandum of Understanding. We particularly thank Dr S. Mankoto for his valuable organizational support.

We express our sincere thanks towards the Belgian Federal Science Policy Office for the sponsoring.

We are indebted to the speakers, many of whom originating from overseas, for their important contribution.

Prof. Dr Yola VERHASSELT
Permanent Secretary
Royal Academy
of Overseas Sciences

Official Opening

International Symposium
Tropical Forests in a Changing Global Context
Royal Academy of Overseas Sciences
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pp. 9-10.

Welcome

by

Danielle DE LAME*

It is a great privilege for me to welcome you at the International Symposium "Tropical Forests in a Changing Global Context", jointly organized by UNESCO and the Royal Academy of Overseas Sciences.

This two-day colloquium is the third materialization of the Memorandum of Understanding that was signed between UNESCO and our Academy in 1994. The first joint activity was a two-day seminar on "Science and Development: Prospects for the 21st Century", which took place in December 1998. The proceedings were published in 1999. In 2001, a second international conference was held jointly with UNESCO on "Science and Tradition: Roots and Wings for Development", the proceedings of which came out in 2002.

The recent awarding of the Nobel Prize for Peace to Professor Wangari Mathai from Kenya has highlighted a global concern for forest conservation. This awarding is also an incentive to personal entrepreneurship in the South, and especially to endeavours meant to promote solidarity in the pursuit of common good at a global level.

As a prelude to the present symposium, the Commission "Environment and Development" (chaired by Prof. Morgan De Dapper) of the Academy had organized three workshops whose main purpose was to emphasize different aspects of the state of the art of the tropical forests: the first workshop's topic was "Monitoring the Evolution of the Tropical Forest Area" (27 May 2002), the second one dealt with "Sustainable Management of the Tropical Forest" (17 September 2002), and the third one focused on "Tropical Forest and Industrial Society" (19 March 2003).

Being conscious of the increasingly deteriorating situation of tropical forests worldwide, and that most of them are located in developing countries,

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the Royal Academy of Overseas Sciences and UNESCO have decided to restore the weakened public concern for the fate of tropical forests. This is the main purpose of the present symposium during which the following themes will be highlighted: Governance, Commercial Exploitation, Local Exploitation.

We are particularly pleased to see so many scholars from overseas present at this symposium.

On behalf of the Academy, I would like to express my gratitude towards UNESCO for the co-organization and sponsoring and towards the Belgian Federal Science Policy Office for the financial support.

International Symposium
Tropical Forests in a Changing Global Context
Royal Academy of Overseas Sciences
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Address*

by

Walter ERDELEN**

Madam Chairperson, Excellencies, Ladies and Gentlemen,

I regret that I cannot participate in this important meeting to deliver this message in the context of the official opening of the International Symposium on "Tropical Forests in a Changing Global Context", jointly organized by the Royal Academy of Overseas Sciences and UNESCO, with the financial support of the Belgian Federal Science Policy Office. I have however requested my colleague Samy Mankoto, whom you know very well, to deliver this message on my behalf.

1. Introduction

In fact, history is repeating itself: it has been three years, in the scope of the Memorandum of Understanding which was signed on 15 December 1994 between UNESCO and the Royal Academy of Overseas Sciences, since I had the pleasure to return to Brussels for the International Conference on "Science and Tradition: Roots and Wings for Development" in 2001, where I gave a speech for the opening session, in the name of my organization, just like today. But before then, it was the Director-General of UNESCO who led the UNESCO delegation at the International Symposium on "Science and Development: Prospects for the 21st Century" in 1998 and was one of the keynote speakers at this scientific meeting.

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Conscious of the rapidly deteriorating situation of the tropical forests worldwide, most of which are situated in developing countries, the Royal Academy of Overseas Sciences and UNESCO's Man and the Biosphere Programme have decided to jointly reanimate the weakened public concern for the fate of tropical forests by organizing an International Symposium on "Tropical Forests in a Changing Global Context". I have taken note that this two-day meeting will emphasize the following themes: governance (conservation, biodiversity and the ecosystem approach); commercial exploitation (sustainable management, logging, mining activities, plantations) and local exploitation (traditional use of tropical forests and forest products, the role of indigenous knowledge, etc.) of tropical forests.

2. State and Development of Tropical Forests. Some Figures

The attention of the international community on the state of tropical forests was once more mobilized at the time of the XII World Forestry Congress organized by FAO in Quebec, Canada, in September 2003. The general theme of this Congress was "Forests, Source of Life", a gathering of more then 4,000 participants from all over the world. UNESCO had an active role in this important meeting through its Man and the Biosphere (MAB) Programme.

If there is a consensus with regard to tropical forests, it is the alarming situation in which they are found. Recent studies based on satellite images (MAYAUX *et al.* 2004) for monitoring tropical deforestation are alarming. During the period of 1990-1997, a considerable reduction of natural forests, dense and open, was observed. The annual deforestation in the humid tropics is estimated at 58,000 km^2 (5.8 million hectares). Added to this, each year there were 23,000 km^2 of forests in a state of significant degradation (fragmentation, very intensive logging and bushfires) representing a total of 81,000 km^2 of forest disappearing or degrading strongly.

Southeast Asia is where forests are most threatened; the rate of deforestation is about 0.9 % per year; for Latin America the rate is estimated at 0.37 %; annual deforestation is more serious in West Africa (2.1 %) than in Central Africa (0.6 %) (UICN 1996). On a global scale, the humid forest area, logged and burned each year was estimated in 1993 at about 110,000 km^2. The causes of the destruction and degradation of tropical forests continue unabated. Direct causes, such as extensive agriculture, are often associated with forest exploitation and road construction, firewood

and charcoal fabrication, forest fires, plantation expansion, urbanization, mining and industrial impact, etc. Indirect causes related to socio-economic conditions are a primary factor and include: unsatisfactory living conditions — the local populations who must resort to the use of forest resources in order to ensure their essential needs — and the loss of traditional knowledge, together with the issue of illiteracy, have a great impact on the degradation of natural resources.

Before this situation, all authors were in agreement that the disappearance of tropical forests constitutes a global catastrophe. Its consequences will be dramatic for populations who live in tropical regions, which is to say, millions of people.

3. UNESCO Activities in the Area of Conservation and Sustainable Use of Tropical Forests

3.1. Man and the Biosphere (MAB) and the World Network of Biosphere Reserves

UNESCO launched the Man and the Biosphere Programme in 1970 in order to highlight the necessity of understanding the interrelations between man and the other elements of the biosphere, in an interdisciplinary fashion. Since its creation, the MAB Programme has had special interest in the question of sustainable management of forests, and in particular tropical forests. In fact, the very first projects adopted by the MAB International Coordinating Council were related to the following:

— "Ecological effects of increasing human activities in tropical and subtropical forests ecosystems": MAB project no. 1;
— "Ecological effects of different land uses and management practices on temperate and Mediterranean forest landscapes": MAB project no. 2.

With the launching of the biosphere reserve concept and the development of the World Network of Biosphere Reserves, which includes 459 sites in 97 countries, the international community benefits from a tool through which innovative approaches to biodiversity conservation can be tested in real life conditions, and environmental conservation can result from an alliance between local populations and their natural surroundings. The basic model has not changed since its creation in the early 1970s, but has been adapted to and been transformed in response to new demands, notably the reinforcement of the role of biosphere reserves in land management schemes, sustainable

development experimentation, local population participation in biosphere reserve management, conflict resolution, and benefit sharing between the various stakeholders involved (*cf.* Objective no. 6 of the Minsk Action Plan, 1984; Main Objective no. II of Seville Strategy and Article 4 of the Statutory Framework of the World Network of Biosphere Reserves).

For example, the role of biosphere reserves as "regional laboratories or pilot and demonstration sites" is well illustrated through the project: "The Mananara-Nord Biosphere Reserve in Madagascar — a Challenge for Conservation and Integrated Development". In 1996 the government of Madagascar, inspired by the development experience in the scope of the UNESCO/MAB track during 15 years in the Mananara-Nord Biosphere Reserve — a project financed by PNUD, Germany, the European Commission and the Netherlands — voted into law (law 96-025) a system called GELOSE (Local Security Management), signed between the State, the municipalities and the rural communities, on the principle of land property mediation. The globalization of a network of such local experiences, particularly in Africa where there is often conflict between customary rights and modern legislations with regard to land tenure, could lead to conservation of nature associated with cultural diversity and social development. The potential for progress is enormous, but it must be said that we are a long way from successfully developing an "enabling institutional environment", necessary in overall change for conservation.

Today, the global network counts many biosphere reserves that include tropical forest ecosystems in the world (*e.g.* the Mata Atlântica in Brazil, 30 million hectares). More and more, member states are interested in transboundary biosphere reserves. I had pleasure in inaugurating the very first transboundary biosphere reserve in Africa: the "W" Transboundary Biosphere Reserve, created between Benin, Burkina Faso and Niger; it was in the village Kanaré, situated a few kilometres from Niamey, in the presence of Ministers from the three countries, representatives from the ECOPAS regional project, the European Union and many administrative and local authorities. The MAB Secretariat has received requests to assist in the creation of transboundary biosphere reserves in other regions. Among these requests, the one recently received from Central Africa was submitted by the governments of the Republic of Congo, the Democratic Republic of the Congo and Angola in the Mayombe forest region. This is seen as an opportunity to reinforce collaborative efforts between UNESCO and the countries in the subregion, especially in the framework of the RAPAC (*Réseau des Aires Protégées d'Afrique Centrale*), NEPAD and CBFP (Congo Basin Forest Partnership).

3.2. Convention concerning the Protection of the World Cultural and Natural Heritage

This Convention adopted in 1972 by the General Conference of UNESCO aims to protect the natural and cultural heritage which it considers as having outstanding universal value. Today there are approximately 788 sites of which 611 cultural, 154 natural and 23 mixed established in 134 state parties. The Salonga National Park is the biggest of the natural world heritage sites with 3,600,000 hectares.

Within the framework of this Convention, UNESCO has launched a new regional project "CAWHFI" (Central Africa World Heritage Forest Initiative) funded by UNF (United Nations Foundation), FFEM (*Fonds Français pour l'Environnement Mondial*), FAO, the European Union and several other partners, such as WWF, WCS, CI and Jane Goodall Institute.

3.3. Capacity Building and Training

Interest in biodiversity depends partly on education received at the primary level as well as in higher education training. The best way to understand ecosystems as complex as tropical forests is to apply the holistic approach. To this effect UNESCO launched in 1999 a pluridisciplinary training project, which is now considered as a regional flagship MAB project: ERAIFT (Regional post-graduate Training School on Integrated Management of Tropical Forests and lands).

ERAIFT was the concrete realization of special recommendations of the N'Sele regional seminar on "African tropical forests — a heritage in urgent need of protection" sponsored by UNESCO/MAB and ACCT (which is now International Organization of Francophone Countries) in cooperation with the Democratic Republic of the Congo (Kinshasa, N'Sele, 18-23 March 1991). ERAIFT responds to the need of training a new generation of African specialists and decision-makers *in situ*, capable of applying the ecosystem approach and of combining the most advanced data in the fields of ecology, economy and the new technologies to achieve the Millennium Development Goals (MDGs), in particular MDG 1 (eradication of poverty) and MDG 7 (environmental sustainability). So far over 40 African students have graduated from the ERAIFT School. I take the opportunity to thank the government of Belgium and the European Commission for their substantial support to ERAIFT. UNESCO is planning to launch a network to link ERAIFT with other training and research centres in the region, as is already the case of the project between ENEF (*Ecole Nationale des Eaux et*

Forêts) of Gabon and ERAIFT, financed by the European Commission. The MAB Council recommended that UNESCO/MAB promote such linkages with many similar centres that exist in the three major tropical forest regions of the world — Amazonia, the Congo Basin and South-East Asia (Indonesia, Malaysia) — in order to capitalize on the comparative advantages of such a collaborative network in terms of exchanges of scientific data, experiences and researchers.

4. Biodiversity and Scientific Research

The WSSD Plan of Implementation has set a goal for reducing biodiversity loss by 2010, thus creating another new time-bound international goal. Biodiversity science in UNESCO is carried out in the framework of its Intergovernmental Programmes: the MAB and Biosphere Programme (MAB), the Intergovernmental Oceanographic Commission (IOC), the International Hydrological Programme (IHP), Basic Sciences Programmes activities, and in the context of the International Geosciences Programme (IGCP).

A few examples are:

— Activities conducted under the topic "Land-Water interactions: towards sustainable development", a joint work of the MAB Programme and the International Hydrological Programme (IHP) on the development, testing and implementation of the ecohydrology theory, which allows water resources to be managed in such a way as to maintain supporting ecosystems.

— A fruitful collaboration exists between the Earth Sciences (IGCP), World Heritage Centre and MAB Programme on the elaboration of digital mapping and for the monitoring of Great Apes' habitats in the framework of the UNESCO/MAB-UNEP/GRASP Partnership. This activity is also supported by the European Space Agency (ESA) and provides training for site managers in remote sensing and GIS.

— UNESCO partners with ICSU, SCOPE and IUBS in coordinating and promoting the implementation of DIVERSITAS, which is an international programme on biodiversity science. DIVERSITAS has recently been recognized as the fourth of the global change family of research programmes, along with the International Geosphere-Biosphere Programme (IGBP), the World Climate Research Programme (WCRP) and the International Human Dimension Programme (IHDP). An International DIVERSITAS Open Science Conference is scheduled to take place in Oaxaca, Mexico, in November 2005.

— UNESCO participates in the Global Terrestrial Observing System (GTOS), which, together with the Biosphere Reserve Integrated Monitoring Initiative (BRIM) under the MAB Programme, is expected to provide methodologies necessary to detect major changes in terrestrial and coastal ecosystems and for the management of biosphere reserves for the benefit of local communities. The main expectation with regard to GTOS is that the Programme will significantly contribute to measuring progress towards the reduction of biodiversity loss by 2010. BRIM has produced two methodological guides on abiotic and social monitoring in biosphere reserves, and a desk study containing a critical selection of biodiversity indicators for their application in biosphere reserves, respectively.

4.1. Global Initiative on Biodiversity Education and Public Awareness

The question of education for biodiversity is an important issue for two fundamental reasons:

— UNESCO has been designated as the focal point for the Global Initiative on Biodiversity Communication, Education and Public Awareness (CEPA) under the Convention on Biological Diversity (CBD). The implementation plan for the Global Initiative prepared by UNESCO in consultation with CBD and a number of other partners had been endorsed by the 7th Conference of Parties (COP7) of the CBD convened in Kuala Lumpur, Malaysia, in February 2004.
— In December 2002, the United Nations General Assembly adopted the Resolution 57/254 on UN Decade of Education for Sustainable Development (UNDESD) spanning from 1 December 2005 to 31 December 2014. The General Assembly designated UNESCO as the lead Agency in charge of promoting the Decade. In terms of the Natural Science Sector's input to UNDESD, this can be summarized as follows: provision of scientific content; quality control of the contents of UNDESD activities and products; participation in strategic decisions; MAB's significant contribution to the design and implementation of demonstration activities, for example, activities related to tropical forests, rich in terms of biological diversity. This important initiative could be an opportunity to develop a strong cooperation with partners and donors at regional and international levels in order to implement the concept of Education for Sustainable Development and its relationship with Education for All (the Dakar Action Plan), the United Nations Literacy

Decade (UNLD) and the Millennium Development Goals (MDGs). For example, UNESCO/MAB in the framework of the regional project "Asia-Pacific Cooperation for the Sustainable or Renewable Natural Resources in Biosphere Reserves and Similarly Managed Areas (ASPACO)", which is financed via extrabudgetary resources by Japan, is elaborating a second version of the *World Atlas of Mangroves* in cooperation with several partners (FAP, UNEP, WCMC, UNU-INWEH and ISME).

5. Conclusion

Tropical forest is diminishing at an alarming pace. I have enumerated the multiple causes of this situation.

The launching of the World Network of Biosphere Reserves recognized in the framework of the Intergovernmental Programme on Man and Biosphere (MAB) provides an alternative for biodiversity conservation and sustainable development based on the "ecosystem approach" as recommended by CBD. The application of this approach contributes to reducing the degradation of forests, but we need to take action. One of such actions is to train a new type of specialists capable of applying this holistic approach. This is what UNESCO is trying to do with its many projects in capacity building such as ERAIFT.

In addition, to achieve a humanly and ecologically viable sustainable development, we need to place man in the centre of development as an actor and as a beneficiary of services and revenues generated by the utilization of natural resources. Most degradation observed in the forest zones is the result of actions undertaken by local populations for their survival.

To conclude, it is with pleasure that I note the cooperation between UNESCO and the Royal Academy of Overseas Sciences. The theme of this International Symposium "Tropical Forests in a Changing Global Context" represents an important field for exchange of scientific knowledge between our two Institutions.

I would therefore like to appeal to the Royal Academy and all experts gathered at this meeting to participate in the International Conference on "Biodiversity, Science and Governance" organized by France and UNESCO to be held in Paris from 24-28 January 2005 under the auspices of President Chirac.

International Symposium
Tropical Forests in a Changing Global Context
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L'aménagement durable des forêts tropicales face à la multiplicité des fonctions attendues des arbres et des écosystèmes forestiers. Le cas du Bassin du Congo

par

Jean Prosper KOYO*

RESUME. — Depuis une vingtaine d'années, l'humanité tout entière accorde une attention sans précédent aux problèmes de la déforestation et de la dégradation des ressources forestières ainsi qu'aux multiples fonctions que les forêts procurent à la planète et à ses habitants. Plusieurs conférences et sommets au niveau régional et mondial ont permis l'élaboration, l'adoption et la ratification de plusieurs conventions et traités. Des programmes et de nouveaux concepts, pratiques et outils relatifs aux forêts ont été conçus. C'est ainsi que les Sommets de Rio en 1992 et de Johannesburg en 2002, pour ne citer que ces deux-là, ont généré pêle-mêle le programme dénommé Agenda 21, le concept du développement durable et de partenariat, les trois conventions sur la désertification, la diversité biologique et les changements climatiques.

Malheureusement, cet impressionnant arsenal de conventions et de concepts internationaux sur les forêts n'a pas permis de faire reculer de manière significative la déforestation et la dégradation des ressources forestières dans le monde, particulièrement en zone tropicale, ni de couvrir de manière satisfaisante et soutenue les besoins de l'humanité en produits et services de tout genre attendus des écosystèmes forestiers. Bien au contraire, la déforestation se poursuit à un rythme alarmant de plus de quatorze millions d'hectares par an, particulièrement dans les pays en développement, avec toutes les conséquences écologiques, environnementales et climatiques que cela comporte.

Rien ne présage un avenir rassurant à moyen terme quant à l'amélioration de la situation des forêts dans le monde. Le niveau de pauvreté des populations riveraines des zones forestières des trois principaux bassins forestiers tropicaux d'Amazonie, du Congo et de l'Asie du Sud-Est reste parmi les plus élevés. L'insécurité alimentaire touche encore plus de huit cent quarante millions de personnes dans le monde et le déficit en bois de feu ne cesse de croître au fil des années. Les effets des changements climatiques préoccupent de plus en plus la communauté

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internationale. L'incohérence entre les politiques forestières et celles des autres secteurs conjuguée avec le faible niveau de développement socio-économique des populations rurales des pays tropicaux ainsi que les modes de gestion inappropriés actuels des ressources forestières en zone tropicale constituent les causes profondes de cet état de choses. Il est à noter également que l'essentiel des dégâts causés aux forêts provient en grande partie des activités étrangères au secteur forestier.

Face aux préoccupants enjeux actuels et futurs des forêts tropicales, que peut-on imaginer comme nouvelle stratégie pour l'avenir de ces forêts dans le monde? Outre l'introduction et l'aperçu général des forêts tropicales dans le monde, la communication présentera les principaux éléments de cette nouvelle stratégie afin de dégager de nouvelles approches d'aménagement durable des forêts en relation avec les différentes fonctions attendues des forêts tropicales. Parmi ces éléments, il y a en particulier: i) la prise en compte des politiques des autres secteurs (agriculture, élevage, énergie, industrie, etc.) dans l'élaboration des politiques forestières; ii) la recherche et la formation en matière de forêts; iii) la coopération internationale et le partenariat; iv) la lutte contre la pauvreté et v) l'approche participative et la gouvernance.

1. Introduction

Les forêts du Bassin du Congo constituent, avec celles d'Amazonie et de l'Asie du Sud-Est, les trois principaux massifs tropicaux, denses et humides de la planète.

De tout temps et en tout lieu, ces forêts ont toujours constitué des réservoirs de ressources, de services et de matières premières très variés: terres agricoles, bois d'œuvre, bois énergie, viande de chasse, poisson d'eau douce et divers autres produits ligneux et non ligneux comestibles et médicinaux.

Depuis une vingtaine d'années, l'humanité tout entière accorde une attention sans précédent aux problèmes de déforestation et de dégradation des ressources forestières ainsi qu'aux techniques pour leur gestion durable.

Plusieurs conférences et sommets au niveau mondial et régional ont permis l'élaboration et l'adoption de plusieurs conventions, traités et programmes ainsi que de nouveaux concepts, pratiques et outils relatifs aux forêts. C'est ainsi que les Sommets de Rio en 1992 et de Johannesburg en 2002, pour ne citer que ces deux-là, ont généré le programme dénommé Agenda 21, le concept du développement durable, les trois conventions sur la désertification, la diversité biologique et les changements climatiques et, enfin, le concept de partenariat.

D'après la FAO (2000), les forêts du Bassin du Congo sont déboisées à un taux annuel de l'ordre de 0,48 %. Cette déforestation et la dégradation des ressources forestières qui l'accompagne, sont le résultat d'un ensemble de déséquilibres croissants entre, d'une part, l'exploitation effrénée de ces ressources, avec des techniques traditionnelles, pour satisfaire aux besoins tant des populations locales que du marché international en matières premières, et, d'autre part, l'inconséquence des efforts déployés pour assurer la régénération et la conservation de ces ressources, le tout dans un contexte de mauvaise gouvernance et de pauvreté des populations de plus en plus inquiétantes.

Face à une telle situation, les pays riverains du Bassin du Congo et la communauté internationale multiplient les initiatives, depuis quelques décennies, en vue d'inverser les tendances et d'atteindre une gestion durable de ces forêts. Force est de constater que, malgré tous ces efforts, la déforestation en Afrique centrale reste encore élevée, soit environ un million d'hectares par an.

Quant à la satisfaction des multiples besoins humains en produits et services provenant des écosystèmes forestiers, rien ne présage un avenir rassurant à moyen terme. Le niveau de pauvreté des populations riveraines des zones forestières des trois principaux bassins forestiers tropicaux d'Amazonie, du Congo et de l'Asie du Sud-Est reste parmi les plus élevés dans les régions concernées.

L'insuffisance de cohérence entre les politiques forestières et celles des autres secteurs du monde rural, notamment l'agriculture et l'énergie, couplée avec le faible niveau de développement socio-économique des populations rurales et les modes de gestion inappropriés actuels des ressources forestières en zone tropicale, constituent les causes profondes de cet état de choses. Il est à noter, par ailleurs, que l'essentiel des dégâts causés aux forêts provient des activités étrangères au secteur forestier.

Face à un tableau aussi difficile, voire préoccupant, de la situation des forêts tropicales sur la planète, particulièrement en Afrique centrale, la présente communication analyse le cas du Bassin du Congo en passant en revue quelques approches stratégiques en vue d'un aménagement durable des forêts de cette sous-région. Parmi ces approches, il y a, entre autres: i) l'articulation des politiques des autres secteurs (agriculture, élevage, énergie, industrie, etc.); ii) la lutte contre la pauvreté; iii) l'adaptation de la sylviculture aux multiples utilisations des ressources forestières; v) la recherche et la formation en matière des forêts; vi) la coopération internationale et le partenariat.

2. Aperçu du contexte actuel du Bassin du Congo

2.1. Contexte ecologique

Dans la quasi-majorité des pays de l'Afrique centrale, à l'exception du Burundi et du Rwanda, ce déboisement touche plus particulièrement les zones à fortes concentrations. Traversées par l'équateur, les forêts denses humides du Bassin du Congo couvrent 240,7 millions d'hectares (FAO 2000). Elles sont, en superficie, le deuxième massif tropical dense humide d'un seul tenant du monde après celui d'Amazonie.

Très hétérogènes et très riches en espèces animales et végétales endémiques, notamment certains types de primates, de pachydermes, d'amphibiens, etc., ces forêts couvrent, à des degrés variables, les pays suivants: le Cameroun, les deux Congo, la République centrafricaine, le Gabon, la Guinée équatoriale, les contreforts du Burundi et du Rwanda.

Les plantations forestières sont insignifiantes et ne représentent qu'environ 648 000 ha, soit 0,2 % de la superficie totale (FAO 2000). Elles sont essentiellement à base d'espèces exotiques à croissance rapide: eucalyptus sp. et pins tropicaux. Quelques milliers d'hectares de deux ou trois essences autochtones (*Terminalia superba*, *Aucoumea klaineana*, *Triplochiton scleroxylon*, etc.) ont aussi été plantés au Cameroun, au Gabon et dans les deux Congo.

Entre 1990 et 2000, le couvert forestier est passé de 250,1 à 240,7 millions d'hectares, soit un déboisement de 9 400 000 ha en dix ans (FAO 2000).

Le réseau d'aires protégées couvre environ 11 100 000 ha, soit 5 % de la superficie forestière totale du Bassin du Congo. Il s'agit des parcs nationaux, de réserves forestières, de réserves de chasse et de réserves de la biosphère.

2.2. Contexte politique

Les politiques forestières dans la presque totalité des pays du Bassin du Congo sont dérivées de celles léguées par les administrations coloniales dans lesquelles le domaine forestier était défini comme propriété exclusive de l'Etat. Ces politiques sont par ailleurs sous-tendues par les fondements suivants:

— Une intégration insuffisante du développement forestier au développement national en général et du monde rural en particulier;

— Une approche participative et une gouvernance fort insuffisantes, ce qui ne permet pas aux acteurs du développement rural (populations rurales, ONG, secteur privé, etc.) de participer à la conception, à la mise en œuvre et à l'évaluation des politiques forestières;
— Une éducation nationale orientée vers la formation de cadres non seulement coupés de leur milieu naturel, mais aussi fort spécialisés, chacun se sentant autosuffisant dans son domaine;
— Une recherche scientifique à la fois inadaptée à la réalité nationale, mal soutenue par les pouvoirs publics et ne prenant pas souvent en compte les problèmes du monde rural;
— Une concentration très forte des investissements publics dans et autour des capitales politiques et des villes économiques, ce qui a occasionné un flux massif des populations de la campagne vers les villes (exode rural);
— Une instabilité des institutions et des guerres civiles récurrentes qui affectent la plupart des pays de la sous-région.

Il est évident que si, dans un contexte politique aussi mal articulé, on y ajoute les effets de la mauvaise gouvernance et le poids de la dette, on comprend pourquoi la pauvreté s'est aggravée dans les campagnes, avec pour conséquences directes la déforestation et la dégradation de l'environnement naturel.

2.3. Contexte socioeconomique

Avec une population totale d'environ 100,5 millions d'habitants, soit une densité de 18 habitants/km^2 (FAO 2000), les pays riverains du Bassin du Congo sont au nombre de dix: Burundi, Cameroun, République centrafricaine, Congo (Brazzaville), Congo (Kinshasa), Gabon, Guinée équatoriale, Rwanda, São Tomé e Príncipe, et Tchad. Dans l'ensemble, il s'agit de pays dont les économies reposent presque exclusivement sur le secteur primaire, c'est-à-dire l'extraction et l'exportation de matières premières brutes: produits agricoles, forestiers et miniers. Le revenu moyen annuel par habitant est de 677 $ US (FAO 2000).

Les infrastructures de communication sont très faibles en Afrique centrale. Sur 220 000 km de routes au total, 8 700 seulement sont asphaltés. Il s'agit là d'un véritable facteur limitant pour le développement de la sous-région.

Tous les pays d'Afrique centrale, ou presque, sont très endettés et donc soumis au programme d'ajustement structurel contraignant.

L'agriculture traditionnelle, appelée aussi «agriculture itinérante sur brûlis», reste de loin la plus dévastatrice des espaces forestiers. En moyenne, l'agriculture et la forêt représentent 23 % du produit national brut (PNB) et emploient plus de 58 % de la population active.

L'exploitation sélective de grumes destinées à l'exportation, souvent avec des investissements extérieurs, reste encore parmi les activités économiques essentielles dans la sous-région. Les productions annuelles de grumes et de bois énergie ont été estimées en 2000 respectivement à 12,7 millions de m^3 et 96 934 000 de m^3 (FAO 2000).

Comme on peut le constater à travers ces quelques données, le bois énergie représente plus de 88 % de la production ligneuse totale. Il y a également lieu de signaler que près de 40 % en volume de bois d'œuvre coupé est abandonné en forêt; le taux de transformation ne dépasse pas 30 % avec des rendements en matières de l'ordre de 25 %.

Outre les terres agricoles et les productions ligneuses, les forêts denses humides du Bassin du Congo offrent aussi plusieurs autres ressources qui alimentent les marchés locaux et internationaux. Il s'agit, en particulier, des produits de chasse — plus d'un million de tonnes par an — et de tous les produits forestiers non ligneux comestibles et médicinaux.

3. Causes de la déforestation et de la dégradation des ressources forestières dans le Bassin du Congo

Tout, ou presque, a déjà été dit ou écrit sur les causes de la déforestation et de la dégradation des forêts tropicales en général, et d'Afrique centrale en particulier. Pour les uns, c'est l'agriculture itinérante sur brûlis et l'exploitation forestière qui en sont les causes, pour d'autres, c'est plutôt la pauvreté et les fortes pressions démographiques, etc.

Pour ma part, la cause principale de la déforestation et de la dégradation des forêts d'Afrique centrale réside essentiellement dans l'incohérence des politiques de développement rural mises en œuvre jusqu'ici dans les pays concernés.

En effet, la vraie cause de la déforestation vient de la difficulté qu'éprouvent les décideurs à concevoir et mettre en œuvre des politiques cohérentes et intégrées de développement durable des ressources naturelles destinées à la fois à satisfaire les besoins humains actuels et futurs, et compatibles avec les capacités de production et de régénération de ces mêmes ressources.

Fig. 1. — L'exploitation forestière.

En d'autres termes, l'incohérence des politiques de développement socio-économique du monde rural et la pauvreté, qui en est la conséquence directe, constituent les causes fondamentales de la déforestation et de la dégradation des forêts en Afrique centrale.

Les autres phénomènes cités plus haut, à savoir l'agriculture itinérante, l'exploitation forestière, la pression démographique, sont, dans la plupart des cas, soit des causes secondaires ou apparentes, soit des conséquences d'un mal plus profond et mal cerné, soit enfin des circonstances aggravantes.

En effet, une agriculture itinérante ou une exploitation forestière pratiquées dans un contexte de bonne gouvernance et de développement rural maîtrisé ne causerait pas autant de dégâts à l'environnement. Mais *a contrario*, un développement rural mal articulé, livrant les populations et les autres acteurs à leur triste sort, ne peut que conduire à l'aggravation des dégâts sur l'environnement.

Fig. 2. — Agriculture itinérante sur brûlis.

4. Efforts régionaux et internationaux pour la gestion durable des forêts du Bassin du Congo

4.1. Initiatives regionales

Au cours des vingt-cinq dernières années, plusieurs initiatives ou organisations régionales, ainsi que des exercices de planification et de gestion durable des ressources forestières, ont été engagés en Afrique centrale. Il s'agit en particulier de:

4.1.1. L'Organisation Africaine du Bois (OAB)

L'OAB a été créée en 1976 dans le but de permettre aux pays membres d'étudier et de coordonner leurs efforts et moyens en vue d'aboutir à

une utilisation optimale et une conservation de leurs ressources forestières.

L'OAB regroupe treize pays membres: Angola, Cameroun, République centrafricaine, Congo-Brazzaville, Congo-Kinshasa, Côte-d'Ivoire, Gabon, Ghana, Guinée équatoriale, Liberia, Nigeria, São Tomé e Príncipe et, enfin, Tanzanie. Parmi les réalisations réussies par l'OAB, on peut citer en particulier la mise au point des critères et indicateurs en collaboration avec l'OIBT et le CIFOR.

4.1.2. La Conférence sur les Ecosystèmes de Forêts Denses Humides d'Afrique Centrale (CEFDHAC)

Créée en mai 1996, la CEFDHAC est un cadre de concertation et de réflexion sur toutes les questions relatives à la gestion durable des écosystèmes forestiers d'Afrique centrale. Elle regroupe onze pays membres (Burundi, Cameroun, République centrafricaine, Congo-Brazzaville, Congo-Kinshasa, Gabon, Guinée équatoriale, Rwanda, et São Tomé e Príncipe) et est ouverte à tous les intervenants dans le secteur forestier de la sous-région, notamment les politiques (parlementaires et ministres), le secteur privé et les ONG.

Depuis 1996, l'IUCN assure le secrétariat exécutif de l'institution qui a bénéficié d'un important appui financier des Pays-Bas et de l'Union européenne.

4.1.3. Processus de Yaoundé

Le Processus de Yaoundé est né suite au Sommet des chefs d'Etat, tenu le 17 mars 1999 à Yaoundé, en présence des chefs d'Etat du Cameroun, de la RCA, du Tchad, de la Guinée équatoriale et des représentants des chefs d'Etat du Congo et du Gabon ainsi que du prince Philip, duc d'Edimbourg. Le Sommet avait centré les discussions sur les problèmes relatifs à la conservation et la gestion durable des ressources forestières du Bassin du Congo dont, en particulier, la création de zones protégées transnationales.

4.1.4. Partenariat Forestier dans le Bassin du Congo (PFBC)

Créé à l'issue de la Conférence des Nations Unies sur l'Environnement tenue en septembre 2002 à Johannesburg, le PFBC est une association de vingt-neuf organisations gouvernementales et non gouvernementales œuvrant pour l'amélioration de la communication et la coordination des programmes,

projets et politiques en vue de la gestion durable des écosystèmes forestiers dans le Bassin du Congo.

4.1.5. Réseau des Aires Protégées d'Afrique Centrale (RAPAC)

Le Réseau des Aires Protégées d'Afrique Centrale est né sous les cendres du programme régional ECOFAC (Ecosystèmes Forestiers d'Afrique Centrale), financé par l'Union européenne sur les fonds régionaux du 6e FED.

4.1.6. Agence Internationale pour le Développement de l'Information Environnementale (ADIE)

A l'origine financée par la Banque mondiale, l'ADIE est une initiative qui vise à la promotion de la coopération en matière de production, échange, diffusion et usage des informations environnementales entre les pays d'Afrique centrale. Placée sous la coordination de la COMIFAC, elle est chargée, entre autres, de collecter, traiter, diffuser, archiver, créer les bases de données, échanger les informations environnementales à des fins de développement durable.

4.1.7. Réseau des Institutions de Formation forestière des Etats d'Afrique centrale

Le réseau est né à la suite d'un atelier sous-régional organisé par la CEFDHAC, les 4 et 5 octobre 2001 à Libreville, à l'attention des instituts de formation forestière d'Afrique centrale. Il vise à l'harmonisation des programmes d'enseignement forestier, au recyclage des professeurs et aux échanges d'étudiants. Le réseau regroupe les principaux instituts, facultés et écoles de formation forestière des pays d'Afrique centrale.

4.2. Dialogue international sur l'environnement et les forets

C'est à la Conférence des Nations Unies sur l'Environnement humain tenue à Stockholm, Suède, en 1972, que le concept de la dégradation de l'environnement a réellement commencé à attirer l'attention de la communauté internationale. La Conférence des Nations Unies sur l'Environnement et le Développement (CNUED), tenue à Rio de Janeiro, du 3 au 14 juillet 1992, a permis ensuite de sceller le concept de développement durable, c'est-à-dire l'ensemble des compromis tolérables entre, d'une part, la satisfaction des besoins actuels et futurs de l'humanité en ressources forestières,

y compris la qualité de la vie, et, d'autre part, la gestion équilibrée et durable de ces mêmes ressources.

Les principaux résultats de la Conférence de Rio, connue aussi sous le nom de «Sommet planète Terre», ont été:

— L'Agenda 21, un audacieux et vaste programme d'actions destiné à régir les nouvelles pratiques de gestion et de valorisation des ressources en vue d'un développement durable;
— La Déclaration de Rio, un ensemble de vingt-sept principes destinés à être appliqués universellement afin d'orienter l'action internationale sur la base de la responsabilité environnementale et économique;
— La Convention-cadre des Nations Unies sur les changements climatiques ayant pour objectif la réduction et la stabilisation des concentrations de gaz à effet de serre dans l'atmosphère à un niveau qui préviendrait l'interférence anthropique avec le système climatique;
— La Convention sur la diversité biologique ayant pour objectifs: la protection de la diversité biologique, l'utilisation durable de ses composantes et le partage juste et équitable des bénéfices provenant de l'utilisation des ressources génétiques;
— La Convention sur la lutte contre la désertification.

L'adoption et la signature, en juillet 1992, de l'Agenda 21 et des différentes conventions par cent septante-deux gouvernements caractérisaient à la fois la volonté politique et l'engagement de la communauté internationale à concilier désormais le développement socio-économique avec la gestion équilibrée et durable des ressources naturelles. Cela marquait aussi le point de départ d'un processus de partenariat et de dialogue ouverts et transparents sur les problèmes de développement en relation avec ceux de l'environnement.

Ce dialogue s'est poursuivi de 1995 à 2000 à travers le Panel Intergouvernemental sur les Forêts (PIF) et le Forum Intergouvernemental sur les Forêts (FIF). Suite à la résolution 2000/35 du Conseil économique et social des Nations Unies, le Forum des Nations Unies sur les Forêts (FNUF) fut créé pour:

— Faciliter la mise en œuvre des accords sur les forêts et permettre une compréhension commune de l'aménagement durable des forêts;
— Favoriser et entretenir la coopération internationale et la coordination en matière de politique et de programme forestiers;
— Assurer le suivi et l'évaluation des progrès réalisés;
— Renforcer l'engagement politique sur la gestion, la conservation et le développement durable de tous les types de forêts.

Le Partenariat de Collaboration sur les Forêts (PCF) fut ensuite créé en avril 2001 dans le double but de soutenir l'action du FNUF et de ses membres et de renforcer la coopération et la coordination entre les membres dans le domaine des forêts. Le PCF compte quatorze membres, essentiellement des organisations internationales (CIFOR, FAO, ITTO, IUFRO, UNDP, UNEP, ICRAF, WB et IUCN) et des secrétariats des trois conventions issues de Rio, du GEF et du FNUF. La FAO en assure le secrétariat.

En 2002, le PCF créa un réseau, conçu comme un mécanisme permettant la participation active aux travaux du PCF d'un grand nombre d'organisations, institutions, instruments et processus concernés dans le but d'acheminer au PCF les contributions d'un grand nombre d'entités et de processus. Le réseau est composé de l'ensemble des parties prenantes intéressées par les problèmes forestiers: ONG, secteur privé, organisations régionales, etc.

La Conférence des Nations Unies sur l'Environnement et le Développement (CNUED), qui s'est tenue à Johannesburg du 26 août au 4 septembre 2002, avait pour objectif, dix ans après Rio de Janeiro, de faire le point sur le niveau de réalisation de l'Agenda 21 et des autres mesures adoptées à Rio. Un des résultats importants du Sommet de Johannesburg aura été la création de plus de deux cents partenariats sur le développement durable. Ils constituent un moyen d'appui complémentaire à la mise en œuvre de l'Agenda 21.

4.3. Analyse des efforts regionaux et internationaux sur les forets d'Afrique centrale

4.3.1. Au niveau régional et local en Afrique centrale

Même s'il est vrai que, depuis le Sommet de Rio de Janeiro, des évolutions conceptuelles et institutionnelles ont été observées en Afrique centrale, en termes de prise de conscience réelle des problèmes d'environnement et de gestion durable des forêts, de création de plusieurs organisations régionales (CEFDHAC, COMIFAC, OCFSA, ADIE), de prolifération des ONG et associations, etc., il n'en reste pas moins vrai que le résultat concret sur le terrain reste encore en deçà des attentes. En effet, les conférences et les sommets des chefs d'Etat d'Afrique centrale n'ont pas encore permis une amélioration significative des phénomènes de déforestation et de dégradation des forêts du Bassin du Congo.

La déforestation (un million d'hectares) et l'écrémage des essences se poursuivent à un rythme inquiétant. L'insuffisance de cohérence entre les politiques forestières et celles des autres secteurs du monde rural, couplée avec l'insuffisance de dialogue entre les différents acteurs, constituent sans aucun doute une des causes profondes de cet état de choses. Le très faible niveau de développement socio-économique des populations rurales des pays concernés, ainsi que les modes de gestion inadéquats des ressources forestières actuellement en vigueur, en sont des facteurs aggravants.

Les recommandations et résolutions des conférences tenues au niveau international et régional sont rarement relayées par les organisations ou institutions appropriées au niveau national et local.

L'implication à part entière des secteurs tels que l'agriculture, l'énergie, l'industrie, les travaux publics, les municipalités, l'éducation, etc. et des autres acteurs (ONG, société civile, collectivités locales, etc.) aux décisions stratégiques concernant le développement durable des forêts, est très faible, voire inexistante.

L'approche participative, qui vise le noble objectif d'impliquer directement les autres partenaires du développement, en particulier les communautés locales, dans tout le processus d'identification, de formulation, d'exécution et d'évaluation de projets, est aussi quasiment tronquée. Les institutions en place, ainsi que le personnel susceptible d'appliquer cette approche, ne sont pas correctement préparées à cela.

4.3.2. Au niveau international

Au cours des douze dernières années, les efforts déployés au niveau international ont permis des progrès indéniables, entre autres:

— La promotion des neuf processus de critères et indicateurs sur l'aménagement forestier durable. Plus de cent cinquante pays disposant de 85 % des forêts du monde y participent activement.
— L'établissement et le renforcement d'un dialogue au niveau international, en particulier à travers le FNUF, PCF, sur la politique forestière mondiale. Dans ce cadre plus de trois cents projets ont été négociés. La recherche de financement pour leur mise en œuvre est en cours.
— La mise en œuvre des trois conventions issues de Rio sur la diversité biologique, les changements climatiques et la désertification, qui ont été signées et ratifiées par la grande majorité des pays du monde.

— L'élaboration de concepts, de pratiques et d'outils d'aménagement durable des forêts dans le cadre non seulement de traités régionaux et mondiaux, mais aussi de programmes nationaux.

En considération du niveau actuel élevé et des tendances de la déforestation (de l'ordre de quatorze millions d'hectares par an) et de la dégradation des ressources forestières, particulièrement dans les pays en voie de développement, force est de constater que les efforts déployés jusqu'ici au plan international sont loin de produire les résultats escomptés. Les participants au 12e Congrès forestier mondial, tenu en septembre 2003 à Québec, au Canada, s'étaient grandement inquiétés de cette situation.

Tant que les ressources forestières continueront de constituer la principale source de vie pour les populations des pays en voie de développement, il sera extrêmement difficile de combler l'écart grandissant entre les progrès en termes d'élaboration des concepts et pratiques et le fort taux de déforestation et de dégradation des forêts dans le monde. La vraie thérapeutique de la déforestation se trouve sans doute dans l'amélioration des conditions de vie des populations riveraines aux massifs forestiers.

L'appui de la FAO dans le Bassin du Congo en matière de développement des forêts est ancien, notamment dans les domaines des inventaires forestiers, de l'aménagement durable et de la formation. Dans le cadre du Processus de Yaoundé et la naissance de la COMIFAC, cet appui se situe désormais à la fois au niveau national et régional. C'est ainsi que le Département des Forêts de la FAO a élaboré une stratégie de son assistance actuelle et future en se basant sur le plan de convergence de la COMIFAC et en prenant soin de créer les conditions de synergie et de complémentarité avec les autres agences et donateurs intéressés par les problèmes forestiers du Bassin du Congo. Cette stratégie comporte les quatre axes prioritaires suivants : i) la mise au point, le développement et la mise en œuvre des techniques de gestion, d'exploitation des forêts et de transformation du bois dans le cadre de l'aménagement durable; ii) l'appui à la mise en place et au fonctionnement d'un système d'information sur les ressources forestières au niveau sous-régional destiné à créer et gérer les bases de données issues d'informations sur les ressources forestières collectées dans chaque pays, selon un réseau à concevoir et développer progressivement; iii) le soutien au renforcement et à l'amélioration des capacités de gestion et d'utilisation durable des ressources forestières pour tous les acteurs du développement forestier dans le Bassin du Congo; iv) le soutien au renforcement des cadres institutionnels, politiques et légaux en vue d'une meilleure gestion des ressources et de la distribution équitable des revenus qui en découlent.

5. Eléments de nouvelles approches stratégiques d'aménagement durable des forêts du Bassin du Congo face à la multiplicité des fonctions attendues de ces forêts

5.1. La lutte contre la pauvrete et les nouvelles politiques forestieres

Les forêts du Bassin du Congo sont un grand réservoir d'importantes ressources à caractère économique et environnemental. La déforestation et la dégradation des ressources forestières sont généralement en corrélation directe avec le niveau de développement des populations. Les forêts bien gérées constituent un atout majeur pour soutenir le développement socio-économique des populations riveraines. Dans ce cas, elles sont un puissant moyen de lutte contre la pauvreté. *A contrario*, si elles sont mal gérées, elles contribuent alors à l'aggravation de la déforestation et de la dégradation des ressources environnementales, avec toutes les conséquences écologiques, sociales et climatiques que cela comporte.

Au regard de la complexité et de la fragilité des écosystèmes forestiers de zones tropicales humides, les politiques devant régir leur gestion se doivent désormais d'être suffisamment souples et ouvertes aux problèmes des autres secteurs, tout en visant le développement durable, c'est-à-dire un équilibre positif entre la satisfaction des besoins humains actuels et futurs et la pérennité des écosystèmes. Elles devront s'articuler autour des principes de base suivants:

— Une harmonisation des politiques de développement forestier avec celles de développement national en général et développement rural en particulier; ce qui signifie, en d'autres termes, la mise en cohérence de toutes les politiques de développement agricole, énergétique, artisanal, etc. avec celles relevant des forêts et de l'environnement en vue d'une gestion raisonnée des ressources forestières.
— Une meilleure cohérence et dynamisation des politiques forestières et des initiatives sous-régionales en matière de gestion durable des forêts afin de gérer les forêts du Bassin du Congo sur des bases plus ou moins semblables. Une bonne articulation des initiatives sous-régionales autour du Processus de Yaoundé éviterait des conflits institutionnels et chevauchements inutiles.
— Un zonage du domaine forestier national en domaine forestier permanent réservé aux aires protégées et aux forêts classées, et en domaine forestier non permanent destiné à l'exploitation industrielle et aux activités rurales intégrées (agriculture, foresterie communautaire, élevage,

agroforesterie, etc.). Le zonage sera le résultat d'un compromis, judicieusement dosé entre, d'un côté, les services publics (les services des eaux et forêts, de l'agriculture, des travaux publics, etc.) et, de l'autre, les collectivités locales, les populations rurales, les ONG et le secteur privé.

5.2. Adaptation des techniques sylvicoles aux multiples utilisations des ressources forestieres

Définie comme un outil scientifique et technique de gestion durable des ressources forestières pour la satisfaction des besoins actuels et futurs de l'humanité, la sylviculture devrait désormais se mettre à l'écoute et au service des autres utilisateurs de l'espace forestier. La responsabilité du sylviculteur serait ainsi engagée dans la mise au point et l'application des techniques sylvicoles adaptées aux différentes fonctions dévolues et attendues des forêts et des arbres. Dans ces conditions, on peut imaginer quelques cas de figures où la sylviculture jouerait un rôle déterminant dans la satisfaction de multiples besoins des hommes en produits forestiers. Il s'agit en particulier de:

— *L'exploitation agricole*: l'agriculture et l'élevage traditionnels étant parmi les causes sous-jacentes de la déforestation et de la dégradation des ressources forestières, il paraît désormais impérieux de mettre au point des techniques sylvicoles adaptées à toutes les formes d'agriculture et d'élevage traditionnels en zone tropicale. Il est vrai que les populations rurales pratiquent depuis toujours des formes traditionnelles d'agroforesterie. Il est aussi vrai que, depuis quelques dizaines d'années, des expérimentations sont menées par des centres de recherche spécialisés (ICRAF) sur plusieurs technologies agroforestières. L'application à grande échelle de certaines de ces technologies souffre encore d'une insuffisance de vulgarisation et d'évaluation au niveau de chaque élément du système en termes de gains globaux. La sylviculture devrait prendre une part plus active dans les travaux en cours. Elle pourrait apporter une contribution significative dans le choix à la fois des espèces forestières compatibles avec les cultures agricoles et les animaux, les modèles d'associations agroforestières les plus bénéfiques, tant au plan des rendements agricoles et forestiers que de l'environnement, les traitements sylvicoles les plus appropriés aux arbres agroforestiers, etc.
— *L'aménagement des bassins versants*: dans les zones de montagnes densément peuplées l'appauvrissement des sols et la menace des sources d'eaux douces, consécutifs à une intense érosion des sols, et une surexploitation des terres conjuguée avec une forte pression sur les autres ressources naturelles nécessitent, dans la plupart des cas, des

programmes d'aménagement global et intégré des bassins versants afin d'en assurer une exploitation durable et soutenue. Ces programmes consisteraient à boiser les crêtes dénudées des collines, à installer sur les versants des haies anti-érosives isohypses, mixtes composées d'arbres agroforestiers, d'herbes et d'arbustes fourragers et, enfin, à intégrer les cultures agricoles et les animaux en stabulation semi-permanente à tout le système, le fumier ou le compost résultant du système revenant au sol pour y maintenir sa fertilité. Il est évident que le reboisement des crêtes dénudées, qui sont le plus souvent rocailleuses avec un sol peu profond, nécessite un choix adéquat d'essences et de techniques sylvicoles spécifiques.

— *La production de bois énergie et de service*: les politiques forestières des pays d'Afrique centrale ne donnent pas toujours assez d'importance aux conséquences socio-économiques et environnementales liées à la forte consommation du bois énergie dans ces pays, surtout dans les zones urbaines et périurbaines. Et pourtant le bois énergie représente plus de 80 % du volume de bois coupé chaque année dans ces pays, entraînant dans beaucoup de cas une déforestation et une dégradation des ressources quasi irréversibles. En fonction des situations locales, une sylviculture adaptée, combinant des microboisements familiaux (systèmes agroforestiers) et des boisements privés, avec des espèces à croissance rapide améliorées et des techniques sylvicoles appropriées, pourrait être mise au point dans des zones à forte demande de bois énergie afin de limiter la pression sur les reliques de peuplements naturels encore en place.

— *La plantation forestière industrielle à très haut rendement*: les besoins croissants en bois de trituration et en séquestration de carbone exigent aujourd'hui des plantations forestières industrielles avec du matériel végétal hautement sélectionné. Il se trouve, par ailleurs, que les plantations forestières sont de plus en plus installées sur des sols pauvres et sous des climats peu propices. Pour parvenir à des productions intéressantes dans ces conditions écologiques aussi marginales avec du matériel végétal de qualité, il va falloir désormais mettre au point et user de techniques sylvicoles spécifiques en fonction des sites.

— *L'ouverture de routes publiques sur le périmètre forestier*: l'ouverture de routes en zone de forêts occasionne généralement une destruction importante de la forêt. Pour une route d'une assiette définitive de 7 à 8 m, la forêt est détruite sur une largeur de plus 50 m. Ce qui est très dommageable pour la couverture forestière et de l'environnement.

En réponse à cette forme de déforestation, une sylviculture spécifique, destinée à reboiser les abords de routes en construction avec des espèces utiles, serait à mettre au point.

— *La foresterie urbaine et périurbaine*: les densités de populations de plus en plus fortes dans les agglomérations urbaines du monde entier, couplées avec les différents modes de vie des citadins et le faible niveau de ressources forestières dans et autour de ces mêmes agglomérations, nécessitent aujourd'hui des types de sylviculture susceptibles non seulement de réduire ou juguler des phénomènes de pollution atmosphérique, l'érosion en milieu urbain, mais aussi de permettre un environnement agréable tout en approvisionnant, de manière durable, ces mêmes villes en produits agricoles, énergétiques etc.

— *L'exploitation forestière industrielle en zone tropicale*: sous la pression des pouvoirs publics et des ONG, les sociétés d'exploitation forestière industrielles sont de plus en plus soumises au respect des principes de gestion durable des forêts. C'est ainsi qu'elles commencent timidement à élaborer et appliquer des plans d'aménagement de leurs concessions. Dans le cas du Bassin du Congo, ces plans d'aménagement se limitent principalement aujourd'hui à un inventaire préalable des essences commercialisables, l'estimation des volumes à prélever chaque année et le respect de ces prévisions. Les questions liées à la régénération naturelle ou artificielle des espèces exploitées ne semblent pas préoccuper pour l'instant les pouvoirs publics et les sociétés forestières. La sylviculture a donc là un gisement d'activités dans la mise au point des techniques de régénération naturelle et/ou artificielle d'une gamme très importante d'espèces de ces forêts tropicales. La création des connaissances approfondies sur la biologie et le comportement de ces espèces, tant en situation de peuplements naturels mélangés qu'en peuplements monospécifiques, est une tâche immense. La sylviculture devrait occuper une place déterminante dans la conduite des recherches y relatives.

— *L'exploitation des produits forestiers non ligneux*: les produits forestiers non ligneux, notamment les plantes médicinales et les parties comestibles de certaines plantes (fruits, feuilles, écorces, racines, résines, etc.), sont aujourd'hui de plus en plus exploités sans aucune précaution pour la survie de ces plantes. La sylviculture pourrait ici aussi apporter sa précieuse contribution en étudiant la biologie et le comportement de ces plantes, tout en mettant au point les techniques de régénération et de production optimale de ces mêmes plantes afin d'en assurer une exploitation durable et soutenue.

5.3. Recherche et formation forestieres

L'avenir de la sylviculture, voire du métier de forestier, dépendra des réformes que les écoles forestières apporteront aux programmes de formation. Si la sylviculture doit servir d'interface aux autres secteurs, les programmes de recherche et de formation devront non seulement élargir et approfondir le domaine de la sylviculture, tout en intégrant les préoccupations majeures de secteurs tels que l'agriculture, l'élevage, l'écologie, etc., mais aussi promouvoir les disciplines pluridisciplinaires, notamment l'agroforesterie, ainsi que la communication, les sciences sociales, la vulgarisation, etc. La formation devra aussi mettre l'accent sur la connaissance des écosystèmes forestiers, les techniques de leur aménagement, le travail en équipe, la responsabilité du forestier à assister techniquement les autres utilisateurs des ressources forestières, les concepts de base sur la conservation de l'environnement, etc.

Des réformes stratégiques s'avèrent donc nécessaires dans la recherche et la formation des forestiers afin de redonner un nouvel élan à la sylviculture et contrebalancer, par voie de conséquence, la très forte offensive exercée, depuis quelques décennies, par les environnementalistes.

La sylviculture ne pourra jouer son véritable rôle d'interface que si elle est sous-tendue par une recherche et une formation forestières plus étendues pour non seulement la création de connaissances approfondies sur le fonctionnement des écosystèmes forestiers, mais aussi la mise au point de techniques simples d'aménagement, de gestion et de conservation des ressources.

6. Conclusion

Le Bassin du Congo est un patrimoine forestier et une réserve d'eau douce parmi les plus précieux au monde. La mise en valeur soutenue et durable des ressources que recèle ce patrimoine passe par l'élaboration et la mise en œuvre de politiques intégrées et cohérentes dans les pays riverains du Bassin du Congo, la lutte contre la pauvreté, l'adaptation des techniques sylvicoles aux multiples utilisations des ressources forestières, la recherche et la formation forestières et, enfin, la coopération internationale et le partenariat.

La volonté politique qui anime à présent les pays de la sous-région à travers le Processus de Yaoundé et la CEFDHAC devrait résolument s'accompagner des nouvelles stratégies évoquées ci-dessus et d'un réel essor socio-

économique. Car le risque de voir les déséquilibres environnementaux, déjà en place, s'aggraver est grand, tant que la forêt continuera d'être la principale source de vie des économies des pays de la sous-région et des populations locales très pauvres, sans autre alternative.

L'appui de la communauté internationale au plan technique, financier et matériel est impérieux pour permettre aux pays de la sous-région d'avancer vers le développement socio-économique, seul gage du développement durable des ressources forestières.

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International Symposium
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United Nations Educational, Scientific
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pp. 39-41.

Contribution of Belgian Science to the Tropical Forests

by

Philippe METTENS*

Excellencies, Monsieur le Ministre, Ladies and Gentlemen,

It is a great pleasure and honour for me to address to this international audience a few introductory words, reflecting Research and Development, as well as coordination efforts, which the Federal Science Policy Office is making with respect to the tropical forests in their changing global context. The principal missions of our Office can be summarized as follows:

— Implementing scientific and technical resources to support policy and developing a national expertise serving the Federal Authority's competency;
— Co-ordinating, monitoring and promoting ten Federal Scientific Institutes;
— Initiating programmes, actions and networks to foster international cooperation and integration.

We consider tropical forests as being a crucial element in the "package" of the global environment governance, along with the Framework Convention for Climate Change and the Biodiversity Convention.

Let me express, taking our historical context into account, a special attention to Africa and in particular to the Congo Basin, affected by deforestation and characterized by a rehabilitation phase and continuing population increase. We have to face in the Central African region the urgent challenge of promoting socio-economic development, based on a sustainable use of natural resources.

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How does Belgian science contribute to the "tropical" forest issue?

In any case, science does not have any borders! And scientists have to address more and more the understanding and the proposal of solutions and instruments for global problems requiring an integrated approach, such as sustainable development, environment and security... where natural sciences and social sciences have to go hand in hand.

I would like to insist on the recommendation to foster the number ánd the types of partnerships to address the tropical forest challenge and on the multidisciplinary approach of research projects. I am pleased to invite all of you, in this context, to visit the exhibition "Congo: Nature and Culture" which illustrates in a remarkable way the diversity of values of the African forest (exhibition to be held in the Royal Museum for Central Africa from 23 november onwards, after having brightened up UNESCO rooms in Paris).

It is my pleasure to mention, among the R&D activities of our office, a successful cooperation project we ran (2002-2004) with the UNESCO-World Heritage Programme (WHP) which focussed on 5 WH-sites in danger in the Democratic Republic of Congo: Virunga, Kahuzi Biega, Okapi, Salonga and Garamba Parks. Belgian experts, together with local decision and management authorities, NGOs (non-governmental organizations) and international organizations have developed reference maps and an information and monitoring system, in support of the wise management of protected areas.

Exchange of information is ongoing with the Royal Institute for Natural Sciences and with the Royal Museum for Central Africa, regarding the contribution of their data and experiences to the sustainable management of these unique parks, during the second project phase (2004-2006). In this phase, Belgian experts are planning to contribute to the intersectorial dialogue by organizing a meeting with the departments of Environment, Forestry, Tourism, Infrastructure, Mining to discuss about the use of forest resources or the planning of activities, respecting the borderlines of protected areas.

I am happy to announce you also that we are making efforts, in the frame of this and of other projects affecting tropical regions, to intensify the synergy between Research and Development Cooperation.

In the framework of Remote Sensing and Global Change Programme activities, our office supports R&D concerning monitoring and modelling of the tropical forest status and processes at regional and global scale.

In the former TELSAT programme, specific deforestation and afforestation issues were studied in some countries in Latin America, West and Central Africa and in Southeast Asia.

In spring 2004, the Belgian Coordinated Collections of Micro organisms (BCCM) and 14 other partners started an EC-funded "Specific Support Action" called MOSAICS, to promote sustainable use of microbiological resources and to manage the Access and Benefit Sharing (ABS) issues in the context of the enforcement of the Biodiversity Convention and other relevant international rules.

Culture collections like BCCM have the important role to make (micro)biological diversity from all origins, including the rich tropical forest zones, accessible to users for scientific, technical, industrial, educational and training purposes. MOSAICS helps stakeholders to implement efficiently international and national laws regulating the flows of microbiological material and related information.

Along with the funding of R&D activities, I would like to mention that the Federal Science Policy Office hosts the Belgian focal point (by web) for the European Tropical Forest Research Network (ETFRN). This is a forum of communication allowing efficient information exchange among Belgian and European experts and international forestry organizations, as well as the shaping of the research agenda with respect to tropical forests. ETFRN encourages the seting-up of partnerships and of European projects towards the "conservation and wise use of forests and woodlands in tropical and subtropical regions".

In the near future, I am happy to announce you the organization of a scientific symposium "Tropical biodiverstiy: science, data, conservation" in April 2005 (17-18). This happens in the frame of the organization of the 10th meeting of the governing board of the GBIF (Global Biodiversity Information Facility, 17-23/04/05).

Last but not least, I would like to give you the message that we are engaging ourselves to ensure rapid and global visibility of our research objectives ánd results, allowing all interested stakeholders to reap the benefits of it and to capitalize upon in order to facilitate the transfer of research results in decision-making cycles.

State of the Art in the Continents Concerned

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African Rain Forests: Evolution and Threats

by

Jean-Louis DOUCET*

KEYWORDS. — Rain Forest; Central Africa; Logging Impacts; Sustainable Management.

SUMMARY. — According to recent data (GLC2000 map), African dense forests cover *c.* 236 million ha, that is 7.9 % of the total continent area. The Central African forest is the last contiguous block of tropical forest in Africa; it covers an area of *c.* 203 million ha, whereas the forest cover of West Africa (*c.* 10 million ha) is highly fragmented.

At the fringes of the Congo Basin, forests are replaced by woodlands and shrublands, mixed in some places with croplands. Woodlands and shrublands together cover 27 % of the continent, while grasslands represent 15 % of the land. The largest desert in the world is the Sahara desert that covers an area of *c.* 900 million ha or 33 % of the African continent.

Agricultural activities extend over 12 % of the continent. The area of cropland is more important in West Africa than in Central Africa, respectively 16 % and 7 %. Closely related to agriculture, the deforestation rate is higher in West Africa (1.7 % versus 0.4 %). The other causes of deforestation are logging, mining activities, infrastructure development and fires.

The most forested countries of the continent are: Central African Republic (*c.* 8 million ha), Gabon (*c.* 21 million ha), Cameroon (*c.* 21 million ha), Congo (*c.* 26 million ha) and D. R. Congo (*c.* 125 million ha). These five countries account for 85 % of the African dense forest.

In Central Africa, 45 % of the total forest area is under a logging concession status. As a consequence, logging activities play a major role in the Central African rainforest's future.

According to the ITTO (International Tropical Timber Organization) figures, in 2003 the estimated productions of the five previously mentioned countries were: *c.* 7.4 million m^3 of logs; *c.* 1.1 million m^3 of sawn wood; *c.* 380,000 m^3 of plywood and veneer, that is less than 1 % of the world production.

Logging in Central Africa is characterized by its high selectivity. For economic reasons, only a few species are commercialized. Usually only one to two trees are

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felled per hectare and the cover disturbance is about 10 %. The most felled species can be grouped in two categories: hygrophilous evergreen rain forest species and moist semi-evergreen rain forest species. The first category is mainly composed of azobe *Lophira alata*, beli *Julbernardia pellegriniana*, douka *Tieghemella africana*, kevazingo *Guibourtia* spp., okoume *Aucoumea klaineana*, pachyloba *Afzelia pachyloba*, tali *Erythrophleum ivorense*. The second category is made up of afromosia *Pericopsis elata*, agba *Prioria balsamifera*, ayous *Triplochyton scleroxylon*, dibetou *Lovoa trichiloides*, frake *Terminalia superba*, iroko *Milicia excelsa*, kossipo *Entandrophragma candollei*, moabi *Baillonella toxisperma*, movingui *Distemonanthus benthamianus*, padouk *Pterocarpus soyauxii*, sapelli *Entandrophragma cylindricum*, sipo *Entandrophragma utile*.

The major forest companies in the region are mostly subsidiaries of larger European firms (French, German, etc.) although Asian business is becoming more and more important. Obliged by the recent evolution of the Central African forestry laws, some of these logging companies are conceiving forest management plans. The management methods currently implemented were developed as normative regulations issued under the forest laws in the region. The basis of these methods is a statistical inventory of the resources which allows the determination of the population structures, *i.e.* the number of stems per diameter class. Considering increment and mortality, rotation and/or minimum felling diameters are adapted to reach a satisfactory reconstitution rate. Unfortunately, fundamental knowledge about the species population dynamic parameters is still lacking and finally the precision on the rate of reconstitution after a cutting cycle is jeopardized. Moreover, these methods do not pay any attention to long-term preservation of the logged species, since species could have a satisfactory level of reconstitution after one rotation, but could disappear after a second cycle. For such species specific interventions are needed to improve their natural regeneration capacities.

In this paper, examples are given for a 176,000 ha management unit in Cameroon for flagship species: assamela *Pericopsis elata*, ayous *Triplochyton scleroxylon*, iroko *Milicia excelsa*, moabi *Baillonella toxisperma*, sapelli *Entandrophragma cylindricum* and tali *Erythrophleum ivorense*.

The obtained results attest the need to implement sylvicultural techniques in order to maintain the production capacity of the African rain forests, this production capacity being the best guarantee for the preservation of their integrity.

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MAYAUX *et al.* (2004) group under the term "rain forests" the following forest types: evergreen and semi-evergreen formations with a tree layer superior to 70 %, degraded forests originating from these formations (tree layer between 40 and 70 %) and mangroves. Defined this way, African rain forests would cover a surface of 235,910,000 ha, that is 7.9 % of the total surface of the African continent. Besides rain forests, they also identify closed deciduous forests that they group together with woodlands. This category represents 411,582,000 ha, or 13.7 % of the total surface of the continent.

The FAO (2001) gives a much larger definition of forests; it puts in this category all formations of at least 0.5 ha with a tree layer of at least 10 %. This definition therefore brings together woodlands and wooded grasslands as defined by WHITE (1983) and LETOUZEY (1969). The African forest surface announced by the FAO is thus superior with nearly 650 million ha, which almost corresponds to the cumulated surface of rain forests and woodlands of MAYAUX *et al.* (2004).

The other categories of "canopy cover" would be: shrublands corresponding to about 13.4 % of the continent, bare soils (mainly the Sahara desert) with 33.2 %, grasslands with 15.4 %, croplands with 11.6 %, mosaic forests with 4.3 % and wetlands with 0.6 % (MAYAUX *et al.* 2004).

The Central African forests constitute the last great massif of the continent, the second worldwide after the Amazonian Basin, with a total surface of 203,367,000 ha. West African forests are much more degraded with a total surface of only 10,389,000 ha (fig. 1) (MAYAUX *et al.* 2004).

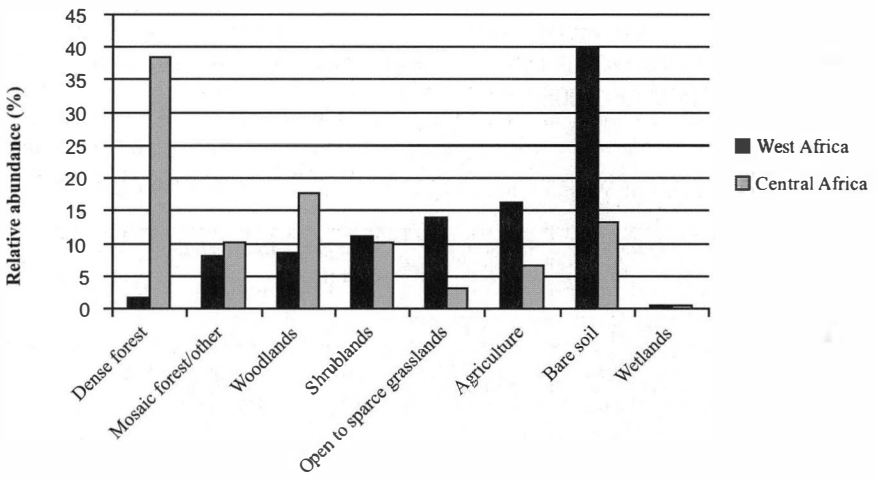

Fig. 1. — Relative abundance of the main land-cover classes (adapted from MAYAUX *et al.* 2004) for West African countries (Benin, Burkina Faso, Ivory Coast, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo) and Central African countries (Burundi, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of Congo, Equatorial Guinea, Gabon, Rwanda).

Five countries account for more than 85 % of the total surface occupied by African rain forests (fig. 2). These are the Democratic Republic of Congo (DRC) (124,566,000 ha), Congo (25,914,000 ha), Cameroon

(21,436,000 ha), Gabon (21,190,000 ha) and the Central African Republic (CAR) (8,227,000 ha).

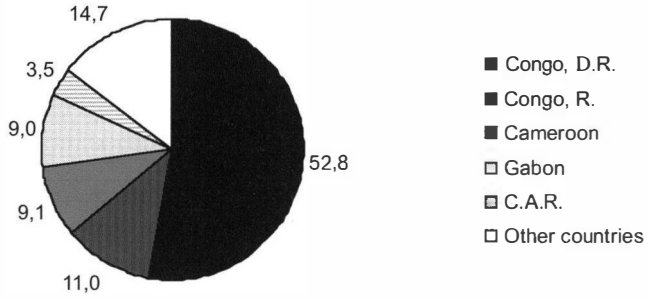

Fig. 2. — Distribution (in %) of the rain forest in major African countries (adapted from MAYAUX 2004).

According to the FAO (2001), Africa has the highest deforestation rate of all the continents, with an annual rate of 0.8 %. West Africa is without any doubt most affected by this problem, with a mean annual deforestation rate of 1.7 % (tab. 1) (FAO 2003a).

Table 1
Characteristics of Western and Central African rain forest (1999-2000)

Subcontinent / Countries	**Population density** (N/km²)[2]	**Dense forest area** (000 ha)[1]	**Area *per capita*** (ha)[2]	**Deforestation** (%)[2]	**Percentage of cropland** (%)[2]
West Africa	43.0	10,389	0.8	1.7	16.4
Cameroon	31.6	21,436	1.6	0.9	10.6
Congo, DR	22.2	124,566	2.7	0.4	0.4
CAR	5.7	8,227	6.5	0.1	1.5
Congo, Rep.	8.4	25,914	7.7	0.1	0.6
Gabon	4.6	21,190	18.2	< 0.1	0.1

[1] *Source*: MAYAUX *et al.* (2004); [2] *Source*: FAO 2001, 2003a.

Between 1990 and 2000, West Africa lost about 1.2 million ha of forest each year, corresponding to about 24 % of the annual deforestation in Africa. Nigeria, Ivory Coast and Ghana were responsible for 62 % of this deforestation within the subregion even if they only have 37 % of the forest surface in West Africa. Apart from this reduction in forest cover, the most alarming effects of this evolution are the degradation and fragmentation of the forests. Estimations indicate that less than 20 % of the zones in

West Africa that are considered as forests can still convene for timber production goals. In Nigeria *e.g.*, only 1 million ha of the total forested surface (13.5 million ha) could currently still be used to produce timber (FAO 2003a).

Several factors have caused this important degradation, in particular the conversion of land into croplands (commercial or subsistence agriculture), logging, mining, the development of infrastructure and natural disasters such as fires (FAO 2003a).

Unfortunately, forecasts are not at all optimistic: in the next twenty years, the population in West Africa will grow by an estimated 110 million inhabitants, corresponding to 28 % of the total population increase in Africa (FAO 2003a). This growth will lead to an increasing demand for croplands and wood. Estimations indicate that about 91 % of produced round wood is currently being used as fuel wood. In 2000, no less than 175 million m^3 were used in this way, whereas the production of industrial round wood was only equal to 18 million m^3 or 26 % of the African production. By 2020, the annual consumption of combustible wood will be equal to about 235 million m^3 (FAO 2003a).

Deforestation in Central African forests is less worrying with a mean rate of 0.4 % per year. The main countries in this region are affected in different ways. Cameroon and the Democratic Republic of Congo have the highest deforestation rates with 0.9 and 0.4 %, while in Congo, the Central African Republic and Gabon they remain rather low (less than 0.1 %). As in West Africa, deforestation seems to grow as a result of the population growth (see tab. 1) and manifests itself by the conversion of forests into croplands. Taking into account the important available forest area per inhabitant, one can suppose that deforestation rates will remain the same during the next two decades. An expansion in agriculture does not seem probable in this context of availability of land (De Wachter 2001).

Despite the fact that scientists have shown that agricultural development is cited as a cause of deforestation in all the studies dealing with this subject (FAO 2003b), logging companies are often accused of being responsible for it.

Place and Impact of Forest Logging

An estimated 45 % of the forest cover in Central Africa has a forest concession status with important differences between the countries (36 % of the forest surface in DRC and 79 % in Congo) (Minnemeyer 2002).

In 2003, the five main forest countries in Central Africa produced about 7.4 million m^3 of round wood, 1.1 million m^3 of sawn wood, about 380,000 m^3 of veneer and plywood. Even if figures regarding production volumes differ quite a lot according to the consulted sources (FAO 2003a, b; ITTO 2003), it is amazing to see that the Central African production volumes are less important than those of West Africa, despite a forest surface that is almost twenty times bigger.

Globally, Central Africa only plays a minor role as its share in the world production remains low (fig. 3): it produces only 4.4 % of all fuel wood, 0.7 % of all worldwide produced industrial round wood, 0.7 % of sawn wood and 0.2 % of wood-based panels. Moreover, Central Africa is not at all present on the pulp and paper market (FAO 2003b).

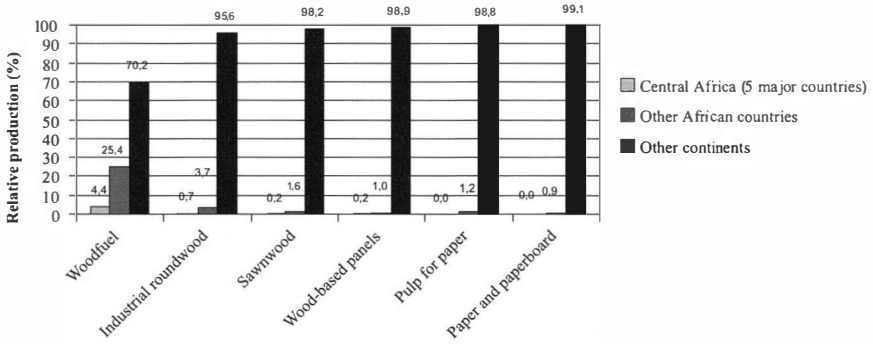

Fig. 3. — Relative part of the African and Central African countries (Central African Republic, Cameroon, Congo, Democratic Republic of Congo, Gabon) in the global production of wood (FAO 2003b).

Logging firms operating in Central Africa are often subsidiaries of foreign (European or Asian) companies, sometimes operating on concessions of several million hectares (AFLEG-INFO 2003). The WRI (2000) estimates that half of the forest concessions in Gabon are allocated to 5 % of the concession holders. These firms export sawn or round wood (according to the national legislation restrictions) mainly to Europe and Asia. In 2003, two out of three Gabonese trees were exported to Asia, while the exported round wood and sawn wood from Cameroon were mainly exported to Europe (respectively 56 et 84 %) (ATIBT 2004).

The timber market is very selective and logging is limited to a very small number of species (tab. 2). A group of twenty-three species constitutes 90 % of the total exported volumes from Gabon and Cameroon. The forest would,

however, be composed of about 1,000 tree species (VANDE WEGHE 2004). In general, one or two species make up more than 50 % of the exported volumes, this is the case of the okoumé in Gabon (64 %) and the ayous and sapelli in Cameroon (55 %) (ATIBT 2004).

Table 2
The most exported species from Cameroon and Gabon
(at least 1.0 % of the total exported volume in one of the two countries)

Species	Scientific name	Favourite variant of rain forest	Sawnwood from Cameroon	Logs from Gabon
Azobé	*Lophira alata*	Evergreen	6.1	1.7
Béli	*Julbernardia pellegriniana*	Evergreen	0.0	2.0
Douka	*Tieghemella africana*	Evergreen	0.0	1.5
Kévazingo Bubinga	*Guibourtia tessmannii, G. pellegriniana*	Evergreen	0.3	2.9
Okoumé	*Aucoumea klaineana*	Evergreen	0.0	64.0
Ovengkol	*Guibourtia ehie*	Evergreen	0.0	1.0
Tali	*Erythrophleum ivorense*	Evergreen	6.2	1.2
Doussié	*Afzelia bipindensis*	Evergreen & semi-evergreen	1.1	0.5
Pachyloba	*Afzelia pachyloba*	Evergreen & semi-evergreen	4.2	0.0
Acajou	*Khaya ivorensis*	Semi-evergreen	1.2	1.0
Assamela	*Pericopsis elata*	Semi-evergreen	1.5	0.0
Ayous	*Triplochyton scleroxylon*	Semi-evergreen	31.6	0.0
Dibétou	*Lovoa trichiloides*	Semi-evergreen	1.5	0.2
Fraké	*Terminalia superba*	Semi-evergreen	1.7	0.0
Iroko	*Milicia excelsa*	Semi-evergreen	8.4	1.1
Kossipo	*Entandrophragma candollei*	Semi-evergreen	2.2	0.1
Moabi	*Baillonella toxisperma*	Semi-evergreen	1.8	3.2
Movingui	*Distemonanthus benthamianus*	Semi-evergreen	2.4	2.0
Padouk	*Pterocarpus soyauxii*	Semi-evergreen	0.7	6.4
Sapelli	*Entandrophragma cylindricum*	Semi-evergreen	23.1	0.7
Sipo	*Entandrophragma utile*	Semi-evergreen	2.2	0.4
Tola, agba	*Prioria balsamifera*	Semi-evergreen	0.1	1.4
Bahia	*Hallea* spp.	Swamp	0.0	1.2
TOTAL			96.3	92.5

Sources: ATIBT 2004, DOUCET 2003.

The exploited species can be classified into two main groups according to chorological criteria: (1) the species of the hygrophilous coastal evergreen rain forest limited to the most western part of the Guineo-Congolian Region,

that is West Gabon and West Cameroon; (2) the species of the semi-evergreen forest, the most important forest type in Cameroon, the Central African Republic, the Democratic Republic of Congo and Congo. Amongst the first group, we find the azobé, béli, douka, kévazingo, okoumé, ovengkol and tali. The second group is mainly composed of the following species: acajou, assamela, ayous, dibétou, fraké, iroko, kossipo, moabi, movingui, padouk, sapelli, sipo and tola (DOUCET 2003).

Despite their economic importance, the ecology of these species remains almost unknown. Indeed, few studies on the ecology of these species have been carried out (BRUNCK *et al.* 1990, DEBROUX 1998, GROULEZ & WOOD 1984). The FAO (2003b) mentions that research in sub-Saharan Africa is rather limited, as only 0.7 % of all worldwide published scientific articles deal with this region.

Current logging practices in Central Africa involve the cutting of 0.5 to 2 trees/ha, that represents 5 to 15 m^3/ha (FARGEOT *et al.* 2004, DOUCET 2003). The impact on the forest cover remains low, only about 10 % (DOUCET 2003, WHITE 1992, WILKIE *et al.* 1992). Moreover, the number of damaged trees is generally lower than on other continents (STRUHSAKER 1997, JOHNS 1988, CROME *et al.* 1992). DOUCET (2003) estimates that for each conventionally felled tree (without applying low-impact logging techniques) 9 trees (dbh ≥ 10 cm) are destroyed, 11 are seriously damaged and 18 are slightly damaged. This corresponds to 13 % of the initial stand.

On the other hand, as forest exploitation is limited to a very small range of species and to the best trees, it can cause genetic creaming which might even lead to genetic drift (NANSON 2004). Moreover, as most of the commercial species have a rather heliophilous character, their regeneration is often deficient (the opening of the forest cover as a result of exploitation efforts is not sufficient to stimulate the regeneration). As a result, the impact of exploitation on species populations could be very important (DOUCET 2003, GOBERT 2002, DEGUERET 2002).

Besides the impact on the structure and quality of populations, exploitation can also have an impact on the different components of biodiversity (landscapes, ecosystems, communities, species and genetic aspects). PULTZ *et al.* (2000) propose quite a complete overview.

In Central Africa, exploitation makes access to previously inaccessible zones easier, which generally leads to an increased impact of hunting and to the development of commercial circuits of bush meat (MATHOT & DOUCET 2005). One also has to consider the impact on the structure of local communities (VERMEULEN & DOUCET 2005).

Growing towards a Sustainable Forest Management

In order to limit the negative impact of exploitation and to ensure sustainable production, most Central African countries have modified their legislation in the past decade (AFLEG-INFO 2003). Logging companies are now obliged to develop a management plan. CASSAGNE *et al.* (2004) estimate that more than 17 million ha are currently undergoing "management interventions", from preparatory studies to the implementation on the field. The creation of a network of sustainable managed forest concessions could complete the protected areas network with an estimated surface of about 16 million ha.

A management plan is based, among other things, on a statistical inventory of the available timber resources using a sampling rate situated between 0.5 and 1.5 % (BAYOL & BORIE 2004). The obtained results make it possible to establish — for each species — population structures which correspond to the evolution of the number of trees per diametric class. These structures are key elements to determine essential management parameters such as the rotation, minimum felling diameters (MFD), the delimitation of "annual harvest areas", etc. A management plan must also include a detailed cartography of the concessions and should include the measures necessary to minimize ecological and social effects. Forest management costs cannot be neglected as they vary from 4 to 5 €/ha (FORNI & BAYOL 2004).

The applied procedure is based on the experiments conducted during the nineties in Cameroon and the Central African Republic. These experiments have obtained the status of "examples" and have been integrated into national legislations (BAYOL & BORIE 2004). Unfortunately, some gaps in knowledge, sometimes very important, remain and could even jeopardize the durability of the management efforts.

To illustrate this statement, a managed forest concession situated in the south-western part of Cameroon is taken as an example. The studied forest concession has a surface of 176,000 ha inventoried at a 0.64 % rate and is part of a transition zone between semi-evergreen and evergreen forest types (FETEKE *et al.* 2004).

The structures of populations of commercial species were established using the inventory results. Figures 4 and 5 present the population structures of some of these species: sapelli *Entandrophragma cylindricum,* moabi *Baillonella toxisperma,* tiama *Entandrophragma angolense,* assamela *Pericopsis elata,* ayous *Triplochyton scleroxylon,* tali *Erythrophleum ivorense,* iroko *Milicia excelsa.*

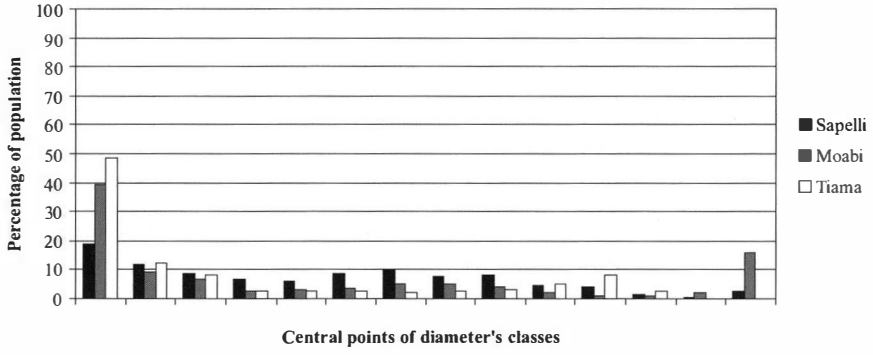

Fig. 4. — Population structures obtained from a management inventory (176,000 ha in South-East Cameroon).

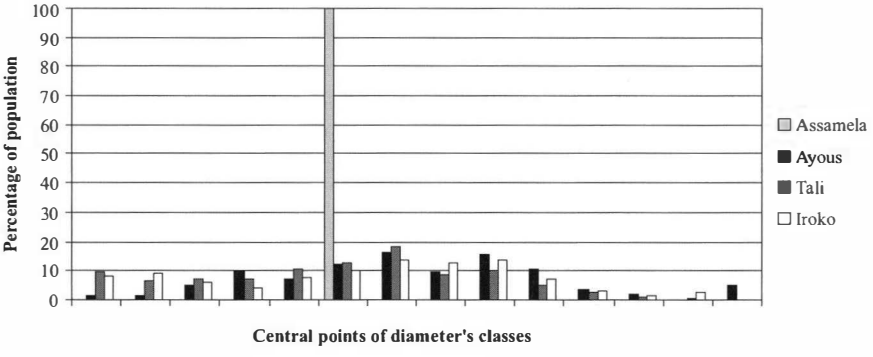

Fig. 5. — Population structures obtained from a management inventory (176,000 ha in South-East Cameroon).

Of the seven species presented, four have obvious regeneration problems as young trees are very rare. The concerned species are the iroko, the assamela, the ayous and the tali. Only the tiama, moabi and — to a lesser extent — the sapelli have quite good regeneration rates.

In order to determine the levels of reconstitution after exploitation of these populations, the following formula is used (DURIEU DE MADRON & FORNI 1997):

$$\%RE = 100 \frac{[N_0(1-d)](1-a)^{T}}{Np}$$

With:

% RE = reconstitution rate of the number of exploitable trees; N_0 = number of trees in diameter classes inferior to the MFD that contribute to the reconstitution of the exploited volumes; MFD = minimum felling diameter; Np = number of trees with a diameter superior to the MFD; a = annual mortality rate; d = damage rate due to logging; T = rotation.

Legislation in Cameroon fixes the rotation period at thirty years, annual mortality at 1 % and exploitation damage at 7 %. It also defines legal minimum felling diameters (MFD); these can be reviewed in order to attain a reconstitution rate of at least 50 % for the managed species. Moreover, trees with a diameter superior to the MFD + 40 cm are not taken into account as they do not intervene when calculating the reconstitution rates. These are very old trees, sometimes several hundred years old. They cannot be replaced within a thirty-year period. The number of stems participating in the reconstitution (N_0) is directly dependent on the growth rate of the species. Indeed, the quicker a species grows, the bigger the number of stems participating in the reconstitution will be. Growth rates are also fixed by the Cameroon legislation. Table 3 presents reconstitution rates according to different exploitation diameters for the seven species previously cited.

Table 3
Simulation of the reconstitution rate for seven commercial species on the basis of a management inventory in South-East Cameroon (176,000 ha)

Species	**MFD** (cm)	**MAD** (cm)	**Rate of reconstitution** (%)			
			MFD	MFD + 10	MFD + 20	MFD + 30
Sapelli	100	0.5	48	77	100	254
Moabi	100	0.4	50	80	102	93
Tiama	80	0.5	20	23	29	54
Iroko	100	0.5	52	114	206	278
Assamela	80	0.4	*	*	*	*
Ayous	80	0.9	35	64	88	162
Tali	50	0.4	12	14	26	55

MFD = minimum legal felling diameter; MAD = mean annual diametric growth; * = no stems above MFD.

For two of these species, the minimum reconstitution rate (50 %) is reached at the legal MFD. The species concerned are the iroko and the moabi. For the others, a rise of this MFD is needed to reach this rate; it should be 10 cm for the ayous and the sapelli, 30 cm for the tiama and the

tali. As the assamela does not have any stems superior to the MFD, its exploitation must logically be prohibited.

We are therefore confronted to quite a contradictory situation. On the one hand, species like the tiama with a population structure that guarantees its long-term preservation are touched by a notable restriction in terms of exploitation. On the other hand, species like the iroko with a very unfavourable population structure can be exploited when the legal MFD is attained. The exploitation of this species is however very problematic for its survival.

The determination of reconstitution rates, key element for management, is problematic in itself. Even a little change in some parameter values can lead to completely different reconstitution rates. Thus, when considering the example of the moabi (tab. 4), a slight modification in the mean annual growth rates (from 0.4 to 0.6 cm) causes an increase in reconstitution rates from 50 to 76 % for a MFD of 100 cm.

Table 4

Influence of different parameters on the rate of reconstitution of the moabi population on the basis of a management inventory in South-East Cameroon (176,000 ha)

MFD (cm)	**MAD** (cm)	**AM** (%)	**LI** (%)	**Rate of reconstitution** (%)			
				MFD	MFD + 10	MFD + 20	MFD + 30
100	0.3	1	7	37	57	68	57
100	0.4	1	7	50	80	102	93
100	0.5	1	7	63	104	142	136
100	0.6	1	7	76	128	182	180
100	0.4	1	10	49	77	99	90
100	0.4	1.5	7	42	66	85	77

MFD = minimum legal felling diameter; MAD = mean annual diametric growth; AM = annual mortality (% of stems); LI = logging impact (% stems destroyed).

Although the growth rate plays a key role in forest management, very few studies deal with this subject (DURRIEU DE MADRON *et al.* 1998, 2000; DEBROUX 1998; DETIENNE *et al.* 1998; BEDEL *et al.* 1998; DOUCET 2003). Moreover, when calculating reconstitution rates, growth rate is often considered as a constant factor not related to the diameter class. This however does not correspond to reality. DEBROUX (1998) noted annual growth rates of 0.1 cm for moabi trees with a diameter of 10 cm, while annual growth can reach 0.95 cm/year for trees with a dbh situated between 40 and 70 cm.

As a result, the very expensive statistical resources inventory and the management plan that is based upon this inventory are finally established by

means of rough estimations of reconstitution rates, which threaten the sustainability of management efforts.

Conclusion

In the past decades, West African rain forests have undergone an important degradation. Population growth and the accompanying pressure on forest resources will probably not decrease in the coming years, even if recently adopted laws promoting a decentralized and community-based forest management are important steps in the right direction.

Central African forests still represent quite an intact massif although forests that are not affected by human pressure become increasingly rare (BRYANT *et al.* 1997). They are however of major ecologic interest due to their biological richness (VANDEWEGHE 2004).

Forest exploitation can play an important role to maintain forests. As forests obtain an economic value (generating jobs and foreign currencies), most of the states in the region recognize forests as reliable tools for development in an era where non-renewable resources are becoming dangerously scarce. Forest exploitation can nevertheless only contribute to sustainable development when the social and ecological impacts are minimized.

In order to maintain forest production capacity levels, forest management aiming at a permanent renewal of the resource is necessary. The traditionally used methods only consisted in the calculation of the reconstitution rate after one rotation of a duration generally comprised between twenty and thirty years (variable according to the countries and the current legislation). These methods can only guarantee a short-term renewal and do not take into account the conservation of species in the long term.

However, this conservation is crucial to guarantee sustainable production. A diversification of the exploitable species can be considered, but this does not resolve the risk of extinction of certain species.

Two recommendations can be formulated in order to guarantee sustainable production. The first concerns the development of knowledge regarding the ecology of the exploited species. Indeed, it is impossible to manage their populations without basic knowledge of their growth, their phenology, their natural mortality,... The second concerns the regeneration methods. For the species with unfavourable structure curves — established according to the results of the management inventory — supporting regeneration is essential. This support must be as pragmatic as possible so as not to put a strain on the already high costs of management. Techniques of

plantation in felling gaps, as the ones proposed by DOUCET (2003), currently tested in several forest concessions in Cameroon and Gabon, seem to produce encouraging results.

Despite the current management efforts carried out on over 17 million ha, continuous efforts in research and the improvement of techniques are essential to guarantee sustainable forest management.

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pp. 61-92.

Asia's Tropical Forests in a Changing Global Context: Can Expert-led Policy-making Cope with Change?

by

Rajindra PURI* & Deanna DONOVAN**

KEYWORDS. — Tropical Forest; Asia; Deforestation; Landscape Assessment; Environmental Policy.

SUMMARY. — This paper reviews the state of tropical forest in Asia today, highlighting political, social, economic and ecological characteristics of the changing global context and the ways in which these factors are affecting the tropical forest and how various organizations are addressing these changes and their impacts. While the forest and to some extent the forestry sector are recognized to be inherently dynamic, the pace of change has increased dramatically in recent years. As a consequence, Asia has been experiencing a series of forest-related crises, few of which are being dealt with wholly successfully. By way of example, CIFOR's Multidisciplinary Landscape Assessment (MLA) project in Indonesia is discussed. While successful at generating data on local people's valuation of forest resources, there remains the problem of effecting change in government policies to reflect this new information, a problem not unique to Indonesia. Questions raised by this project, and many others, include: how can we integrate the findings of field research into the decision-making processes, and can expert-led policy-making meet the challenge of multiple stakeholder participation and greater democracy in knowledge production? Successfully tackling these questions may well determine the fate of the tropical forest in the changing global context.

Introduction

Forest and human society have been inextricably linked throughout human experience despite the fact that our ancestors climbed out of the

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trees several million years ago. Forest products have served virtually our every need, from shelter to sustenance, and the forest's influence on the larger environment is increasingly recognized as crucial to the hospitable climate we enjoy. Throughout history the resilience of the forest, that is, its capacity for regeneration after disturbance, human induced or otherwise, has been both the boon and bane of human existence. Over the past century the growth of the human population and technological change have progressed at such a rapid pace that the ability of the forest to recover from intervention is threatened in many places (FORREST 2003). As globalization brings the sometimes dubious benefits of new technology to even the most remote areas of the planet, it is appropriate that we look closely at these areas under threat. Much of the world's remaining tropical forest, rich in biodiversity, survives, though increasingly tenuously, in remote regions. It is fitting therefore that we ask how projected changes, primarily human induced, might affect the tropical forest and what these changes might mean for the societies that depend on these ecosystems and their varied resources, directly and indirectly. Can scientists and forest experts mediate the impact of these changes so that human society can continue to live in relative harmony with the natural environment and to benefit from the forest ecosystem?

In this paper we focus on Southeast Asia, where the bulk of Asia's tropical forests survive. Although the forests of mainland and insular Southeast Asia are perhaps most famous for their highly prized tropical hardwood timber, they are extraordinarily rich in a great variety of plant and animal species. Though only one fifth the size of Africa's forests (FAO 2003, LAURANCE 1999), yet thirty-four times the size of Belgium, the forests of Indonesia are home to more mammal species than the whole of Africa, including the endangered orang-utan, Asian elephant, Sumatran tiger and Sumatran rhino (MACKINNON *et al.* 1996). We discuss recent research on the rates of deforestation, proximate and underlying causes of forest loss, both in the past and for the future, and programmes and mitigation measures proposed and implemented by governments and various non-governmental organizations (both international and national level NGOs) in tropical Asia. We have chosen to focus on countries from both island and mainland Southeast Asia [1] *, primarily because of the units of analysis adopted by previous researchers and compilers of statistics (FAO 2003). For these reasons the analysis presented here excludes the

* The numbers in brackets [ ] refer to the notes, pp. 86-87.

tropical forests in Papua New Guinea, Sri Lanka and India, although we recognize these to be important as well.

Following a brief overview of the current situation, its development and the major issues, we focus on a typical community-based project aimed at promoting sustainable forest management in Indonesian Borneo. Ongoing since 1999, CIFOR's Multidisciplinary Landscape Assessment (MLA), sponsored by CIFOR, ITTO, and the EC [2], involves local, national and international researchers and organizations. We discuss attempts by the MLA team to introduce their research results into local and national decision-making processes, and then offer comments of a more general nature on why such interventions are likely to prove difficult if not impossible.

We conclude, and thus agree with BLAIKIE & MULDAVIN (2004), that to assume that government officials charged with forest management and development work from a model of expert-led decision-making and suffer from a lack of knowledge is a mistake. While local knowledge about particular locations is critical to decentralized planning, it may be difficult for democratically generated local knowledge to get a fair hearing. Competing powerful interests and the prevailing discourse on economic development collude to discount such knowledge. Thus, unless truly democratic institutions evolve to complement recent efforts to decentralize decision-making, real bottom-up, sustainable forest management is unlikely to develop or to deter the continuing unsustainable exploitation of tropical forests in Asia or elsewhere. We see historical tradition and particular cultural values and norms of traditional decision-makers, which exhibit great inertia in the face of economic and technological change, as major impediments to this process of democratization essential to sustainable resource management. Developing local traditions that support social advancement while discouraging customs that undermine positive development and environmental sustainability is the challenge facing all levels of government in Asia today (see also World Resources Institute 2003).

Background

Before we delve into a discussion of what impacts might be expected from the changing social, political and economic environment, it may be helpful to pause for consideration of the historical perspective. In short, to first understand the current condition of the tropical forest we need to understand the conditions that have propelled us to this position.

The Historical Role of the Forest in Tropical Asia

People have inhabited the tropical forests of Asia since the Pleistocene, yet we have only recently begun to clearly understand their impact on ancient forests (Bellwood 1985). Archaeology, archaeobotany and forest chronology, areas of growing interest and research, are adding significantly to our understanding of past environments and early human-nature relationships. Humans have come to dominate the landscape only since the last ice age; 8,000 years ago most of Southeast Asia was under forest cover (Billington *et al.* 1996 in Sodhi *et al.* 2004). Over the millennia, as mankind shifted from a hunting-gathering or nomadic herding existence to a relatively more sedentary, agriculture-based lifestyle, dietary change demanded a greater effort be made to secure salt, a critical mineral in human and livestock diets and thus salt became one of the earliest traded commodities (Kurlansky 2003). In addition, the differential distribution of highly prized natural products, very often forest products, motivated interaction between neighbouring populations became the basis of important trading relationships, many of which have lasted well into the modern era (Hirth & Rockhill 1911, Wheatley 1959, Schafee 1985, Donovan 2003). Attracted by the silks, spices and other luxury products of the Far East, western European merchants and governments in the 15th century financed exploration around the world.

The colonial era followed as European powers with superior military might sought to secure control of both markets and raw materials, primarily in natural products. Commodities such as pepper, cinnamon, various aromatic and decorative woods (*e.g.*, sandalwood, ebony), resins, lacquer, deerskins, and tortoiseshell came directly from the forest or semi-domesticated forest species (St. John 1862, Reid 1993, Boomgaard 1995). The colonial period was also important for the introduction and widespread planting of commercial tree crops such as rubber (*Hevea brasiliensis*), oil palm (*Elaeis guineensis*) and coconut (*Cocos nucifera*), which came to cover 20-30 % of the total cultivated area in the region (Flint 1994 in Sodhi *et al.* 2004). These crops, subsequently important export commodities and foreign exchange earners, replaced natural forest or forested fallows. The increasing local and global demand for rice (*Oryza sativa*) in the 1880s also led to large-scale land conversion bringing yet more forest land under agriculture (Flint 1994 in Sodhi *et al.* 2004). Between 1880-1980 in Southeast Asia, average annual loss of forest due to conversion was 0.3 % (Flint 1994 in Sodhi *et al.* 2004).

Throughout history the forest has been perceived as a 'strategic' resource (Donovan *et al.*, forthcoming). In addition to offering refuge from raiders

and invaders, the forest provided means for defence. From the forest came the raw materials for construction of ramparts and battering rams, the charcoal to produce the armaments, and the timber and naval stores to build battleships, which played a major role in military defence until the end of the 19th century. Historically, even after the cessation of violent conflict, forests have continued to play an important role by providing the victors the resources to reward family, friends, loyal followers and other favourites for their support. In addition the forest provided high-value products, which governments could sell or trade. For many of the governments in South and Southeast Asia the trade in forest products remained a major source of government revenues well into the 20th century (REID 1993, BOOMGAARD 1995, DONOVAN 2003). Well into recent times a major expense for many of Southeast Asian governments has been the maintenance of the existing power structure with a strong military. Following historical tradition many countries have financed this military support directly from the proceeds of natural resource (especially forest) exploitation (*e.g.*, NETTE 1995, VAN ZORGE 1999, BARBER & TALBOTT 2003).

After World War II and the dismantling of colonial governments throughout the region, increasing demand for timber worldwide coupled with technological innovations (such as the crawler tractor) that improved access to forest resources led to a boom in logging. Southeast Asia was well placed to meet this demand. As WHITMORE (1998) noted, the tropical forests of Southeast Asia, rich in dipterocarp species, were particularly attractive from a commercial standpoint because their many species of hardwood timber could be grouped into just a few end-use classes, which facilitated marketing. Moreover, new species introduced into the market could follow in the established footsteps of the earlier, well-known and much appreciated historically traded Asian timber species such as teak (*Tectona grandis*), rosewood (*Dalbergia* sp.), and ebony (*Diosyros* sp.), among others.

THE CURRENT STATE OF ASIA'S TROPICAL FORESTS

The post-war timber boom seems to have fixed in the public mind the link between Asian forests and tropical hardwood timber. However, more recently forests, as multi-level, complex, dynamic ecosystems composed of a broad spectrum of living organisms — plant, animal, insects, fungi, among others — are increasingly coming to be appreciated for what they hold in addition to timber. The resurgence of interest in non-timber forest products (such as resins, fruits, and medicinal plants), in the many and

varied forms of tropical forest wildlife, and in the people who have long inhabited forested areas is testimony to this growing awareness. Here we review briefly current conditions vis-à-vis forest cover, forest biodiversity and forest peoples.

Forest Cover

Asia's tropical forest is of special concern to both conservation and commercial interests not only because it is smaller (316 million ha) than other tropical areas (Americas with 916 million ha and Africa with 527 million ha), but because it experiences the highest relative rates of deforestation and logging (LAURANCE 1999). During the period of 1990-2000, rates of loss in forest cover increased dramatically from 1.2 to 1.4 % per annum (FAO 2003). Officially Indonesia lost 1.3 million ha per year; unofficially the figure is probably closer to 2 million ha per year (FWI/GFW 2002, FAO 2001, SODHI *et al.* 2004) [3]. Worldwide, during this period, about 14.6 million ha of forest were lost annually, while only 5.2 million ha were gained in plantations, for a net loss of 9.4 million ha per year (an area three times the size of Belgium) (FAO 2001) [4]. Asian rates of tropical forest lost are higher than those for other species-rich tropical areas such as Africa (0.8), Central America and the Caribbean (1.2 %) or South America (0.5 %) (FAO 2003), though Latin America has the highest rate of forest conversion in absolute terms (LAURANCE 1999). Currently, insular Southeast Asia has a land area with 53 % forest cover but it is estimated that less than half (*i.e.*, from 41.3 to 44.2 %) of the original forest of tropical Asia remains today (FAO 2003, SODHI *et al.* 2004).

Not all forest impacted by human intervention is clear-felled. A significant portion, however, is so dramatically affected that it is termed 'degraded'. Degraded forest land is so severely compromised and damaged by excessive harvesting, poor management, repeated fire, grazing or other disturbance that re-establishment of forest is significantly delayed (SIST *et al.* 2003). Worldwide an estimated 350 million ha of tropical forest have been so severely damaged that forests will not grow back spontaneously. Of this total, 35 % are in Asia (ITTO 2002). On the other hand, Vietnam through an aggressive reforestation programme has increased its forest cover by 0.5 % per year during the 1990s (FAO 2003). Enrichment planting, reforestation or land rehabilitation may improve many ecological services including the forest's protective and productive functions but the original forest can never be fully reinstated. Degraded forests are often most at risk, for although with proper management most could regenerate into healthy,

Table 1
Forest cover and change in Southeast Asia, 1990-2000

Country	Area (000 ha)	Forest area (000 ha)	Proportion of land in forest (%)	Annual change of forest area (000 ha)	Annual rate of forest change (%)
Brunei Darussalam	527	442	83.9	– 1	– 0.2
Cambodia	17,652	9,335	52.9	– 56	– 0.6
Indonesia	181,157	104,986	58	– 1,312	– 1.2
Lao People's Dem. Rep.	23,080	12,561	54.4	– 53	– 0.4
Malaysia	32,855	19,292	58.7	– 237	– 1.2
Myanmar	65,755	34,419	52.3	– 517	– 1.4
Philippines	29,817	5,789	19.4	– 89	– 1.4
Singapore	61	2	3.3	n.s.	n.s.
Thailand	51,089	14,762	28.9	– 112	– 0.7
Vietnam	32,550	9,819	30.2	52	0.5
Total	434,543	211,407	0.48	– 2,325	– 1.09

Source: FAO 2003.

productive forest, they are often targeted for conversion or, as in Indonesia, become the victims of devastating wildfires.

Some scientists have called attention to the perhaps uncertain future of the tropical forest in Southeast Asia based on what appears to be a compromised reproductive capability. As CURRAN *et al.* (1999) demonstrate, logging around Gunung Palung National Park in West Kalimantan, coupled with increasingly strong El Niño events, has led to a reduction in the volume of mast fruiting that occurs periodically in Southeast Asian dipterocarp forests. While normally the intermittent fruiting events produce enough fruit to overwhelm voracious seed predators, such as bearded pigs, smaller fruit sets mean that few fruits are left by the hungry animals, thus threatening the regeneration of these species and the structure and composition of the indigenous forest.

Forest Biodiversity

According to the most recent reports the state of biodiversity in the Asian tropical forests is even worse than the state of forest cover. Regulations have been passed and reserves established but these remain difficult to enforce in most areas, leading to many protected areas being labelled

'paper parks' (CURRAN *et al.* 2004). Poor administration as well as the lack of coordination across government policies contributes to the poor record in forest protection (GOI/IIED 1985, DONOVAN 2003). Research by Brooks, Sodhi and others predicts drastic declines in biodiversity for Singapore, which they see as a harbinger for the rest of Southeast Asia. The city-state has lost 95 % of its forest cover and an estimated 28 % at least of its biodiversity since 1819; the true extinction rate could be as high as 73 %. Butterflies, fish, birds and mammals have been particularly affected. They predict that by 2100 Southeast Asia will have lost 74 % of forest and between 13 and 42 % of plant and animal species in the region (SODHI *et al.* 2004, BROOK *et al.* 2003). Although only three plant and eight animal species have been listed as extinct by the IUCN (The World Conservation Union), there are high levels of endangerment for many more owing largely to isolation caused by habitat fragmentation. Based on IUCN categories, SODHI *et al.* (2004) report that the number of threatened species, that is, from 'critically endangered' to 'vulnerable', are: from 20 to 686 for vascular plants; for fish, from 6 to 91 species; for amphibians, from 0 to 23 species; for reptiles, from 4 to 8 species; for birds, from 7 to 116 species; and for mammals, from 5 to 147 species. Furthermore, because of a high incidence of endemism — almost 60 % of Indonesia's roughly 30,000 plants species are endemic — regional losses are likely to result in global extinctions (World Resources Institute 2003). Even less is known about the micro-organisms lost due to forest clearing and mismanagement, while more and more scientists come to appreciate the symbiotic relationships between various life forms and the contribution of even the smallest to the resilience and productivity of tropical forest ecosystems.

Forest Peoples

Increasingly it is recognized that people have long been, and in many areas still are, an integral element of the tropical forest environment. Indeed, the majority of experts would agree that there are no 'pristine', or humanly untouched, tropical forests in Southeast Asia. For a variety of reasons, however, the myth of the 'virgin' forest has been slow to die with unfortunately significant consequences for the treatment of forest peoples (DENSLOW & PADOCH 1988, SPONSEL *et al.* 1996). Roughly 70 million Indonesians, or one third of the country's citizens, rely on the forest, either directly through subsistence production and extraction, or indirectly. An estimated 10 to 15 million people from 748 ethnic minorities and indigenous groups across Indonesia, Malaysia, the Philippines and Thailand have

been affected by forest policies and deforestation (COLCHESTER 2004). Deforestation and biodiversity depletion affect human cultures directly through loss of habitat and preferred resources needed to maintain traditional livelihoods and cultural practices. The nutritional and psychological impacts of deforestation, resettlement and changes in lifestyles are readily apparent among indigenous people worldwide: malnutrition, increased incidence of non-communicable diseases, alcoholism, drug abuse, demoralization, despair and suicide are common in these societies (COLCHESTER 2004, DOUNIAS *et al.* 2004, HEADLAND 2004).

Deforestation also contributes to the extinction of localized languages and indigenous peoples themselves (ALCORN 1993, CHIN *et al.* 1992, WEISSMAN 1994). Recently much has been made about the close geographical association of high levels of biological and linguistic diversity (SUTHERLAND 2003). Indeed, the nations harbouring Asia's tropical forests boast nearly 24 % of the world's languages. The Summer Institute of Linguistics (SIL) records a total of 1,459 languages for tropical Asian countries, 12 of which are now extinct and 28 nearly extinct (7 % of the world's nearly extinct languages) (*Ethnologue* 2004). Deforestation often contributes to or exacerbates the loss of local languages and thus the knowledge and culture they encode and represent. The colonization of deforested areas along access roads by politically and culturally dominant populations and the displacement, removal or resettlement of indigenous populations from national parks, forest reserves, future reservoirs and timber concessions to urban and or other areas leads to linguistic 'swamping' by the dominant groups, resulting in increasing bilingualism and eventual language loss, especially among school children (HEADLAND 2004). The health problems noted above and often related to these locational changes can lead to increased mortality, especially among elders, thus reducing the speaking population to dangerously low numbers (DOUNIAS *et al.* 2004).

Today roughly 12 % of the world's surface has been set aside in some 100,000 'protected areas', 50 % of which, some estimate, have been established on indigenous, traditional territories. The consequences of these impositions on the lives of indigenous peoples are staggering, including dispossession, forced resettlements, and other gross violations of human rights (box 1) (GHIMIRE & PIMBERT 1996, GRAY *et al.* 1997, MACKAY 2002, NELSON & HOSSACK 2003, COLCHESTER 2004). While exact numbers for tropical Asia are unknown, COLCHESTER (2004) reports that as many as 600,000 tribal people have been displaced in India alone. In Indonesia, military maneuvers, following initial discussions about relocation with resident pepper farmers, may have intimidated the reluctant and forced them to leave

Box 1
Consequences of protected areas for indigenous peoples (COLCHESTER 2004)

- Denial of rights to land.
- Denial of use of and access to natural resources.
- Denial of political rights and the validity of customary institutions.
- Disrupted kinship systems.
- Disorganized settlement patterns.
- Loss of informal social networks, fundamental to the local economy.
- Undermining of livelihoods, loss of property, no compensation.
- Poverty.
- Disruption of customary systems of environment management.
- Enforced illegality. People become 'poachers', 'encroachers' and 'squatters' on their own land and are subject to petty tyrannies by park guards.
- Forced resettlement.
- Leadership systems destroyed, for if the community leaders accept the relocation they are accused of betraying their people, but if they resist they are proved powerless. Forced resettlement presents a no-win situation to community leaders.
- Symbolic ties to environment broken.
- Cultural identity weakened.
- Intensified pressure on natural resources outside the protected areas.
- Popular unrest, resistance, incendiarism, social conflict, and ensuing repression.

Bukit Soeharto National Park in East Kalimantan between 1990 and 1991 (VAYDA & SAHUR 1996). Attempts to meet international targets of protecting 10 % of total area per country, established at the 1992 UNCED (United Nations Conference on Environment and Development Collection) summit, mean new protected areas are still being established, for instance in Myanmar, and more cases of forced displacement of economically disadvantaged residents and the creation of conservation refugees can be expected (MACKAY & CARUSO 2004).

Conservation targets are thus often achieved at the cost of increased impoverishment of nearby residents, increased pressure on surrounding forests, and heightened resentment and alienation of former residents. This often leads to conflict between park managers and local communities, reducing people's interest in long-term stewardship and causing greater damage to the conservation values that the protected area was created to safeguard (COLCHESTER 2004). It is now common for revenge 'poaching' and destruction of resources and facilities to occur when park protection weakens as a result of political or economic crisis or conflict (DONOVAN

1999). The clearest example of this is the continuing assault on national parks in Indonesian Borneo, including Tanjung Puting, Kutai and Gunung Palung, following the economic and political crises of the late 1990s and recent decentralization policies associated with forest administration (MURPHY 2001, SUNDERLIN 2002, BARR & RESOSUDARMO 2002, SMITH *et al.* 2003, CURRAN *et al.* 2004).

Poverty and ill health remain high among indigenous peoples as most appear to have been neglected, ignored or disenfranchised in national development programmes of the last half-century. While conservationists and development agents preach the mantra of participation and collaboration, forest-based communities are rarely taken seriously and their attempts to survive on their own terms are often ignored.

The Changing Global Context

The recent dawning of the new millennium brought a flurry of interest in future studies and projections of what we might expect in the coming century. Sustained rapid advances in biology, computers and communications technology in particular continue to stimulate these forecasts. Increasingly, however, one recognizes that scientific discoveries and technological progress do not flow unimpeded into our everyday world. Rather their introduction is mediated by political, sociocultural and economic elements serving in effect as midwives. Thus, the key factors to consider when assessing the future of the forest must be those underlying political, social and economic forces. The environmental changes that scientists identify today echo the accumulated impact of a long list of activities, past and present.

Box 2 details some of the key factors in each category that may be expected to affect the fate of Asia's tropical forest. There are quite a few positive changes occurring across Asia's political landscape, especially with regard to changes in forest policy, regional cooperation via APF (Asia Peace Foundation), ITTO, ASEAN (Association of Southeast Asian Nations) and APEC (Asia-Pacific Economic Cooperation), greater public-private sector cooperation in forestry research and forest certification, and in some instances decentralization (BROWN & DURST 2003). Decentralization, however, has created in many cases a growing number of environmental crises especially in regions that have little if any human resource capacity to deal with the new rights and responsibilities, while the central government is unable or unwilling to address these issues (BARR & RESOSUDARMO 2002, RIBOT 2002). Conflicts in Myanmar, southern Philippines, Cambodia and parts of Indonesia

are leaving forests open to exploitation both by outsiders as well as local entrepreneurs often in collusion with individuals or groups seeking resources to finance public or private armies. Illegal logging is less likely to be controlled in a political climate of uncertainty where judicial systems are less than effective, especially at local levels (Ross 2000, Smith *et al.* 2003). Thus, as in the past, the forest continues to be used to serve political ends.

In terms of social factors, Asia's societies are becoming more urban and a growing middle class with an escalating level of disposable income and internet connectivity shows ever greater awareness of environmental issues, global news and current events. Civil society is growing with a larger number of national, regional and local non-governmental organizations dedicated to environmental and human welfare issues. Even as wealth increases in many of these countries, poor marginalized populations, such as indigenous peoples, remain mired at the bottom of the socioeconomic ladder. As arable land and readily accessible forest resources become ever more scarce this segment of the population can expect to be pushed further to the margins economically, politically, and geographically, if not forced to relocate, resettle and assimilate.

Asian tropical countries continue to suffer from the consequences of the economic crises of the late 1990s; people made poor or poorer by the economic turmoil continue to participate in incursions into previously protected areas and even commercial plantations, either alone or under contract to illegal logging and smuggling operations (Sunderlin 2002). The problem of heavily indebted forest companies in Indonesia is also worrying, as clearly not enough standing timber exists in legal concessions and plantations to cover the operating costs and debts of many of these corporations (Barr *et al.* 2002, Barr & Setiono 2003). Heavy indebtedness puts pressure on forest resources in protected areas and on vulnerable landscapes and is one of the driving forces of illegal logging in that country. The continuing explosive growth of China's economy is the other major economic factor impacting Southeast Asia's forest and wildlife (Donovan 1999, Sun *et al.* 2004). India's imports are also starting to rise, but whether this will have a significant impact on Southeast Asia's forests is uncertain. In general, increases in overall prosperity across Asia are leading to increases in demand for better housing, consumer goods and luxury items (Smith 1997, Sodhi *et al.* 2004). For many, high status foods and medicines are derived from wild plants and animals, and thus rising incomes are putting increased demands on the trade in wildlife, especially in mainland Southeast Asia (Donovan 1999, 2004).

Without a doubt China with a GDP (gross domestic product) growth rate more than double that of any of the western industrialized economies and

half again as high as any of its neighbours, will continue to exert a significant influence as it becomes increasingly a more important player in the world economy (*Economist* 2005). China has consolidated its position as the world's largest importer of tropical logs and sawn wood products, and the world's second largest importer of forest products in general. The majority of its forest product imports comes from Russia, Indonesia, Malaysia and Canada. Its imports of plywood, primarily from Indonesia, and other processed forest products are, however, shrinking as it builds up its own wood and paper products industry. Between 1997 and 2002, China's imports of forest products rose from USD 6.4 to USD 11.2 billion, an increase of 75 % (SUN *et al.* 2004, FAOSTATS 2004). By the end of September 2004 the total value of China's wood products trade was more than USD 23 billion, an increase over the year of 30 %. With wood furniture, the major export, up 40 %, paper products, waste paper, and wood pulp were the top imported wood products with the latter up 114 % (ITTO 2004). A 1998 ban on felling domestic old-growth timber has rendered China almost completely dependent on imported materials for its industrial pulp needs, at least in the near term (HYDE *et al.* 2003, FAOSTATS 2004). According to experts, China's rapidly expanding pulp and paper mills lacking domestic supplies over the next 10-15 years could well provide incentive for a surge in illegal logging in neighbouring countries such as Indonesia (KYNE 2004, SUN *et al.* 2004). Sources of timber may be shifting, however, from the tropics to temperate forests in Russia, Europe and North America as in these areas the annual increment of wood exceeds annual harvest. On a positive note, we see new sources of wood supply being developed as researchers explore new ways to utilize the wood from exhausted rubber, coconut and oil palm plantations (DURST & BROWN 2000, DURST *et al.* 2004). Indeed, rubber wood has become the basis of the new furniture industry in Malaysia and Thailand while bamboo is making a strong entry not only into the furniture market but into the realm of flooring and decor as well.

Most tropical nations aim to develop their wood industry and increase the export of processed wood products as opposed to raw material. With competition from 'certified' environmentally friendly wood products, a growing concern [5], some countries such as Malaysia and Indonesia are seeking to develop their own independent certification systems (MOLNAR 2004). Increasingly stakeholders and governments in countries, big and small, are developing new ways of cooperation to improve forest law and governance, *e.g.* bans on illegally sourced forest products including as conflict timber (ROCHEFORDIERE & MITCHELL 2001, JOHNSON *et al.* 2003, ARD 2003). The development of certified forests and certification programmes across

Southeast Asia, and the development of niche markets for forest products suggest a maturing of the sector away from simple extraction. Advances in biotechnology may improve the utility of various commercial species; for instance, increasing the cellulose content of pulp species may enable foresters of the future to reduce the land area required to produce a given quantity of wood pulp.

The most significant environmental changes occurring in Asia today are undoubtedly brought about by the loss of natural habitat for many endangered species, especially mammals (SODHI *et al.* 2004). Equally as important could be the conversion of traditional land-use systems to modern production systems. For example, the conversion of swidden cultivation systems to permanent agriculture is also thought to reduce the overall biomass of upland agroecosystems by eliminating fallow vegetation and thus reducing carbon storage (FOX 2002). Similarly, the harnessing of river systems for hydroelectric production floods extensive, often forest, areas and the conversion of mangrove ecosystems to commercial shrimp farms disrupts important local ecosystems. Air and water pollution, the 'collateral damage' of unregulated industrialization also threaten the environment across Asia. In urban areas there has been a steady increase in levels of vehicle generated air pollution, which are expected to affect human and wildlife health in these environments (HAQ *et al.* 2002).

Slower and perhaps more insidious is the environmental modification that could be brought about by climate change. CURRAN *et al.* (1999) note that the increased frequency of extreme El Niño events, possibly due to a changing global climate, brings the risk of more frequent droughts and crop failure as well as flooding and soil erosion throughout the Asian tropics. El Niño events are also understood to exacerbate the incidence and severity of tropical forest wildfires, which are increasingly recognized as a transboundary hazard for both people and wildlife across Southeast Asia (FAO 2003). Other impacts of climate change are more difficult to determine at this point, but higher temperatures in tropical areas can be expected to reduce primary productivity due to increased respiration (SODHI *et al.* 2004).

Across the region an increase in environmental problems, such as the wildfires, has enhanced public awareness of environmental issues which in turn has led to a growth in the number of national and local environmentally focused non-governmental organizations and an increase in region-wide legislation and programmes aimed at addressing some of these issues. As we see from a comparison of the factors of box 2 with those of boxes 3 and 4, many would contribute to exacerbating what have already been identified as either proximate or underlying causes of forest destruction and degradation.

Box 2
Key factors of global change

Political factors
- Terrorism.
- Internal conflicts or civil war funded by natural resource extraction (*e.g.*, conflict timber) and often fuelled by the competition for resources.
- Increasing role for ASEAN and other regional institutions.
- Decentralization with or without devolution.
- Increased participation and public-private sector collaboration.
- Civil society becoming more proactive and involved in public interest litigation.
- Increased recognition of collective rights and free, prior and informed consent as a principle in international law, private sector, NGO and national policies.

Social factors
- Increasing urbanization.
- Changing demographic structure as people live longer.
- Widening inequalities between rich and poor, rural and urban.
- Widespread and deepening rural poverty.
- Increasing awareness (via international organizations, media, internet).
- Increasing social activism and importance of NGOs.
- Improving position of urban, white-collar workers.
- Emergence of distinct urban middle class.
- Rural-urban migration.

Economic factors
- Expanding global market with increasing economic integration and interdependency. Improved telecommunications and infrastructure (reaching to the village level). Increased commercialization of local crops.
- Increasing level of materials consumption.
- Rise of China as economic power.
- Increasing influence of India in the market (and possibly Indonesia if it gets its political house in order).
- Increased demand for consumer goods, increasing demand for raw materials.
- Continued development of the biotechnology and IT sectors with convergence developing.
- Market developing for environmental services or public goods, including water, ecotourism and wildlife habitat.
- 'Precision' forest production for niche markets.
- Non-performing debt of forest companies (CIFOR project).

Environmental factors
- Decreasing area of natural forest while plantation area expands.
- Climate change, with higher temperatures possibly reducing productivity given increased respiration rates.
- Increasing awareness of environmental issues.
- Environmental degradation contributing to poverty.
- Loss of habitat and pushing many wild species of plants and animals to extinction. Increased air pollution with increased car population.
- Transboundary nature of environmental issues (including health issues).

Perceived Drivers of Forest Change

Explaining the accelerated rates of deforestation of the recent past has been something of a cottage industry for over twenty years now. From numerous studies we have been able to distinguish a variety of both proximate and fundamental causes of forest destruction and degradation. Below we document a range of direct and indirect causes of forest loss identified (box 3) and offer a broad selection of the more subtle, underlying factors posited to be drivers of the process (box 4).

Box 3
Direct and indirect causes of forest destruction and degradation

Wood extraction, formal and informal, legal and illegal;
Fires, intentional and accidental;
Pests and disease;
Introductions and invasive species;
Spontaneous or sponsored migration;
Infrastructure development, *e.g.*, roads, dams, urban settlement, markets etc.;
Trade in wild plant materials (*e.g.*, medicinals), animals and animal products;
NTFP extraction affects particular species but also may cause forest degradation in the process of being exploited;
Conversion to cultivation, including swidden systems, permanent agriculture, horticulture, forest plantations, or pasture.

Sources: Myers 1984, Fearnside 1993, Brown & Pierce 1994, Bawa & Dayanandan 1997, Laurance 1999, Geist & Lambin 2002, Sodhi *et al.* 2004.

Box 4
Underlying causes or drivers of forest destruction and degradation

Demographic factors, including population growth;
Economic development (GNI, GDP);
Technology;
Need (poverty or impoverishment);
Greed (capital accumulation);
Grievance;
Cultural values;
Inequitable and insecure land tenure;
Corruption;
Misguided government policies;
Institutional failures, lack of law enforcement;
Climate change, extreme weather events.

Sources: Painter & Durham 1995, Geist & Lambin 2002, FAO 2003, Sodhi *et al.* 2004.

A simplified ecological model for Southeast Asia is given by SODHI *et al.* (2004), whereby population density and gross national income (GNI) are negatively correlated with remaining forest cover. Thus, both economic development and population pressure are seen as the prime drivers of forest conversion. These factors far outweigh any impact currently associated with or expected of environmental modification, such as climate change, nitrogen deposition, invasive species and altered levels of atmospheric CO_2. However, the long-term and synergistic impacts of environmental change remain poorly understood. For example, increases in the wildlife trade and hunting for bushmeat are perceived to be driven by population pressure as well as rural poverty, complemented through the expanding market created by increasing disposal income in some urban areas; further, the deleterious impact of this traditional activity is exacerbated by a declining forest area, logging, road construction, spread of new technology, and ineffective protection of wildlife. Underlying all of these factors, the demand for wildlife derives from widespread and deeply entrenched cultural beliefs and values regarding pets, wild foods and traditional medicines (DONOVAN 1999, PURI 1999, KNIGHT 2004, DONOVAN 2004).

Challenging simple models of deforestation, anthropologists, geographers, political ecologists and other social scientists link local changes in forest cover to wider political, economic and sociocultural factors. GEIST & LAMBIN (2002) warn that the causes of deforestation are neither due to single causes, nor so complex and locally specific so as to be non-generalizable, rather "tropical deforestation is driven by identifiable regional patterns of causal factor synergies, of which the most prominent are economic factors, institutions, national policies and remote influences (at the underlying level) driving agricultural expansion, wood extraction, and infrastructure extension (at the proximate level)". Thus, natural population increase and shifting cultivation are rarely sole or primary causes of deforestation. In Asia, rather, one frequent pattern of causal interaction involves the expansion of road building for the purposes of commercial agricultural expansion and commercial wood extraction, which is driven by policy decisions regarding economic development, cultural values — such as little concern about forest — lack of property rights and policy failures (GEIST & LAMBIN 2002).

Further detail and complexity can be added to this scenario by considering the work of political ecologists, who explain deforestation as resulting from coincidental processes of impoverishment and capital accumulation — or need and greed to use simpler terminology (PAINTER & DURHAM 1995, RUDEL & ROPER 1997). In Asian contexts, these processes are interlinked politically and economically as follows: politicians trade access to forest resources, tax concessions and subsidies to 'infant industry'

entrepreneurs in return for financial and political support. The forces of order — military and police — trade protection and intimidation of opposition to timber barons for financial gain. The tropical forest provides the resources that fuel these arrangements (STILES 1991, ROBERTSON & SCHAIK 2001, SMITH *et al.* 2003). This system of kickbacks is in effect an indirect, if inefficient, tax system that weighs heaviest on the poor. Local and indigenous communities, dispossessed of their lands and natural resources, are often pushed into marginal lands where their attempts to survive lead to further forest destruction and degradation and impoverishment [6]. In retaliation, local people may raid forest concessions, plantations and officially gazetted 'protected' areas, 'poaching' the resources that they believe are rightfully their own in an effort to obtain material products that may be traded for cash or commodities on the informal market (PAINTER & DURHAM 1995, COLCHESTER 2004). Following extraction of commercial timber or land clearing by government resettlement schemes, such as the transmigration programme in Indonesia, spontaneous migration may cause further forest destruction engendering more resentment and sowing the seeds of future communal conflict. Thus together need, greed and grievance set the stage for conflict that more than once has erupted into extreme violence so prevalent in the tropical forest regions these days (DONOVAN *et al.*, forthcoming).

In examining these factors driving change, we should emphasize that no single factor or trend will likely be dominant. These factors do not work independently — some may be mutually reinforcing while others may work at cross-purposes, and the impact of each factor will vary in different regions and countries. Together, these driving factors and trends interact to create a picture about which we can make projections with varying degrees of confidence.

Addressing Forest Loss and Degradation

Despite the relatively recent (twentieth century) mobilization of international interest and resources to address forest degradation, concern for environmental destruction dates back several centuries if not millennia (see for example GLACKEN 1967, WORSTER 1977, GROVE 1995).

Southeast Asian countries have come a long way in their forestry policies and related legislation (BROWN & DURST 2003, tab. 2 below), with most adopting principles and policies of sustainable forest management (SFM) (but see SIST *et al.* 2003). Unlike African and Latin American nations that

Table 2
Sustainable forest management tools adopted by Southeast Asian countries

Tool	Brunei	Cambodia	Indonesia	Laos	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
National Forest Management Plan			X		X		X	X		
Criteria and Indicators[b]	X	X	X	X	X	X	X	X	X	X
Code of Practice (ASEAN adopted)		X	X	X	X	X				X
Logging bans (may not be total)		X	X[a]	X[a]			X[a]		X	X[a]
Regulated Concessions	X	X	X		X		X			X
State-owned corporations				X		X				
Direct incentives					X					X
Private sector research			X		X		X			
Certification			X		X	X				
Model forests			X			X	X		X	
Reduced Impact Logging Research			X		X					

Notes: [a] Partial ban only; [b] ITTO regulations adopted by ASEAN.
Source: BROWN & DURST 2003.

have not reached Asia's levels of deforestation and degradation, several countries including China, Thailand, Cambodia, Laos, Vietnam, Philippines and Indonesia have already reached situations where full or partial logging bans have become national policy. The effectiveness of these bans is debatable, however, especially since so much illegal logging plagues the region. The Association of Southeast Asian Nations (ASEAN) has also adopted ITTO regulations for Criteria and Indicators as well as Codes of Practice for SFM, but application in each nation is variable. Certification programmes, scientific research, model forests and reduced impact logging (RIL) studies are also all well advanced in Asia. Unfortunately, while many countries have made all the right moves in terms of policy, legislation, and international cooperation [7], there is often poor if any implementation and enforcement of the new laws and only minimal attempts to counter growing illegal extraction, mismanagement and corruption at the local level (SMITH *et al.* 2003, SIST *et al.* 2003).

Over the past decade the mushrooming, both in number and size, of the NGO community, many of which address conservation issues, is notable (tab. 3). Whether their activities are effective in halting or even hindering the course of events that annually contribute to the destruction and degradation of Asia's tropical forests is debatable. Rich rhetoric regarding the goals

and objectives of the various conservation organizations and foreign development assistance agencies abounds on their websites and in their promotional literature. Focusing on forestry alone, one can easily list more than thirty such organizations. In addition there are special programmes that have emerged to address particular issues, such as the Biodiversity Support Program of USAID, or the Darwin Initiative in the UK. To these must be added the various university initiatives and product-focused programmes, such as INBAR (a bamboo and rattan group). A sceptical environmentalist might conclude that an excessive amount of work is or has been done in this area already.

Many of the change factors noted in box 2 are undoubtedly perceived as positive and contributing to economic growth and improved human welfare. However, some factors, it is argued, may selectively favour one social or economic group over another and thus contribute to widening income disparity and increasing poverty, a trend widely perceived as a threat to sustainable development. Recently, the identification of these obstacles to growth and welfare has been the target of the various organizations involved in conservation and development assistance, with some claiming that such a focus has sidelined biodiversity conservation and funding for protected areas (LAPHAM & LIVERMORE 2003). In 2002 the World Bank approved a new forest policy, adopting a strategy that it hopes will improve both the economic condition of local people as well as environmental protection of the world's forests. The three 'interdependent pillars' of this policy are (1) the protection of forest values and services, (2) harnessing these to reduce poverty and (3) the integration of forests into sustainable development. According to the World Bank (2003), illegal logging results in losses of between USD 10-15 billion worth of forest resources which could support development. How do the various foreign development assistance organizations perceive the changing global context and its impact on the tropical forest and what are their strategies to address these issues? Tables 3 and 4 summarize the focus areas of some of the major non-governmental players in this arena.

Has foreign development assistance in the forest sector been effective? Would we have lost more forest without these efforts? Has it been sufficiently consistent over time to make more than a blip in the trend line of forest loss? It is difficult to know. Some would argue that too many development organizations become bogged down in their own 'self-perpetuation' with enormous effort devoted to public relations campaigns designed to create 'an illusion of effectiveness'. Moreover, it is argued, financial imperatives appear to reinforce the tendency to time-limited interventions and to engender a dependency among aid recipients (DICHTER 2003). Conservation seems to be one of those Promethean challenges in which

Table 3

Forest-related programmes of selected NGOs in tropical Asia

Topical focus	WWF	FFI	CI	TNC	WCS	RAN
Forest Conservation			X			
Biodiversity Conservation	X	X	X	X	X	
Sustainable Forest Management						
Community-based conservation	X	X		X		
Protected Areas	X	X	X	X	X	
Enterprise-based Conservation	X					
Certification	X			X		X
Reduced Impact Logging						
Governance	X					
Policy building	X	X		X		
Capacity building of local organizations	X	X	X	X	X	
Reducing demand						X
Corporate responsibility		X		X		X
Development funding by Banks						X
Independent funding for conservation (Emergencies)		X		X	X	

Sources: websites of WWF: World Wide Fund for Nature; FFI: Fauna and Flora International; CI: Conservation International; TNC: The Nature Conservancy; WCS: Wildlife Conservation Society; RAN: Rainforest Action Network.

Table 4

Direct development and/or research programmes of major international NGOs in Asia

Programme	WWF	FFI	CI	TNC	WCS	RAN
Non-timber Forest Products	X					
Illegal Logging	X			X		
Bushmeat Trade					X	
Wildlife Trade	X	X			X	
Conflict Timber	X					
Climate Change	X					
Forest Fires	X					
Forest Conversion	X					

Sources: websites of WWF: World Wide Fund for Nature; FFI: Fauna and Flora International; CI: Conservation International; TNC: The Nature Conservancy; WCS: Wildlife Conservation Society; RAN: Rainforest Action Network.

protagonists appear to be moving pebbles up the slope in the face of an oncoming landslide. Perhaps we can understand better the struggle and success of these efforts by examining in detail one such project.

Case Study: CIFOR's MLA Project [8]

Between 1999 and 2001, researchers at the Center for International Forestry Research (CIFOR) conducted an evaluation of resources in the Malinau River region of East Kalimantan, Indonesian Borneo. The Malinau, a rugged, sparsely populated region still containing a large contiguous extent of tropical forest, is an area of considerable conservation significance. The main indigenous populations in the area are the Merap, Punan and Kenyah ethnic groups. In the aftermath of the economic crisis of 1997-8, an increase in the export value of palm oil encouraged prospecting by private investors. The recent devolution of power from the central government in Jakarta to local authorities has given control over logging and land-clearing permits to local people. New roads are opening up previously inaccessible areas. For residents in this area it is a time of great change and uncertainty.

CIFOR's Multidisciplinary Landscape Assessment (MLA) Project was undertaken to discover 'what really matters' to communities living in the Malinau area by linking conventional biophysical methods of landscape assessment with anthropological and ethnobotanical techniques (SHEIL *et al.* 2003). The underlying premise was that rational, expert-led decision-making is the way governments work (BLAIKIE & MULDAVIN 2004), and that truly democratic decision-making, weighing the interests of all parties equally, would be possible if only there were clear understanding of the concerns and resources of local people. The work focused on four main tasks: (1) asking local people what occurs where (as in classical biodiversity assessments), (2) asking why it matters to local communities, (3) evaluating the implications and possible courses of action of this information, and (4) sharing these insights and implications with stakeholders and decision-makers. The results have been not only rich and multifaceted (SHEIL *et al.*, forthcoming) but instrumental in formulating recommendations for national and local-level decision-makers based on local value and priorities. Here we explore two examples of such recommendations.

Understanding local views suggests modifications to current forestry practices could improve conditions for local people. Timber harvesting regulations (TPTI — the Indonesian Selective Logging and Planting System) require concession holders to slash all undergrowth and climbers each year for five years after felling to reduce 'weeds' that might impede timber regeneration. In practice, however, many useful species are cut, including rattan canes and timber seedlings, as well as plants with medicinal, food, craft and habitat value. Even if the regulations were applied properly, the silvicultural benefits would appear to be limited while the impacts on

biodiversity and community resources are considerable. Implemented concession wide, even in rugged areas where logging itself is impractical, slashing may be doing more damage than the harvest itself. As a result of this information the CIFOR Project suggested that this policy be reviewed (SHEIL *et al.* 2003b, SIST *et al.* 2003).

Soil data developed by the Project helped to clarify the potential for various crops. Chemical analyses showed consistently low fertility and aluminium toxicity with hard-pan. Steep slopes further restrict cultivation options. According to local perceptions, the best soils are mostly found on the limited area of the alluvial plains. Formal evaluation (involving national guidelines and criteria) of the 200 sample sites indicated that all are unsuitable for sustainable production of cash crops such as pepper, coffee, cocoa, candlenut, rubber and oil palm — all of interest to local government. However, some alluvial areas have potential for rice and coconut cultivation. In fact, all the suitable sites identified are already under cultivation (or fallow) even though they are less than ideal with nutrient status low and flood risk high. Consequently the economic feasibility of large-scale agriculture in this area is assessed as low. It would appear then that the future well-being of this area depends largely on the successful and sustainable management of forest resources.

The MLA Project, successful in generating important information and raising awareness among local people, faces an uphill battle in convincing decision-makers to pay attention to their research findings despite the several methods developed to disseminate study results. There have been various meetings and discussions with local stakeholders and a widespread publicity campaign using a series of large colourful posters summarizing survey results, all with seemingly little impact on local government officials. The biggest obstacle appears to be the structure of decision-making used by local officials and elites; it is hierarchical and prejudicial and, in large part, has not accepted the principle of 'prior, informed consent' when designing and enacting local development initiatives, despite the requirements of new legal provisions (COLCHESTER & MACKAY 2004). Neither does the area government appear to adhere to its own model of expert-led decision-making. Instead it seems to submit to strong pressure both from within the government and from external interests such as the powerful timber industry, plantation developers, and local police and military. Unfortunately, in March 2004, the regional government signed an agreement with a Malaysian company to develop an oil palm plantation on 40,000 ha, due to start with in the next two years. The plantation will be established on poor soil where all the evidence shows that it will be neither economically viable nor environmen-

tally sustainable. The development site may include areas of forest important to local livelihoods and locally significant in terms of cultural value. The mature forests on these poor soils also have an important role in sheltering the area's rich biodiversity. It seems probable that this plantation scheme may be merely an excuse to remove valuable timber and will in the long run leave the local communities worse off. Thus, whereas the research was technically successful, its application has so far proved a failure given the ineffective institutional environment into which the information was delivered. This is only one of many examples to call into question the effectiveness of expert-led policy-making in times of change.

Conclusions

Historically the forest has been viewed as a strategic resource, the source of important materials for both nation building and defence. This is still true today as one sees forest revenues as significant in the contribution to both GNP and military coffers in many countries. Over the past several decades, however, much of Asia's tropical forest has been converted to alternative uses with too much of the proceeds of timber sales disappearing into non-government accounts. With traditional sources of livelihood often severely compromised if not destroyed by commercial timber exploitation and land development with little benefit passed on to forest-dependent people, it is not surprising that poverty is now a dominant theme in development assistance in the forest and environmental sectors. New technology has, among other things, improved recovery rates of harvested wood, enhanced the number of commercial species and increased the variety of species that can be grown in plantation. Despite these advancements, given the rapid growth of Asia's new market economies followed by that of India and a recovering Japan, the increasing demand for raw materials is expected to put increasing pressure on Southeast Asian forest resources. Technological responses, including plantation timber, plus higher prices may not be sufficient to produce the innovations and efficiencies needed in time to avoid a heavy toll on tropical high forest. Southeast Asia because of its proximity to the world's fastest growing markets and the massive development of new road and rail systems in this region, much of it financed by China, is likely to feel the heaviest pressure on forest resources.

Most scientists and policy-makers would now agree that understanding local people's needs is vital to the conservation and sustainable development

of the tropical forest. Most developing country researchers, NGO activists, planners and policy-makers are still struggling, however, to understand how to reduce rural poverty and at the same time halt environmental degradation, including forest loss. There remains a need to strike a better balance between conserving forests and finding ways to employ forest resources to enhance the lives of the millions of people and societies who depend on them. In this context we see that Southeast Asia's fight to protect its environment is inextricably linked to its struggle for good governance and economic modernization, and that science can and should make a contribution to that effort.

Changing social and political attitudes brought about by selective adoption of scientific discoveries and inventions, such as genetically modified plants, will influence how society defines and manages the natural environment, that is, its raw material or resource base, of which the tropical forest is one element. Disparate perceptions of the most appropriate disposition and distribution of resources could well contribute to social and political discord both locally and internationally. The potential impact of environmental change, which affects the ability of the forest to meet the needs of a changing society, is, however, less recognized by policy-makers. The area of tropical forest remaining in Asia today is much reduced from the time when Europe and the United States experienced their modern growth spurts. Has or will the development, or the environment, of modern Asia be compromised in meeting the diverse demands of a changing society given forest conditions today?

Worldwide society continues to struggle with the recognition that environment is not 'other'. The tropical forest is not merely a stock of resources, nor a convenient backdrop for industrial activity, a charming home for cute and curious looking wildlife, or a carbon sink. The forest is an integral element of the complex biogeochemical system that is, very literally, society's life support system. Given the current macro-political climate, the future of the tropical forest looks bleak. Community-based environmental initiatives that reflect local people's respect for the environment and the best that science can provide in seeking solutions to economic inequalities and social injustice offer a ray of hope in an otherwise bleak vista. Such initiatives must be multiplied and magnified if Asia's tropical forests are to meet the challenge of responding to the increasing pressure of the demands of the region's fast growing economies while at the same time maintaining environmental health and ecological functions.

The case of the Malinau study provides an excellent example of how the social and political elements conspire to ineffectuate expert-led decision-

making in the environmental planning process. Thus, though change is natural and inevitable the course of change is a socially and politically mediated process. Questions that must be addressed with regard to conservation and development attempting to cope with change include: how do we inject new research findings into the decision-making processes, and is expert-led policy-making open to the challenges of multiple stakeholders and greater democracy in knowledge production? In a society traditionally hierarchical in terms of political and social class, where the display of one's wealth and social status is critical, it is not surprising that attempts to introduce a more egalitarian form of decision-making with regard to natural resource use and development would be problematic. Cultural norms and values change slowly, even with the introduction of a western style secular education and the mountains of information available through local research and the worldwide web.

Other than resorting to the tactics of public relation experts, lobbyists and advertisers, at this point we have few suggestions to recommend that scientists might find palatable. While there is research underway into this very subject (YOUNG & COURT 2004), scientists may have to take a page from their textbooks on participatory co-management and engage in face to face conversations and debates, explaining in familiar, culturally appropriate, and understandable terms the finding and their consequences. As development anthropologists have found out in other contexts (GARDINER & LEWIS 1996), scientists must be ready to suggest alternatives for policy-makers to consider.

Forests and forest dependent cultures may not have that long to wait. Change is coming. And although change is not new, the pace of change, from all indications, is much greater than ever before. The primary uncertainty lies in the direction of change. The direction of change — whether guided by accumulated knowledge and social welfare or personal aggrandizement — may determine the fate of the forest and human society not only in Asia but worldwide.

NOTES

[1] Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam.

[2] Center for International Forestry Research (CIFOR), International Tropical Timber Association (ITTO), and European Commission (EC)

[3] While illegal logging contributes greatly to underestimates, BROWN & DURST (2003) remind us that forest inventory methods are variable across the region; use of remote sensing and/or extrapolation from old models and data are often unreliable and imprecise.

[4] One should be very careful, however, in setting statistics of plantation against that of natural forest area cleared, as 'reforestation' is most definitely not 'deforestation' in reverse.

[5] This is a process which determines whether wood is grown in an environmentally sound and sustainable production system.

[6] Clearly forest modification by indigenous peoples practising shifting cultivation has a long history, but numerous studies have demonstrated forest peoples can have a benign and even positive influence on forest biodiversity in the long term (DOVE 1985, BALEE 1989, BROOKFIELD & PADOCH 1994, SUNDERLIN 1997, DOVE *et al.* 2005).

[7] In 2003 a coalition of government agencies, NGOs, industry and international agencies formed the Asian Forest Partnership (AFP) to combat the traffic in illegal logs and promote sustainable forest management (BROWN & DURST 2003).

[8] Excerpted from SHEIL *et al.* (forthcoming). For additional publications see http://www.cifor.cgiar.org/mla

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Biodiversity Management and Loss of Traditional Knowledge in the Largest Forest of the Amazon. Examples from Amazonas, Venezuela and Ecuador

by

Maurizio PAOLETTI *

KEYWORDS. — Biodiversity; Edible Species; Amazon; Alto Orinoco; Ecuador; Venezuela; Traditional Knowledge; Ethnobiology; Semidomesticated Plants; Edible Invertebrates; Minilivestock.

SUMMARY. — Approximately 183 ethnic human groups have been reported as being native inhabitants of the Amazon but an unknown number has disappeared since contact was made in the 15th century. 90,000 plants and possibly 2-10 million species of animals, especially small invertebrates, live in the largest tropical forest and savannah complex in the world. The majority of these still need to be described and some are only known to the local peoples. It has been argued that most of these species will remain unknown and underappreciated due to the rate at which the forest is being destroyed and the scarcity of support for projects and peoples involved in such an enormous effort (ecologists, taxonomists, ethnobiologists). Deforestation has been calculated as being the main cause of decline in tropical biodiversity but the destruction of native cultures and their associated unwritten experiences is the greatest problem and our greatest loss.

The measure of Amazonian biodiversity is far from being understood. The understanding of these resources has been in the hands of the local peoples and this knowledge is based on approximately 11,000 years' experience built up since the time of the probable first colonization of South America.

The Amerindian experiences accumulated in the Alto Orinoco region within different ethnic groups will be discussed. The wealth and meaning of local biodiversity knowledge among different ethnic groups, the loss of knowledge, the way in which existing knowledge could be safeguarded and preserved will be discussed. What is edible among plants and small animals (semi-domesticates and minilivestock) and strategies developed to select the best available food will be also considered.

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Introduction

The Amazon is the largest forest and savannah system in the world covering about 8 million km^2 which, over time, has undergone a rapid transformation of land use. It comprises an incredible number of different animals and plants and a diversity of local human populations. If BAHUCHET (1993) sets the number of living human aboriginal groups at 183, so many have disappeared since European contact after the 15th century that this number could well have been at least twice as high (POSEY & DUTFIELD 1996).

Plant species have been estimated to be 90,000 in the Neotropica (BISBY 1995) but invertebrates alone may well run into the millions and no complete inventory is available for most small invertebrates (ERWIN 1982, 1997).

In this paper the diversity of local knowledge will be discussed including domestication, the semi-domestication process and the potential, fundamental importance of maintaining and promoting local knowledge for the welfare of communities, the maintenance of overall biodiversity and the promotion of the sustainability of locally based development. The examples discussed are especially from Amazonas in Venezuela, Brazil and Ecuador.

The Perspective of Biodiversity

Biodiversity is the core resource of our planet, is the combination of abundance of living species and diversity of environments and human knowledge (WILSON 1988, HEYWOOD & WATSON 1995).

The number of species living on our planet is still a major topic of debate and the answer is far from being resolved, as documented in the specialized literature. For instance, the total number of living species described on our planet is around 1.8 million. However, the number of species estimated, dominated by small-sized invertebrates, is anything from 7.2 to 82 million and these data are based on tropical environments especially on the Amazon where these evaluations have been especially undertaken (STORK 1988; MAY 1992; PAOLETTI *et al.* 1992; ERWIN 1982, 1997).

Most biological knowledge, and in particular taxonomy, the branch dealing with the description of animals and plants, has traditionally been focused on a few groups, such as mammals, birds, large plants and butterflies, and most inconspicuous organisms such as mites, most tiny inconspicuous insects, earthworms, microorganisms, etc., have practically been ignored. What is the reason for this? Reading the chronicle of Alfred Russell Wallace, one of the foremost explorers and naturalists travelling in the Amazon in the 19th century, it is

interesting to note that, in essence, the kind of creatures he collected particularly were large insects, birds, mammals and reptiles — the colourful or conspicuous ones — that could be sold by his very active agent in London, Mr Samuel Stevens (RABY 2001) to museums and which were attractive to private amateurs and collectors. Possibly, even today, knowledge is still influenced by peoples' limitations in appreciating and accounting for diversity of biota.

For instance, for most western people, the term "earthworm" is applied to all kinds of legless worms living in soils — two or three names may be known — by people who enjoy line fishing. The Ye'Kuana living in the Alto Orinoco (Amazonas, Venezuela) provide us with at least sixteen ethnonames for earthworms (tab. 1) and at least two different species are

Table 1

List of earthworms (Glossoscolecidae) ethnonames from only two Ye'Kuana villages in the Alto Río Padamo area, Amazonas, Venezuela

Guatamo: group of persons and Luis Garcia; at Alacran Angel Garcia 1998-2002	**Earthworms ethnonames**	**Characteristics**	**Use**
?	SCICIU	White-pink 6 cm upper river banks	Only for fishing
?	***CATASU***	Red-brown 6 cm upper river banks	Only for fishing
?	*MAWADA*	?	Only for fishing
?	*CANAJE'*	?	Only for fishing
Andiorrhinus			
(Amazodrilus) motto n. sp.	*MOTTO*	White, lower river banks	Edible
	DAICIK	White small lower river banks	Edible
	VEJAJ	White medium size	Edible
	TOCCAMO	White	Edible
	TAEGIC	White	Edible
	MODOIDDI	White	Edible
	MOUATO	?	Edible
	ARAITO'	?	Edible
	CETOKA	?	Edible
?	*KURUJICETTE*	30 cm, dark brown, in the forest	Only for fishing
Andiorrhinus			
(Amazodrilus) kuru n. sp.	*KURU*	Red-brown 40-60 cm, in forest	Edible
?	*SARIDI*	40-50 cm dark brown, in forest	Edible

eaten and considered delicacy (PAOLETTI & DUFOUR 2005). None of these species has a scientific name yet except for the two edible ones, *motto* and *kuru* (fig. 1) that have been scientifically described recently (MORENO & PAOLETTI 2004). For the same Ye'Kuana, for instance, two species such as *scisiu* and *catasu* (fig. 2) are used only for line fishing but are not eaten. The incredibly detailed knowledge of earthworms these Amerindians have is comparable only with the knowledge the Maori have (on the Northern Island of New Zealand recorded last century by BENHAM 1904) who can provide ten ethnonames for earthworms most of which are considered edible.

Fig. 1. — Edible earthworms *kuru* (left) and *motto* (centre) are appreciated by the Ye'Kuana and are eaten raw and smoked (right) (Amazonas, Venezuela).

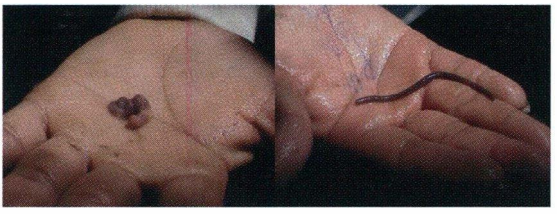

Fig. 2. — *Scisiu* (left) and *catasu* (right) are earthworms used only as bites for line fishing in Alacran by the Ye'Kuana Amerindians.

These differences between people's very limited current knowledge and "scientific knowledge" make the tragedy of the limited protection of biodiversity even more problematic. It is difficult to protect or even notice plants and animals that are not formally known, used or considered of any use. In most cases, simply setting hot-spot areas out of bounds to humans may well be the only way to maintain biodiversity (WILSON 1988). However, a great deal of the knowledge in the hands of local inhabitants is being lost as the local illiterate cultures diminish with their rapid assimilation into a mainstream lifestyle (MBG 2002, LAIRD 2002).

Essential local knowledge, then, is based on species that are or are not useful; but, this oral knowledge is based on direct experience of using these resources especially for food and medicine (DUKE & VASQUEZ 1994; PAOLETTI *et al.* 2001, 2005).

The Yanomamo, for instance, living in the forests of Amazonas, Venezuela, consider edible at least 392 species (out of the 527 they easily recognize with ethnonames) which they hunt, trap, collect or cultivate in their forest swiddens (tab. 2). In this outstanding number are found only 2-3 ethnonames for earthworms, nothing in comparison to their Ye'Kuana neighbours. But apparently the Yanomamo do not eat earthworms. The Guajibo or the Yukpa Amerindians colonizing the savannah prefer grasshoppers that forest peoples such as the Piaroa and the Yanomamo, even if these species are present in their territory, dislike as food (RUDDLE 1973, PAOLETTI & DUFOUR 2005).

Table 2

Potential knowledge of species ethnonames of an 11-year old Yanomamo in Amazonas, Venezuela. Column I lists the total species potentially known in different categories; column II lists the edible species; column III lists ethnonames collected by a missionary during many years of contact with villagers in the Alto Orinoco. Columns I and II were obtained by a group of seven Yanomamo of different villages (they listed the species "from memory")

THE BIODIVERSITY KNOWLEDGE OF THE YANOMAMI
tentative, very prudential, assessment

ORGANISMS	TOTAL	eaten	Finkers, 1986
Plants conuco ICARI	22	19	40 ???
MEDICINAL -DGS	15	?	7 (yopo)
MAGIC, ORNAMENT	?	?	16
For fishing (barbasco and making traps)	5	0	
Mushrooms - edible	15	12	11
Trees in the forest	59	0	
Palms	13	13	
Trees bearing fruits	66	66	136 (fruits and roots)
Mammals	44	44	64
Birds	98	95	240
Fishes	47	47	122 (incl 6 which are not edible)
Reptiles, lizards	11	4	
Snakes	21	11	41
Anurans	13	6	37 (incl. 19 which are not edible)
Insects	72	65	143 ? (incl. 6 which are not edible)
Spiders	7	5	2
Gastropods	4	1 (aquatic)	
Crustaceans	4	4	6
Myriapods	5	no	
TOTAL	**521**	**392 (75.73)**	**865 (?)**

Again, the Yanomamo eat 25 different types of caterpillars (tab. 3) but currently, only one species has a defined scientific name: *omoposhi* is *Erinnyis ello* (fig. 3), yet another example of the incredible difference between folk and scientific knowledge, regarding, in this instance, butterflies. Folk taxonomy in the Amazon is developed on edible stages of invertebrates such as caterpillars, whereas western taxonomy needs adults for precise identification since the origin of western scientific knowledge is based on colourful adults appreciated by collectors and amateurs for their entomological exhibitions.

Table 3

Ethnonames of caterpillars consumed by the Yanomamo, Alto Orinoco, Venezuela, July 1997

Caterpillars (Lepidoptera)	**Host plants**
MAGNA	HUMISCI
IROKIRI	MOKHE
WAGIO WAGIO	*WAGIOWAGIO NATO vine
CASHA	KANAIIHA and HAWARI vine
PARIMA	TAHINANI tree
MAMO CORI CINA	CANAININI tree
IRO KRUKUIU	ATARI HAHI tree
PASCOU	TOHO TOTO vine
WERO WERO	SCAWARA CURIMI tree
OPO MOSHI	PENAHE' and OHATA WACO tree
PENAHE NOSI	*PEENA PEENA and CURATASCI COTE tree
WATEOMA	WARAPAHI tree
PARURI HESIKAKI	?
HEWAKEMA	?
NIYA	?
KIRAKIRAMI UMO	?
SHAKUKUMI	?
KRAYA	?
MAYA	?
YAKURETO	KUMICIHENATI tree
MAPAYAWA	*MAPAYAWA HENA tree
HEWEKEWEKEMOREWE	PITAHAMU tree
WAWA HENA	MAECOTOMA tree
SHIYAHUMI	ATARIHIA tree
PORE MAPUUSIKI	PITAHA tree

* The only available similarities in the folk name between host plants and caterpillars.

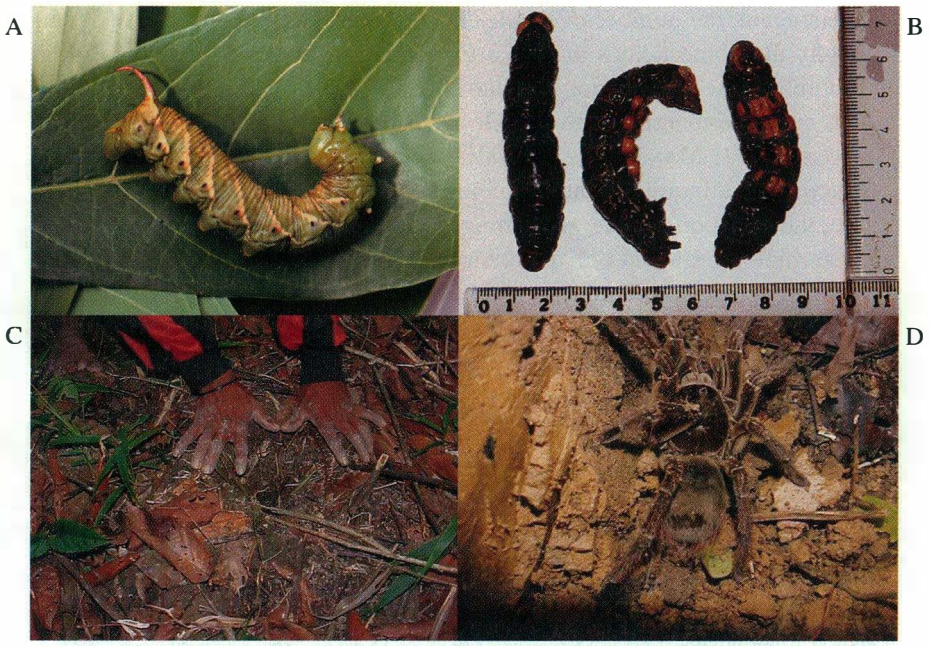

Fig. 3. — *Opomosci* (*Erinnyis ello*) (A) is one key edible caterpillar living on Yuca (*Manihot esculenta*) in Amazon. It is appreciated by several Amerindians including the Yanomamo. *Chinere* for the Piaroa and *Masamasadi* for the Ye'Kuana (B) is a very appreciated edible caterpillar living on *Pourouma* sp. Edible terrestrial, burrowing spiders in Alto Orinoco (C, D) *Theraphosa apophysis*.

What We Eat and Knowledge of Biodiversity

Key species adopted by humans are no more than 20, supplying up to 85 % of the world's food base. About 5,000 plants have agronomic interest but around 20,000 plants (of a total of 250,000 described) and possibly 6,000 animals, more currently, are estimated to have been used as food in some part of the world (PIMENTEL & PIMENTEL 1996, ESQUINAS-ALCAZAR 1993, PIPERNO & PEARSALL 1998), all representing the diversity known by humans. But, in our opinion, the proportion of the few most-used species on the 1.8 million already described on the planet is still inappropriate.

It has been argued that insects, together with other small invertebrates, alone represent about 85 % of all described species. But at least 10 million species of insects have prudently been forecasted as living on the planet, ten times the number of those described (HAMMOND 1995). Some projections have given numbers ranging between 30 and 70 million insect species (ERWIN 1997, HAMMOND 1995).

Then, again, the number of species is far larger than the few species dominated by the domesticates in the Fertile Crescent. In most cases, local food and more diverse food is not less nutritious or healthy than "western food" found on supermarket shelves (DE FOLIART 1999; NAC 1989, 1996; MALAISSE 1997; MANCONI *et al.* 2001).

But when we inquire about the number of species known and considered edible, the situation is quite disarming, even among supposed "specialists", such as biology students at university (tab. 4). In addition, when the ten most-cited species are listed they always appear to include: tomatoes, carrots and cherries or apples — all red or orange in colour! Apparently, our ability to record edible species is influenced by colour.

Table 4

Estimated (maximum) number of species known and consumed as food by western civilized peoples and forest- and savannah-dwelling peoples in Amazonas (Venezuela)

Population	Plants	Mammals	Fish	Birds	Insects	Total
Students at Padova University	48	10	12	5	0	75
Guajibo Amerindians	38	22	18	18	31	127
Curripaco Amerindians	46	18	32	25	11	132
Piaroa Amerindians	68	24	18	38	28	182
Yanomamo Amerindians	125	52	56	96	89	418*

* Based on different sources and evaluations, the total number could be around 1,400 species.

Note: Interviews were performed by university personnel (1995-1996) using forms filled out in class; oral interviews were carried out in Amerindian villages located near Puerto Ayacucho, Amazonas (1997). The university students were attending animal ecology courses in their third year at the University of Padova, for their degree in Natural History. The Guajibo live in the savannahs near P. Ayacucho, Amazonas, Venezuela. The Curripaco are an expert river margin-dwelling group living near P. Ayacucho, Amazonas, Venezuela. The Piaroa and Yanomamo are more strictly forest-living Amerindians in the Alto Orinoco, Amazonas, Venezuela. The Yanomamo maintain strong links with the forest for their survival.

Is it Possible to Consider Alternative Resources from Biodiversity to Improve the Environmental Conditions of the Landscape?

Are the species that we use (mostly in Western Culture) the right ones, the only ones available that have been domesticated and spread everywhere? This is the case with wheat, rice, corn, sorghum, barley, oats, soybeans, potatoes which have been spread everywhere and dominate rural landscapes in

China, Australia, Europe and Africa, North and South America. The same can be said for animals — the large animals — cows, hogs, sheep, goats, horses, chickens, ducks, salmons and trout that have dominated most of the world's landscapes (DIAMOND 2002). Another view suggests much more diversity based on the many different species adopted in areas with high biodiversity and based on local knowledge and experience, linked to thousands of species not currently found in our supermarkets but considered locally as valuable food although not appreciated enough outside their small range of attention and local use (NAC 1989, 1996; MALAISSE 1997; MANCONI *et al.* 2001; LAIRD 2002; BOND 2000; PAOLETTI & BUKKENS 1997; PAOLETTI 2005).

What is Wild and What is Semi-domesticated?

It has been noted that a few plants and animals have been domesticated in the Amazon lowlands whereas most plants and animals used are in a state of semi-domestication (NAC 1989, PIPERNO & PEARSALL 1998) with only a few domesticated. The swiddens and especially their fallow stages are important in hunting and collection, as well as for crop production (DUFOUR 2000). The large burrowing spiders, for instance, are collected especially in abandoned swiddens under fallow (fig. 3C, D). Scarabaeids larvae are also frequently collected from dead unburnt rotting logs in the swiddens together with larvae of Cerambycidae and Passalidae under barks and inside seasoned wood.

A further example could be the semidomesticated earthworm *motto* (fig. 1): "Native people manage these resources that the newcomer would normally consider wild. For instance, the earthworm (*Andiorrhinus motto*) (an anellid belonging to Glossoscolecidae, only recently described scientifically) is normally farmed by the Ye'Kuana (in Alto Orinoco, Amazonas, Venezuela). They collect adults and cocoons during April-May (at the time of reproduction) from river banks and introduce them into river banks where they are absent. One year later they return and collect the inseminated earthworms" (PAOLETTI & DUFOUR 2005).

Sustainable Swiddens and Appropriate Indicators?

Swiddens are scattered in the forest in one appropriate design if land is available and human pressure is limited (LOPEZ HERNANDEZ *et al.* 1997). Time for garden fallows is also crucial to maintain enough diversity in the forest landscape. In some situations, indicators for identifying the right place

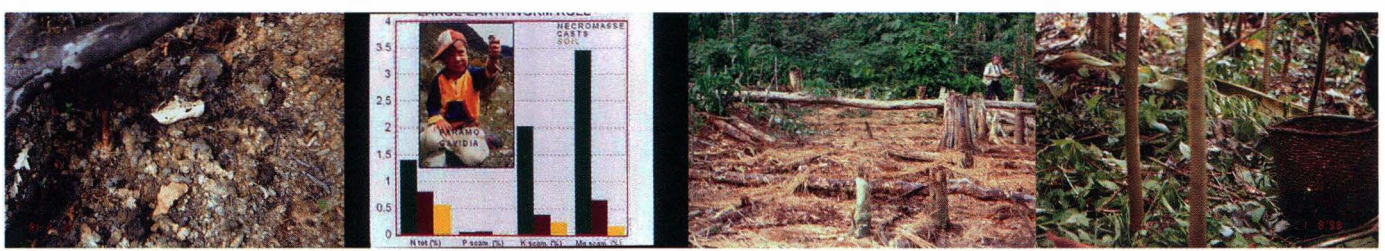

Fig. 4. — Amerindian swiddens. Near Pavoni, Amazonas, Venezuela bearing a large amount of earthworm excrements as positive sign of good soil for the implementation of a garden (A). Large earthworm at Paramo de Gavidia associated to good situation to plant potatoes (B). Mulched swiddens near Lago Agrío, Ecuador (C, D).

to slash and burn a portion of forest to settle a new garden are detected in the vegetation cover, soil structure and colour and animal features such as the presence of forest earthworms made evident by the presence of surface excrement or burrows. The presence of excrement of aquatic earthworms (such as *motto*) would not appear to be appreciated in places where a potential new garden is to be established, which is understandable as such earthworms live in places that are easily flooded (fig. 4).

We found in the Andean region that local villagers (for instance at Paramo de Gavidia near Mérida, Venezuela) indicated a large earthworm presence as a key element in deciding which soil is regenerated enough to plough and sow potato seeds. Large earthworms and a good potato yield seem positively associated there. The introduction of mulch to cover the soil of the burnt swidden is not frequent but has been observed for instance in Ecuador near Lago Agrío and was performed traditionally by Amerindians living there (fig. 4). Such attention to cover apparently improves soil conditions and micro-climate as well as organic material turnover. This could be a strategy worth spreading and promoting in other Amazonic areas.

Some Processes from Wild and Semi-domesticated Species

An example could be the attention paid to some berries of the genus *Solanum*, section *Lasiocarpa*. The commonest species in the lowland Amazon are *S. sessiliflorum* and *S. stramonifolium* present under two main forms armed and unarmed. Apparently, at least in Amazonas, Venezuela, wild forms are not frequent but dissemination close to villages and swiddens is a rule. If the armed form seems to be less appropriate for a domesticated plant, sometimes the armed form is preferred over the unarmed which seems the most appreciated in some places because it does not harm harvesters during fruit collection (Rascio *et al.* 2002, Volpato *et al.* 2004). Smaller berries called *Iranac* (possibly *S. monachophyllum* Dunal) are not cultivated but collected from the wild in the Alto Orinoco and apparently belong to a wild species that has not yet been observed as edible (M. Nee 2002, pers. comm.) but is eaten at least by the Yanomamo (fig. 5).

Again, some rodents, such as paca and agouti, can be attractive for their tasty meat (fig. 6). At present they are hunted in the wild in the Amazon, and are protected since hunting pressure is increasing. Sometimes attracted by swiddens in which they can feed on some cultivated plant and fruit materials,

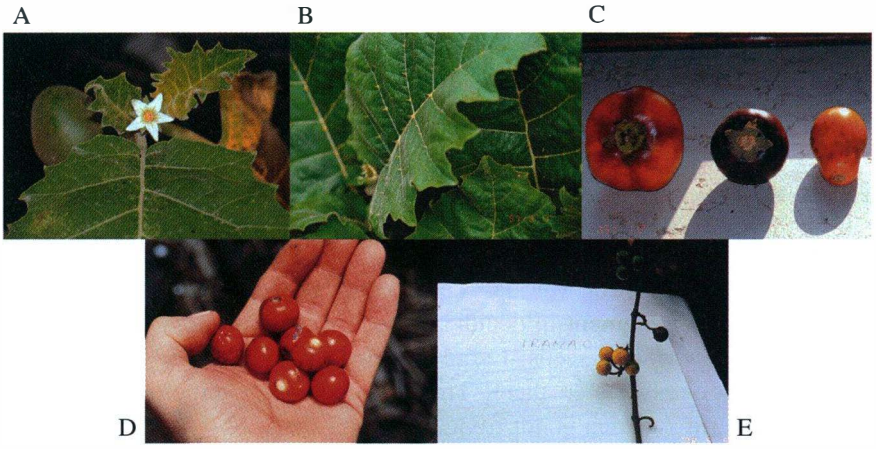

Fig. 5. — Unarmed and armed *solanum* (*Lasiocarpa*) *sessiliflorum* and berries (A, B, C). A small cousin of the tomato, *Maiapi* (*solanum stramonifolium*) from Amazon (Alto Orinoco) greatly appreciated by the Curripaco Indians but not spreading locally even in the Indian markets, and a more known species, tupiro (C), appreciated by the Guajibo (Amazonas, Venezuela). Iranac (possibly *S. monachophyllum* Dunal) (E) is only collected in the wild.

Fig. 6. — Paca is a very much appreciated hunted meat (A) all over the Amazon. *Agouti paca* is a rodent that eats fruits, seeds, roots and leaves and that could be domesticated (B) in appropriate paddocks (C, D).

they could be domesticated, in addition they are already well accepted as pets in many Amazonian villages (GOVONI *et al.* 2005). Projects are needed not to introduce new candidates but just to reinforce domestication processes already underway that could benefit local peoples and decrease pressure on the wild animal contingents.

The Yara Yara (*Duguetia lepidota*) is a large delicious Annonacean fruit as large as an orange (fig. 7) from the Alto Orinoco and well known to Piaroa Amerindians as a delicious fruit and medicine (MAAS *et al.* 2003). From a sister species (*D. hadrantha*) in Brazil, promising alkaloids have been isolated with curative antimalarial, cytotoxic and antifungal properties (ILIAS *et al.* 2001). Figure 8 shows examples of berries and small fruits, rich in vitamins and well accepted by children: two *Passiflora*, an unidentified berry called *mututa* by the Ye'Kuana, and *Pourouma cercopifolia* cultivated and appreciated for its sweet fruits similar to the grape; another tree, wild in the forest, *P. guianensis*, produces edible fruits, and there are the much appreciated caterpillars *masamasadi* (fig. 3) eaten at least by the Ye'Kuana and Piaroa in the Alto Orinoco.

In reality, most species not yet domesticated are undergoing a semi-domestication process that is "care in the wild" of a consistent number of utilized species (POSEY 1979). To give just one example, taken from our trip in the forest in Amazonas, during which we found the yarayara tree (fig. 4): on the way back to the village the Piaroa Amerindian was eating a fruit he was carrying and spitting the seeds around. Apparently this strategy of dissemination is designed to improve the chance to have these trees, not even cultivated in the swiddens, more actively disseminated inside the forest on familiar tracks.

Fig. 7. — A very striking delicious fruit from Amazon forests (Alto Orinoco, Venezuela) that has never been cultivated (but also never commercialized even in the local markets), *Yara Yara* for the Piaroa (Amazonas, Venezuela). On the right the fruit peeled.

Fig. 8. — Edible berries: two passion fruits very much appreciated in some villages (Passifruit *Passiflora seemannii* and *P. foetida*) (Amazonas, Venezuela). A red edible berry, *Mututa*, good when ripe and cooked, eaten in Alto Orinoco by the Ye'Kuana. A delicious fruit similar to grape found in the Amazon (*Paurouma cercopifolia*) here at Lago Agrío, Ecuador.

Education?

The educational programmes need to transfer knowledge from local communities to large "civilized" communities, and not just the other way round. Educational programmes and small-project support have to be provided for local activities through a variety of bodies including non-governmental organizations so as to deal with these objectives, and provide knowledge of such species beyond the local villages. Very few projects try to maintain and improve local knowledge, increase it and disseminate it to "the markets" in the large neighbouring communities. An example of this is some fruits that have never been adopted, even in the nearest Indian markets, not collected because no one asked for them (fig. 4, 7). Aromatic, cosmetic, medicinal, and wood-fuel plants should be developed. Knowledge of biodiversity and the sustainable domestication of plants and animals must become a continuous

process in local villages (BLANCO *et al.* 2002, OTERO *et al.* 2002, RODRIGUEZ *et al.* 2002).

Without such transfers, sparking of a new trend which takes into account local knowledge, experience and resources related to biodiversity will be exceedingly difficult. The most important focus for planners, experts and teachers is to humbly learn from the local people.

Strategy: Towards Invertebrates as Food

As explained in previous paragraphs, several small invertebrates are considered food and medicine in the Amazon. Around 500 species are probably prudentially consumed in the Amazon: from insects, especially in larval stages to spiders, earthworms, molluscs and crustaceans (PAOLETTI *et al.* 2000, PAOLETTI & DUFOUR 2005). However, if many different organisms are eaten, those associated with leaves and litter especially seem to be the core resource. This style of invertebrate harvesting is exemplified by the available data on 39 ethnic groups. The most commonly-harvested invertebrates include the following four categories linked to leaves and litter, the most renewable portion of the Amazon: (i) leaf-cutter fungi-farming ants of the genus *Atta*; (ii) caterpillars having a strict link with leaves of the canopy; (iii) litter-cutter termites of the genus *Syntermes*; and (iv) some earthworms (in a few cases, see fig. 1) consuming litter on the surface soil (fig. 9). This forest sustainable food is nutritious and healthy (tab. 5).

Fig. 9. — Some edible key invertebrates eaten by Amazonic peoples: caterpillars, *Panaceapnola* eaten in Ecuador, and *Atta cephalotes* eaten in many places including Colombia, Vaupes.

Table 5

Nutritional value of some insects consumed in tropical South America compared with other animal foods. Composition per 100 g edible portion (DUFOUR & SANDERS 1999)

Food	Moisture %	Energy kcal	Protein	Fat
Female ant *Atta sexdens*	6.1	628	39.7	34.7
Female ant *Atta cephalotess*	6.9	580	48.1	25.8
Soldiers termite *Syntermes* sp.	10.3	467	58.9	4.9
Palmworm *Rhynchophorus palmarum*	13.7	661	24.3	55
Caterpillars various (smoke dried)	11.6	425	52.6	15.4
River fish (smoke dried)	10.5	312	43.4	7
Tapir (smoke dried)	10.3	516	75.4	11.9

Conclusions

Everyone travelling in the tropics has found large projects, centrally or locally directed, that have provided cars, computers and buildings to some groups of people concerned with investigating biodiversity. In general, it is the bureaucrats, sometimes the heads of some local organization, who lead the projects. In most cases, these projects do not encourage the exchange of knowledge available locally to different groups of people to help maintain their knowledge and generate new knowledge in order to improve a sustainable development of biodiversity. In most cases, only the package of species known by "experts" in the projects are suggested as resources, and little attention is being paid to local biodiversity resources and their traditional use. Encouraging local knowledge in schools, maintaining ethnonames, and transcending the boundary of each village with the "local" knowledge are the mechanisms required to develop appropriate management strategies to produce a sustainable use of local resources.

Efforts are needed to encourage local cultures and keep their knowledge alive and, where possible, to export some biodiversity resources. Ecotourism and export agreements can help but appropriate measures have to be adopted in order not to disrupt small illiterate communities. Small projects, in most situations, are better than large ones.

Westerners, as well, need an improved educational framework in order to better incorporate biodiversity knowledge in their countries and elsewhere, including the Amazon. They have to learn rather than only to teach how to use natural resources from traditional knowledge. Plants, animals and

microbes with medicinal, pesticidal and aromatic properties provide many opportunities for people in all nations. Reasonable laws are needed to protect national resources and prevent the introduction of pest species. Equitable strategies to develop and manage different species using local knowledge have to be implemented and sustained.

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Stratégie systémique appliquée à la gestion de la biodiversité. Cas de la Réserve de biosphère de Luki (RDC)

par

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RESUME. — La Réserve de Biosphère de Luki est située dans la République Démocratique du Congo, Province du Bas-Congo (500 km de Kinshasa, 60 km de Boma). Le territoire, auparavant *Réserve forestière*, fut créé en 1937 et placé sous le contrôle de l'Institut national pour l'Etude et la Recherche agricoles du Congo (INERA). Il est devenu Réserve de Biosphère en 1976. Dans le cadre d'un projet de recherche destiné à la Réserve de biosphère, l'Ecole régionale de Formation du Troisième Cycle sur la Gestion intégrée des Forêts tropicales et de l'Utilisation des Terres (ERAIFT, Université de Kinshasa, lancée en avril 1999 par l'UNESCO/MAB avec le soutien de l'UNDP, Belgique, la Commission européenne et plusieurs pays d'Afrique subsaharienne) a entrepris une étude globale de la Réserve de Biosphère qui révèle de nombreuses questions cruciales concernant tant les conditions de vie de la population (pauvreté, ressources, santé et enseignement déficients) que le niveau de dégradation écologique (perte de la biodiversité, destruction des forêts, érosion des sols, etc.).

Afin d'améliorer la situation, il est suggéré d'appliquer à la gestion de la Réserve de la Biosphère une nouvelle stratégie, l'approche systémique, pour résoudre les problèmes complexes du développement humain. Fondée sur l'Analyse de Système, l'approche systémique prend en considération tous les secteurs et éléments impliqués (ressources humaines et naturelles) et possède une ampleur interdisciplinaire, globale et intégrée. Cette approche se fonde sur différents concepts (interaction, globalité, organisation, complexité) et un ensemble de lois. Pour s'attaquer aux problèmes prioritaires, trois principes orienteront la recherche: (1) adoption et application de l'approche systémique; (2) participation de la population locale dans la planification et la gestion du territoire ainsi que recommandé par le Stratégie de Séville et par le Cadre statutaire du Réseau mondial des Réserves de Biosphère; (3) adoption d'une stratégie de gestion intégrée pour laquelle un plan d'action globale a déjà été élaboré (voir fig. 1).

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1. Introduction

La situation des forêts tropicales, notamment en République démocratique du Congo (RDC), septième pays forestier du monde avec 3,1 % des forêts (FAO 1977), est préoccupante. A l'échelle du monde, la superficie des forêts tropicales se réduit chaque année de 94 000 km^2 (estimation 2000). Cette évolution régressive est le résultat des effets conjugués de la pression démographique, de systèmes de production souvent inappropriés, de modes de gestion des terres inadéquats (approche sectorielle) et d'absence de politique de développement cohérente. On trouve une situation analogue en RDC, où la pression démographique est très élevée (3,2 % pour 1975-2000, 3,3 % pour 2000-2015) (PNUD 2002).

Une telle dégradation du milieu est triplement préjudiciable. D'abord, elle représente un gaspillage de ressources et entraîne de profondes perturbations dans le déroulement normal des fonctions environnementales des écosystèmes forestiers. Ensuite, elle empêche les forêts de satisfaire, comme elles le devraient, les besoins des populations. Enfin, elle fait obstacle au maintien de la biodiversité et au développement durable.

L'UNESCO, en lançant, en 1970 (UNESCO-MAB 1971), le «Programme sur l'homme et la biosphère» a mis l'accent sur la nécessité d'appréhender les interrelations entre les hommes et les autres éléments de la biosphère sous l'angle de l'interdisciplinarité. Avec le lancement du concept de «réserve de biosphère» (RB) et la création du Réseau mondial de RB, qui compte actuellement 459 sites dans 97 pays (UNESCO-MAB 2004), l'on dispose d'instruments qui permettent d'inventer, de tester et d'appliquer de nouvelles approches en vue de promouvoir la protection de la biodiversité, la conservation de l'environnement et le développement durable à l'échelle locale.

Promouvoir le développement durable implique un changement radical de méthode. En effet, la complexité des problèmes de gestion de la biosphère, d'aménagement intégré du territoire et de développement ne peuvent plus se satisfaire de l'approche sectorielle habituelle, largement responsable de la situation qui prévaut actuellement. L'alternative à privilégier est l'approche globale, intégrée et interdisciplinaire, ou, en la qualifiant de façon plus précise et rigoureuse, l'«approche (ou la stratégie) systémique».

2. Approche systémique appliquée à la Réserve de biosphère de Luki (RBL)

Dans le cadre de l'approche systémique retenue, la RBL est considérée comme un système. Pour bien saisir cette approche, les éléments fondamen-

taux de l'analyse systémique seront, d'abord, succinctement, passés en revue. Suivra un bref aperçu de la RBL. Nous appliquerons, ensuite, la stratégie systémique aux problèmes de la RBL en vue de leur trouver des solutions.

2.1. Base conceptuelle: l'approche systemique

La systémique est une nouvelle approche, située à l'opposé de l'approche analytique, traditionnelle. Son application est indispensable dans le cas de problèmes complexes. L'approche systémique (Maldague *et al.* 1977) repose sur la théorie générale des systèmes où l'on distingue des «concepts» de base et des «lois».

2.1.1. Concepts fondamentaux

Le concept de **totalité**: un système est composé d'éléments, mais il n'est pas la somme des éléments qui le composent.

Le concept d'**interaction**: les divers éléments d'un système interagissent entre eux. On trouve ici des relations de rétro-action (*feedback*): rétro-action positive ou amplificatrice, et négative ou régulatrice (par ex., dans le cas de la thermorégulation).

Le concept d'**organisation** (aspects: structurel et fonctionnel): l'organisation est une propriété clé de tout système, concept central de la systémique.

Le concept de **complexité**: le degré de complexité d'un système dépend du nombre de ses éléments et des relations qui lient ces éléments entre eux. La complexité est une dimension essentielle des systèmes.

2.1.2. Lois fondamentales

Loi des **rapports du système avec son environnement**: les systèmes du monde réel sont des systèmes ouverts, caractérisés par de nombreux échanges avec leur environnement.

Loi de l'**organisation hiérarchique des systèmes**: l'organisation se manifeste par le fait que tout système peut être décomposé en sous-systèmes. Le fonctionnement d'un système est de nature hiérarchique.

Loi de la **conservation des systèmes**: hiérarchiquement organisé, un système doit assurer sa conservation, sa survie. Interviennent ici les notions d'«état stationnaire» et d'«homéostasie».

Loi du **besoin de variété**: la variété ou diversité d'un système est une condition *sine qua non* du maintien de son équilibre, de sa stabilité dyna-

mique. La diversité est liée à la richesse des composantes du système considéré et à leurs interactions.

Loi de l'**évolution des systèmes**: le système complexe, organisé (structuré et fonctionnel), diversifié et biocénotiquement stable (stabilité dynamique) évolue, dans le temps, vers toujours plus de complexité.

La cohérence entre les lois de la systémique, les lois de biocénotique fondamentale et le deuxième principe de la thermodynamique mérite d'être soulignée.

2.1.3. Approche systémique

L'approche systémique englobe, par définition, l'ensemble des éléments du système considéré. L'examen du «système rural» permet d'illustrer les portées respectives des deux approches; ce système peut être subdivisé en six sous-systèmes, à savoir:

1. Les écosystèmes caractéristiques de la région, qui déterminent les potentialités de la production;
2. Le système de production proprement dit;
3. L'aménagement intégré du territoire, où s'inscrit le système de production considéré;
4. Les caractéristiques socio-économiques du milieu dont dépendent les conditions de vie de la population;
5. Les catalyseurs internes;
6. Les catalyseurs externes.

De fait, la définition de l'écosystème, donnée par l'organe subsidiaire de la Convention sur la Diversité Biologique (CDB), chargé de fournir des avis scientifiques, techniques et technologiques, se lit comme suit: «un complexe dynamique formé de communautés de plantes, d'animaux et de micro-organismes et de leur environnement non vivant qui, par leur interaction, forment une unité fonctionnelle». C'est la formulation classique de l'écosystème que l'on trouve chez Gaussen, Duvigneaud, Boyden, etc. On observera que l'homme n'est pas inclus dans cette définition.

Le programme MAB (l'homme et la biosphère) de l'UNESCO déborde le cadre restrictif des écosystèmes puisqu'il a pour objet l'étude des interactions entre l'homme, les communautés humaines et la biosphère, et s'inscrit dans le cadre de l'environnement. Ce dernier, dans son acception globale, intègre l'écosystème, la population humaine et les éléments culturels qui en dérivent. L'approche systémique, par son ouverture, est en mesure d'appréhender les problèmes de grande complexité qui confrontent

la gestion de l'environnement. La protection de la biodiversité ainsi que le développement humain et durable sont tributaires de la mise en œuvre de cette approche.

2.2. Bref apercu de la Reserve de biosphere de Luki

La RBL, créée en mai 1979, et gérée par le Comité national MAB de la RDC, est située dans la province du Bas-Congo, à 120 km de la côte atlantique. Elle constitue la pointe méridionale extrême du massif guinéo-congolais et occupe une superficie de 32 710 ha. Deux saisons bien tranchées: sept mois pluvieux (mi-octobre à mi-mai), cinq mois secs (mi-mai à mi-octobre). Le climat est chaud, toute l'année (22 à 28 °C), avec un fléchissement en saison sèche (19 à 23 °C). Précipitations moyennes annuelles (1970-1983): 1 120 mm, avec 164 jours de brouillard. La géomorphologie est caratérisée par une série de collines de 300 à 500 m. La végétation est une forêt dense humide semi-caducifoliée; sa biodiversité végétale est importante, avec 1 050 espèces (Lubini 1992).

En 1961, la population de la RBL, des enclaves et des alentours était estimée à 18 000 personnes (Pendje 1992); en 1990, elle est passée à 43 000, soit une augmentation de 235 % en vingt-neuf ans. La RBL est coupée en deux, sur 40 km, par la route nationale n° 1, ce qui provoque un fort accroissement des groupements traversés dont l'impact est sensible sur la Réserve. Un important réseau (500 km) de routes d'exploitation forestière sillonne la Réserve. Une telle situation pourrait à terme conduire à sa fragmentation.

Les activités économiques sont du type traditionnel et moderne. Dans le premier cas, c'est l'agriculture itinérante sur brûlis qui domine (bananes plantain et de table, manioc, taro, maïs, arachide, igname; arbres fruitiers plantés: safoutiers, manguiers, avocatiers, etc.). La population pratique également la chasse, la pêche et la cueillette, même dans l'aire centrale. Le petit élevage (caprins, porcins, ovins) et la volaille sont répandus dans les villages. Sur le plan énergétique, le prélèvement de bois de chauffe et la carbonisation sont très actifs (ravitaillement des villes de Boma et de Matadi).

Les activités modernes portent sur les cultures industrielles (café, cacao), associées à l'exploitation du limba (*Terminalia superba*). Les exploitants forestiers viennent prélever, sélectivement, les essences précieuses à l'aide d'une machinerie lourde. De tels modes d'exploitation, très préjudiciables à la biodiversité, devraient être remplacés par des techniques d'abattage à faible impact, qui ne perturbent pas les sols (McNeely 2002).

L'aire centrale (8 000 ha) est représentative de l'écosystème forestier du Mayombe.

2.3. Mise en œuvre de l'approche integree dans la RBL

Les recherches, lancées en 2000, cherchent à savoir comment se déroulent, à Luki, les fonctions des RB, telles que définies dans la Stratégie de Séville (1995): la fonction de conservation qui a pour objectif la protection de la biodiversité (ressources génétiques, espèces, écosystèmes, paysages); la fonction de développement, cherchant à promouvoir un développement économique et humain durable; et la fonction de support logistique visant à appuyer les activités de recherche, d'éducation, de formation et de surveillance continue.

Grâce à la RBL et à l'«Ecole régionale post-universitaire d'aménagement et de gestion intégrés des forêts et territoires tropicaux» (ERAIFT), les travaux de recherche bénéficient, sur le terrain, d'infrastructures, de matériel roulant, d'instruments et d'encadrement technique et scientifique (Bridgewater 2002).

L'application de l'approche systémique comprend un certain nombre d'étapes méthodologiques qui ont été décrites (Maldague *et al.* 1977) et testées, sur le terrain, à de nombreuses reprises (Congo, Guinée, Madagascar, Sénégal, RDC). La méthode adoptée permet de recueillir, en peu de temps et à un coût modique, des données de première main concernant tous les sous-systèmes qui constituent le «système rural». Elle va dans le sens des idées de Ludwig *et al.* (cité par Sheil 2002) suivant lesquelles les bons gestionnaires de ressources savent que dresser un inventaire n'est pas une priorité et qu'il est bien plus utile d'identifier rapidement les menaces afin de prendre les mesures de gestion qui s'imposent. Les recherches sur le terrain avaient pour objectifs:

— D'étudier la RBL en regard du *concept de réserve de biosphère* et de l'analyser à la lumière des concepts et des lois de la systémique;
— D'établir la monographie des principaux villages, situés dans la RBL, et d'en dégager les problèmes, chaque village étant appréhendé comme un système;
— De poser un diagnostic global sur l'état du développement, humain et durable, dans la RBL.

Les équipes d'étudiants-chercheurs ont vécu, durant la période expérimentale, dans les villages étudiés. Le contact des étudiants avec la population villageoise est un atout majeur: il détermine un climat de confiance réciproque, facilite le travail et permet une meilleure appréhension des problèmes.

La collecte des données comprenait: (1) des observations de terrain; (2) des enquêtes auprès de la population; (3) des entrevues avec les responsables locaux. Ces données, interprétées à la lumière de *grilles d'analyse*, ont donné lieu à l'établissement du diagnostic du développement rural, aboutissant, d'une part, à l'élaboration d'un *système de problèmes*, expression qui met l'accent sur les interactions entre l'ensemble des problèmes rencontrés dans l'ensemble des sous-systèmes considérés, et, d'autre part, à l'élaboration *in fine* d'un *système de solutions*, correspondant.

3. Résultats

Les potentialités de la RBL sont importantes du fait de la haute biodiversité du milieu et des fonctions propres à la forêt (fonctions de protection, de régulation et de production), ainsi que des valeurs (FLINT 1991, cité *in* BURLEY 2002) qui sont associées à la diversité biologique. Les multiples ressources de la RBL, tangibles et intangibles, devraient contribuer à satisfaire, sur une base durable, les besoins essentiels des populations.

Cependant, pour de nombreuses raisons liées aux aléas politiques que le Congo a connus durant des décennies, à la guerre qui y sévit depuis 1998, au manque de gestion et à de graves lacunes dans la formation de nombreux responsables et agents, les observations de terrain, les enquêtes et entrevues, réalisées dans les villages, conduisent à de durs constats que nous résumons brièvement ci-dessous:

— La conservation de la RBL n'est pas assurée. Sa diversité biologique est menacée jusque dans l'aire centrale, affectée par les cultures, le braconnage, la coupe illégale de bois et la récolte de produits forestiers non ligneux (PFNL).
— Aucun projet ni programme de développement n'existe actuellement.
— Les écoles et les centres de santé, situés dans les enclaves, sont, en grande partie, dépourvus de mobilier et d'équipements.
— Le manque de crédits empêche l'INERA de mener des études dans ses quatre domaines de recherches: café, cacao, fruits et bananes, conservation des ressources naturelles.
— Depuis la construction du pont qui, à Matadi, relie les deux rives du Congo, les ressources de la RBL doivent faire face aux demandes, non plus seulement de Boma, mais encore de Matadi et de Kinshasa.
— Aussi, après avoir épuisé les ressources forestières de la zone de transition, la pression s'exerce, actuellement, sur l'aire centrale et les zones

tampon. Pour assurer sa survie, la population cultive dans la Réserve, et y prélève des produits de manière incontrôlée.

— Avec l'accroissement de la population locale, cette pression est telle que d'ici deux ans, c'est la population de la Réserve qui se trouvera elle-même dans une situation précaire.

4. Discussion

4.1. Avantages de la strategie systemique

Sheil (2002) souligne que dans le domaine scientifique, l'accent est trop souvent mis sur l'observation de l'évolution des problèmes plutôt que sur leurs solutions. La stratégie systémique adoptée a permis de recueillir de multiples informations, dans tous les secteurs du système rural considéré, de les analyser, d'en dégager les interactions et d'aboutir à des pistes de solutions.

Reste à les mettre en œuvre. Pour ce faire, un plan directeur, souple et progressif, portant sur l'aménagement et le développement intégrés de la RBL est en voie d'élaboration. Il se fonde sur l'organisation hiérarchique des priorités qui découlent de l'analyse des systèmes de problèmes mis en évidence.

Dans une situation comme celle rencontrée à Luki, la stratégie systémique commande de dégager, au sein du système analysé, des *points d'amplification* (fig. 1). En d'autres termes, il y a lieu, dans le cas d'un système complexe — comme la RBL —, de chercher les points sensibles et d'y intervenir simultanément en appliquant une combinaison de mesures. Cette méthode permet non seulement de résoudre plusieurs questions, de manière quasi simultanée, mais il peut, en outre, en résulter des effets qui n'avaient pas été prévus (émergence, potentialisation, synergie).

On mesure ainsi les gains de temps et d'argent qu'entraîne l'adoption de la stratégie systémique et surtout sa capacité à mettre un terme à la fois au gaspillage des ressources humaines et naturelles.

4.2. Grandes orientations du projet de plan directeur de la RBL

Ce projet de plan, fondé sur l'approche systémique, vise à améliorer l'état général de la RBL, tant en ce qui concerne le milieu physique que le milieu humain. Par suite des contraintes éditoriales, nous le présentons sous la forme d'une figure de synthèse.

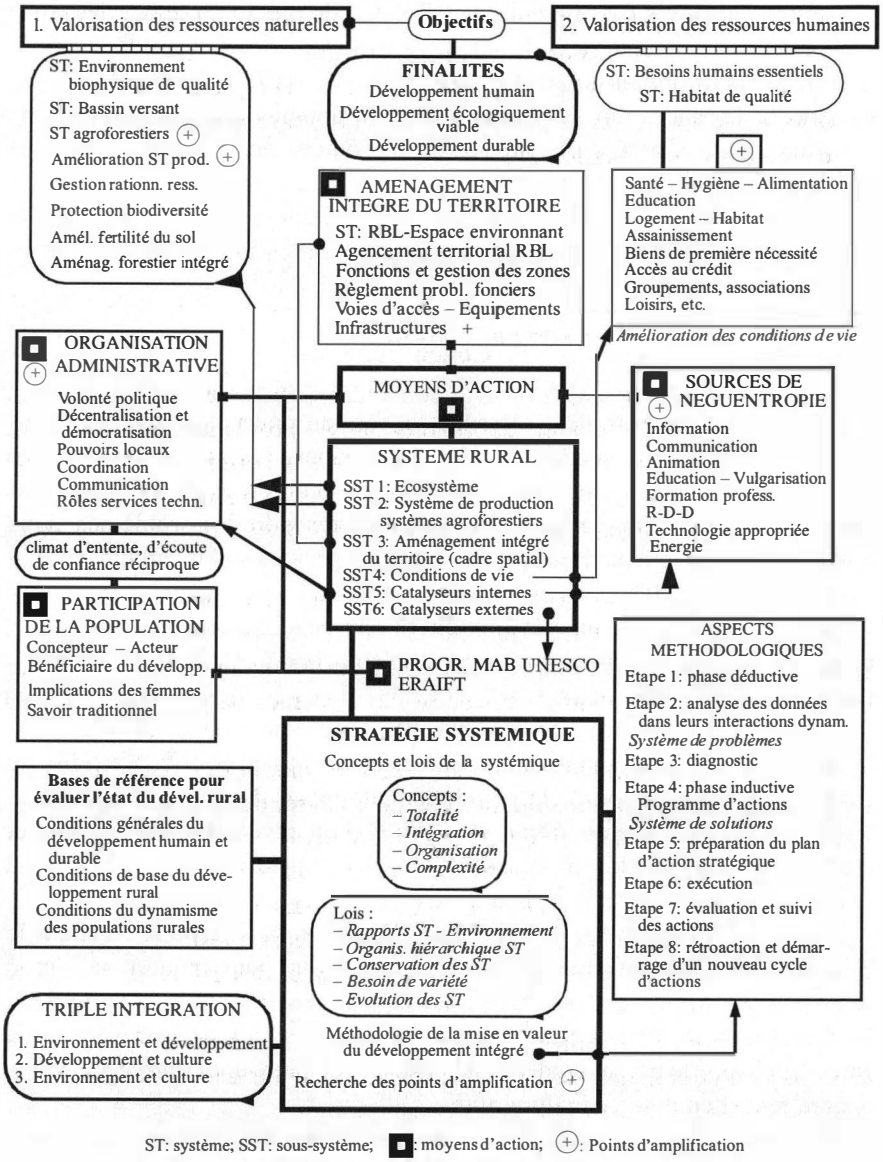

Fig. 1. — Approche systémique du plan directeur projeté (RBL): aménagement, gestion, analyse d'impacts, measures de mitigation.

L'approche suivie est pragmatique: il s'agit de mettre en œuvre les solutions retenues (système de solutions). Les moyens d'action portent essentiellement sur: l'organisation administrative de la RBL, qui déborde, nécessairement, le cadre de la réserve; la participation de la population; l'aménagement intégré du territoire; et les sources de néguentropie disponibles ou potentielles.

Les points d'amplification, qui peuvent avoir pour effet de stimuler le dynamisme latent de la population, sont spécialement indiqués.

5. Conclusion

Les réserves de biosphère offrent à la fois un concept et un outil pour répondre aux besoins spécifiques des populations. La grande biodiversité forestière de la RBL fournit à la population de nombreuses possibilités, mais pour en tirer parti à long terme, il convient de résoudre les problèmes aigus qui se posent actuellement. Pour ce faire, trois principes peuvent être proposés (MALDAGUE 2003) pour orienter les actions.

Premier principe: adopter et appliquer l'approche systémique dans l'aménagement et la gestion intégrés du système constitué par la RBL et son environnement territorial.

Deuxième principe: reconnaître que l'homme doit occuper la place centrale dans le développement en tant que concepteur, acteur et bénéficiaire de celui-ci. La participation de la population aux prises de décisions qui affectent son milieu est une condition *sine qua non* du développement durable et écologiquement viable. Responsabilisée, la population sera motivée à conserver et améliorer son milieu de vie.

Troisième principe: les dégradations observées dans la RBL résultent le plus souvent d'actions menées par la population pour assurer sa survie immédiate. A terme, un tel laisser aller ne peut conduire qu'à la perte de la biodiversité et de la capacité du milieu à supporter la vie. En revanche, la forêt tropicale, avec sa biodiversité, est bel et bien une *source de vie*... encore faut-il en assurer la durabilité.

Pour cela, il faut s'attaquer aux *causes profondes* de la situation observée; celles-ci résident essentiellement dans les conditions de pauvreté et de retard éducationnel qui sont le lot de la population de la réserve et de ses alentours. Outre une série d'actions, portant sur l'amélioration des conditions de vie, il convient de réorienter l'éducation vers un développement durable, mieux sensibiliser le public et l'amener à assumer ses responsabilités. Une personne qui a appris quelque chose est capable de changer d'attitude.

La stratégie systémique retenue peut être appliquée, *mutatis mutandis*, dans tous les projets d'aménagement intégré du territoire, de gestion des aires protégées, de plans de développement intégré, de gestion rationnelle des ressources naturelles, etc. Elle possède à ce titre une portée universelle.

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Gouvernance des aires protégées dans le Bassin du Congo: principes et pratiques

par

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MOTS-CLES. — Gouvernance; Jeu d'acteurs; Normes pratiques; Cogestion; Aires protégées; Bassin du Congo.

RESUME. — L'aire protégée est considérée dans son acceptation normative, c'est-à-dire un espace classé avec des objectifs spécifiques de conservation de la biodiversité et de gestion durable des ressources naturelles. Ces espaces, en pleine expansion dans les pays du Bassin du Congo, sont délimités et aménagés avant tout pour honorer les engagements pris à l'échelle internationale. En dépit des appuis multiformes apportés à ces aires protégées dans le cadre de projets financés par la communauté internationale, celles-ci seraient dans une situation de «sous-administration» ou «d'ingouvernabilité». La quête de la «bonne gouvernance» serait encore loin d'atteindre les résultats escomptés. La formation insuffisante des gestionnaires des aires protégées et la corruption des agents de l'administration ont été souvent invoquées pour justifier ces faibles performances. Cette lecture n'est pas aussi exempte de faiblesses. En effet, elle procède par une analyse des comportements des gestionnaires des aires protégées qui reste focalisée sur les normes officielles et occulte les mécanismes concrets par lesquels les aires protégées sont gérées au quotidien.

La gouvernance au quotidien des aires protégées renvoie, au contraire, au «savoir-faire» personnel de chaque agent, à l'art d'ajuster les éléments du modèle officiel au contexte local, bref aux normes pratiques. A la différence des normes officielles, ces dernières ne peuvent être observées directement, mais sont reconstruites à partir des comportements qu'elles régissent. Ces comportements peuvent aller à l'encontre des objectifs poursuivis (cas de la corruption) tout comme ils peuvent produire des résultats proches de ces objectifs. Dans cette perspective, la gouvernance des aires protégées n'est pas redevable de normes officielles tout simplement, mais les performances observées s'effectuent par la capacité des gestionnaires de manipuler aussi bien les normes officielles que les autres systèmes de règles et de construire des nouvelles bases institutionnelles sans éliminer les anciennes. La connaissance de ces normes pratiques apparaît

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alors indispensable non seulement pour comprendre les faits observés (les faibles performances par rapport aux normes officielles, notamment), mais aussi pour organiser l'action.

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La gouvernance est aujourd'hui un thème central des débats sur la bonne gestion forestière dans le Bassin du Congo. De nombreux séminaires et ateliers ont été consacrés à ce thème depuis la fin des années 1990. L'attention a été portée sur les ressources forestières, en général. Le glissement vers les aires protégées, en particulier, s'est opéré surtout dans le cadre des travaux préparatoires du dernier Congrès mondial des Parcs qui s'est tenu à Durban en septembre 2003. Parallèlement, la quête de la «bonne gouvernance» des aires protégées s'est aussi intensifiée sur le terrain. Cette dynamique a été accompagnée récemment par l'engagement des Etats à œuvrer pour la bonne gouvernance des ressources forestières. Une Déclaration ministérielle sur l'application de la législation forestière et la gouvernance en Afrique (AFLEG) a été signée à Yaoundé en octobre 2003. En dépit de l'intérêt accordé à la lutte contre l'exploitation forestière illégale, cette Déclaration a contribué à légitimer les actions antérieures en faveur de la bonne gouvernance des aires protégées.

Dans cette contribution, nous nous proposons d'analyser la mise en œuvre de la «gouvernance» des aires protégées dans le Bassin du Congo. On examinera dans un premier temps l'image d'une aire protégée supposée faire l'objet d'une bonne gouvernance, à la lumière des critères véhiculés à l'échelle internationale. Dans un deuxième temps, on analysera les mécanismes concrets par lesquels les aires protégées sont gérées au quotidien. Nous emprunterons pour cela, le modèle exploratoire proposé par OLIVIER DE SARDAN (2001). Ce modèle tente d'interpréter les comportements des agents publics comme renvoyant à des normes pratiques et non comme un simple écart par rapport aux normes officielles. Enfin, les normes pratiques révélées par cette lecture nous permettront de discuter de la faisabilité des réformes initiées pour améliorer la gouvernance des aires protégées dans le Bassin du Congo.

1. La gouvernance d'une aire protégée telle qu'elle devrait être

Il est assez difficile d'esquisser une image d'une aire protégée qui ferait l'objet d'une bonne gouvernance. L'exercice est d'autant plus délicat dans la

mesure où il n'existe pas, contrairement aux espaces forestiers affectés à la production de bois d'œuvre, des normes de résultats, plus connues sous l'appellation de principes, critères et indicateurs de la gestion durable des forêts. On peut néanmoins imaginer le «look» d'une telle aire protégée en se référant aux critères de gouvernance véhiculés à l'échelle internationale (World Bank 1992, 1994; RIBOT 1999, 2001; SMOUTS 1998). Dans une contribution antérieure (NGUINGUIRI 2003), cet exercice a permis d'esquisser les caractéristiques suivantes:

— Une politique de gestion de proximité qui insiste sur la décentralisation et le mode de gouvernement par délégation oriente la mise en œuvre de la gouvernance des aires protégées. Le principe de subsidiarité est de mise. Un cadre légal précise les règles du jeu, définit les obligations et les devoirs de chaque partie prenante et veille à ce que la sécurisation de l'aire protégée n'entraîne pas l'insécurisation des populations locales, et vice versa. Un plan d'aménagement est élaboré et mis en exécution.
— Une autorité locale chargée de gérer l'aire protégée dans laquelle chaque partie prenante se reconnaît, veille au respect du cadre légal. Elle est représentative de tous les groupes d'intérêt. Elle est non seulement légitime, mais elle est aussi légale. Elle respecte les règles et les fait respecter, s'il le faut au moyen de la force publique. Elle est tenue de rendre compte de sa gestion. La corruption ou les abus de pouvoir qui caractérisent les relations de connivence entre braconniers et conservateurs des aires protégées relèvent du passé; un code d'éthique est appliqué à la lettre.
— La responsabilisation de toutes les parties prenantes est effective. Celles-ci participent à l'émergence d'une forme de citoyenneté locale en rapport avec un référent identitaire commun qui est l'aire protégée. Les populations locales et les autres groupes d'utilisateurs des ressources naturelles participent à la prise de décisions et à la répartition des coûts et des bénéfices de la conservation.
— Toutes les parties prenantes ont accès à l'information disponible. Les lois sont vulgarisées, les principaux résultats attendus du plan d'aménagement sont connus, les parties prenantes savent où elles vont, comment elles vont procéder et quels résultats ont été déjà obtenus. En définitive, la transparence est totale et permet l'émergence de contrepoids au pouvoir dévolu à l'autorité chargée de gérer l'aire protégée.

Cette image montre que la gouvernance ne peut être réduite aux préoccupations de gestion d'une aire protégée en soi. La gouvernance renvoie au contraire à l'environnement politique, administratif et légal qui facilite ou

qui entrave la bonne gestion de l'aire protégée. Les réformes politiques, législatives et institutionnelles sont certes indispensables, mais les changements de gouvernance sont surtout redevables d'une confrontation entre acteurs aux intérêts divergents (RIBOT 1999). Dans cette perspective, l'analyse de la gouvernance d'une aire protégée ne se limite pas qu'aux normes officielles, mais fait appel aux acteurs, au jeu de pouvoir et de contre-pouvoir.

2. La gouvernance des aires protégées au quotidien

L'aire protégée est considérée dans son acceptation normative; c'est un espace classé qui a été affecté à la conservation de la biodiversité et au développement durable. Elle est administrée par une autorité de gestion qui peut comprendre:

— Des agents des services des eaux et forêts, parmi lesquels on note le conservateur, le responsable du suivi écologique, le responsable de la lutte antibraconnage, etc.;
— Du personnel temporaire composé principalement par les animateurs et les écogardes;
— Des conseillers techniques affectés dans le cadre des projets de conservation et de développement durable;
— Des bénévoles, parfois, intervenant dans le cadre du Comité de gestion multipartite ou du comité consultatif.

Les normes officielles régissent son fonctionnement. Bien qu'étant encore dominées par l'héritage des modes de gestion centraliste, celles-ci offrent de plus en plus des possibilités de participation, de dialogue et de négociation. Ces normes officielles sont consignées dans les lois et règlements, le plan d'aménagement, le règlement intérieur de l'aire protégée, l'accord de financement de projet, etc. Elles sont appliquées dans un contexte caractérisé par:

— La diversité des acteurs: autour d'une aire protégée plusieurs acteurs et groupes d'acteurs entrent en confrontation, chacun défendant des intérêts particuliers;
— La pluralité des normes: normes officielles qui ne sont pas toujours claires, normes locales ou traditionnelles, normes internationales sous la forme de conventions et d'accords internationaux;
— Un empilement des centres de pouvoirs et des centres de décisions: le conservateur, mais aussi le chef de lignage propriétaire d'un territoire

clanique situé à l'intérieur de l'aire protégée, le chef du village riverain dont le terroir est recouvert par une partie de l'aire protégée, le commandant de la brigade de gendarmerie, le sous-préfet, etc.

Dans ce paysage, l'équipe chargée de gérer l'aire protégée se situe à l'interface d'un certain nombre de «mondes» ou mieux de configurations de représentations. Il y a le monde des populations locales, le monde de l'administration des eaux et forêts, le monde des donateurs et des bailleurs de fonds, le monde des organisations non gouvernementales, le monde des grands groupes industriels qui exploitent le bois d'œuvre en périphérie de l'aire protégée, etc.

Dans un tel contexte, l'application des normes officielles renvoie aux enjeux de pouvoir, c'est-à-dire à la capacité d'influer sur la décision des acteurs qui font partie des autres mondes. Les résultats réels sont, dans ce cas, étroitement liés au savoir-faire personnel de chaque membre de l'équipe de gestion, c'est-à-dire à l'art d'ajuster les éléments du modèle officiel au contexte local, bref aux normes pratiques, si l'on veut reprendre les termes d' Olivier de Sardan (2001). En abordant le sujet dans cette direction, trois cas de figure émergent de l'analyse de la gouvernance des aires protégées dans le Bassin du Congo.

Le premier cas de figure se rapporte aux gestionnaires qui se sont distingués par une conduite que l'on peut qualifier de consciente. Ils sont agents des services des eaux et forêts, conseillers techniques ou membres du comité multipartite de gestion de l'aire protégée. Ils ont eu le mérite de déployer des efforts particuliers pour faire appliquer les lois et les règlements au pied de la lettre. Il a été constaté qu'en général, ces individus finissent dans des conflits, d'abord avec leurs collègues qui les traitent de naïfs et ensuite avec les acteurs des autres mondes.

Dans le Parc national de Conkouati-Douli au Congo, par exemple, la collaboration entre le conservateur et la Force publique dans la lutte antibraconnage a produit l'effet inverse, comme le rapportent Chatelain *et al.* (2004). Les soldats censés réprimer les délits ont organisé un système de taxation des animaux braconnés et une sorte d'alliance s'est constituée entre les gardes armés et les braconniers, qui ne sont pas membres des communautés locales et qui viennent de l'extérieur du parc, les premiers devenant les protecteurs des seconds.

Dans ces conditions, humiliations et bien d'autres maux ont été infligés à ces gestionnaires «rigoureux». Dans la réserve de faune du Dja au Cameroun, par exemple, en juillet 2001, les gardes qui ont tenté d'intercepter un camion militaire transportant 250 kg d'ivoire, se sont fait rosser par les mili-

taires occupant le camion ... qui a continué sa route avec son chargement (Programme ECOFAC & Projet WWF Minkébé 2001).

A cela s'ajoutent les frustrations liées à l'acquittement des délinquants quand les activités illicites font l'objet de poursuites judiciaires. Au Cameroun, par exemple, COLLOMB (2001) note que 4 % seulement des violations rapportées en 1992-93 ont fait l'objet de poursuites judiciaires et les amendes ont été levées. Une plainte sur cinq a été retirée après l'intervention d'une personne influente.

La position de victime dans laquelle se retrouvent ces gestionnaires contribue à accroître la vulnérabilité de l'aire protégée. Le pouvoir conféré par les normes officielles apparaît ainsi insuffisant pour faire face aux acteurs des autres mondes. L'approche sectorielle de la bonne gouvernance peut se révéler, dans ce cas, inefficace. Nous pouvons donc convenir avec RIBOT (2000) que la bonne gouvernance environnementale a plus de chance de succès que si elle s'inscrit dans un processus de bonne gouvernance à tous les niveaux et dans tous les secteurs.

Le second cas de figure se situe à l'opposé du premier. Il renvoie au personnel des aires protégées qui font usage des normes officielles pour défendre des intérêts particuliers. Les arrangements pratiques sont caractérisés ici par la mise en négociation des pouvoirs conférés par les normes officielles. Les avantages du métier procurés par de telles manœuvres sont de différentes natures. Ils concernent aussi bien le prestige que la corruption.

Le port de l'uniforme par un écogarde recruté localement est un signe d'ascension sociale et de prestige. Comme toute personne faisant partie de l'élite locale, l'écogarde est appelé à consolider sa nouvelle position dans l'arène politique locale. A cet effet, il fait parfois preuve de largesse face aux braconniers. En fermant les yeux, il met en jeu les opportunités offertes par sa position de pouvoir pour accroître en retour son réseau de relations. A chaque fois que l'occasion se présente, il ne manque pas de rappeler à la personne ayant bénéficié de ses faveurs ou à sa famille, ou encore à son village, ses actions de bienfaisance: «j'ai sauvé telle personne ou telle autre de la prison». Ces pratiques sont tributaires de la logique de la redistribution des ressources reconnue au «grand type» pour affermir leur position de pouvoir. Elles vont au-delà des préoccupations liées au maintien des équilibres sociaux, évoquées par le Programme ECOFAC et le Projet WWF Minkébé (2001).

> Chasseurs et agents du parc sont souvent liés par la famille. Le tissu socioculturel est tel qu'il ne faut pas espérer voir un agent dénoncer un membre de sa famille, même élargie. La protection des éléphants n'est pas une priorité pour les populations. Trouver de l'argent, et maintenir des équilibres sociaux, oui. (Programme ECOFAC & Projet WWF Minkébé 2001.)

Les acteurs de la conservation ne sont pas aussi réputés corruptibles que leurs collègues chargés du contrôle de l'exploitation de bois d'œuvre. Néanmoins, il a été signalé des cas isolés de grande corruption liés au trafic d'ivoire et au commerce de perroquets. Etant donné que les risques associés à la dénonciation de la corruption sont beaucoup plus grands que les gains potentiels (BRUNNER & TCHAMOU 2001), il n'est pas aisé de collecter des informations sur ce sujet. La petite corruption, par contre, n'est pas du tout un sujet tabou, dans la mesure où l'on reconnaît à certains agents des aires protégées le défaut d'être faible face au *gombo*. En cas de contrôle routier, par exemple, le braconnier ou le chauffeur de taxi-brousse, pour «bien parler», peut faire usage du *gombo* en glissant une certaine somme d'argent aux agents en patrouille pour solliciter leur indulgence. Ces pratiques socialement acceptables, pour autant qu'elles ne soient pas dévoilées, sinon elles sont sanctionnées, vont à l'encontre des objectifs de la bonne gestion de l'aire protégée.

Le dernier cas de figure concerne aussi des manœuvres axées sur la reconversion en capital relationnel des ressources offertes par les normes officielles. A la différence du cas de figure précédent, ce capital relationnel est ensuite mobilisé pour atteindre des objectifs professionnels. Dans ce registre d'échange généralisé de biens donnés et de services rendus, on peut citer, par exemple, le bon de carburant offert de temps en temps au sous-préfet ou au commandant de la brigade de gendarmerie, les per diem payés aux autorités locales pour leur présence à la cérémonie d'ouverture d'un séminaire de formation des écogardes, ou encore l'implication des chefs «traditionnels» dans l'identification des futurs écogardes. Il est bien évident que ces pratiques ne sont pas conformes aux normes; les per diems ne devraient être payés que si des nuitées ont été passées en dehors du lieu de résidence habituelle, les prérogatives et les compétences nécessaires pour le recrutement du personnel de l'aire protégée n'étant reconnues qu'au conservateur et/ou aux conseillers techniques. En mettant en négociation ses prérogatives dans le recrutement des écogardes ou en redistribuant abusivement les ressources affectées à l'aire protégée, le conservateur poursuit des objectifs personnels liés au renforcement des alliances avec les autres centres locaux de pouvoir. En effet, la connaissance personnelle des autres acteurs détenteurs de pouvoirs spécifiques liés à leur fonction permet de se tirer d'affaires avec eux en cas de problème personnel ou professionnel. A travers ce tour de main, le gestionnaire de l'aire protégée arrive non seulement à renforcer son pouvoir mais aussi à créer un environnement institutionnel favorable à l'application des normes officielles. De ce point de vue, les cas d'humiliations cités précédemment sont la marque d'un déficit de capital relationnel.

Il apparaît de ces trois cas de figure que les résultats réels de la gouvernance des aires protégées sont redevables de la capacité des gestionnaires à réagir, à manipuler des systèmes différents de règles et à construire de nouvelles bases institutionnelles sans éliminer les anciennes (CHAUVEAU & JUL-LARSEN 2000). Ces observations convergent vers la gouvernance telle qu'elle est abordée en sociologie politique, notamment ses quatre propriétés suivantes (SMOUTS 1998):

— La gouvernance n'est ni un système de règles ni une activité mais un processus;
— La gouvernance n'est pas fondée sur la domination mais sur l'accommodement;
— La gouvernance implique à la fois des acteurs privés et publics;
— La gouvernance n'est pas formalisée et repose sur des interactions continues.

3. Implications pour les réformes sur la gouvernance des aires protégées

Les initiatives impliquées dans la bonne gouvernance des aires protégées dans le Bassin du Congo ont fait de la gestion participative leur cheval de bataille. Sur le plan de l'action, cela renvoie à la création de nouvelles institutions de gestion multipartite de l'aire protégée qui s'ajoutent aux institutions préexistantes. Cependant, toutes ces initiatives ne privilégient pas la même démarche. Certaines procèdent par une offre d'innovation institutionnelle et d'autres privilégient l'émergence d'arrangements institutionnels à partir d'une logique de négociation (NGUINGUIRI 1999).

L'offre d'innovation institutionnelle est l'approche la plus courante. Elle est facile d'utilisation et consomme peu de temps et de ressources. D'une façon caricaturale, elle consiste à plaquer un modèle d'organisation élaboré par une agence d'appui sur la base des résultats d'enquêtes socio-économiques. En d'autres termes, il s'agit d'administrer aux acteurs locaux un modèle d'organisation prescrit par les experts. Ce modèle d'organisation est administré en mettant souvent en avant des incitations sous la forme d'activités alternatives ou d'écodéveloppement et parfois des menaces habillées sous la formule des conditionnalités de l'aide au développement. Des mécanismes de contrôle sont également mis en place. Contrairement au secteur forestier, on n'assiste pas encore dans les aires protégées, à la présence d'observateurs indépendants imposés par les institutions internationales pour garantir la bonne gouvernance. Au Cameroun, en particulier, l'ONG *Global Witness* joue le rôle d'observateur indépendant dans les commissions d'attribution des

titres d'exploitation forestière et dans le contrôle des opérations d'exploitation forestière.

Cette pratique, qui rappelle l'approche gestionnaire observée dans la formulation des politiques forestières (BUTTOUD & SAMYN 1999), prédispose les gestionnaires des aires protégées à appliquer les lois et les règlements tels qu'illustré dans le premier cas de figure. Cette approche a permis, certes, de faire avancer les réformes dans certaines aires protégées et dans la gestion forestière (BRUNNER & EKOKO 2000), mais la question de l'appropriation — *ownership* — du processus de réformes par les parties prenantes n'est pas encore résolue (KARSENTY 2002).

La seconde approche s'appuie sur une logique de renforcement des capacités des acteurs locaux, ou mieux des parties prenantes — les fameux *stakeholders* — à construire leurs propres systèmes de gestion. Elle procède par la facilitation d'un processus de définition des règles par l'ensemble des parties prenantes et au renforcement de leurs capacités à les appliquer, les modifier au besoin et les adapter aux évolutions du contexte. En pratique, le cheminement suivi comprend trois phases: organiser le partenariat, négocier les plans et accords, et apprendre par l'action. Ensuite, il se poursuit dans le cadre d'un cycle d'apprentissage qui s'organise autour des deux dernières phases (BORRINI FEYERABEND *et al.* 2000).

Cette dernière approche a été privilégiée sur un certain nombre de sites, parmi lesquels on peut citer le Parc national de Conkouati-Douli et le Sanctuaire des gorilles de Lossi au Congo, le Parc national de Waza-Logone et le Parc national de Lobéké au Cameroun. Les arrangements institutionnels façonnés, au sens de *crafting institutions* (OSTROM 1992), et consignés dans les accords de gestion ne sont appropriés à l'ensemble des parties prenantes que si le processus qui a permis de les générer a été démocratique et légitime. Cependant, l'efficacité de ces nouvelles institutions n'est pas garantie d'avance; les résultats sont plus proches des objectifs officiels lorsque les leaders, au sein de l'autorité de gestion, disposent des capacités personnelles de négociation d'une partie de leurs pouvoirs auprès des institutions préexistantes. Cela sous-entend que ces leaders conservent une marge de manœuvre suffisante à l'expression de leur faculté d'entreprendre. La situation souhaitée au terme d'un tel processus est plus proche du cas de figure 3 décrit précédemment.

4. Conclusion

Certes, il est primordial d'engager des réformes législatives et institutionnelles, mais les normes officielles, considérées isolément, ne peuvent

pas garantir la gouvernance des aires protégées. La gouvernance ne se décrète pas. Au contraire, elle est la manifestation des normes pratiques. Ces dernières ne peuvent être observées directement, mais sont reconstruites à partir de l'analyse des comportements qu'elles régissent. Ces comportements peuvent aller à l'encontre des objectifs attendus — c'est le cas de la corruption — tout comme ils peuvent produire des résultats proches de ces objectifs professionnels. Dans cette perspective, la connaissance de ces normes pratiques est indispensable pour la bonne gouvernance des aires protégées. Elle permet de cibler les normes pratiques sur lesquelles l'action peut être organisée et d'appréhender celles qui peuvent annihiler les effets de l'action.

Cette lecture a permis d'évaluer la faisabilité de la gestion participative des aires protégées, notamment des deux principales approches privilégiées dans les initiatives en cours dans le Bassin du Congo. Il est apparu que la gestion participative, perçue sous l'angle d'arrangements institutionnels façonnés par les parties prenantes, peut permettre d'obtenir de bonnes performances. La mise en place d'institutions de cogestion n'étant qu'une étape du processus, ces performances sont étroitement liées à la capacité personnelle des leaders à construire des normes pratiques dans un environnement incertain et fluctuant.

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Development of Conservation Areas. An Effort towards Biological Diversity Conservation in Indonesia

by

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SUMMARY. — Forestry development in Indonesia is supported by the desire to improve the living standards of people through the optimum use of forest resources. To achieve this objective, based on the National Act No. 41/1999 concerning Forestry, the management of the forest resources is allocated according to their function and land-use classification: production forests, protection forests and conservation forests. Based on this function, conservation forests are divided into: nature conservation areas, including national parks, nature recreational parks and grand forest parks; sanctuary reserves, including strict nature reserves and wildlife reserves; hunting parks.

According to the National Act No. 5/1990 concerning the Conservation of Living Resources and Ecosystem, the conservation areas include the terrestrial and marine ecosystem, with three main issues: protecting the life-supporting system, preserving wildlife plants and animals, using park resources sustainably.

In order to sustainably manage forest resources, as an approach to sustained forest development, the Government of Indonesia (GOI) has launched several nature conservation programmes, including *in-situ* activities in the development of conservation areas.

Indonesia is one of the first tropical countries in the world having a protected areas' system. They serve as in-site conservation areas, protecting the natural ecosystem and the species and genetic diversity within them.

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Background

Located between the continents of Asia and Australia, and between the Pacific and Indian Ocean, with a total territory of about 780 million ha, stretched along the equator from Sabang in the West and Merauke in the East, Indonesia covers 1.3 % of the earth's surface area and forms about 50 % of the tropical forest in South-East Asia, or about 10 % of the tropical forest on our Earth.

The geographic and tropical location has contributed to the various types of forests, including mangrove forests, freshwater swamp forests, lowland rain forests, mountain rain forests, monsoon forests, which cover the areas from coast up to the mountain tops more than 3,000 metres above sea level. These forests are the home for thousands of plant species ranging from mosses to giant fig and dipterocarp trees, as well as thousands of animal species; from tiny zooplankton to large rhinoceros and elephants, *e.g.* 10 % of the world's flowering plant species, 12 % of the world's mammal species, 16 % of all reptile and amphibian species, 17 % of the world's bird species, and more than 25 % the world's fish species.

In addition to these terrestrial resources, two thirds of Indonesia's territory (5.8 million km^2) is marine waters, with 81,000 km of coastline. Indonesia is part of the "Coral triangle". This area of the Pacific, including the waters of Indonesia, Malaysia, Papua New Guinea, the Solomon Islands, is a global priority for conserving the biodiversity of the "Coral Triangle" which supports only 35 % of the world's coral reef, but is home for 77 % of the world's coral species, over 50 % of all reef fishes, 58 % of the world's marine molluscs, and the highest diversity of mangroves, sea grass and other groups — an astonishing level of diversity concentrated in less than 1 % of the world ocean's surface area.

Institutional and Policy Framework

The Ministry of Forestry is responsible for managing Indonesia's forests and nature protected areas on a sustained yield basis by recognizing the forest products for economic development while protecting the environmental values in preserving biological diversity, acting as carbon sinks, contributing to climate stability, safeguarding water resources, the ethical, aesthetic and cultural values, for the benefit of its people and acknowledging the global importance of these resources to environmental well-being.

Forestry development in Indonesia is supported by the desire to improve the living standards of people through the optimum use of forest resources. To achieve this goal, based on the National Act No. 41/1999 concerning Forestry, the management of forest resources is allocated according to their function and land-use classification: 1) production forests; 2) potection forests; 3) conservation forests.

As strategic efforts to achieve conservation, several conservation area categories have been developed with numerous criteria. Based on IUCN (The World Conservation Union) criteria and based on this function, conservation forests are divided into: 1) nature conservation areas which include national parks, nature recreational parks and grand forest parks; 2) sanctuary reserves, including strict nature reserves and wildlife reserves; 3) hunting parks.

According to the National Act No. 5/1990 concerning the Conservation of Living Resources and Ecosystem, the conservation areas include the terrestrial and marine ecosystem. Three main efforts are required to preserve the living resources and ecosystem: 1) protect the life-supporting system; 2) preserve wildlife plants and animals; 3) use sustainably the parks resources.

In order to sustainably manage forest resources, as an approach to sustained forest development, the GOI has launched several nature conservation programmes, including biodiversity conservation at three levels: 1) ecosystem conservation, to set aside the representative ecosystem as areas; 2) genus conservation; 3) species conservation, through *in-situ* and *ex-situ* conservation efforts.

Protected Areas and Biodiversity

Indonesia is one of the first tropical countries in the world having a protected areas' system. They serve as in-site conservation areas, protecting the natural ecosystem and the species and genetic diversity within them. Between 1990 and 1999 the extent of protected areas has increased significantly from 16.1 million ha to 22.4 million ha, an increase of 6.3 million ha in nine years. The number of park offices facilitating management of protected areas has risen accordingly (SUMARDJA 2000). Until 2004, Indonesia has gazetted 486 units of protected areas including marine and terrestrial conservation areas, covering a total of 26.4 million ha as presented in table 1. In addition, some 592 protected forest areas, covering 34 million ha, have also been established.

Table 1
Areas and number of protected areas

No.	Protected areas	Size (ha)	Unit
1.	Strict nature reserves	4,479,954.53	223
2.	Wildlife sanctuaries	4,940,886.06	69
3.	National parks	15,208,476.64	50
4.	Nature recreational parks	1,207,812.25	122
5.	Grand forest parks	334,604.80	17
6.	Hunting parks	225,992.70	14
Jumlah		26,403,476.64	491

Source: Ministry of Forestry 2004.

Protected areas are economically important throughout the region, providing destinations for tourism industry, protecting watersheds which support the irrigation system within the whole country, providing research sites and conserving species of plants and animals which make numerous contributions to society. They are thus a national economic asset which justifies a significant government investment. Yet the investment being made by government falls far short of what is required to enable protected areas to make their optimal contribution to modern society.

Some of the national parks have been internationally recognized (tab. 2), including the ASEAN/ASEAN Heritage Sites (Lorentz NP, Gunung Leuser NP, Komodo NP), World Natural Heritage Sites (Lorentz NP, Ujung Kulon NP, Komodo NP, Gn Leuser NP, Kerinci Seblat NP, Bukit Barisan Selatan NP), Biosphere reserves (Siberut NP, Komodo NP, Ujung Kulon NP, Gunung Gede Pangrango NP, Tanjung Puting NP and Lore Lindu NP), Ramsar sites (Berbak NP and Danau Sentarum NP). Three national parks located in Kalimantan and Papua were proposed as Trans-Border Reserve (Betung kerihun NP, Kayan Mentarang NP, Wasur NP).

Table 2
World Heritage Natural Sites (WHS) of Indonesia

No.	WHS	Year inscribed	Size (ha)
1.	Ujung Kulon National Park	1988	122,956
2.	Komodo National Park	1991	173,300
3.	Gunung Lorentz National Park	1999	2,450,000
4.	Gunung Leuser National Park	2004	1,094,692
5.	Kerinci Seblat National Park	2004	1,386,000
6.	Bukit Barisan Selatan National Park	2004	365,000

Source: Ministry of Foestry 2004.

The whole management of conservation areas is under the jurisdiction of the Ministry of Forestry, the Directorate-General of Forest Protection and Nature Conservation (DG of FP & NC). While in-site level, the parks are managed directly by the technical executing agencies. National parks are managed by the National Park Management Authority (Balai Taman Nasional = BTN), and the other protected areas are managed by the Nature Conservation Management Authority (Balai Konservasi Sumber Daya Alam = BKSDA) which are located in every province (some provinces have two BKSDAs). All the park authorities are directly responsible for the DG of FP & NC.

The significance of protected areas is not only seen at national level but also for the benefit of the global community. There are so many grants and loans that have been given for such activities. Many international NGOs have actively been involved in saving conservation areas, mainly national parks.

For instance, the Gunung Lorentz National Park, inscribed in 1999 on the world heritage list, covers over 2 million ha representing the largest tract of pristine rain forest and a biotic richness and diversity without comparison in Asia. The site covers every ecoregion in Irian Jaya from Carstenz Peak, Asia's highest point, and alpine vegetation, to freshwater swamps and coastal mangroves. Lorentz is home to 10,000 people comprised of nine ethnic tribal groups, including the Asmat, known worldwide for their wood carving. Under a WWF project in the area, the nomination was completed and received the approval of the local village chiefs and the four ministries with interests in the area (Forestry, Welfare & Culture, Industry and Mining, and the Army). Further negotiation with Conoco Oil and Freeport McNamara (the world's largest gold mine) secured agreements to redefine the park boundary and release all concessions within the site.

So far a lot of data indicate that ecosystem destruction, species extinction, and erosion of genetic resources in Indonesia have been increasing over the years. In other words, Indonesia is facing biodiversity crisis. The factors and underlying causes are complex and some of them are interlinked. These factors can be classified into two groups: 1) technical factors (human activities, choice of technology and the natural resources); 2) structural factors (policies, institutional and law enforcement).

One of the limitations to conservation efforts is the lack of understanding of the connection between conservation and economic development. Insufficient information on the economic value of biodiversity, which can be processed, absorbed and used by decision-makers, is a serious obstacle to action in the country.

Role of Communities in Protected Area Management

In developing nations like Indonesia, poverty and the mean to increase the welfare of communities is a multifaceted problem. These poor communities are usually concentrated in the interior forest areas. Their livelihood is usually based on what they extract from the forest.

Challenges for Indonesia Conservation

Efforts to manage conservation areas in Indonesia face many challenges. These include a low awareness of the importance of conservation efforts, weak management capacity, and inconsistency of management policies for conservation areas. This situation is set to worsen with the high rate of exploitation of natural resources, particularly in western and central Indonesia. Forest resource use is a common example of over-exploitation, caused by substantial increasing demand for tropical timber at regional and global levels without balancing the demand with reforestation efforts. Marine resources faced the same problem: over-exploitation in the form of overfishing and destructive fishing, coral reef damage and coastal abrasion.

Direct impact of those destructive activities includes declining environmental quality leading to natural disasters such as landslides, flood, forest fire, decreasing soil fertility, erosion, coastal abrasion and biodiversity loss. All these factors become one of the main determining factors increasing poverty and the biggest loss of economic opportunity of the natural resources.

Field level implementation of conservation area management in Indonesia is confronted with several basic obstacles, both from the government when managing the area and from the local community. From the government's perpective, the basic obstacles are related to the inadequate level of awareness and implementation of legal apparatus and policies, and the classic problems of insufficient funding.

From the community point of view, obstacles to protected area management are more complex, particularly as there is more than one perspective represented within a given community. Perspectives cover many aspects, such as economics, education, socio-cultural factors and numerous others, which if further examined can be identified as follows (Ridwan 2000):

— Economic status/condition. In general, the economic status of communities living in or around conservation areas is middle to low, and tends in most cases to be poor with subsistence needs met by depending on resources within the conservation area.

— Educational status. Low level of formal education of part of the population in the vicinity of a conservation area frequently results in a low level of understanding, awareness and support for conservation areas' protection and creates difficulties in socializing the importance of conservation areas' management.
— Village potential and limited infrastructure. In general, infrastructure in these areas is limited, including transportation and communication, among others. Moreover, it can be said that development efforts to date have not yet met the needs of communities in the vicinity of conservation areas.
— Population growth. Population growth of these communities will increase their subsistence needs, which eventually will stress the limits of conservation areas.
— The strong relationship between the socio-cultural needs of the community and conservation areas. The forest of conservation areas for the communities is not only a place to live and obtain subsistence needs, but it also provides them with socio-cultural and spiritual values. These socio-cultural and spiritual values are frequently more important to them than economic values.

Commitment of Government and Civil Society

Facing these many urgent challenges to managing natural resources, the government of Indonesia has actively sought to improve management by delivering commitments made under international conventions over the last three decades, starting from Stockholm Conference on Environment in 1972 until Earth Summit in Rio de Janeiro in 1992, and World Summit on Sustainable Development (WSSD) in 2002 in South Africa.

These various international commitments have become interrelated with the current decentralization process underway in Indonesia over the last five years. Commitments to be more transparent in natural resource management are being implemented for instance in preparing a more participatory process for developing national policy initiatives. Examples of this approach in action include the Decree of the House of Representatives No. IX in 2001 concerning Agrarian Reform and Natural Resources Management.

The government of Indonesia has implemented commitments made in the COP-7 by establishing nine new national parks covering an area of 1.3 million ha. The government has also committed itself to including ramin

(*Gonystylus spp*) and freshwater turtles in the CITES list Appendix II and many other efforts. Conservation commitments have not only come from the government.

National and Global Recognition

National recognition for those who have demonstrated commitment to protecting the environment has been given by the government, business community and non-governmental organizations alike. The Kalpataru Award initiative from the Minister of Environment is given to Adat Leader in Sabba Village, East Biak; KEHATI Award is given to Baduy Community-West Java, for their sustainable farming practices; Rimba Community-jambi, for their strong protection of their ancestral forest; Kokorotan Community-Sangihe Talaud, for their traditional wisdom of Sasi in coastal management; Indofood Award to be delivered to researchers focusing on foodstuff and agriculture. At the local level, Ngata Toro community in Lore Lindu's national park has received the Equatorial Initiative Award for their consistent practice of traditional wisdom.

At the global level, two national parks have achieved international recognition: British Travel Award 2004 for Bunaken National Park in North-Sulawesi and World Legacy Award 2004 in category of Destination Stewardship for Rinjani National Park.

Based on the forestry development policy, the existing conditions and to anticipate the future situation, the DG of Forest Protection and Nature Conservation has developed for the next five years a strategic plan. The vision is to legally develop conservation of biodiversity through institutional support to be able to effectively manage the resources and to develop the optimum benefit for the society. The four main missions concerned are:

— To strengthen the management of nature resources and the ecosystem;
— To strengthen the forest protection efforts and law enforcement;
— To develop sustainable nature resources utilization;
— To develop institutional and collaborative management in managing and protecting nature resources and the ecosystem.

Strategies for park management concerning biodiversity conservation are grouped in the ten main programmes as follows:

— Reviewing the policy on forest protection and nature conservation and the ecosystem to be able to well manage the resources;

— Protecting forest resources including the species of fauna and flora and enforcing the law through cooperation with stakeholders;
— Developing new parks to protect the representativeness of the essential ecosystem and to effectively manage the existing parks;
— Developing the species conservation to prevent their extinction;
— Developing incentive and sustainable financing mechanism in the conservation system, enhancing research and development of parks' potential resources;
— Developing community empowerment, the adoption of local rights and wisdom, collaborative management and partnership;
— Developing nature tourism and environmental services;
— Preventing forest fire;
— Developing and enhancing institutional capability to manage parks and conservation areas;
— Following up the international convention result and participating largely in local, regional, national and international conservation events.

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Forest Management Decentralization in Cameroon. Which Impact on Local Development?

by

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KEYWORDS. — Forest Management; Decentralization; Local Sustainable Development; Practices.

SUMMARY. — In 1994, a new political and legal regulatory framework of the forest resources management was introduced in Cameroon with the aim of improving sustainable use of forest resources, increasing the participation of indigenous and local populations in the conservation and the management of forests and contributing to economic and social development. Forest resources management has therefore a key role to play in the country political and social agenda with the expectation to introduce democracy in forest management issues and ensure economic growth in rural areas. Some years after the forestry reform in Cameroon, this study has the ambition and the challenge to assess the performance and the impact of this important reform on rural livelihoods. From our fieldwork and the literature, it appears that, despite some limitations, the policies and regulations are somehow well developed. The forestry reform has generated some notable changes, for example, the recognition of the legitimate role of local populations in forest management; substantial amounts of money have been generated by timber exploitation even for the rural councils and the riparian populations. But the application of the important aspects of the reform is still facing many constraints in regard to the misappropriation of the reform, the weaknesses of the capacities to understand and apply the forestry reform principles and the lack of clear and effective accountable mechanisms for the local owners of the newly transferred powers on forest resources. Therefore, forest management decentralization is still very far to produce the various political, economic, social and ecological results awaited. Environmental democratic governance is a precondition for the enhancement and

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the consolidation of the role of forest management in sustainable local development.

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Decentralization refers to the transfer of power from a central authority to lower levels in a political, administrative and territorial hierarchy (CROOK & MANOR 1998). It is a political process of redefinition and regulation of the relationship between the centre and the periphery, between the State and local actors (BALME & GARRAUD 1994, BLAIR 1997, SINDJOUN 1996). It is a political, administrative and spatial construction in which the central State transfers some of its powers to local units, to community institutions or to the grassroots (RIBOT 2000). It has two aspects: the administrative dynamic of devolution, delegation and transfer of authority and responsibility from central levels to lower levels, and a political perspective related to the democratic aspiration to participation and inclusion in decision-making, empowerment of the populations and accountability (FERAL 1997, LITVACK *et al.* 2000). It is thus necessary to distinguish decentralization from other forms of transfer (of central authority to lower levels) such as deconcentration, delegation or devolution. Deconcentration seeks to transfer attributions or competencies to dependent bodies of the central administration, whereas delegation is the passing of some administrative authority to local officials or local institutions more or less autonomous with regard to the central administration. Devolution, on the other hand, is the complete form of decentralization. It entails the transfer of authority and resources from the central government to local institutions and populations.

Among the major political changes that have emerged in Cameroon in the last decade, the forestry reforms stand as a frontline event. This has been the result of a convergence of democratic and civic movements, as well as of the tentative State approach to reduce its domination on the society and the search for more inclusion of local populations in public affairs management. Forestry reforms [1]* undertaken in the 1990s led to the decentralization of forest resource management, based on two dimensions: fiscal and political. This reform aimed at implementing the principles of participation and empowerment of local communities in forest resource management, sharing of benefits from forest exploitation between the State, decentralized local councils and neighbouring village communities, implementing democracy and local development. Decentralization was to contribute to a major

* The numbers in brackets [ ] refer to the notes, pp. 169-171.

redefinition of certain activities in forest resource management, increase transparency and institute local democracy in forest management. It was to bring an end to the old policy of State control over forest management and the marginalization of local institutions and rural communities with regard to forest resource management, introduce debate, discussions, dialogue and negotiation over forest resource management between communities living near forests, local institutions, logging companies and public administrations, increase the participation of village communities and all social categories in decision-making in the management of forests, contribute to the realization of social amenities and general improvement of rural livelihoods, guarantee judiciousness and sustainability in the exploitation of forest ecosystems. Despite some gaps and omissions which are difficult to justify, this reform forecasts important changes in the field of the management of forest resources in general, and the political, socio-economic and ecological impact of forest management at the local level, in particular (Ze Meka 1995, Bent 1996, Bigombe 1996).

Presently, nearly a decade after the reform was introduced, what are the major trends in this process of the decentralization of forest management and what are the future challenges for the State and other actors? Can we say whether these expectations have been or are being met? Has decentralization produced or helped to produce the expected changes at the political, socio-economic and ecological domains?

Trends in the Decentralization of Forest Management in Cameroon: an Incomplete Problematic Construction

A Restrictive and Limited Protection of Local Community Access Rights to Forests and Forest Resources

The protection of local communities' access rights to forest resources requires the formalization of use rights of local communities over forests and forest resources, the definition of property rights in the exploitation of forest products, clarification of land tenure protection and the definition of conditions for equitable access to tenure and forest resources.

The present forest legislation recognizes local communities' access rights to forests and forest resources. This shows that there has been an evolution as regards colonial and post-colonial forest legislations of the first generation, which considered the State as the exclusive legal manager of forests and forest resources. The current legislation has formalized use rights [2].

Use rights belong to a category of very old rights [3]. The period of their introduction dates far back in time. It is believed that it occurred in the Middle Ages in Europe; it was the most effective weapon against poverty [4]. It came to be known in Africa only after the advent of colonization; the use of forest products seemed natural and was carried out without any restrictions, except in "sacred forests".

Hence, the colonial administration introduced the concept of use rights into the African context. Thereafter, forest use had an irregular, yet significant and not easily detectable constraint, which gives a holder rights to use certain forest products to satisfy his needs, for the fact that it is within his living area.

Use rights are considered a constraint, because it is beneficial only to the property owner, regardless of the holder or person living on the land, and not to a specific person. In fact, in traditional African societies, a land occupant only has usufruct rights over it, *i.e.* the right to use the land and to collect its products; he/she has no power to give it away. Forest customs are copied from these land systems, in which individuals are not entitled to property rights. These rights could be regarded as natural rights, in that communities living in forest regions obtain these rights from Nature, for the simple fact that they live in these forests and almost completely depend on them for their livelihoods.

Like usufruct rights, use rights are a derivative of property rights, yet it does not give the user any right to "joint ownership". Use rights restrict ownership, in the sense that it limits tenure; what the Romans called *dominium plenum* becomes "a restricted ownership" — *dominium minus plenum.* The owner has to share his property with a second party and even some of the products of the land, yet this partner cannot compel the holder to give up his part of the forest administered under use rights. Thus, a use right has more to do with the sharing of ownership than with ownership *per se.*

In Africa, the application of the theory of use rights faces certain difficulties. In practice, the State is the owner of the largest proportion of forest land, hence users are naturally tempted to increase the content of their rights, and hence, end up behaving as owners of land, which they only have rights to some of its products [5]. However, classification clearly operated by certain recent legislations, for example the Cameroon Law of January 20, 1994, which differentiates state forests, community forests and private forests, if it is accompanied by a strict zoning, should clear up the danger of such mistakes.

Until the recent forest legislation, no definition of use rights was laid down by the various forest regulations, or by the law. One had to settle for

definitions by authors, like those who define use rights as "rights resulting from ancestral material facts through which the inhabitants of a rural community can, in a forest that does not belong to them, either extract certain products, or carry out certain production activities, only for the satisfaction of their real individual or collective needs" [6].

Presently, there is a definition drawn from "positive law". It is found in article 77 of the Guinea Forest Act, which states "Use rights are customary laws that the populations traditionally living inside or near forests can exercise in order to satisfy their requirements for forest products".

Use rights have a certain number of characteristics. They are *private-consumption rights*: they are strictly intended for the satisfaction of family and domestic needs of users. It does not authorize any "commercial transactions on harvested woody products", and "can not be used by a third party". They are *free rights*: recognized users have free access to forest products and can carry out all activities allowed by this right without paying for them. They £are *limited* and *contextualized rights:* they are exercised by "neighbouring populations" of state forests and for "the traditional activities of collection of secondary forest products, in particular raffia, palm tree, bamboo, cane or foodstuffs within these forests". These populations can cut down a number of trees corresponding to their needs, in particular fuel wood and construction wood. These use rights are exercised in forests within state property, except for prohibited sites, or those where regulations by the minister in charge of forests are implemented to ensure conservation of forest resources.

There are at least six types of rights practised as use rights:

— *Collection rights*: this relates to the harvesting of seasonal forest products, in particular fruits, food and medicinal plants, but also the harvesting of mushrooms.
— *Bleed rights*: it is a primitive right relating mainly to the harvesting of raffia, *rônier* or palm-wine; presently, it also relates to some cash crops such as the rubber tree.
— *Felling rights*: this has to do with the felling of trees and shrubs necessary for building of houses and fuelwood, and the gathering of deadwood.
— *Hunting and fishing rights*: it relates to the extraction of wildlife and halieutic resources using traditional methods, in order to provide meat and fish to the populations concerned.
— *Field rights*: it is the right to cattle breeding within forest areas; such a right has some harmful effects on the flora, in particular because of *delimbing*.

— *Farming rights*: it is the right to carry out agricultural activity within forest areas; this activity is regarded today as one of the principal causes of deforestation in Africa, because it results in clearing and deforestation. *Burning right* can be added to this list, which is done mainly for agricultural ends or sometimes breeding.

In the Cameroon legislation, article 8 of the January 20, 1994 law states that "use rights or customary rights is [...] that which is given to forest neighboring populations for the exploitation of all forest products, wildlife and halieutics, except protected species, for individual use" (unofficial translation). However, ministers of forestry, wildlife and fisheries can, due to public need and with the agreement of populations concerned, temporarily or permanently suspend the exercise of use rights when need arises. This suspension falls in line with general rules of expropriation as a result of public necessity. As defined above, use rights cover resources exclusively, and do not relate to forest services. Thus for example, the exploitation of a portion of the forest for ecotourism is not based on community-use-rights over forests. Even though the January 20, 1994 law formally preserves the use rights of bordering populations in Permanent or Non-permanent Forest Estates (PFE/NPFE), in practice, they are concentrated in NPFE. In PFE, use rights likely to be exercised by the populations are not defined by the above law, or by its implementing decree. On the one hand, the law stops at considering the possibility of limiting these rights in return for a compensation following modalities laid down by a decree, if they go against the aims of a state forest, and on the other hand, to defer the definition of these rights to state and communal forest management plans and classification processes. As regards implementing decrees over forests and wildlife systems, they simply specify different types of PFEs where no use rights can be exercised (integral ecological reserve, protected forests, national parks, zoological gardens, etc.), those in which the exercise of certain use rights are prohibited (recreation forests and research and teaching forests, regarding felling of trees and hunting), and those where they envision the regulation of certain use rights (production forests, regarding hunting, fishing and gathering and forestation sites, with regard to grazing land, hunting, fishing and gathering). However, in addition to the silence of these decrees on the modalities and the content of compensations provided by the law, it so happens that most state forests do not yet have any management plans describing the scope of use rights. It results in legal uncertainty as regards use rights, which local communities can legally exercise in PFE, which adds to the severe restrictions on these rights by regulations. In NPFE, legal provisions for use rights are wide

and more or less restrictive at the same time. The January 20, 1994 law and its implementing decrees enumerate a non-restrictive list of traditional activities that can be carried out in state forests. Namely, felling of trees for heating or building, *delimbing*, mutilation of protected woody species, collection of deadwood, collection of secondary forest products (raffia, cane, palm tree, bamboo, foodstuffs, etc.), gathering, hunting, fishing, grazing land, and agriculture.

However, use rights are limited to *private consumption.* Indeed, neighbouring communities can extract timber and non-timber products from forests, without needing authorization from the administration. This extraction is free. But extracted products must be exclusively intended for non-commercial and individual use. These populations are not to market or exchange these products. During forest assessments [7], they are to justify their individual use of these products. These provisions are unrealistic, considering that the marketing of various products extracted from forests within the exercise of use rights, such as fuelwood, game, okok (*gnetum africanus*), njansang (*ricinodendron heudelotii*), honey, medicinal plants, cane, bamboo, is an integral part of the economic activities of rural populations in forest regions. In the market places, the State collects taxes from the sellers of these products. What ensues is a state of confusion, which does not benefit the State, or the local communities, not to mention sustainable forest resource management objectives. Wherever they are exercised, use rights can be suspended or withdrawn, by way of expropriation due to public need, when they are incompatible with forest objectives. Only people who have invested on the land are entitled to any compensation after expropriation [8].

In connection with this, one can only ponder the rationale and the fairness of the conditions stated by the law as regards compensation of the populations, deprived of their use rights over forests through expropriation, which supposedly, has to do with development. What is the aim of giving rights over forests to populations: development or association with communities neighbouring forests? Within the context of the law, development would take precedence over community membership. What would then be, on this assumption, the situation of the Pygmies, for example, whose forest use system does not necessarily involve material and permanent tenure over land?

Ultimately, customary use rights seem to be rights limited to *private consumption*, thus without an economic correlation, strictly regulated and thus precarious. In other words, use rights are considered by the legislature as an inevitable, but dangerous liability for forests that is just being tolerated, though no one will admit it. Although these rights are important to the communities, and that they regulate their attitude towards forests, their

socio-economic impact hardly seems to be taken into consideration [9]. In this respect, it is necessary to mark the absence of any explicit reference to agricultural activities in the use rights given to communities in the 1994 Forest Law or in its 1995 implementing Decree.

The instability of use rights is additional proof that the present forest legislation, like the three previous legislations, hardly cares about timber logging, consequently, even less of other systems of forest use. Hence, though the 1994 Forest Law has over a hundred articles, only about thirty articles are devoted to the social use of forests, the remaining focus on the administrative technical and economic organization of logging operations. No mention is made, neither by policies, nor by forest legislation of the issue of desertification, which is however an alarming issue in the northern parts of Cameroon.

It is not an exaggeration to say that the current forest policy and legislation are only interested in the timber resource (found in forests). The concept of forests in the present legislation is very revealing in this respect. Indeed, a forest is defined as any land "made up of a vegetation cover, with a lot of trees, shrubs and other species that provide non-agricultural products".

Inspired by the colonial regulation and directly by the French model, this definition is based on the concept of forests considered as spaces exclusively intended for timber production. However, to the majority of populations that sometimes only have hoes, a machete or an axe as work tools, timber for one is of little interest. Regarding woody materials, it should be noted that it is rather the exploitation of secondary forest products that are of major interest to the populations, such as bamboo, poletimber, food and medicinal plants, which have social and economic importance. The law in Cameroon has always wanted that the exploitation of forest products having social importance, approved by the legislation on *special forest products*, be regulated by particular texts. Unfortunately, the latter only relates to the exploitation of forest products of scientific or pharmaceutical interest, in other words generators of incomes for the public treasury [10].

The exercise of use rights in PFE should be specified by a *statutory instrument (by-law)*. The law of 1994 mentions them, but the implementing texts remained silent on the subject.

It is necessary to specify procedures and the scope of compensations to local communities in the event of the withdrawal of their use rights. It should at least entail a permanent compensation of their lost use rights, and should be done considering the quality of the forest in question.

The ongoing decentralization of forest logging taxation system should cover exploitation licences for special products, so that communities will

enjoy financial compensation for the use rights they have lost to economic operators.

The setting-up of all non-timber resources as special products of economic interest, by the administration should be replaced by the establishment of a simplified procedure for access to special licences, for the benefit of bordering communities.

Use rights should be extended to forest services, and a law or *statutory instrument* should specify procedures for the exercise of these rights (ecotourism for example). The April 14, 1998 law on tourism imposes an approval for most activities (tourist guide, housing establishments, etc.). It would be necessary to apply a different approach to communities engaged in ecotourism.

The Lack of Substance and Fragility of the Powers devolved to Local Communities: Is it Participatory Management, Co-management or Devolution?

Forest policy and legislation have set up mechanisms for the devolution of powers over forest resource management to local communities. Yet, in practice, devolved powers are still restrictive and fragile. The Government is careful not to carry out a complete, consistent and stable transfer of powers to local communities. A system has been established: community forests, within which community hunting areas have been established [11]. It is one of the most innovative aspects of the decentralization of the forest sector in Cameroon. It marks an evolution in the public strategies of forest and forest resource management in Cameroon and is a key stage in the process of the deconstruction of the forestry State and the invention of the democratic governance of forests and forest resources (Diaw & Oyono 1998, Du Saussay 1999, Nguiffo 1999, Vabi *et al.* 1999).

A community forest is a portion of State forest, free from any logging permit, and having a maximum area of 5,000 ha, over which the State signs a management agreement with a village community. The State retains ownership of the land, but entrusts management of forest resources to local communities concerned for a period of twenty-five years. The agreement signed between the State and the community is complemented with a simple management plan to which all activities undertaken in the community forest must conform. The administration has the power to control and manage community forests, and imposes sanctions on communities, carries out the execution of projects stated in management plan, at the expense of the communities, or even terminates the management agreement (law, art. 38(2)). All forest products from the exploitation of community forests belong

entirely to the community (law, art. 37(3) and 67(2)). Exploitation can be done either through a government-operated system, or within the framework of a subcontract (law, art. 54).

A community forest is allocated to communities living near forests. The local communities should be established as a legal entity (development association, joint-initiative groups, co-operatives) in order to request, acquire and manage forests.

At present, fifty-five community forests have been allocated, and more than one hundred requests are being short-listed [12]. But, local communities are beginning to experience a certain number of problems stemming from the weakness of the powers given to them by the State over the management of community forests. According to the law and recent practice, it is now clear that local communities have decision-making power over the management of forest resources, and not over land. Community forest space remains state property. In fact, community forests are not the absolute property of local communities, but are premises within state property, managed under the control of the State (BENT 1995). The State grants only usufruct rights and it maintains powers over forests. Areas occupied by community forests are considered as state property. Only ownership over forest resources is allocated to beneficiary communities. Lastly, the implementation of legislations relating to community forests is subject to several difficulties, due not only to the novelty of the mechanism, but especially to the shortcomings and limitations of the institutional complementing device, for instance gaps in the law, contradictions between land systems and forest systems, high costs, the slow and complex nature of procedures, extent of the unrestricted powers of the Forest Administration over all stages of the process, the artificial and the inadequate nature of social institutions having community forest initiatives, interferences of politicians and elites in the process, difficulties faced by local communities in appropriating the mechanism, the weak powers of Forest Administration in implementing community forest legislations, poor communication between various actors interested or engaged in community forestry. Legal and lawful provisions are unsuited to the sociological realities of Cameroon forests. As a result of the simple vision for the traditional organization and customary use of forest spaces, the legislature proposed a global guiding model for peasants who wish to obtain and manage a community forest. According to the terms of the implementing decree for forest systems, the community must have a legal status, in the form of a unit approved by the legislations in force [13]. This vision was torn down by local realities, which show that the more or less horizontal nature of the social structure in

southern Cameroon is a hindrance to the development of a solid and continuous associative sector over time [14]. Thus a structure different from the more practical and inclusive model should be developed within the societies in question, which is able to guarantee collective management of forests. In the absence of this, there is every likelihood that the sad experience of previous community forests will be seen again [15]. Forest management institutions were under the control of certain groups or individuals who took advantage of the collaborative management process and the sustainable management plan implementation process. The allocation process is still a big hassle. It is long, complex and involves a lot of money. The possibilities of competition between Sale by Standard Volume (SSV) and community forests on the same spaces are huge.

The zoning plan is unfavourable to communities. Spaces that can be used as community forests are generally located along tracks, and are sometimes more than 5 km away from villages. Some of these spaces are subject to individual customary appropriation, which is an obstacle to their *communitisation.* The zoning plan is only a provisional document subject to modifications according to negotiations with local communities [16]. In practice, the forest administration is reticent to push back the limits of this plan within the framework of a community forest dossier. Many communities have had their requests for community forests rejected for "their non-conformity with the zoning plan".

Lastly, regarding the aim of community forests, there are conflicts between the perceptions and objectives of local populations and the aims of forest administrators and development aid organizations. The traditional system of exploitation more or less imposed on communities by the Ministry of Forestry entails a lot of effort and sacrifice from local communities that were depending on collaboration and partnership with professional logging companies. In the present context, this problem is still ongoing. In addition, the law and regulatory instruments focus more on logging, whereas community exploitation of other resources (NTFPs and wildlife) should also be supported and regulated. This issue should be considered in the ongoing revision and adaptation process of the political and the legal framework of community forestry in Cameroon.

Communal Forests: an Opportunity for Decentralized Forest Management not fully Explored by Decentralized Local Communities

The 1994 forest law and its implementing decrees provide for the creation of communal forests in PFE. The zoning plan allows for eighteen communal

forests over an area of 300,000 ha. Only four communities have taken steps towards obtaining such a forest: Dimako, Djoum, Limbe and Lomié. Dimako is the first to have obtained a communal forest in Cameroon [17]. One of the reasons for this relative lack of interest of mayors for this new local development tool is the imbalance between the real advantages of decentralized taxation — which entails little organization and which is more like a *rent* — compared to those still unknown to communal forestry, which entails a complex organization (management of spaces, resource management, marketing of products,...) and especially a level of transparency and accountability more demanding than that of decentralized forest taxation.

The characteristic of communal forestry is that, contrary to community forestry, the forest-field concerned is classified within state property after which it is transferred to the community as its property by the law [18].

The implication of village communities in the preparation of the classification of the Dimako communal forest (in particular its delineation) was largely supported by the *Forêts et Terroirs* project [19]. They later proposed the creation of a consultative management committee [20] with elected members, excluding communal advisers, except the mayor who is the chairman. This search for transparency is laudable in the perspective of the management of the common heritage, which is the communal forest, in the hope that all local stakeholders are represented [21]. This committee is to supervise the application of the management plan [22]: it will represent a good medium for communication between the populations and the local council in terms of providing information to communities on the management of financial revenues from the exploitation of communal forest products (an anti-establishment force (of sorts) to the local council and the mayor [23]). Besides, the management plan that is not yet approved by the Ministry of Environment and Forestry does not stipulate any particular forest exploitation method. The local council, after meetings held by the consultative committee, can thus carry on either the sale of a tree, the traditional exploitation of certain wood species, or the industrial exploitation of other species. This flexibility makes it possible to adapt the method of exploitation to the type of forest or portion of forest [24].

A Poor Political, Socio-economic and Ecological Performance not Focused on the Decentralization of Forest Management: too Little Benefits for Communities and a Negligible Impact on the Sustainable Management of Forest Ecosystems

The decentralization process of the forest sector had a political (emergence of local democracy in forest management), socio-economic (in terms

of building greater comfort, equity, democracy and transparency) and ecological end (in terms of rational and sustainable management of ecosystems, protection and conservation of the environment, sustainability). The least that can be said at this point is that the socio-economic and ecological impact of the performance is still negligible.

The socio-economic benefits of the decentralization of the Cameroon forest sector are still quite weak. The portion allocated to forest neighbouring communities for exploitation has four types of benefits, each related to one of the four forest exploitation rights provided by the forest law of January 20, 1994. These exploitation permits are exploitation conventions (for Forest Management Units), Sale by Standing Volume (SSV), exploitation permits and individual felling authorizations [25], respectively. Benefits allocated to communities should be proportional to the area under exploitation; the FMU (Forest Management Unit) and the SSV are the main source of revenues in the decentralized forest taxation system. It makes up part of the Annual Forestry Fee (AFF), and a percentage of felling taxes contributing to the realization of social work. The fourth type of benefit — part of the selling price of forest products — comes from exploitation licences and individual felling authorizations.

The AFF is calculated on the basis of the base rate and the financial bid proposed by logging companies during the call for bids. Its rate and methods of calculation of the share of various beneficiaries is fixed each year by the financial law. The current Finance Law sets the minimum rate at 2,500 CFAF/ha for SSVs and 1,000 FCFA/ha for FMUs. The fees are divided between the State (50 %), communities concerned (40 %) and neighbouring local communities in logged forests (10 %). The amount obtained from the share of communities is transferred to the municipal tax collector (January 20, 1994, law art. 68, al. 1; decree No. 98/009 of 23 January 1998 setting the basis and modalities for the collection of rights, fees and taxes from forest operations, art. 10, sect. 3). Each time the exploited territory covers the territory of more than one community, the share of each community is calculated in proportion to the area exploited (1999-2000 Finance Law, art. 11).

Like the AFF, contributions for the realization of social projects are part of the financial responsibility and duty of logging companies. It is listed in the specifications of the law (January 20, 1994, law art. 61, sect. 1 and 3). The forest administration determines the amount (forestry fee) at the time a forest zone is open to industrial exploitation. Among requirements that should be stated in the public call for bids, the August 23, 1995 decree lays down specifications on the quality of the forest, and projected social work after discussions with the communities concerned (art. 51, sect. 2). The

community collects contributions for social projects, which should be used only for financing these social projects to the profit of the local community concerned (January 20, 1994 law, art. 68 (3)).

Neither the January 20, 1994 law, nor the operational guidelines, specifies the method for calculating this contribution. While waiting for this gap in the law to be filled, in Circular No. 370/LC/MINEF/CAB of February 22, 1996, the Minister of Environment and Forestry suggested the unofficial tax of CFA 1,000 per m^3 for wood extracted from state forests. The validity of this text is however subject to a guarantee, a regulatory law that cannot institute a tax or a fee, because this is exclusively within the jurisdiction of the legislative power.

Concerning the percentage of felling tax granted to the populations, this type of benefit is granted only to neighbouring populations in state forest areas exploited under the SSV. The Finance Law sets the applicable tax. The methods of payment of the product of this tax are communicated to the populations concerned during a meeting, held before logging operations begin. This meeting is held by the local administrative authority, in the presence of traditional authorities, local technical managers concerned, and logging companies (Forest Law Implementing Decree, art. 85, sect. 1 and 2).

Lastly, the selling price of forest products granted to the populations.

Exploitation through the use of any of the small-scale logging permits, that is, the exploitation permits and individual felling authorizations, provides only for the recovery of the selling price of forest products (law of January 20, 1994, art. 66 (2)). Part of this selling price is paid to neighbouring communities of forests concerned, through methods laid down in the law (forest law of January 20, 1994, art. 66 (2) and 68 (2)).

How are the benefits granted to the populations managed? The joint order No. 122/MINEF/MINAT of April 29, 1998 lays down the management methods of two among the four types of benefits which the law provides to neighbouring village communities: contributions for the realization of socio-economic projects which is 10 % of the AFF. Management is entrusted to a Forestry Fee Management Committee (FFMC) under the supervision of the sub-divisional officer, and chaired by the mayor. The committee also includes six democratically elected representatives of neighbouring populations and *the chief of the local forest station.* The funds, which are entrusted to him, are regarded as public funds, and are exclusively used in financing local development within the communities concerned. The 2000-2001 Finance Law (art. 11) institutes equalization funds for equitable distribution of AFF allocated to the local council and neighbouring village

communities. This law introduces a particular text with which the authorities will lay down the procedure for fund equalization.

These methods constitute a major progress in the official consideration of the participation of neighbouring village communities in the division and management of revenues from the commercial exploitation of timber.

Presently, there is a clear and precise determination of the scope of decentralized taxation in the forest sector. The communities are entitled to definite and outlined rights. The joint order of April 29, 1998 has brought an end to the monopoly of local councils over the management of contributions for social projects and the AFF intended for neighbouring populations.

However, activities undertaken in this area are still far from satisfying the expectations of neighbouring populations that intend to carry out development with revenues from the exploitation of forest resources. Populations are facing enormous difficulties of actual access to their entitled benefits, and the management of the latter. In fact, these difficulties are due to obstacles, and gaps in the legislations at the same time.

As regards access to benefits, the absence, setbacks or imperfections of methods of implementation of the various types of benefits, provided by the law to local populations, make the effectiveness of the payment of the said benefits sometimes impossible, discriminatory or random. The transfer of certain benefits is legally impossible. This impossibility relates to two types of financial benefits: a percentage of felling taxes, which the law grants to bordering populations living in state forests exploited under SSV. This is because the financial law that is supposed to set the percentage to be applied remained silent on the issue. Furthermore, there is the problem of the share of the selling price of forest products to which populations living near forests can legally lay a claim as an exploitation permit or the *individual felling authorization.* Contrary to what was announced by the January 20, 1994 law, neither the Implementing Decree of forest management, nor other decrees, which followed, lay down methods of calculation and payment of this type of benefit.

So far, the gap in the law as regards the definition of the methods of calculation of contributions towards social projects is still impending. And in spite of the experimental and temporary character of the Minister's of the February 22, 1996 Circular Letter, which proposed the unofficial tax of CFA 1,000 per cubic metre levied on timber extracted from forests, this is the only applicable text on the matter. However, its applicability is limited to SSVs in state forests. However, just like the beneficiaries of SSVs in state forests, SSVs in PFE and exploitation conventions must legally pay contributions for social projects to local populations (law of January 20, 1994,

art. 66 (1)). This leads to discrimination between populations of neighbouring state forests under SSV, entitled to the CFAF 1,000 tax per cubic metre of timber logged from forest, laid down in the terms and conditions of logging companies concerned, and other legal beneficiaries of the same contribution; hence these rights are hampered by legal uncertainty.

Paid benefits never get to the beneficiaries. Of all the tax revenues and *parafiscal* tax revenues from forest logging, partly or entirely granted by the law to local communities, only the AFF is officially approved in order to ensure effective payment of the said taxes to the beneficiaries. This access is however made haphazard by the centralization of the collection and redistribution of all fees. Centralization benefits the Tax Department of the Ministry of Economy and Finance. This is the outcome of the Decree No. 99/370/PM of March 19, 1999 on the Forestry Revenue Security Program. Since this decree, the Tax Department (and not the municipal tax collector) is responsible for collecting payments of revenues intended for the State, and those intended for the local council and local populations. The payments of the share intended for these populations and local councils, which are done in cash, by checks are recovered by the tax collector (decree of March 19, 1999, art. 10). In practice, this handing-over takes place but generally with some delay. When one considers the possibility of payment in cash in relation to the principle of the coherence of state treasuries that control the management of public finances, it reveals one of the reasons for this delay.

Other difficulties of a legal nature considerably limit the extent of decentralization organized for the benefit of local populations over the management of financial revenues from forest logging.

Certain benefits are excluded from decentralized management. In the presentation of its objective, the Joint Order of April 29, 1998 gives the impression that it provides for all revenues from forest logging, intended for the neighbouring populations. However, provisions by this decree on the management of revenues covers only two out of the four types of benefits over which local populations have a legal claim (AFF and contributions towards social projects). One could be tempted to conclude that the joint order cancelled the other two types of benefits that the law of January 20, 1994 granted to the local populations. In fact, such suppression is legally impossible, given the place of a law and a decree in the hierarchy of the legal norms. The incomplete enumeration of revenues from forest logging intended for neighbouring village communities leads to the exclusion of certain types of benefits from co-management laid down by the Joint Order.

Management is marked by the strong presence of the central administration. It can be noticed that the current operation of these committees placed

under administrative and communal supervision does not guarantee their efficiency nor their effectiveness, the persons in charge are more concerned with their personal interests than those of the neighbouring populations. The use of the tax and parafiscal [26] tax in villages with logging operations, does not satisfy villagers' concerns over economic and social development (water supply, electrification, construction and maintenance of roads and bridges, construction, maintenance and equipment of schools and medical training, drugs, etc.). The actual results on the improvement of their livelihoods are negligible. The populations that are paid directly by logging companies divide the money between the important village families and invest on gratification (food, drink, etc.). They claim they are taking their revenge on the State that had been the only beneficiary of forest incomes for a long time. In other cases, where fees are paid to the local council a great share of the funds is misappropriated through fictitious investments and the remainder is, in the best case, given to the neighbouring populations. Cases where funds are directly invested in the construction of social amenities are rather rare, and are generally supported by development aid organizations (MILOL *et al.* 2000).

At first sight, the Joint Order of April 29, 1998 provides for beneficiary village communities to have control over the management of revenues entrusted to the FFMC. Representatives of these communities are indeed the majority in the committee (six members against two from the central administration). And in order for this committee to deliberate and take official decisions, there must be a quorum of half of all the members, and a majority of votes. The Joint Order also brings in important restrictions on the powers of beneficiary communities, on the level of the actual initiation and conducting of the management process.

The initiation of the management process, the creation, and definition of specifications for the organization and operation of the Management Committee is not in the power of beneficiary communities. The Joint Order institutes a committee and organizes the setting-up and operation of the management committee for the communities. The role of beneficiary communities is limited to the nomination of (their) six representatives and auditors. After this appointment, the president of the Committee (the Mayor or his representative) is to launch activities, in particular, by convening its first meeting.

The marginalization of beneficiary communities at this very important stage — the initiation of incomes management process — significantly restricts their powers. Initially, communities targeted by the Joint Order do not always feel involved in the management committee as an institution. Furthermore, they equate the committee with legal development organizations

commonly found in the villages (Common Initiative Groups and associations), and thus feel obliged to create one and have it legalized. In the South province, many of the administrative authorities that are responsible for the legalization of these committees seem to go along with this game, by signing the memos noting the formation of such committees.

Furthermore, many mayors show some reticence in convening the first meeting of the management committee, hence excluding beneficiary communities from the management of the revenue given to the committee. It is true that the Joint Order requires that the chairman of the management committee should convene meetings at least once or every quarter, and more if necessary (art. (1)). But there is no penalty or sanction for not respecting this requirement.

In the management process, the beneficiary communities are subject to strict controls from the administration, both through the allocation of the funds given to the management committee, and through the involvement of administrative representatives in the functioning of this body (local representation of the Ministry of Environment and Forestry, supervision by the sub-divisional officer, and the mayor's role as chairperson, the official in charge of payments).

The local population's powers to prevent misappropriations are also limited. According to the MINEFI/MINAT Joint Order, funds given to the management committee are considered "public funds" (art. 12 (1)). In several respects, this protects the communities' interests. In addition to the intervention of the authorities and State-control bodies in controlling the management of these revenues, there is a strict system to deal with the misappropriation of funds. The penal code provides more severe penalties for the misappropriation of funds (art. 184) than for that of private funds (art. 318). However, the public nature of these financial resources severely restricts the powers of the members of the beneficiary communities to deal with the misappropriation of funds made available to the management committee. Since they cannot be legally considered as victims of misappropriation, the members of beneficiary communities may neither bring a case against the authors of the misappropriation, nor claim damages from them. These are the prerogatives of State representatives and control bodies (namely, MINEF, MINEFI and MINAT, which are State-control bodies). The role of the members of beneficiary communities is restricted to reporting any misappropriation of which they are aware to the State representatives, the prosecutor or the police. The village communities have no power to initiate legal proceedings against the authors of embezzlements in the management of forestry revenue.

Generally, the impacts of the decentralized forest taxation system on local socio-economy are still very limited. This is due to many malfunctions in

strategies and practical redistribution processes, and more especially to the communal management of forest royalties/fees, the weakness of the mechanisms of control and the irresponsibility of forest fee managers.

On the ecological level, the situation is alarming. Forestry fees have revived conflicts and greed over forests, particularly with older folks who want to make the most profit from forest exploitation before they die. Today, logging companies do not necessarily have to go looking for rich and exploitable forests. Local populations themselves engage in negotiations to obtain forest fields, as community forest for commercial logging or in state-owned forests, though exploitation may not be controlled and considered illegal. In addition, neighbouring populations do not request for community forests, they rather prefer to have logging activities in their forests so as to have rights to forestry royalties. A decentralization process for forest fields and taxation management, which is not implemented with complementary measures, in particular, the introduction of reliable local governance is a threat to the development of community forestry, and to the sustainability and governance of forest ecosystems.

These problems are the result of the nature and weaknesses in the development and implementation of policies. The authoritarian decentralization process retains the powers of the State over the management of forest revenues and do not facilitate the dynamics of democratic decentralization: conservatism takes precedence over devolution, innovation and change. Weaknesses and gaps in the drafting and implementation of forest decentralization are numerous: failure or absence of local appropriation and domestication of instituted mechanisms, socio-political legitimacy, as well as the persistence of State control over the exercise of powers devolved to local actors, conflicts and divergence of interests of local actors in the exercise of transferred powers, the inappropriateness of the legal, political and social mechanisms that should ensure the accountability and responsibility of new logging title holders and forest revenue authorities, etc. For a way out of this impasse, and in order to make positive progress in this process, it is necessary to *rethink* the dynamics in the current process of the decentralization of forest management in Cameroon.

Reorganizing and Revising the Decentralization of Forestry Management in Cameroon: the Need for a Democratic Decentralization of Forest Management in Cameroon

To solve the problems identified in the implementation process of the decentralization of forest management in Cameroon, it is necessary to

develop and establish an alternative strategy for the decentralization of forest management. This will entail a fundamental shift from the current authoritarian logics of decentralization. In fact, decentralization dynamics were primarily developed and constructed by the central authority, though institutions and local communities in the "democratization" process greatly solicit the said decentralization. However, the processes of "authoritarian decentralization" bring about "centralization" (RIBOT 1999). They are hardly integrated into local socio-political, economic and cultural domains, which are already very complex, and officiated by groups with divergent interests.

It is necessary to undertake democratic decentralizations of forest resource management. According to MANOR (1999), democratic decentralization aims at increasing the powers of local actors in decision-making, improving the "accountability" of local authorities towards the local populations, internalizing external political, economic, ecological and social dynamics, guaranteeing the institution of participative management over forest resources. The democratic decentralization process avoids creating local bureaucracies and devolving powers over forest resource management to actors who are not accountable; in short, it avoids effecting building "symbolic decentralizations", without an effective devolution of powers or operational mechanisms of control over actors to whom powers have been devolved.

The second point of interest is the extension of decentralization towards the grassroots, the completion of decentralization. At present, many local councils are drafting local or community development plans. Yet, links between the development of these plans and the improvement of livelihoods are still not yet sufficiently elucidated. In the forestry sector, in particular, it is difficult to imagine an efficient and effective management of forest revenues without real mechanisms that will guarantee effective responsibility of the neighbouring communities of forests under exploitation. The extension of the decentralization of forest resource management towards the grassroots (the level village) should thus constitute an important objective in the future.

Lastly, there is a real need to develop, disseminate and capitalize on results and lessons learned from former experiences of the decentralization forest resource management (FRM) processes. In order to increase the chances of the success of future decentralization of FRM, it is important to control development techniques and decentralization dynamics. There are many experiments in Africa and around the world, which could serve as a basis for drafting and developing concepts, but most of all, a methodological guide with operational, flexible tools, adaptable to various contexts. The FAO office for

participatory forestry undertook a project to this end. Collaboration with other international organizations, in particular the World Bank and this office, will make it possible to face this challenge soon enough.

In view of making adjustments to the forestry reform undertaken in 1994, the following changes must be operated in order to guarantee a democratic decentralization of forest management in Cameroon: reinforcing decision-making powers of local actors over decentralized management of forests and forest resources, fair distribution of control and powers to impose penalties between the State, the decentralized territorial communities and the village communities, harmonizing the forest code with land rights, integration of relevant and adapted provisions to customary laws in positive Forest Law, the inclusion of customary institutions into the category of legal entities for the devolution of decentralization responsibilities, the institution of provisions that may help decentralized territorial communities and local populations to deal with power-abuse by local political elites, central authorities and forest administrators, the institution of complementary mechanisms to the decentralization process in positive Forest Law, coordination of environmental decentralization processes with global administrative decentralization, carry out operational processes of decentralization so as to facilitate appropriation by the grassroots, the establishment of local democracy and mechanisms that ensure accountability as regards forest management, and develop, and implement mechanisms that guarantee the investment of forestry revenues in local development, and institute legal and administrative instruments that may enable village populations to control the management of financial revenues from forest exploitation.

NOTES

[1] The Cameroon forest area presently covers more than 22 million hectares of forests, or 47 % of the national territory, including 17.5 million hectares of dense forests on dry land and 4.5 million hectares of degraded dense forest. Apart from its expanse and its immense woody species, and various resources, it plays a key economic, ecological, social and cultural role. Its production has been in constant increase. It went from less than one million cubic meters in the 1970s to 2.5 million in 1993/1994 and to more than 3.3 million in 1997/1998. It is the third largest source of foreign exchange for the State, after agricultural exports and oil. It accounts for 8.9 % of gross domestic product and 28.2 % of non-petroleum exports.

The reform undertaken with the support from international co-operation, between 1990 and 1995, on the institutional, political and legal level, resulted in the creation of the Ministry of Environment and Forestry in 1992, the adoption of a new forest policy, the application of law no. 94/01 of January 20, 1994

which regulates forests, wildlife and fisheries, and its implementing decree no. 95/531/PM of August 23, 1995 which lays down the procedure for implementing the policy regarding forests, the MINEFI-MINAT Joint Order of April 29, 1998 which lays down the procedure for the use of revenues from forest logging for neighbouring village communities.

[2] On the achievements and setbacks of the Cameroon legislation with regard to customary use rights over forests and forest resources, read C. M. Bomba & P. Bigombe Logo "Local community rights in Cameroon forest legislation. What are the achievements? What are the setbacks?", in *Bulletin — Forests, Trees and People Program*, no. 22, Co-management, dec. 2001, pp. 47-62; MINEF-DFID, Implication Strategy of Rural Communities in Cameroon Forests, final Report, Nov. 2001, pp. 53-57.

[3] Read M. Kamto, *Droit de l'Environnement en Afrique (Environmental Rights in Africa)*, Paris, EDICEF, 1998.

[4] See R. Grand, *L'agriculture au Moyen-Age: de la fin de l'empire romain au XVI siècle,* Paris, Editions de Boccard, 1950, p. 224.

[5] See K. Nguessan, *Commentaire du code forestier et de la législation forestière de la Côte-d'Ivoire*, Paris, L.G.D.J., 1989, pp. 30-31.

[6] *Ibid*., p. 211.

[7] Art. 8, al. 1 of the 1994 law; art. 26, al. 2 of Aug. 23, 1995 decree.

[8] Art. 27 of the 1994 Forest Law.

[9] See F. Scmithusen, *La législation forestière dans quelques pays africains,* Rome, FAO, 1986, p. 8.

[10] Art. 86 of Aug. 23, 1995 decree, on implementing procedure for forest systems.

[11] Community hunting zones were created on an experimental basis in southeast Cameroon within the framework of a joint action by the Ministry of Environment and Forestry, World Wildlife Fund (WWF) through the Jengi project and the German Technical Co-operation (GTZ), and through the natural forest management project in Southeast Cameroon (Yokadouma).

[12] Statement by Mr M. Niasan, project manager for the Community Forest Office with the Ministry of Environment and Forestry during the November 2001 Lomé workshop.

[13] Art. 28, al. 3.

[14] Joiris & Tchikangwa 1995, Etoungou 1998, Vermeulen 1998.

[15] It is the case of the Bengbis Community forests in the South province and of Bimboué in the East provinces, all established in 1997. These forests were allocated through the initiative of elites close to forest administration. Later, agreements were signed with forest users over the extraction of woody species, and nothing more. Presently, they are no longer forests, as they go by the name of their owners. An initiative to develop the management of the Bimboué Community forest is being implemented on the field by Enviro-Protect, the FAO Trees, Forests and Rural Communities Programme, CERA, with technical and financial support from UICN-CEFDHAC. The first stage aims at initiating a process of communication and dialogue between stakeholders over conflicts that ensued in the process of the management of this forest.

[16] Decree no. 95/678/PM of December 18, 1995 instituting a prescriptive framework for land use in the southern Cameroon forest belt (art. 1 and 6, al. 2).

[17] It was supported by the *Forêts et Terroirs* project of the French Co-operation. A classification decree for the Dimako community forest (16,240 ha) was signed by the Prime Minister with a visa of the Presidency of the Republic. The weak engagement of local councils in community forests is as a result of lack of information and lack of motivation of mayors on the potential advantages of the innovative aspects of the 1990s forestry reform. In addition, mayors in forest regions in particular, are more concerned with the decentralization of forest taxation relating to logging, as it produces a lot of funds at the local level.

[18] We should note that if the State requires a transfer subject to payment, the budget of the communities cannot support the load of these expenses for land registration. Free transfer would be a good test of the State's desire to politically accept the communal forestry perspective of decentralization.

[19] This project carried out the training of stakeholders and rural communities on the preparation of small development projects, writing up invitations to tender on forest logging for private operators.

[20] Its five-year term of office ends at least two years after that of the communal council, so as to favour continuity in the implementation of the management plan by the different municipal teams.

[21] The *Pol* are the customary owners of the forest. Other local tribes (Bakoum and Baka) and strangers also have access to the forest.

[22] Mainly regarding farmland and fallow land in forests.

[23] This anti-establishment force that is given to local councils is important, given that many cases of financial misappropriations have been noticed in the management of communal incomes.

[24] For details and complementary information, read MINEF-DFID, Local Community Involvement Strategy in Cameroon Forestry, *op. cit.*, pp. 49-51.

[25] Article 46 and the following articles of the January 2004 law; article 3 (20) of the August 23, 1995 decree stating the modalities for the implementation of forest policy.

[26] The first effective payments of the 1,000 CFA per cubic metre tax took place at the end of the 1996/1997 financial years and continued in 1997/1998 (MILOL *et al.* 2000).

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Governance in the Forestry Sector in the North-West Frontier Province, Pakistan. Managing Forests — Is Deterioration Inexorable?

by

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KEYWORDS. — Institution; Policy; Law; Accountability; Property.

SUMMARY. — The study based on a mix of literature review, stakeholder consultations and use of questionnaires, deals with the factors behind the (in)effectiveness of the forest sector institutions in the North-West Frontier Province (NWFP) of Pakistan. The NWFP is one of the four constituent provinces of Pakistan and, as the name indicates, borders the north-western frontiers of Pakistan and has the world's three tallest mountain ranges traversing its landmass, *viz.* the Himalayas, the Karakoram and the Hindukush.

The variety of climatic conditions ranging from arctic through alpine to temperate to semi-arid, provides the NWFP with a rich diversity of environmental conditions to boost a range of forest variety from scrub forests on the low end to the tall coniferous forests at higher altitudes. According to the official forest management regimes, pronounced by the Forest Department, which are closely linked with a tenure pattern and which in turn is associated with the richness of the forest resource, there are three types of forests in NWFP, *viz.* reserved forests (most resource-rich and government-owned), protected forests (resource-rich but with title dispute between the government and the community) and guzara forests (less resource-rich and privately owned but managed under the department's direction). One of the salient features of the forest management in NWFP is the rapidity with which the province lost its pristine forest cover: 52 % over a hundred years from 1880 to 1980. The rate of denudation between 1985 and 1988 was a staggering 12.8 % a year.

The study provides a general appraisal of the forestry sector institutions: the policies, the laws and the governance structures tracing their history as they existed during the colonial period and how this all came to be linked with the various types of forests depending on their resource richness. It then goes on to analyse the effectiveness or otherwise of the forest management in the post-colonial period after independence. The discussion dwells on how the institutional landscape from policy

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to legal framework to governance structures is reflected in the implementation arrangements that until very recently continued to emulate the British philosophy in managing the forests. Its cardinal feature being the exclusion of the owner as well as indigenous forest user from the management of forest; to the extent where a typical state functionary considers the "owner-user duo" as the enemy of the forest *per se*, hence the emphasis on coercive regimes for the protection of forests as against an incentive-based and collaborative forest resource management.

The study benefiting from the stakeholder consultations, feedback from the questionnaires and interviews with key informants, goes on to broadly analyse the malaise affecting the various institutions responsible for forest management in three differentiated strands of a) tenureal issues, b) management of forests and c) the prosecution of forest offence cases in the courts. The issues of tenure being at the heart of the debate consume a significant chunk of the study. The institution of property with its uncertainty-reducing characteristics is discussed at length and then contrasted with the common pool resources. Stakeholders' discussions also revolved most heavily around this theme and were fiercely contested by the opposing sides.

Similarly, the responsibility of forest management, considered by the Forest Department its sole prerogative, does not admit of any meaningful role for the indigenous stakeholders. The latest forest legislation (2000), while grudgingly conceding the right of the owners and users in the forest management through joint forest management committees, arrogates to itself (the Divisional Forest Officer) the authority to regulate and even dismiss these joint forest management committees. This mistrust of the non-departmental stakeholders is there to be found despite extensive exposure of the departmental staff to a heavy dose of foreign funded projects, trying to promote joint forest management practices in the province. The study also discusses the issues of accountability and the working environment of the Forest Department staff and the effect that these factors have on its functioning, including the ultimate objective of sustainably managing the forests.

Towards the end, the paper situates the whole cast in the framework of external factors, *viz.* the mounting population pressure, the poverty and the rudimentary stage of development of the alternate energy sources. Other allied factors include changing sociocultural patterns, market pressures and the climate change.

The paper concludes by roughly assigning equal weight to the (mis)management of the above three strands and attempts to establish their direct linkage with the current state of affairs. The theoretical framework and collection of some hard evidence supports the conclusion about the inadequacy of the policy framework, the institutional dysfunction at the level of the Department and the ineffective judicial reckoning as it takes place in the corridors of justice. There is an urgent need for a more definitive and socially acceptable tenureal regime, rationalized institutional set-up of the Forest Department, a more efficient judicial dispensation regime and recourse to an alternate dispute resolution mechanism.

1. Introduction

This study was originally conducted in 2002 with a view to examining the enforcement of forestry laws, as a requirement for fellowship with LEAD

Pakistan, a national chapter of LEAD (Leadership for Environment and Development) International. In the study effort has been made to ensure that it is a blend of theory on the subject of law enforcement in the forestry sector; is premised on the institutional analysis and on the law enforcement as practised in the field and during the trial. It is thus based on literature review, first-hand exchange of views with the stakeholders and responses to questionnaires.

1.1. Background

NWFP is host to 40 % (1,521 million ha) of forests in Pakistan. Whereas the national forest cover (4.8 %) compares adversely with the other parts of the world, NWFP is better placed with 17 % forest cover. The picture however is grimmer as about 50 % of the declared forest lands in NWFP, *i.e.* 0.7 million ha, have very sparse or no vegetation cover [Strategy for Sustainable Development of Forestry in NWFP 1996 (2001)]. With per capita forest cover in NWFP of 0.08 ha, the picture is six times as worse as that in the developing countries and thirteen times as worse as in the developed countries. The comparisons unfortunately are not static and the trends are moving for the worse. According to WRI and IEED (1998), estimated forest cover in areas comprising Pakistan has decreased by 52 % in a hundred years up to 1980. The satellite imagery comparisons under Forest Development project, Siran Valley, GTZ (1990), the forest area from 1979 to 1985 declined from 84,966 ha to 76,030 ha, an annual reduction of 1.8 %. But from 1985 to 1988 the drop is from 76,030 ha to 46,925 ha, a staggering annual diminution of 12.8 % [*ibid.*].

Apart from being climatic stabilizers and home to a rich biodiversity, forests in NWFP also perform essential watershed functions; they reduce siltation of dams thus enhancing their longevity, protect against floods, slides and land erosion. They provide fuel wood for domestic use and grazing lands for the livestock. Their value as an important source of non-timber forest products (NTFP) is only now being realized.

2. Forest Management in Historic Perspective

It is imperative to see how the important forestry institutions have grown over the years from the colonial times to the present era before actually going into the analysis of the problems that today beset these once premier institutions of the British times.

2.1. Forest Policies

At the time of independence (1947) the forest policy in vogue was that of 1894, which continued until 1955. The emphasis of this imperial forest policy was on forest conservation as a source of revenue for the Crown and the maintenance of watersheds but it also realized the importance of meeting 'the reasonable forest requirements of the neighborhood' (Hamid 2002). This was in line with the well-stocked forests being categorized as reserve forest and the less well-stocked ones, being labelled as wastelands/guzara forests (though there is a countervailing view that at least some of the guzara forests were also well stocked and it is the population pressure which resulted in deterioration).

The 1956 Forest Policy, while not properly addressing the issues of mountain forests and management of watersheds & rangelands, emphasized the irrigated linear plantation. The 1962 Forest Policy, despite being radical in many ways, for instance by proposing the shifting of populations from hills, to acquisition of grazing rights and growing of trees on private lands, did not result in any appreciable increase in the forest cover.

As part of the National Agricultural Policy 1980, the policy on Forestry and Wildlife for the first time spoke of promoting involvement of people in tree plantation and nature conservation schemes. Similarly, Forestry Sector Master Plan 1992 realized the neglect of people's participation in management of forests. This concern had also been reflected in the National Forest Policy of 1991, which had participatory approach as one of its objectives.

The National Forest Policy 2001, despite some gaps in outright commitment on its pronouncements, is a certain improvement over the previous policies. This explicitly recognizes the implications of socio-economic factors on the forestry sector and speaks of the involvement of local government in the maintenance and improvement of renewable natural resources. It also mentions the strengthening of forestry sector institutions as one of its objectives.

The NWFP Forest Policy 1999, is by far the most impressive and covers almost all important areas of concern in the realm of forestry. Whereas it speaks of institutional transformation of the forestry sector, its emphasis is on integrated resource planning, resolution of tenurial issues, involvement of the community/stakeholders in forest management, and updating the forestry legislation.

The common strand running through all these policies up to the 1980s was the emphasis on the protection of forests from 'abuse' by the general public and the policing role of the Department in ensuring that this happens.

2.2. Forestry Laws

In this policy backdrop, the legislation that followed matched the intent of policy with legislative content. The Forest Act 1927, and Hazara Forest Act 1936, both are premised on the fact that the forests are to be protected and their prime use is for the conservation of watersheds and revenue for the state. Both make distinction between the state-owned reserve forests with minimum user rights to the local inhabitants, and wastelands/guzara forests where the owners of these forests need permission of the Forest Department for any timber use both for their domestic use and for commercial harvesting. According to some government accounts however, there are/were guzara forests with fuller rights for the communities and Khawaneen (hereditary landlords).

Both these laws are prohibitive in nature, with little to offer by way of incentives for compliance. They are said to be based on 'game-keeper–poacher approach' and are considered unduly harsh, not so much in the matter of punishments, which still are on the low side, but in uncompromising application of its provisions with no distinction between the subsistence-oriented violations and violations based on commercial interests (Hamid 2002).

The NWFP Forest Ordinance 2001, like its policy predecessor, is an improvement over the Forest Act 1927 and Hazara Forest Act 1936, both of which it proposes to replace, in that it promises to study, clarify and rationalize the statutory and customary rights of owners, right holders, and users in different categories of legal forests. It also enjoins the facilitation of community participation in forest management. But on the other hand it gives undue discretionary powers to Forest Department officers in matters of community participation. With the retention of such discretionary powers with Department officials and no explicit deadline for the final resolution of tenurial issues, certain circles view these pronouncements as cosmetic. According to a senior Forest Department official however, this is a view of the radical NGOs. The new NWFP Act, according to him, has provided legal cover to JFMCs and has increased the fines to market level, so the fines on forest crimes are now market-based.

2.3. Forest Department

One of the most prestigious intuitions of the British India, the Forest Department has been structured around the philosophy enunciated in the imperial forest policies and concomitant legislations. The Department is

pyramidal in structure with a strong chain of command flowing from the Chief Conservator of Forests through Conservators, Deputy Conservators/Divisional Forest Officers (DFO) and the Assistant Conservators to the Range Officers and Forest Guards. The Secretary of the Department, usually a generalist bureaucrat, provides policy guidance with occasional sucking-up of some of the technical decision-making (*e.g.* approval of forest management plans).

The Department through the course of history has been attached with and detached from other Departments like Agriculture, Livestock and Fisheries, etc. but has all along retained its functional unity as far as management of forests is concerned. Presently it is part of the Environment Department in NWFP. The Department still retains the protective policing function and harvesting (though the harvesting has been since 1992) as its chief mandate, closely followed by afforestation/reforestation.

Internal reorganization in 1976 led to the creation of Forest Development Corporation (FDC), with the main responsibility of timber harvesting, ostensibly to break the collusive link between the territorial foresters and the timber contractors. The Department has a notified provincial forestry round-table under a legislative cover, with non-public sector stakeholders participating in it but with little influence over policy-making. The Forestry Commission Act 1999 also mandates the establishment of a powerful forestry commission to help develop forest policy and review its implementation. The yet-to-be constituted commission as per its objectives would ensure impartiality in planning and management and transparency in decision-making, apart from shielding the Department from political interference.

The other associated institutions include Pakistan Forest Institute (PFI), a federal entity functioning without its head for the past three years (though a gentleman not known for his academic brilliance has just been appointed for the job), trains and produces graduates in BSc ad MSc Forestry. Another training institution is Sarhad Forestry School for foresters and forest guards with one year and six months training courses respectively.

2.4. Projects

NWFP has been the testing ground for new and innovative ideas in the forestry sector. The pioneering initiatives under various projects in innovative natural resource management techniques provided some very useful learning and are a capital to build on.

The emphasis and the learning from these projects have been about the watershed management and working through locals while improving their

livelihoods; intensive regeneration, job rationalization and inventorization on modern lines; integrated development planning, infrastructure and human resource development; cost effective participatory systems for sustainable management of grazing lands with rotational grazing regimes; the combination of integrated management and social forestry approaches; forestry sector reforms; and Wildlife and other biodiversity conservation at the valley and watershed levels [Strategy for Sustainable Development of Forestry in NWFP 1996 (2001)].

The persistent attention of the donors and their influence in making NWFP forestry management the most 'progressive' in Pakistan, merits inclusion of the projects as one of the dominant institutions of forestry sector in the province.

3. Why is There then Deforestation?

The literature is replete with explanations and counterexplanations. The Department has its own point of view, communities dispute that and the donors have a third angle. The richness of debate can be gauged from the following diametrically opposite views. According to community stakeholders, "... it is generally perceived that Forest Department staff is also a threat to the forest" (VAN DIJK & HUSSEIN 1994). And according to DOVE (1994), 'the state foresters up until recently maintained that the farmers were not merely the enemies of the forest (*i.e.* state forest) but they were also opposed to trees per se'. Within this cacophony of finger pointing, the literature and the stakeholders' dialogue point towards a set of internal and external factors, responsible for this affliction. The internal factors include:

— The issues of tenure, which though are external to the Department's day-to-day management, yet are part of the overall forest management and important enough to merit separate treatment;
— The management of the forests by the Department;
— The prosecution of forest offence cases, again though part of the overall forest management, yet distinct enough to call for an individual attention.

The external factors are:

— The population growth;
— Poverty;
— Lack of alternate energy.

3.1. Internal Factors

3.1.1. Tenure

As already alluded to, through early forestry legislation in 1878, the British Government nationalized one fifth of India's land area (Hassan 2001). Particularly the well-stocked reserve forest category admitted of almost no rights to the locals, except certain rights of passage, water use, grazing and fuel wood collection as concessions. In guzara forests, locals could make use of forest for liquidation of debts and for their children's education, etc. The commercial exploitation was also allowed in guzara forests subject to payment of fee to the government (Azhar 1990).

This categorization necessitated demarcation between the reserved and guzara forests. The settlement process was met with resistance from the locals and the government had to leave the disputed areas out of the reserved category, which were subsequently labelled as protected forests. The demarcation was put off, to be carried out only after thoroughly determining the nature and extent of rights of the locals. In protected forests, locals had more rights on timber, subject to prior approval of the government. After annexation of princely states in Malakand in 1960, the same sequence of events was witnessed, with government declaring the annexed forests as 'protected'. The locals revolted again in 1976 for increase in their share from the sale proceeds of timber, which the government conceded by enhancing the locals' share to 60-80 % of the sale proceeds.

The lack of any permanent settlement of the disputed protected forests led to a perpetual state of conflict between the Forest Department and locals, and the most popular way of expressing their opposition was through violation of forestry laws (Guha 1993). The uncertain category of protected forests could not be maintained in perpetuity.

3.1.1.1. Conceptual Framework

Hassan (2001) explains this phenomenon through the institution of property, with the institution itself being an economic function according to the New Institutional Economics (NIE). Institutions are humanly devised constraints that shape and guide human interaction and reduce uncertainty in everyday life by providing a structure to human interaction and behaviour (North 1990). Institutions can be both formal like judicial and administrative rules and also informal such as norms and conventions societies evolve overtime. These are socially transmitted constraints and often form part of

the culture. Formal rules may not have ready acceptance in a society and there is often a time-lag before they meet social approval. Until the two match there may be implications for economic outcomes (NORTH 1990).

The argument here is that property as an institution reduces uncertainty in human behaviour and leads to efficient economic outcomes. PEJOVICH (1990) defines property as a relation of an individual vis-à-vis all other individuals with respect to an object. Legally, property is not things but rights in or to things (MCPHERSON 1978). The property is more than a mere possession and implies social recognition and acceptance (*ibid*). McPherson further explains property to be an enforceable claim that is enforced by the society or the state through custom or convention or law.

Property thus is an institution of crucial importance having the usual attributes of coordination, uncertainty reduction and facilitating exchange through reduction in transaction costs and in the process setting the essential rules of the game. Since the property rights determine the access to and control over scarce resources, a set of particular property rights has an impact on economic outcomes. Thus a well-defined property rights' structure induces efficiency in the use of resource (DAMSETZ 1967). According to the economic approach to property, it is a claim to stream of benefits coming from a resource. Efficient ownership structure also implies three other characteristics, *viz.* universality in the sense that all resources are capable of being owned; exclusivity, *i.e.* other persons may be excluded from enjoyment of benefits from the resource; and transferability of the property rights themselves (DAMSETZ 1967).

Ownership creates interest in the thing owned and exclusivity ensures all benefits accrue to the owner alone; there is thus incentive for the asset to be put to the highest value use. And if the externalities are internalized, *i.e.* harmful or beneficial effects of a person's activities are bought to bear on him and no one else, then all inefficiencies in the resource use can be removed. The element of transferability provides incentive to move resources from less productive to more productive uses (DAMSETZ 1967). Thus the institution of ownership accompanied by secure property rights is the most common and effective institution for providing people with incentives to create, maintain and improve assets (MILGRAM & ROBERTS 1992).

3.1.1.2. Common Pool Resources

These resources have less than perfect attributes of ownership. Common Pool Resources (CPR) lack the characteristic of exclusivity and others cannot be stopped from enjoying benefits from these resources. Their second characteristic is subtractability, *i.e.* a resource unit appropriated by one person is not

available to others (OSTRAM & GARDNER 1993). This deadly combination makes the resource vulnerable to extinction.

Natural forests share these attributes with CPR and their users' behaviour needs regulation. Rules need to be set to ensure sustainable exploitation of the forests and an enforcement mechanism also needs to be in place. HASSAN (2001) contends that the rules, which are formal institutions, are the result of a purposive human action based on some objective and to achieve that objective, other proper institutional arrangements need to be made to ensure the observance of the rules, hence the achievement of objective. The rules serve no purpose if they cannot be enforced and in the absence of voluntary compliance enforcement of rules requires external authority.

The enforcement in turn requires ascertaining whether violation has occurred and if so, punishment needs to be meted out to the defaulter. The enforcement thus involves costs and the rules therefore, need to be made keeping in view the enforcement costs. To minimize enforcement costs, rules should be appropriate from the point of social set-up and formal and informal institutions must not stand in contrast to each other (HASSAN 2001).

3.1.1.3. The Practice

Against this theoretical backdrop, let us see how the issue of ownership has been addressed in NWFP forestry sector. The resistance to the British attempts at settling the boundaries between the reserved and the guzara forests, led to the creation of protected forests, with inconclusive ownership rights. The disputed nature of the title subjected the protected forests to constant abuse. While a duly recognized and socially acceptable settlement of property rights remains in limbo, the state wants to continue with control over harvesting, leaving the local claimants dependent upon state. The gap between the formal institution of State titlehood and the informal institution of locals holding this title in contempt and putting up a counter-claim to title has resulted in a constant state of conflict.

While during the Raj period the writ of the state was overwhelming, enforcement had been more effective in a forcibly reduced gap between formal and informal constraints. But during the recent times, with weakened writ of the government, the gap increased again between the formal and the informal institutions and the resultant devastation caused to the protected forests is there to see. In the absence of any exclusive private proprietary rights, the sustainable use of protected forests could only have been ensured through a rational management system. And while attempting to align the interest of the community with sustainable exploitation, the compliance

should have been ensured through the enforcement of rules in a system of quick detection of crime and by meting out punishments, which would outweigh any benefits from the offence.

The tenurial origin of massive deforestation in protected forests and the weakness in the enforcement of forestry laws has been recognized in a forest study by the Government of Pakistan and the Dutch Government "...the management of the protected forest is highly unsustainable. The local people contest the ownership of the forests. They do not allow the Forest Department to plant areas from where natural trees are removed" (VAN DIJK & HUSSEIN 1994). Tenureal uncertainty compels the locals not to allow the Department to plant up the felled tree area as such planting would reinforce government claim to the ownership of forest (KHATTAK 1994).

In the guzara forests, although ownership of forests vests in the locals, the state control over their use violates the condition of exclusivity. This lack of control over and access to the use of forest resources manifests itself in pervasive predilection for illegal tree felling. It was instructive to note, when a workshop participant (himself an owner) pronounced that notorious timber mafias were not collections of shady characters shrouded in mystery, rather they were the owners themselves, who having lost control over their own properties, were now bent upon exploiting these precious resources in a most ruthless and inefficient way.

The NWFP Forest Ordinance 2001 though speaks of defining rights and obligations of government and local communities; it makes no substantial changes in the old tenurial structure. The gap between the pronouncements of NWFP Forest Policy 1999 and the contents of the proposed legislation is obvious.

3.1.2. Forest Management

Forests being provincial subject are managed by the Provincial Forest Department which historically saw its role as the protector of forests to secure the integrity of watershed and as a source of revenue for the state. Subsequently the development function, *i.e.* reforestation/afforestation was added as the third major dimension.

3.1.2.1. The Protection

The protection function demanded police like operations for which the Department divided the forest into blocks and compartments for foresters and forest guards to patrol and safeguard it against 'misuse' by the locals. While

the protection function was satisfactorily discharged during the Raj period, it deteriorated after independence as more and more territorial jurisdiction was added to the area of responsibility of individual guards, with the annexation of more areas to state-managed forests. The protection capacity was further weakened because of the increased population pressure and better access through roads making the forests susceptible to illegal exploitation. Although the Department claims to have secured the protection of reserve forests through the decades, it equally plausibly appears to be a function of the inaccessibility of such forests when seen in comparison with guzara and protected forests, rather than any extra vigilance or efficiency of the Department alone [the Department's claim rests on the premise that since other co-sharers did not exist in case of reserve forests, the Department could devotedly concentrate on their protection function unhindered by outside influences, hence any credit for its protection should go to the Forest Department].

The inability of the forest guard to protect his charge, further gets compounded in view of his meagre compensation package which dwarfs before the temptations, the lucrative illicit timber trade offers. Irrational and politically motivated postings and deployment of the protective staff makes the forest protection still more difficult.

The recent phenomena of klashnikov culture and advanced communication means available to the timber smugglers literally put it beyond the reach of the Department, whose staff sometimes fear for their personal security. The murderers of a forest magistrate and some forest guards in NWFP are still to be apprehended despite the passage of more than a decade.

The issue of non-demarcation of the forest boundaries also leads to frequent breaking-up of the forest lands for agricultural purposes and uncontrolled and ubiquitous grazing ensures that no natural or artificial vegetation growth takes place. The supervisory and senior management staff of the Department, according to the community, do not ever venture into the forest and are hence unaware of what happens inside the forest.

The management of quota for the local use by the Department also leaves much to be desired and adds to the opaqueness in the functioning of the Department, lowering the esteem of the staff and prompting more violations of law. The situation deteriorated further by irrational capping of the local quota to archaic allocation regimes despite manifold increase in rural populations.

3.1.2.2. The Harvesting

The harvesting of forests up to the 1970s belonged to the territorial foresters, also responsible for the protection of forests. The system of

harvesting based on forest management plans, generally suffered from over-prescription as regeneration capacities were assumed to be ideal, though suitable conditions did not exist. The plans usually did not take into account the local peoples' needs and were subject to change under pressure from or in collusion with the local elites or corrupt politicians. The other major factor has been the implementation of only the harvesting part of the management plans, with other allied development functions ignored, due to lack of resources available to the Department which is often dependent on donor projects even for its routine management functions.

The mismanaged forest management plans coupled with the collusion of Department's staff with the contractors, led to severe overfelling of trees. This occurred because the contractors owned the trees marked for felling and any illegally cut extra trees were to their advantage. This nexus was broken in the 1970s, with the creation of Forest Development Corporation for harvesting. The marking of trees remained the responsibility of the territorial forestry. The contractors now did not own the trees but this devise was soon circumvented when the contractors started purchasing royalty rights from the owners/concessionists and restored the old perverse incentive alignment.

The same mismatch of incentives of the Forest Department staff with the objectives of the sector as pronounced in their policies and legislations is at play when it comes to the development operations of reforestation. This misalignment of interests now bordering on antipathy also characterizes the behaviour of locals who are least concerned with any regulated livestock grazing practices to allow new plantation to settle and take root.

Political interference in the functioning of Forest Department is a well-documented phenomenon. "Powerful political elements are involved in forestry. Forests have also been frequently used for political patronage" (KHATTAK 1994). All this has played havoc with the functioning of the Department with consequent negative fall-out for the forests.

3.1.2.3. Participatory Management

Based on the premise that ownership structure and property rights are economic tools to enhance the efficiency of investments, the thinking of late but basically donor driven, has been the involvement of communities in the forest management through the alignment of incentives. A phenomenon, which despite several policy pronouncements, has not met with any enthusiasm within the Forest Department barring a few who see the Department's reach exceeding its grasp and to them, sharing the burden with the community

appears the only way out. The history of community involvement in the management of forests remains confined to the projects with apparently encouraging but yet-to-be up-scaled outcomes.

In pursuit of the NWFP Forest Policy 1999, though trailing behind by a wide margin, the proposed NWFP Forest Ordinance 2001 envisages stakeholders' involvement in all types of forests but leaves much of it to the discretion of the Forest Department staff, thus defeating the purpose. Whereas joint forest management appears to make better sense in the reserved forests and also in protected forest, its extension to the guzara forests, which are owned by the locals, requires a lot of explaining. This also goes against the principle of exclusivity of a private property and may very well result in less efficient outcomes. As one owner put it "involvement of community in privately owned forests, would make the forest a prostitute and would lead to confusion and social conflict between owners and non-owners. How could one allow them (the users) to share centuries' old ownership?" He also did not see any sustainability for such partnership between strange bedfellows.

3.1.2.4. Accountability

The concept of accountability within the Department is quite weak and nobody has ever been held responsible for reduction in the forested area or for increase in Nautore, the newly broken land for agricultural use. Although action has off and on been taken against Department officials on the charges of corruption, there is no regular system of monitoring the health of forests under charge of a forest officer. "... (the law) says nothing about the obligations of the government and provides no mechanism for remedial action when forest depletion is the result of its own action (KHATTAK 1994). Forestry laws are mostly administrative in nature and not based on technical requirements of managing the forests. Forest Department staffs, with misaligned incentives, are not likely to ensure protection of the resource unless held responsible for any shirking in this regard.

3.1.3. Prosecution and Trial

Coming to the most visible part of the enforcement of the forestry laws, the phenomenon needs to be examined in terms of the contents of the law and the process from lodging of the report of a forest offence to prosecution and trial, including the capacity issues both within the Department and the court.

3.1.3.1. The Law

There has been a general dissatisfaction among sections of society and universally in the Department that the punishments provided in the Forest Act 1927 and Hazara Forest Act 1936, have grown out of synch with ground realities. Whereas the punishments for the forest offences remain unchanged since the first version of the Indian Forest Act of 1865, the profitability of illicit trade in timber has increased 500 times (KHATTAK 1994). Viewed against the rationale of meting out punishment where consequences of punishment outweigh the benefits from the crime, the provisions of the forest acts appear ridiculously inadequate.

The draft NWFP Forest Ordinance proposes the replacement of the old punishment regime of Rs. 500 and imprisonment for six months as maximum pecuniary and corporeal sentence, with the new much harsher regime of imprisonment up to two years and fine up to Rs. 50,000, with flooring provisions in appropriate cases, where the punishment would not be less than a fine of Rs. 5,000 /- and imprisonment of one month apart from making good the loss caused.

Surprisingly, discussions and responses to questionnaires (about 40 % of sixty-nine responses) considered the quantum of punishment in forest offence cases under the existing regime sufficient and there stance was that hardly any one was awarded the maximum punishment and almost no one was sent to jail, even for a few days of which would have made the difference. This was verified by the Department and in Abbottabad circle, no one was imprisoned out of thousands of cases in a three years' period between 1998 and 2000. The main grievance of the Forest Department was bailable nature of forest offences. The Criminal Procedure Code decides whether an offence would be bailable.

3.1.3.2. The Process

In the Department: apart from roadside seizures during anti-smuggling operations, the common pattern of taking cognizance of offences, is getting to know of illegal cutting by the forest guard, which almost always happens after the offence has been completed with the forest guard writing a damage report based on hearsay. In certain situations, the forest guards may simply be helpless onlookers before an armed gang of professional smugglers. In either situation, the damage report carries doubtful identities of culprits, often with no access to the case property, the illegally cut timber or the implements used for the offence.

As most of the damage reports are written weeks and months in arrears the quality of damage reports leaves much to be desired, both on account of

memory lapses as well as due to the level of education and experience of forest guards. Almost as a rule there is no independent witness to support the prosecution claim in the court during trial.

In the office of the DFO these damage reports are collected and compiled but usually at a leisurely pace and then submitted in the court of forest magistrate for trial. The scrutiny of the damage report at the office level does little to improve the quality of the complaint and the usual delay it causes is between one to three months which makes the whole prosecution process look ineffective, especially when the accused is not even summoned for about four to six months after the commission of offence.

The Department has little capacity to handle this legal side of its mandate and generally there is only one legal retainer in a circle at a very modest package to prosecute on average 10,000 to 15,000 cases in various courts.

In the Court: once the case reaches the trial stage, the service of summons is the next hurdle to cross. The forest offence cases generally held in low esteem by judiciary are also the neglected cases when it comes to the police for service of summonses, who are already burdened with a lot of other summonses and warrants in other cases.

If the production of the accused materializes, the production of case property is usually not possible. Mostly it is not available as having been taken away or is so remotely located as to make its production before the court almost impossible. The Department has no resources to cause the production of the case property before the court with no budget line item in its annual allocations. Given the nature of case property and remoteness of locations, even the mobility of the court does not help as it is virtually not possible for the trial magistrate to visit all such places.

Under such circumstances, chances of successfully prosecuting the offender and ensuring award of deterrent punishment become extremely slim. It is only under pressure of improving disposal that confessions are managed from accused on the understanding that a lenient view would be taken and a light pecuniary punishment would be announced. This rids the court, the prosecution and the accused all, of the agony of going through the pointless motions of a trial.

In such a scenario, the enhancement in the quantum of punishment as suggested in the draft NWFP Forest Ordinance 2001 appears self-deluding, as no court would award punishments especially under the new harsher provisions, when so much needs to be done to make the prosecution case worthy of submission for a decent trial. The chances are that with flooring provisions and with hopelessly inadequate prosecution quality, more and more trials would either linger on or would end in acquittals.

However, the performance of the courts was also seriously criticized by the workshops' participants especially in anti-smuggling seizure cases and corruption and political influence were often cited as reasons for failure of justice. The shortage of judicial magistrates and the immensity of work load further lead to the deterioration of quality of decisions and all this appears to point to a losing battle. To top it all, there is a general lack of awareness in the judicial magistrates about the importance and seriousness of forest offence cases.

3.2. The External Factors

The external factors provide a powerful and outcome-determining context in which the forest management and forestry laws have to operate.

3.2.1. Population Pressure (tab. 1)

Table 1

Variation in rates of forest decline with the density of surrounding population

Name of circle	1989 population (000)	Annual decline in area 1979 to 1988 (%)
Battal	054	1.4
Baffa	151	2.1
Oghi	120	5.1
Mansehra	244	8.8

Source: Strategy for Sustainable Development of Forestry in NWFP 1996.

Draft Abbottabad Conservation Strategy put the district annual sustainable yield at 192,905 cubic metres with 20.3 % of the area of the district under forest cover. This annual yield of the most vastly and densely forested district of NWFP, compares hopelessly with its total fuel wood requirement of 549,396 cubitc metres. The calculations above do not take into account constructional timber requirement of the area. The rural areas use wood as a construction material for reasons of almost total dependence and free availability.

Population pressure further translates into conversion of pristine forests into agricultural fields, in an attempt to ensure the food security of burgeoning numbers. The collateral damage in the form of degraded mountain slopes further lends to soil erosion and indirect forest loss. So just to meet the local fuel wood and other domestic needs the current stock of wood in the forests of NWFP is not sufficient in terms of sustainable yield harvest-

ing and at present rates of deterioration the official estimates envisage the province to be treeless by 2025 [Provincial Forest Resource Inventory, Jan. 2000].

3.2.2. Poverty

Connected to the population pressure is the endemic poverty of mountain people, causing their dependence on cutting of wood for domestic use and sale. Poverty, apart from being the result of geometric growth in population, is a distinct phenomenon endemic to most of the mountain areas. With scant resources and almost no economic activity, the dependence of the locals on timber as a source of livelihood is a foregone conclusion. According to one workshop participant, 'with an annual per capita income of Rs. 1,426 in Allai Battagram (figure could not be independently verified but the assertion points towards the abject poverty in the area), felling of trees being the sole means of survival for locals cannot be stopped'.

Their heavy dependence on livestock and consequent uncontrolled grazing are a sure recipe to make certain that any natural or artificial vegetation does not survive. Poor quality, low output livestock in huge numbers does not yield to any regulated manger feed or rotational grazing practices.

Whereas the timber smuggling gangs and their sponsors are invariably from the middle and upper middle classes, on the spot illegal tree felling is almost exclusively done by the local poor driven by hunger and want. 'With basic needs of locals secured, smugglers would find no one to undertake tree felling operations' was the claim of workshops' participants.

3.2.3. Alternate Energy

Whereas the provision of natural gas to Abbottabad and Mansehra has reduced the pressure on the forests for domestic fuelwood use of at least these urban centres, the malady continues in other mountainous areas of NWFP, which are subject to extreme temperature drops and the requirements of heat energy during winters translate into direct forest loss. Even if it were possible to extend the supply of piped or bottled gas, the crushing mountain areas' poverty would not allow the locals to buy the energy substitutes. Lack of awareness and know-how of appropriate energy conserving construction technology and energy efficient fuel stoves, further fuels the energy requirements, thus putting pressure on the woodlands.

4. Recommendations

The issue of property rights over and in the protected forests must be resolved as a priority through a dedicated capacity with no other official distractions, and in a transparent manner, with the involvement of all stakeholders.

A broad legal arrangement should precede the settlement process, ensuring consideration of both statutory and customary laws and their integration in decision-making to reduce the credibility gap and ensure greater ownership and acceptance of decisions.

The harvesting prescriptions should be revised in the light of the real regenerative capacities of the forests taking into account the recent climatic trends and genuine local needs for fuel wood and timber in consultation with the local communities.

The discretionary authority with the Forest Department staff should be deleted from the proposed NWFP Forest Ordinance 2001. Sense of ownership created by the institution of joint forest management would itself stand guard against overfelling by the contractors beyond prescription and discourage the sale of royalty rights by the local concessionists to the contractors.

The areas of jurisdiction of the forest guards and foresters need to be rationalized to make it more realistic and manageable. Protective staff should be posted to their own native areas with strict checks and balances.

Security of the Forest Department staff should be ensured through involvement of community in protective functions, after their stake in the forest management has been secured through resolution of tenurial issues.

Incentives for legal trade should be put in place while effectively discouraging illegal trade through the involvement of the private sector and local stakeholders laying emphasis on optimum exploitation of non-timber-forest-produce, like medicinal plants, honey, lac, sericulture, etc.

Whereas enhancing capacities of the field staff would help in damage report writing, the real solution thus lies in establishing local tribunals involving local community to deal with forest offence cases. This would certainly ensure swift prosecution, judgement and enforcement of the orders with far deeper effect in terms of retribution and deterrence. Formal judicial process should only be invoked as an appellate mechanism or for serious en route smuggling cases.

Forestry laws should provide compliance incentives apart from the prohibitory provisions. The fines and imprisonment prescriptions need rationalizing after a passage of seventy years and should be pegged with the damage caused and the restoration costs.

All this needs to be backed up by a system of rational accountability standards. The basis of accountability needs to be tied up with the health of the forests through verifiable indicators to ascertain the performance of the responsible staff. Loci of accountability should be matched with necessary decentralization. Coupling official accountability with social accountability in the form of joint forest management teams, should act as an effective deterrent. Capacity of the departmental and the civil society stakeholders need to be enhanced for effective monitoring and control regimes.

But nothing works in the absence of an enabling policy and legislative environment. Consistency in the policies and laws and integration with broader governmental priorities are essential to bring about synergies from multidimensional reform measures. Absence of the rule of law has been the bane of our society; uniform application of laws and their enforcement no matter how unfashionable must be ensured.

Population control measures, macro-economic stability and growth coupled with targeted poverty reduction measures would be steps in the right direction. Any reforms at the department level must be supplemented with appropriate growth enhancing measures at the national level. Culture of efficiency in fuel use needs to be introduced through mass contact, involvement of community and awareness raising. Small hydel power schemes, for which there is a lot of potential in the province, should be introduced through integrated development interventions. Heat conserving construction material and techniques would result in a lot less burden on the forests.

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A Stakeholder Approach to Natural Resource Management in Peri-urban Central Africa

by

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KEYWORDS. — Central Africa; Peri-urban Areas; Governance; Natural Resource Management; Research Methods.

SUMMARY. — Environmental governance is the way in which power over nature is structured. It addresses the question "Who has the right to do what and why?" with respect to natural resources. Environmental governance is influenced by very specific political, cultural, ecological and economic factors. The key variables are actors, resources and space. In the weak and failed states of Central Africa, new political configurations and cultural logics emerge, evolve and reinvent themselves. Local level factors in governing/managing/exploiting/conserving natural resources are of particular importance because the theoretical legal framework rarely corresponds to the living reality of ordinary local people. Understanding the negotiation process between sets of actors thus becomes crucial. Environmental governance in this framework depends on the juxtaposition of institutional factors and the political economy of communities.

Environmental governance in peri-urban Central Africa is particularly challenging on the theoretical and practical levels because these spaces are underconceptualized: little work has been done on trying to define what is meant by peri-urbanity. Even less work has been done at trying to characterize how people living and working in these areas perceive themselves. Another challenge stems from the way these spaces are regulated by a complex series of hybrid arrangements. Traditional authorities and state agents vie for power, access to resources and legitimacy in an unending negotiation process. Relations at the level of authority tend to be characterized by conflict, animosity and betrayal, even though a semblance of accommodation can be witnessed. The potential for conflict in these areas is exacerbated by pressure from outside actors such as urban elites or rural migrants. The two extremes meet here to carry out profitable economic activities such as farming, fuelwood harvesting and Non-Timber Forest Product (NTFP) extraction. New housing construction also puts pressure on land tenure practices. These spaces are gradually developing the appearance

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of urbanized districts but infrastructure is not sufficient, resembling an urbanization process without urban planning.

This paper is based on work currently being carried out in peri-urban Kinshasa and Lubumbashi in DR Congo and Brazzaville (Congo Republic). It will present preliminary results that have emerged from a systematic and comparative set of research topics, *i.e.* (1) characterization of the peri-urban research site, (2) inventory of governance actors and their involvement in natural resource management, (3) access to natural resources and peri-urban space, (4) inventory of economic activities in the research sites, (5) relations between the peri-urban site and its rural hinterland and relations between the peri-urban site and the city, (6) analysis of conflict and resolution mechanisms and (7) analysis of successes and failures of development initiatives in the research site.

1. Introduction

How do people living in the halos of Central Africa's expanding cities cope with the challenges of natural resources management? What stakeholder groups are involved? How do local populations perceive and experience the new dynamics of 'environmental governance', and what do western experts mean by this relatively young and complex concept? Why are peri-urban areas socially, ecologically, politically and economically important from a development perspective?

These are the general questions addressed in an ongoing research project in peri-urban Kinshasa and Lubumbashi in the Democratic Republic of Congo and Brazzaville, Republic of Congo [1]*. These cities have been going through years of severe economic crisis and political turmoil which continues to reconfigure the dialectical relations they have with their hinterlands. At this stage of the project cycle, it is too early to present final results. It is however possible to present the conceptual framework, the research approach and preliminary findings. The paper is consequently divided into two parts: first, some background is presented on the definition, characterization and conceptualization of peri-urban space. Next, the notion of environmental governance is briefly outlined and critically examined. In the second part, the research protocol is presented in detail.

2. Why is Peri-urban Space a Natural Resource Management Priority?

Natural resource management in peri-urban areas in Central Africa is challenging on both the theoretical and practical levels. These spaces are

* The numbers in brackets [ ] refer to the notes, pp. 219-220.

underconceptualized: relatively little work has been done on trying to define what is meant by the broad concept of peri-urbanity, especially from a social science perspective. Even less work has been done at trying to characterize how people living and working in these areas perceive themselves and their environment. The Food and Agricultural Organization (FAO) defines a peri-urban area as "an area on the periphery of the urban area of the town and its suburbs" (CIPARISSE 2003, p. 52). Perhaps geographically satisfying, the definition needs considerably greater nuance at the social and political levels. Another attempt at a definition has been made by BIRLEY & LOCK (1998, p. 89): "the peri-urban zone can be broadly characterized as a mosaic of different land uses inhabited by communities of different economic status, in a state of rapid change with a lack of infrastructure and a deteriorating environment". Pierre Vennetier, a French geographer who has examined peri-urban spaces from the point of view of agricultural practises, emphasizes two major forms of peri-urban land use (small-scale urban dwellers farming in the periphery and urban elites who increasingly occupy large tracts of land for commercial farming). Vennetier's work primarily focuses on the dominance of urban elites and entrepreneurs in the urban periphery. It highlights new power relations and access to land in the agricultural sector, but without taking into account local political dynamics (VENNETIER 1991, p. 64) [2].

This interdependency between cities and their hinterlands has also been echoed by Jean-Marie COUR: "... towns are now closer to the rural world as rural populations and rural activities tend to become concentrated in peri-urban areas, closer to markets and urban services" (1996) quoted in BAKER (1997, p. 12). The narrowing of the rural-urban gap has resulted in large part from improved transportation possibilities, a situation examined in detail around the city of Dar es Salaam by BRIGGS & MWAMFUPE (2000). The tendency of city-dwellers to colonize agricultural space in urban hinterlands as well as increased rural-type attitudes and behaviours within cities (DEVISCH 1995) has led to what can be described as the 'rurbanization' phenomenon (BAKER 1997, p. 12; TREFON 2003).

Drawing on these views of peri-urban space, we propose the following multivariate definition: peri-urban areas in Central Africa can be characterized by proximity to a densely populated urban settlement, rapid population growth, severe environmental degradation, hybrid governance structures that juxtapose State agencies and traditional authorities, extractive and productive economic activities for subsistence and trade (heavily dependant on natural resources and agriculture) and a 'hinge' dimension linking peri-urban areas to both cities and rural hinterlands. This hinge dimension is reinforced by ongoing crisis as well as the ambiguities that it generates. This situation

is confirmed by our preliminary findings: ideally, new migrants and established households both perceive peri-urban areas as transit zones towards attaining well-being in the city. In reality, however, they admit that settling or remaining in peri-urban areas is a far more interesting subsistence alternative.

This relative absence of conceptualization and related research is a handicap at the policy level because there is nonetheless a concentration of international donor activities in urban hinterlands. Support of *ceinture verte* initiatives [3] and fuelwood projects (KALIPENDI & ZULU 2002) are the most obvious examples. There are also numerous examples from the health, transportation and water distribution sectors. The good intentions of development schemes often fall awry in peri-urban areas because the complex land tenure and social determinants that govern these spaces — and consequently the projects that are based there — are frequently overlooked in the project design phase. This problem is emphasized in a World Bank autocritique of its more-than-twenty-year experience in urban development projects: "Le foncier a toujours représenté un obstacle à la mise en œuvre des projets urbains. Ceci est dû, en grande partie, au fait que les problèmes fonciers ont souvent été sous-estimés et que les solutions envisagées sont délicates et très politisées" (FARVACQUE-VITCOVIK & GODIN 1997, p. 4). The complexities of land tenure in Africa have been studied in depth by an interdisciplinary network of social scientists: AFREFA (Association pour la Promotion des Recherches et des Etudes Foncières en Afrique) (LE BRIS *et al.* 1991). They suggest a model of land tenure which suits the peri-urban context relatively well. It is in their view, the totality of social relations based on land and space. These social relations are primarily conditioned by politics, economics, institutions and the nature of infrastructure (*ibid.*, p. 13), making land tenure a "total social fact" (*ibid.*, p. 21). Somewhat surprisingly, they do not include ecology or environment in their model.

This World Bank study makes particular reference to infrastructure and housing problems in peri-urban areas:

> Les extensions urbaines recouvrent à la fois les zones périphériques mais aussi les zones interstitielles. Ces zones font souvent, de la part des ayants-droit coutumiers, l'objet d'opérations foncières qui donnent lieu à des occupations initialement peu denses mais qui progressivement deviennent des quartiers irréguliers. Les inconvénients d'une telle pratique sont multiples: il sera difficile, au fur et à mesure que ces quartiers se densifieront, de les intégrer dans l'ensemble du dispositif urbain, de les équiper et de disposer d'une offre organisée de terrains à bâtir (FARVACQUE-VITCOVIK & GODIN 1997, p. 32).

A major development obstacle is the complex series of hybrid arrangements that regulate these spaces. Traditional authorities (as well as other

civil society actors) and State agents vie for power, access to resources and legitimacy in an unending negotiation process. Relations at the level of authority tend to be characterized by conflict, even though a situation of fragile accommodation can be worked out. Like HERBST (2000) or BIERSCHENK & OLIVIER DE SARDAN (1997a), we can consider that the degree of political control in Africa decreases in relation to the distance from the capital city. Land tenure practices around Kinshasa, Lubumbashi and Brazzaville clearly support this hypothesis. Traditional authority is just as important to local populations as is modern law with respect to access, usufruct and ownership of land. In the Zaire of Mobutu, huge parts of the country were beyond the effective reach of any form of state authority, a situation that has not been resolved today despite post-conflict political agreements. This reality is encapsulated in the title of POURTIER's (1997) article "Du Zaïre au Congo: un territoire en quête d'Etat" (From Zaire to Congo: a territory in search of a state).

The potential for conflict in these areas results from this hybrid political system and it is exacerbated by new demographic pressure caused by outside actors such as urban elites, traders and rural migrants. As housing plots and agricultural land within the city become rare and expensive, people move towards the city's outskirts. Likewise, new migrants hailing from rural areas also tend to occupy land in these areas for the same reasons. From an interesting Australian case study, it is possible to compare similar existing demographic patterns in Central Africa and foresee patterns that may emerge in future years. Tania Fisher has conceptualized a model to illustrate population growth in peri-urban areas in developed countries that include the combined effects of four growth processes. *Suburbanization* (in-migration from metro area to peri-urban locations adjacent to the metro boundary), *counter-urbanization* (in-migration from throughout the metro area to peri-urban locations, both adjacent and distant from the metro area), *population retention* (increased period of residence and reduced rate of out-migration), and *centripetal migration* (in-migration from outlying rural areas (FISCHER 2003, p. 553). Results published from another interesting study on land use in peri-urban Accra (Ghana) confirms our observations about the potential for conflict due to the co-existence of customary land tenure and state involvement in the land market (GOUGH & YANKSON 2000).

New settlers, migrant traders and established residents converge in peri-urban areas to carry out economic activities such as farming, fuelwood harvesting and Non-Timber Forest Product extraction. Many of these activities are subsistence, but commercial activities are also important. Commercial activities can be both small-scale and local (with negligible profit margins),

or larger-scale — especially as urban elites appropriate large concessions for themselves through political manoeuvring. These new settlement and economic patterns clearly put pressure on land tenure practices. These spaces are gradually developing the appearance of urbanized districts, but infrastructure is not sufficient: haphazard urbanization processes are taking place without urban planning.

3. What is Environmental Governance?

Drawing on RIBOT's (2001, 2004) theoretical discussions on environmental governance, we view it as the way people organize power over nature. Environmental governance addresses the question: "who has the right to do what and why?" with respect to natural resources. It is influenced by locally specific political, cultural, ecological and economic factors. The key variables are actors, resources and space. In the weak and failed states of Central Africa, new political configurations and cultural logics emerge, evolve and reinvent themselves. Local level factors in governing, managing, exploiting or conserving natural resources are of particular importance because the institutionalized legal frameworks rarely correspond to the lived reality of ordinary local people. Understanding the negotiation process between sets of actors is thus crucial. Environmental governance in this context depends on the juxtaposition of institutional factors and the political economy of communities.

Although our interpretation of environmental governance clearly emphasizes the importance of giving local populations voice and empowering them to be stronger actors in managing their natural resources, we are also aware that this approach is not devoid of serious theoretical and practical pitfalls. Indeed, the process of empowerment throughout much of Africa has been characterized by tension, conflict, violence and betrayal, as much as by innovative forms of solidarity, networks, commercial accommodation and inter-dependencies. Along these same lines, the pitfalls of 'local' empowerment have been critically analyzed by Sara Berry who

> ... re-examines the common argument that defining and securing local ownership of resources and social activities is the key to sustainable development and democratization in contemporary Africa. In the process of deciding who and what are local, administrators and policy makers often provoke debates and struggles that lead to conflict rather than cooperation, and complicate rather than clarify practices of resource management and government (BERRY 2004, p. 79).

In order to make the link between the need to improve our understanding of peri-urban dynamics and the need to provide local-level empirical data on

environmental governance, we have conceptualized a detailed research protocol and are now applying it in three Central African sites. This protocol and the context in which it was developed are presented below.

4. Methodology and Research Questions

Social science research throughout much of Africa since the 1980s has been marked by a clear shift away from a previously fashionable 'area studies' approach towards problem-oriented issues. This shift largely emanates from the development challenges faced by the continent with the result that research for research's sake is a luxury that fewer funding agencies are willing to support. Other factors also account for this shift, such as the marginalization of Africa in the global political economy, real and perceived security concerns and the existence of other attractive research sites in, for example, Latin America or Asia. Social science research in other words is increasingly influenced by donor priorities. Despite the disadvantages of donor-driven aid, there are also positive implications. These include the improved partnership between policy-makers and researchers, new perspectives to carry out action-research and a greater sense of professionalism within the Ivory Tower. Our peri-urban research is representative of these trends.

The conceptual phases of this research benefited from preliminary work carried out in the context of other action-research projects. One, the EU-funded project *Avenir des Peuples des Forêts Tropicales,* that had a strong focus on forest-city relations (BAHUCHET 2000, TREFON 2000); the other, a project on land use changes around two mid-sized Gabonese cities (Franceville and Oyem) funded by USAID (WOLFF *et al.* 1999, MWANZA *et al.* 2003) [4]. At the theoretical level these experiences enabled us to start understanding the social dynamics in peri-urban areas from a comparative perspective. At the more practical level, these experiences (and the first year of the current research project [5]) helped us identify reliable local experts, form the research teams and eventually coordinate the work being carried out by these teams in the field from an office in Brussels [6]. Although now obvious for younger researchers, the widespread access to the Internet in Central Africa has made this type of North-South coordination workable. Prior to approximately the late 1990s, this type of coordination would have been much slower and less efficient.

The research questions presented below were formulated over a period of nearly one year. The process included a classic literature review, capitalizing on the related experiences outlined above, a workshop in Kinshasa with

an interdisciplinary group of experts and, finally, the drafting and re-drafting of the protocol until it struck a balance between the demands of social science research within the individual research sites, while at the same time, reflecting more general policy priorities. The resulting protocol is divided into the following sections: (i) the characterization of the peri-urban research site, (ii) the inventory of governance actors and their involvement in natural resource management, (iii) access to natural resources and space, (iv) analysis of conflict and resolution mechanisms, (v) the inventory of economic activities in the research sites, and (vi) the relations between the peri-urban site and its rural hinterland on the one hand and relations between the peri-urban site and the city on the other.

4.1. Activity 1: Characterization of Peri-urban Space

The first series of research questions seeks to characterize the peri-urban space being studied by using a multivariate and comparative approach. The three broad sets of variables are (i) the geo-physical setting, (ii) demographic and social factors and (iii) peri-urban residents' perceptions of themselves and their environment. The goal is to identify contrasts and similarities that will help us conceptualize what is meant by peri-urbanity to better understand how people live in and perceive these particularly challenging social spaces.

4.1.1. The Geo-physical Settings

The research site's location, surface area and boundaries are identified and presented in the form of a map.

The geomorphology is described with information about soil, rainfall, climate, vegetation and ecosystem.

Habitat is described: How is village space laid out (linear, circular, ...)? How are house lots organized? What building materials are used for housing (adobe, cement, brick, corrugated metal roofing, ...)?

What infrastructure exists? Here, a detailed inventory is needed with respect to roads and transportation, schools, healthcare facilities, administrative buildings, places of worship, missions, water and electricity (or gas) distribution, sewerage, radio and television reception, cell phone antennas, cyber-cafés, ...

4.1.2. Demographic and Social Factors

How many people live in the research site and what is the demographic distribution according to sex and age groups (<15, 15-65, >65)?

What is the annual number of births and deaths?

What is the annual number of arrivals and departures to and from the research site, and what are the places of origin and departure destinations?

What is the degree of social homogeneity (do residents belong to the same ethnic group, clan or lineage; do they speak the same language or dialect)?

Is the research site subdivided into distinct social spaces based on, for example, family ties, occupation or status?

Since when do people live in these areas and what factors account for their settlement?

How many individuals live in a typical household? What is the household composition (<15, 15-65, >65)? What kinship ties link household members and the household head?

What are the principal and secondary occupations of men, women and children?

What is the structure and nature of the community's associational activities (savings, *tontines*, trade, production, farming, harvesting, fishing, ...)? Is affiliation based on family or ethnic ties, neighbourhood priorities, profession?

Detailed information on kinship ties and patterns is crucial to Activity 1. Is kinship patriarchal or matriarchal? Whose name is given to a newborn? Who does a child consider as father, mother, brother, etc.? What family ties are the most important? What marriage practices are dominant? Does a new couple go to live with the wife's or husband's family? What are a wife's/husband's rights and responsibilities towards the family-in-law?

4.1.3. Peri-urban Residents' Perceptions of Themselves and Their Environment

This information is important because it contributes to the conceptualization of these areas by using local popular discourse.

A series of relevant questions are: What positive things do people say about their areas (quiet, safe, less expensive than the city, access to land and housing, close to fields, ...)? What negative things do people say about their areas (isolated, far from social infrastructures, boring, not modern, ...)? How do people refer to themselves (city-dwellers, villagers, intermediaries, country bumpkins, ...)? How do peri-urban dwellers refer to their urban and rural neighbours, and what connotations do these references have? What stories or anecdotes do people tell about their areas?

4.2. Activity 2: Inventory of Governance Actors and Their Involvement in Natural Resource Management

The objective of Activity 2 is to identify all the actors involved in natural resource exploitation or management, categorize them according to 'strategic groups', and analyze the relationships between these different sets of actors. This step draws on the Bierschenk and Olivier de Sardan theory of 'political arenas' to understand how these sets of actors interact. The processes of negotiation between actors are crucial here, as is their degree of accommodation and conflict. The local, national and international political contexts are addressed in this section. This section will ultimately help respond to the overriding questions of who has power over natural resources in the research site, and what is the impact of this power on the environment. This section will also take into account the way people perceive the challenges of environmental management and the ways of improving it and making it more participatory.

Within the local political arena, civil society actors are the first group to be categorized, taking into account a large number of social layers.

4.2.1. Individuals

What individuals wield power either in the public realm or in the family context? What is the nature of this power, and in what conditions is it manifested?

4.2.2. Households

4.2.2.1. Typical Households

What authority does the household head have over the people living under his or her roof? What is the nature of this power and in what conditions is it manifested? Does the spouse benefit from the authority or prestige of the household head (within and beyond the household context)? What authority (if any) do other adult members of the household have?

4.2.2.2. Atypical Households

What authority does a male or female household head have within a single parent household? What is the nature of this power and in what conditions is it manifested? These questions need to be considered for households headed by unmarried individuals, widows, sterile women, disabled, etc.

4.2.2.3. 'Elite' Households

Are there households headed by individuals who have particular forms of power or authority (emanating from, for example, wealth, success in the city, education, ties with influential people, etc.)? Do household members benefit from the prestige of the head of household? If so, in what way?

4.2.3. Family and Extended Family

What large or important families reside in the research site? Do these families have any particular form of power or authority? What is the nature of this power, and in what conditions is it manifested? Does the family elder benefit from any particular prestige? Does this prestige extend beyond the family (within the community or public sphere for example)?

4.2.4. Associations

What is the nature of associational life in the research site? What is the *raison d'être* of associations? What services are provided? How many members are in them? What are the criteria for membership? What is the relationship between the association and other social and economic activities? Does the impact of the association extend beyond the research site?

4.2.5. Entrepreneurs, Traders, Trade Unions, Craftsmen, Churches, NGOs, ...

What groups have power or influence in the research area? How are they organized? What is the nature of their power, and in what conditions is it manifested? How many people are involved? In what spheres of public life do these groups have voice?

Institutional actors fall in the second group to be inventoried in Activity 2.

4.2.6. Traditional Authority

Who represents traditional authority (village chief, elders, land owners, ...)? How was their authority achieved (vote, nomination, inheritance, ...)? What power do they have over the community? What are the institutionalized and social relations between the representative of traditional authority and representatives of the State (security agencies, administration, municipal offices, ...)? What are their mutual rights and responsibilities? What are their areas of jurisdiction? Can they levy taxes (and if so of what nature)?

How are traditional tribunals organized? Who takes part? What is the nature of cases (witchcraft, adultery, divorce, land issues,...)?

4.2.7. State Agents

A complete list of all State agents present (permanently and/or sporadically) in the research area is required here. What are their official roles and how are they perceived by local residents? What positive things do residents say about them? What negative things do residents say about them?

4.2.8. 'Multi-cap' Actors

Amongst the actors identified above, do any of them have rights and responsibilities that straddle strategic groups (a village elder is the president of an NGO, for example)? What do residents say about this straddling? How is this situation justified? Is it a widespread or isolated phenomenon? What implication does it have for decision-making in the environment sector?

4.2.9. Outsiders

What outside actors influence the local political context with respect to natural resource management (urban-based officials, wealthy traders, private investors, international NGOs)? What is the nature of their power and in what conditions is it manifested?

4.3. Activity 3: Access to Natural Resources and Peri-urban Space

To respond to the question "how do people gain access to resources in peri-urban areas?" this section focuses on the negotiation processes between stakeholders. It addresses the rights and practices that enable people to access resources individually and collectively. Questions are ordered according to the strategic groups established in Activity 2.

4.3.1. Civil Society Actors

4.3.1.1. Individuals

What was the initial activity or project of the actor? In what way is it linked to natural resource use?

What procedures (administrative, traditional) did he have to follow to have access to land or resources and subsequently start working? What documents or permits were required? Who delivered them and in exchange for what?

From the point of view of the actor, was it really necessary to go through these procedures and have these documents?

Did the actor meet any particular obstacles? With which authorities? How were they resolved?

Did the actor need help from a facilitator or another actor to fulfil the administrative procedures? Which other actors? What procedures?

What outside factors (status, family, profession, elite connections, ...) enabled (or handicapped) the fulfilling of the administrative procedures?

Did the actor have any alternative strategies to accomplish his objectives in case of obstacles? If yes, what strategies?

Once the actor was guaranteed access to land or resources, what follow-up procedures are necessary (gifts to the chief, city or communal taxes, ministerial permits, ...)?

Are there any other constraints or conditions that the actor is subject to (bribes, other forms of 'motivation')? How often is this required? Are sanctions imposed if these conditions are not met? What kind of sanctions?

How does the actor perceive the current situation? Does he consider his rights to be secure? Or, do these rights have to be constantly affirmed and renegotiated? Are these rights transferable (by inheritance for example)? If so, under what conditions?

What modifications in these procedures does the actor suggest to improve access to resources?

4.3.1.2. Groups, Associations and NGOs

These same questions need to be repeated for other civil society actors. However, for these other actors, additional questions also need to be clarified. Questions for rotating saving associations (*tontines*) or other neighbourhood, vocational or women's groups are: in what way has the particular nature of the association facilitated or handicapped access to land or resources and the development of activities based on natural resource exploitation? What are the formal and informal conditions that enable the association to carry out their activities? For local NGOs or development organizations: What legal status do they have that allows them to carry out natural resource exploitation? How does the status or reputation of a development NGO or institution (and eventually links with a western partner)

influence access to land or natural resources? Who are these NGOs' or institutions' local partners, and how did these local partners facilitate their access to land or natural resources?

4.3.2. Institutional Actors

4.3.2.1. Traditional Authority

According to traditional authority, what are the rights and practices (access, usufruct, inheritance, right to plant trees, distribution of land, ...) of people living in the research area? How are these formulated? What are the mechanisms or steps to follow to make these rights concrete?

Are ownership rights recognized by traditional authorities? If yes, how are they manifested? If no, what is the dominant system? What do local populations think about this situation?

What local authorities do people have to contact to gain access to a plot of land or resources?

What are the specific prerogatives of traditional authorities in these issues? What guarantees these prerogatives and why? Are there conflicts of interest between these authorities and other actors? Specify examples if possible.

Do residents of the peri-urban zone enjoy more rights or advantages than new settlers or other 'outsiders'? Specify examples if possible.

What land rights or natural resource issues do traditional justice systems examine most frequently?

What markers (trees, posts, ...) are used to identify boundaries between plots? Who does (and does not) recognize the legitimacy of these markers?

Are there cases of litigation between traditional and administrative authorities concerning land ownership claims? If so, how are they resolved?

Can a decision taken by a village chief be questioned, circumvented or annulled by a State agent? If so, provide examples.

4.3.3. State Agents

Note here that we are primarily interested in establishing the practical aspects of procedures, contacts and arrangements between State agents and civil society actors more than the normative discourses on how these dimensions should function.

List all State services present in the research site that are involved in land issues or natural resource management. What are their mandates? What

laws, decrees, codes, ... define these mandates? What do these documents specify with respect to environmental and land issues?

How does the State define land and resource ownership and usufruct?

What documents does the State recognize testifying to land ownership?

Are their examples of coordination between different State services concerning land and natural resource issues? Are their examples of conflict or rivalry?

What administrative services monitor natural resource exploitation (in the areas of wildlife, fishing, NTFP harvesting)? What do individuals in the research site say about these services?

What State agents not officially mandated to oversee environmental issues do so anyway?

What are their relations with economic or civil society actors? What form does their involvement take? How do they justify their involvement?

4.4. Activity 4: Analysis of Conflict and Resolution Mechanisms

The objective of this activity is to identify all forms of environmental conflict in the research site and the strategies designed to resolve them. All questions in this activity must be raised in a way that provides information on environmental issues. The first step is to interview a sample of actors from each strategic group and get them to respond to the following questions: Are you currently in a state of conflict or disagreement with other people residing in the peri-urban zone? Have you been in the past? Who is involved in this conflict (another individual, group of individuals, a State agent, a traditional authority, someone from outside of the area, ...)? What is the source of conflict? What are the stakes (social, economic, ...) at risk in this conflict? What are the prospects for a peaceful settlement? Are these types of conflicts rare, occasional, frequent, ...?

The information collected from these questions is necessary to establish a typology of conflicts, which is the second step in this activity. The list should include the following general categories: (i) intra-family conflicts, (ii) neighbourhood conflicts, (iii) conflicts opposing an individual or a group of individuals and a civil society association, (iv) conflicts opposing an individual or a group of individuals and a recognized institutional actor (municipal authority, security agent, ministry official, ...), (v) conflicts opposing an individual, or a group of individuals, and a recognized traditional authority, (vi) conflicts opposing a resident of the peri-urban area and someone from the city or hinterland who is involved in a commercial activity in the area.

The third step in this activity is to describe conflict management strategies in these categories, based on the following questions: What types of conflict do you and the community perceive as being minor and easily resolved? What types of conflict do you and the community perceive as being serious and resolved with difficulty? What are the usual ways of resolving a specific conflict? How long does it usually take? Which actors are involved in the resolution process? What is the usual nature of the settlement (an apology, retribution, ...)? Do you know of any conflicts that have been resolved quickly? Do you know of any conflicts where the plaintiff refused to bring the conflict to the attention of traditional or State authorities? Do you know of any conflicts that were resolved thanks to the intervention of an influential third party? Do you know of any conflicts where none of the concerned parties were satisfied? Do you know of any conflicts where local authority was superseded by an outside authority? What do you think are the advantages and or disadvantages of the strategies used to resolve environment conflict (based on specific examples)? Do you have any suggestions on how to improve environmental conflict resolution?

4.5. Activity 5: Inventory of Economic Activities in the Research Sites

The information required for Activity 5 is less conceptual then the previous ones and is more matter-of-fact. The objectives are to have an overall picture of economic activities in the research site, understand the environmental impacts of these activities and analyse local dynamics of credit and savings. This can be done by following four steps.

4.5.1. Step 1. Inventory of Economic Activities

4.5.1.1. Agriculture

What crops (cereals, vegetables, leafy vegetables, root vegetables, beans, fruit trees, herbs, condiments, medicinal plants, decorative plants, ...) are cultivated in these three types of spaces house gardens, fields, commercial farms? Are these crops consumed by the family or sold (or both)? If sold, through what channels? What is the average size of cultivated areas? Describe trade networks. How much money do people earn through sales?

4.5.1.2. Breeding

For small-scale breeding: What animals are left to roam around freely in the compound or village? What are they used for (consumption, sale, savings, gifts,...)?

For intensive or semi-intensive breeding: What animals are raised? What is the size of the herd? In what type of infrastructure are animals raised? What are they fed? What veterinary care is provided? By whom? Describe trade networks. How much money do people earn through sales?

Ask similar questions concerning fish farming.

4.5.1.3. Hunting and Fishing

Domestic hunting and fishing: describe techniques, equipment used, the profiles of people engaged in the activity, frequency and seasonality, consumption patterns, ...

Semi-specialized hunting and fishing: raise the same questions focusing on cases where part of the production is used for domestic use and part is sold.

Commercial hunting and fishing: raise the same questions focusing on cases where the production is sold. Describe trade networks. How much money do people earn through sales?

4.5.1.4. Forest Product Harvesting

Domestic use of fuelwood and non-timber forest products (mushrooms, insects, palm wine, building materials, medicinal plants, ...): what products are harvested and used at home? In what conditions are these products harvested (on the way to fields, while hunting,...)?

Commercial harvesting: What products are harvested for sale? What are the transformation techniques (cane into furniture, wood into charcoal, ...)?

4.5.1.5. Industries

Are there any industries in the research site? If so, what do they produce? Where do raw materials come from? Describe the infrastructure. How many people are involved? Is the owner local, from the city, abroad? For how long has the industry been operating?

4.5.1.6. Services

Describe the major commercial services in the research site such as markets, shops, stands, hotels, bars, etc., even if they are not necessarily related to environmental issues.

4.5.1.7. Transportation

Describe transportation conditions in and out of the peri-urban zone with a focus on the transport of natural resources

4.5.2. Step 2. Economic Actors

4.5.2.1. First, Identify a Sample of Actors who are Most Pertinent in the Research Site from the List below

An individual who is primarily involved in subsistence agriculture (in addition to hunting, fishing and harvesting).

An individual who, in addition to the above, is involved in the sale of natural resources.

An individual involved in production, who is also involved in small-scale trade to meet basic household needs.

An individual involved in an association who individually or collectively practices commercial agriculture or transformation to cover the costs of the association.

A formal association of farmers, breeders, fishermen or traders that carries out the production of local products.

Small-scale local entrepreneurs specialized in extraction, production or transformation of natural resources.

Traders involved in extraction, production or transformation of natural resources in the hinterland who transit through the peri-urban zone.

Traders involved in extraction, production or transformation of natural resources who buy goods in the peri-urban zone to sell them in the city.

Large-scale local entrepreneurs involved in an economic activity that required significant local investment and the employment of a local workforce.

Outside NGOs working in the area.

State-owned companies, parastatal institutions: what is the precise nature of their environmental work? How long have they been present?

Large-scale city-based entrepreneurs involved in extraction, production or transformation of natural resources in the peri-urban zone to sell them in the city.

4.5.2.2. Second, for Each Sample, Provide the Following Information

Production methods and degree of involvement: What is your principal activity? What are your other activities?

Supply and trade networks: Where do the resources that you depend on come from?

The micro or macroeconomic role of the economic actor: Do you consider yourself to be part of a trade network? If so, which one(s)? Where do you position your activity on the production-to-consumption chain?

Use of money earned by exploiting or trading natural resources: What do you do with the money earned from your work? How much is used to satisfy basic household needs? How much is saved or re-invested? How much, if any, goes into *tontines*? Does any of the money leave the peri-urban zone (for children studying in town, investment, ...)?

4.5.3. Step 3. Perceptions

From a sample of the above-mentioned economic actors, address the following issues in order to have an idea of their perceptions about the impact of their activities on the environment and the sustainability of their activities.

Are the resources you exploit abundant or rare?

Have these resources always been available since you have started your work?

Do you think that you will still be able to carry out the same activity over the next ten years or will the resources become exhausted?

With whom are you in competition over resources?

Do you think that this competition is fair? Unfair? Describe whatever problems there could be about competition.

What factors facilitated or hampered the development of your activities?

What factors could help or hamper your activities in the future?

If your current activities are not possible in the future due to inaccessibility to resources, what activities will you develop?

4.5.4. Step 4. Financial Dimensions

Describe the savings and credit dimensions of these environmental economic activities by interviewing a sample of actors identified in Activity 2. The following questions need to be addressed: What groups, associations, NGOs deal with credit and savings? How are they organized? What are their rules? What are the adherence conditions? What rates are practiced? How much money do people have to contribute and how often? Do people belong to more than one such entity? What do people do with savings or credit generated by adherence to these entities?

4.6. Activity 6: Relations between the Peri-urban Site and its Rural Hinterland and Relations between the Peri-urban Site and the City

The objective of this activity is to describe the links between the peri-urban area and adjacent social spaces. This pertains to social and economic links, trade networks and perceptions that peri-urban populations have of themselves, their social space and their counterparts in the city or in the hinterland.

4.6.1. Links between People in the Peri-urban Area and Their Family in the Rural Hinterland

Which geographic regions do the extended families living in the peri-urban zone come from?

How far away are these regions from the peri-urban area?

How do people travel between the peri-urban area and the region of origin?

How often do people return to their place of origin?

What goods (food, manufactured products, money, ...) are exchanged between the peri-urban area and the rural hinterland?

Is the nature of these exchanges social or commercial?

What kind of services or favours do people from the two areas do for each other (lodging, employment, looking after children, financial help, ...)?

How do people in the peri-urban zone perceive their family 'back in the village'?

Is the peri-urban zone perceived as a transit area towards the city or as a destination in itself?

What kind of psychological attachment do peri-urban dwellers have with their rural past? Do they return to the village? If so, how often? Do they intend to return there for retirement or burial?

Do these perceptions and psychological links influence peri-urban dwellers' attitudes and behaviours towards the environment?

4.6.2. Commercial Relations between the Peri-urban Area and the Rural Hinterland

Where do commercial products transiting through (or ending up in) the peri-urban area come from?

Do commercial relations between peri-urban traders and rural populations necessitate going into the village or is trade carried out by intermediaries?

Do peri-urban traders have exclusive relations with village-based producers or is trade carried out along an open market approach?

Are these commercial relations influenced by ethnic or family ties?

Can they create family ties through marriage?

Do peri-urban traders operate in one or more than one village area?

Have commercial relations between peri-urban traders and the rural ceased? If so, for what reasons?

4.6.3. Links between Peri-urban Populations and City-dwellers

What kind of ties do peri-urban populations have with their urban counterparts?

How often do peri-urban populations go into the city? For what reasons?

What is the nature and strength of family relations between peri-urban populations and their urban family members?

What goods are exchanged between peri-urban populations and their urban family members? How often and in what circumstances?

What kind of services or favours do people from the two areas do for each other (lodging, employment, looking after children, financial help, ...)?

How present are family ties in commercial exchanges between peri-urban populations and their urban family members?

Other than family members, with whom do peri-urban populations interact in the city? What is the nature of the interaction? How often do these interactions transpire?

What is the nature of administrative business that peri-urban populations undertake in the city? How often do they have to go into the city for this business?

Are some peri-urban residents former city-dwellers? If so, what motivated their move?

4.6.4. Commercial Relations between the Peri-urban Area and City-dwellers

From the list of links between peri-urban residents identified above, which ones are of a commercial nature that involve natural resource exploitation?

Is there an evolution in the supply of peri-urban natural resources and the urban demand?

Are there resources produced in the peri-urban area that were previously abundant but now are rare? If so, which ones? Why?

Have the traders dealing in these products shifted towards other products or other activities? If so, which ones?

Have there been new demands for peri-urban resources over the past ten years? If so, for what products? Why?

Are there currently new demands for peri-urban resources in the urban marketplace? If so, for what products? What accounts for these new demands?

Are there urban–based economic actors who are present in the peri-urban area to support their urban activities? If so, what is the specific nature of their activities?

Has the presence of these urban-based actors in the peri-urban area involved innovations in terms of new techniques or technology (chain saws, chemical fertilizers, ...), new environmental management ideas, new knowledge...?

4.6.5. Perceptions that Peri-urban Populations have of the City and City-dwellers

How do peri-urban populations perceive the city and city-dwellers?

Would they prefer living in the city or are they satisfied with living in the peri-urban zone?

What are the perceived advantages of living in the city?

What are the perceived disadvantages of living in the city?

Is the peri-urban zone perceived as being dependant on or independent of the city (or a combination of the two)?

How do people living in the peri-urban zone compare themselves with city-dwellers (inferior or superior, higher standards of living or lower standards of living...)?

Do city-dwellers have any names to refer to peri-urban people?

Do peri-urban people have any names for city-dwellers?

5. Conclusion

These research questions are not intended to provide us with answers about all of the environmental priorities in peri-urban Central Africa. They are, however, intended to provide a broad overview of these priorities from the double standpoint of environmental governance and what can be referred to as 'environmental anthropology'. 'Environmental anthropology' refers to the perceptions and actions of stakeholders with respect to environmental

issues, in particular cultural contexts. These fields of study can support the efforts of development planners, project officers, natural resource managers, NGOs and donors working in what has come to be one of the most challenging social spaces in Central Africa. Researchers working in other peri-urban areas can adapt these questions to harmonize local specificities with broader natural resource or development objectives.

Based on preliminary results and results from other studies carried out in peri-urban areas, it is clear that demographic pressure will continue, the environment will be increasingly degraded and people living in these areas will find access to land for housing and agriculture more and more challenging. Access to basic infrastructure (transport, health, education, drinking water, ...) will remain a daily preoccupation for ordinary people. These problems stem in large part from deep-rooted political failures. State administrations have never fully come to terms with the importance of traditional authorities in these areas, and vice versa, traditional authorities have never fully accommodated themselves with State actors. Despite the existence of varying intensities of tension and conflict caused by this hybrid juxtaposition, few local stakeholders or outside observers see the future as a zero-sum situation. The way forward, therefore, can only be based on a mutual acceptance of this hybrid governance context by stakeholders at all levels. In a situation characterized by ambiguity, opportunism, greed and strikingly stratified power relations, finding the means of reaching such a consensus is an urgent challenge.

NOTES

[1] GEPAC (*Gestion Participative en Afrique Centrale*) is a four-year project funded by the development branch of the European Commission. Information about GEPAC is available at http://www.ulb.ac.be/socio/anthropo/Gepac/index.html

[2] Examples of these forms of agricultural land use are provided in P. Vennetier (Ed.), *La péri-urbanisation dans les pays tropicaux*, Talence: CEGET, 1989. The role of peri-urban agriculture is also addressed in N. Bricas *et al.*, *Nourrir les Villes en Afrique Sub-Saharienne*, Paris, L'Harmattan, 1985. For a comparative example from the Brazilian Amazon, see Slinger 2000.

[3] The écocité programme (http://www.ecocite.org/) is a notable example. It seeks to improve stakeholder involvement in natural resource management around a number of West-African cities.

[4] For related work in the Libreville hinterland, see Trefon 1999.

[5] Year one was devoted to elaborating the research protocol and constituting the research teams; years two and three (ongoing) are devoted to implementing the research protocol and year four will be spent writing a synthesis report.

[6] The Brussels-based coordinator travels to the field approximately every three to four months to consult with members of the research team and other resource people.

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The Problem of Sustainable Forestry Management in Humid Tropical Forests. The African Example

by

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KEYWORDS. — Sustainable Forest Management; Reduced Impact Logging; Management Plan; Certification; Governance and Legality.

SUMMARY. — The sustainable forest management advocated in Johannesburg in 2002 (RIO + 10) is difficult to implement in developing forested countries. Although the forestry sector contributes a non-negligible amount to the economies of tropical forested countries, the sector more than often meets with problems of a general nature with which these countries are confronted.

In contrast with the terms of economic development and demographic pressure, the millions of hectares of dense, humid tropical forest have to answer on the one hand to the needs of a population aspiring to a quality of life similar to that in northern countries, and on the other hand, to the demands of sustainable management from the international community.

The Congo Basin, with a small forestry population, a considerable biodiversity and difficult access to higher areas, constitutes at present a relatively intact African "laboratory", and representation of tropical forests, in general 20 million hectares of forest concession, are already engaged in the sustainable management process, with 2.5 million hectares having already established a management plan and 1.6 million hectares being certified by the Dutch certification system KEURHOUT.

Forest management planning has become possible thanks to important changes in foresters' mentalities and working methods, which have gone from an attitude of resource mining to one of long-term sustainable management. This new management requires an integrated knowledge of the forest, its inhabitants, its biodiversity, the planning of production and the implementation of reduced impact logging methods. It is beneficial for local populations, the companies themselves and for the future of the forest. However, its application is made difficult by the complexity of the tropical environment, the lack of technical know-how, financial means and available professional skilled labour.

Management plans and their application have become statutory in tropical countries, but at the moment they are uniquely within the means of large companies, due

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principally to their complexity, the size of the concessions required, and the expenses incurred, which are hard to recover in increasingly competitive international markets.

Certification, the universal tool for the promotion of sustainable management in the 1990s, unfortunately shows the limits of its efficiency in the tropical environment. The priority that has been given to the implementation of this tool to the detriment of its overall objective, is certainly one of the reasons for this inefficiency. Furthermore, the problems of governance and legality cruelly prejudice the serious and formal part of the profession, and are now the subject of specific actions of those engaged parties.

Nevertheless, the objective of sustainable forest management remains indispensable, but it has to be pursued in consideration of the realities in the field, leaving aside emotional and discriminatory import measures and concentrating on specific actions of cooperation in the field of production.

These actions can be financed with bilateral or multilateral support, by eliminating tropical countries oppressing international debts or through the new scheme of carbon credits.

1. Sustainable Forestry Management

The concept which the new term of 'sustainable management' refers to, has, through the centuries, followed the evolution of environmental sensitivity, and also that of a progressive globalization of economic, social and environmental problems.

The notion of passing down forestry resources is well anchored within European traditions. In France, for example, it seems to have been set forth for the first time by Philippe VI de Valois in ... 1346.

More recently, the **Brundtland Report** (1987) defines 'sustainable development' as "a form of sustainable development which meets the needs of the present without compromising the ability of future generations to meet their own needs".

The **Rio Summit** — the earth summit (1992) — specifies the notion of 'sustainable forest management' as: "the resources and the forested land must be managed in an ecological viable way in order to respond to social, economic, ecological, cultural and spiritual needs of present and future generations".

The **Johannesburg Summit** (2002), 'RIO + 10', completes these approaches in insisting on a reality that all those working actively in the field know well: "there cannot be environmental protection without the eradication of poverty".

At present this notion of sustainable development seems well established in northern countries, and even well accepted throughout the world. How-

ever, the speed of its application varies according to the countries, due to cultural differences or simply a matter of economic development.

Indeed, in many tropical countries that are, in general, developing countries, the forest provides an essential contribution to economies, as well as an individual or collective financial income level, as available surfaces for other purposes. The investment in sustainable methods is heavy, the second rotation is also random and distant; other uses of forested areas are much more profitable, whether it be fast rotating food-producing cultivations such as manioc, rice, corn, or agro-industrial cultivations like coffee, cocoa, palm tree and hevea plantations or even grazing as in the Amazonian Basin. It is well known that agricultural clearings and overexploitation for firewood are responsible for 80 to 90 % of deforestation. The forest road infrastructures are often accused of being the vectors of this deforestation. Yet, they are essential in the development of tropical countries [1]*.

Demographic pressure is an important factor in deforestation and the number of inhabitants below the poverty line (1 US $ per day) can legitimately make one fear for the future of the planet's large forests. For instance, 80 million Indonesians are below this poverty line and, if at present, each head of family (one for ten inhabitants) clears one forest parcel of 2 hectares (ha) for food production the result is the deforestation of 8 million ha per year (the parcel being abandoned after two years). The same goes for America and tropical Africa.

2. The African Forest Resource

2.1. Uneven Territories in Forested Surfaces and in Population Density

The dense and humid forest zone spreads out over a more or less large part of African tropical countries from Sierra Leone on the Atlantic coast to Angola. The total remaining surface of these forests is in the order of 250 million hectares. Of course, they are in a very contrasted state, due to the different economic developments, and particularly the demographic pressure over time.

One may classify the countries in different ways according to their economic and political situation as well as the situation of their forests and, consequently, find out whether there is the possibility to develop sustainable forest management.

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* The numbers in brackets [ ] refer to the notes, p. 240.

2.1.1. Land of Civil Wars or Land of Investments

War is one of the first contrasts. Unfortunately, five of the fourteen ATO countries (African Timber Organization) are actually more or less engaged in civil wars: Sierra Leone, Liberia, The Ivory Coast, The Democratic Republic of Congo (Kinshasa - DRC) and Angola. One might add that Conakry Guinea, the Central African Republic and the Republic of Congo (Brazzaville) are politically unstable and therefore attract few serious investors, who are indispensable players of deontological and sustainable management methods. In addition to the disastrous human aspect, these civil wars have a high cost on forest fauna and flora (for instance, in Liberia and in the DRC, millions of refugees invaded the forests, hunting and clearing to survive).

2.1.2. Forests or Agriculture?

The second challenge comes from development. There are those countries with heavy demographic pressure where competition exists between clearing for agriculture and sustainable forest management. In this category, the most affected is Nigeria, but it should also be remembered that since the Second World War, the Ivory Coast and Ghana have suffered simultaneously from the pressure of forestry investors looking for essential materials to rebuild Europe, and also, as a consequence of economic prosperity, a very heavy demographic expansion (internal and due to immigration) resulting in a 50 to 80 % loss of the dense forest area in favour of agriculture.

2.2. The Congo Basin, an Area of Experiments

The Congo Basin covers partially or totally all Central African countries — Cameroon, the Central African Republic, Equatorial Guinea, Gabon, the Republic of Congo (Brazzaville). The Democratic Republic of Congo (Kinshasa) and Angola are, on the contrary, still sparsely populated. These countries have maintained a large part of their forests which at present cover a total surface area of about 204 million ha, some 80 % (*i.e.* about 150 million ha) of which is dense forest with a large economic forestry potential. This region will serve as our concrete example of what is being done to establish sustainable forest management and, on the contrary, what should have been done in West-African countries around fifty years ago.

This vast tropical forest surface (the second largest after the Amazonian Basin) has fundamental characteristics.

2.2.1. A Sparse Forest Population

The population density is generally less than ten inhabitants per km^2. In zones of several ten thousands of km^2 in Gabon and in the two Congo's, it is less than one inhabitant per km^2. In all of the Congo Basin, Bantus and Pygmies constitute what has become known as 'village populations'. Pygmies were until the end of the 20th century itinerant, but are now increasingly settled. African States have only recently begun to recognize their rights as a Pygmy population that lives in general from hunting or fishing and sometimes benefits from agricultural and forestry companies [2].

The state ownership of the forests and the income the state earns from the forests are starting to be questioned.

2.2.2. A Very Rich Biodiversity

Of the 150 million ha, about 50 million are attributed by the states to forestry production and between 15 and 20 million to protected zones in which the objective is biodiversity preservation. These figures are often presented with caution as definitions may be vague, state statistics confused and, above all, the respect of government decisions most random.

As in the rest of the humid tropics (which contain 70 to 80 % of the animal species), biodiversity in this area is of considerable importance. The Congo Basin is habitat for some 400 mammal species (among which are four of the worlds six ape species), 400 species of reptiles and more than 1,300 bird species. In addition, there are more than 10,000 species of superior plants, of which more than 3,000 are endemic.

2.2.3. Hard to Access

Access is especially hard in the countries that form the High Basin of the Congo river, as the rapids at the level of Brazzaville/Kinshasa do not allow a direct evacuation towards the ocean. The same goes for the 'second zone' of Gabon, located in the east of the coastal zone, in which the mountainous landscape has made penetration very hard. These access difficulties have slowed down the development of these remote forests. From a strictly forestry point of view, one could also put forward that the latter has allowed them to escape from the big development conquests in the post-colonial period and given them the possibility to be developed today.

3. Surfaces under Management

Even though forestry laws now demand that granted concessions establish a preliminary forest management plan, for political, economic and technical reasons that we will look into later, the reality is very different. To this day:

— 20 million ha are engaged in the **management process**, *i.e.* they are in the course of carrying out their forest inventories;
— 3 million ha have already been subject to a **forest management plan** authorized by the State owners' administrations and are under what one commonly calls 'sustainable production';
— 1,6 million ha are already **certified** by the Dutch system KEURHOUT, giving the products originating from these forests the right to be commercialized with this certification label [3].

Today, not one hectare of African humid forests is certified by the environmental certification system FSC. Only one million hectares of plantations in South Africa are FSC certified.

4. Forest Management: an Economic and Cultural Revolution

One of the big changes in the use of African tropical forests in wood production corresponds to the passage from a mining behaviour to a real controlled management of the resource. In contrast to what is being done in most of the other regions in the world, the African States, owners of the forest, put the costs of establishing the forest management plan on the concessionary, only reserving for themselves the approval of the plan once established.

Even though it seems presumptuous, if not utopian to speak of maintaining biodiversity under management plans, it is certain that the efforts of the tropical concessionary tend towards that objective. Nevertheless, the great richness in tropical forest biodiversity and the very recent knowledge of that richness (indeed even its actual discovery) make the work that is carried out very complex and expensive, and many tropical countries highlight that the burden of these expenses is difficult to bear in a situation of international competition.

Be that as it may, all the big companies in the Congo Basin are launching the process, particularly those regrouped in the heart of the "European Foundation for the Preservation of the African Forest Resource".

Here are the different stages.

4.1. Knowledge of the Forest

The first stage in the management plan resides in the knowledge of the forest. The elements of this knowledge are the following:

- Definition and delimitation of the concession with the administration.
- Cartography by using existing documents such as national maps, satellite images, aerial photos, and even topographical ground notes by the forest inventory teams, and GIS.
- Zoning of the concession by vegetation type or by posting permitting a first appreciation of zones that are exploitable or not (savannahs, swamplands, highly graded biodiversity zones, villages, sacred forests, agricultural cultivations, etc.).
- Forest inventory of the management plan bearing on the whole of the exploitable zones in as homogeneous subgroups as possible. This forest inventory at a variable sample rate but covering the whole of the concession, allows:
  - Better knowledge of the characteristics of the natural environment and its surroundings;
  - Identification of the demographic characteristics, the activities and the livelihood conditions of the populations living in or close outlying the concessions;
  - Consideration of the rights and the habits of these populations and to initiate participatory approaches in the most active way during the development of the concession;
  - Estimation of the number of stems of actual commercial species and to class them into diameter groups in order to, if possible, gain an appreciation of the average volumes and of the quality of the exploitable trees.

This forest inventory will not only determine the production planning, but also that of the company's whole course, its profitability and its acceptance by the village populations. At this stage (because of the complexity of the task), it is recommended that the companies seek advice from a management plan consultancy and even by experienced NGOs.

In this regard, one has to notice the important disparity between the knowledge of the companies operating in unknown tropical forests and the one gathered in the tempered countries through several generations of foresters (especially in the matter of quality, texture, colour and wood defects).

This culture of forest knowledge has made us Europeans adopt a selective approach to the African forestry activity. Being used to differentiate the Burgundy oak trees from those in Limousin, the Vosges beech from the one

in Normandy, we have in the same way differentiated the Sipo and the Obeke following their origins, not only by country, but also by forestry zone.

4.2. Production Planning

With the information on the surveyed concession, the work in the office can therefore begin with the help of computers. The following will thus be determined:

— The production series (industrial vocation);
— Series of biodiversity protection (not exploited);
— Series of social protection (villages, sacred forests, plantations, etc.);
— The forestry activity programme: basis of the annual logging depending on the forest legislation (twenty to thirty years depending on the country);
— The species to extract (marketing in logs or local industrializing);
— The minimum exploitation diameter (DME, often regulated, but can also be determined by the forest inventories);
— The specific silviculture treatments laid down by the mission statement, or decided by the management planner (future stem upturns, etc.);
— The infrastructures: principal and secondary roads, camp-office, housing, schools, dispensaries, etc., factories.

As one can understand, these decisions are interactive and simultaneous. The competence, but also the financial means of the company are determining factors. In this respect, it must be reminded that the aid brought directly to the company by the AFD (the French Development Agency), but also, in certain cases, by the European Union through the WWF — which have put at the companies' disposal important financial intermediary chains —, has been the true trigger to the forest management plans. This AFD pioneer aid, quite controversial in the years 1995 to 2000, is now recognized as beneficial by all of the donors, and even by certain environmentalist NGOs such as the WWF and the WCS (Wildlife Conservation Society), which often serve as lawyers and intermediaries for the finance.

4.3. Reduced Impact Logging Methods

Once the planning is established, the work begins and the forestry production expertise, which was for some years kept by a minority, is now moving towards more common knowledge.

These methods of reduced impact concern all the aspects of the company activity, from social relations (within the company as well as externally), the

infrastructures (roads, bridges, camps), logging, skidding, the valorization of the harvested wood and even maintenance of forestry engines (recycling of oil, shells, etc.).

These methods not only protect the social and biological environment and secure the future of the following rotations, but they will in general also provide an increase in material output.

Trainings in these methods are offered by the IFIA (Interafrican Forest Industries Association) thanks to financial aid from the CDE (Centre for the Development of Enterprises) and the bilateral American cooperation (USAID). However, due to financial and logistic reasons, they still only remain available to the big companies.

The fauna management by the forest company is also developed in handbooks and trainings (interior regulations prohibiting poaching, care regarding the infrastructure, "eco-guards", game breeding, etc.). In this domain the assistance of specialized NGOs is invaluable.

4.4. Advantages of Forest Management Plans

Knowledge of the concession, production planning and reduced impact logging methods are most certainly the basis of modern tropical forestry and — it must also be modestly admitted — a cultural revolution for the big majority of forestry companies.

The forest management plan is above all the following.

4.4.1. An Opportunity to Protect the Forests

The legal obligation of the forest management plan has brought about big changes for the forestry company in:

— Its relations with the administration (duration of permits, permanent contacts, mission statement, inspections, etc.);
— Its approach which, from being that of a 'miner', will go to that of a medium and long-term investor;
— Its improved integration with the populations;
— Its better cooperation with the personnel (training, etc.);
— Its new patrimonial management of the concession.

4.4.2. A Better Development of the Forest

The knowledge of the standing stock will allow a planned commercialization and industrialization of secondary species. The reduced impact methods will

lead to a certain waste reduction and even reduce the degradation of ligneous potential, and therefore a better development of the forest.

4.4.3. A Knowledge of the Financial Assets

This notion is new, and not yet much considered as a financial tool. But it is certain that the long-term contract with the State, and knowledge of the standing stock will allow the increase in value of the company result. This increase, and eventually a contract of guarantee for the concession itself, may result in an improved flexibility regarding local financial support. The latter will have the advantage of not emptying the companies' shareholders equity and to overcome the bank guarantee demands, in general international and in strong currency, and allows in this manner the development of local African companies.

Now, I would like to insist on a determining point concerning the investment of serious players. **There cannot be a serious capital investment without the confidence of the home country.** In the African countries, two factors are essential to attract capital: the assurance of the investment and financial intermediaries.

4.5. Difficulties of Forest Management Plans

So, with all of these advantages, why have industries not gone massively and spontaneously into forest management plans?

4.5.1. Technical Difficulties

The complexity of the tropical environment, when it is not often discovered, demands a high level of expertise from operators and their specialists. I think that the experts in this assembly will not contradict me on the fact that we most certainly made as much progress in the characterization of sustainable management in the last decade as in all the 20th century, and it is not over! There is so much to discover! This complexity of definition and application of sustainable management in the tropical environment remains the number one handicap.

4.5.2. Financial Difficulties

The establishment of a forest management plan costs around 5 € per ha for concessions of about 200,000 ha. The follow-up of the data in the course of production costs the same. These costs are very important and constitute the number two handicap in the application of forestry regulations.

It is clear that political instability (civil wars or weak governance) is another handicap in the long-term investment (25/30 years) that the establishment and implementation of a forest management plan demands.

4.5.3. Human Difficulties (Labour Expertise)

To the technical and scientific complexity of tropical forest management plans, one must add the problems raised by professional training of leaders and personnel. The GPS has replaced the compass, the computer has replaced the tree-felling book, the crosscutter has replaced the axe and powerful skidders on fast tires have replaced the heavy bulldozers. Competent men are needed for all these new functions.

Governments, donors and NGOs cannot demand cultural revolutions of the companies without being concerned by training the personnel in order to implement it all.

There is at present a big professional training deficit, and that is handicap number three of the tropical forest management plan.

4.5.4. A Tool Intended for the Big and Rich?

We know that the forest management plan and its implementation have been laid down in the regulations in the Congo Basin countries. However, the implementation of these obligations is complex and expensive in concessions of 100,000 ha or more. It has been shown that planning with a rotation of 25/30 years is technically and financially impossible for small concessions. Indeed, a successful forest exploitation requires a critical production threshold in the order of 5,000 m^3/month or 60,000 m^3/year; this threshold is necessary to write off the cost of a minimum technical production site, with the human means and, also, materials such as the camp (housing, garage, etc.) necessary. If the average production is of 10 m^3 per ha, the annual consumption of granted surface will be 6,000 ha/year; for a rotation of thirty years, one would therefore need a concession of about 200,000 ha. These numbers are rough but give you an idea of the surface needed to economically establish a forest management plan. Is regrouping in a cooperative form possible? But how do you make an African contractor go from short-term income to an income planned over 25/30 years? These are social, political, economic and environmental questions that can not be ignored. It is thus desirable to work on these parameters if one wants to allow the nationals to participate in sustainable development of the forest patrimony.

5. The Eco-certification

After dealing with technical and financial problems of the forest management plan, I would like to address a corollary problem that has become political, that of "eco-certification".

5.1. From Boycott to Certification

Now and again, it is a good thing to go back to the initial definition of 'certification', which was to have a double action; for one, as a promotional tool for the sustainable forestry production managements, 'by his preferential choice of certified products, the consumer should assure the promotion of sustainable forestry management from which the product in question derives'; and two, as a commercial approach, 'the certification being the producers voluntary approach in his desire to regain the consumers' confidence and in this manner obtain a premium choice and if possible price for the product offered'.

The two key concepts of certification were therefore compatible with the international free trade and the rules of the WTO:

— Consumers' preferential choice must assure the promotion;
— Producers' approach is voluntary.

Initiated at the time of the Rio Summit preparations, and from the media coverage of tropical deforestation, boycott of tropical wood was for a long time one of the environmental NGOs demands.

Realizing the absurdity (even the immorality) of boycotting one of the resources in developing countries, the big NGOs created the FSC (Forest Stewardship Council) in 1993. Malaysia, Indonesia and Brazil then demanded the extension of the obligation of certification to the whole of the world forests, and the ITTO engaged in 'Objective 2000', that is "100 % of global wood trade from sustainable managed and certified forests".

It was utopian but politically correct and governments, donors, NGOs and professionals got happily on the battle horse that saved everybody. In this manner, certification became the primary objective of all the parties concerned and the universal promotional tool of sustainable management.

5.2. The System Limits

The professionals know the system limits, and even the present deviations of the 'certification' tool. These limits are particularly aggravating in tropical countries.

Indeed, after ten years of promoting certification and the millions of € and US$ engaged in these campaigns, one may ask oneself about the credibility of certification as a protective tool for tropical forests.

One of the principal causes explaining the loss of credibility was putting the priority on certification and not on the management plan itself. This was all together:

— A chronological fault: the certification can only intervene after the management plan.
— A policy deficiency: the certification maintained the unequal treatment between tropical and temperate forests, that is to say between rich and poor countries. Furthermore, the campaigns, which do not care about the supply, but only the demand, become a real boycott for tropical products. This absence of supply in certified tropical wood has even brought many distributors to favour the label itself on the technical quality of the supplied products. The decision-makers and the consumer must know that only 3 % of the tropical forests are certified and that in Africa, as we have just noticed, none of the small national producers (which now represent close to 50 % of the produced volume) have the chance of being certified in the ten years to come.
— The proliferation of certificates through the purchasers' and producers' club, but also the certification's chain of custody, etc. create much confusion in the minds of the consumers in countries that are sensitive to the environment. This is certainly done on the detriment of the tropical wood consumption in the northern countries in favour of trade towards less demanding countries.
— A **technical fault**: how can a tool that covers only a few percent of the forestry production have an efficient influence on that same production? The relative part of the local, regional and finally international markets that are sensitive to certification is very weak. The latter is even truer in the tropics where clearing for agriculture and the overexploitation for firewood are the principal causes of deforestation as we noted earlier.
— Certain tropical countries consume locally all or a big part of their forestry production. Moreover, only some markets in Northern Europe are sensitive to certification. At present, Asian countries such as China and India, for which the needs increase every year, already absorb close to 80 % of exported logs from the Congo Basin countries.
— Finally, a **financial error**: it seems to us that the considerable amounts of money engaged by the donors in certification promotion could have been used directly in forest management plans and in aid to tropical forestry administrations with a much better feedback.

— In short, the tool is efficient when there is no danger and very inefficient when there is a real need to protect the forests.
— Be that as it may, the certification slowly gets stronger and becomes a desirable investment for commercial reasons.

But for us professionals, the real priority remains: ensuring the promotion of sustainable management, but also the mutual recognition between the different certificate systems.

5.3. PAFC Gabon

The opportunity for a worldwide promotion of the Pan-African certification is based on ATO/ITTO PCI.

6. Another Increasing Demand: Governance and the Legality of the Forestry Productions

6.1. AFLEGT

It is a fact that weak governance and political instability in African countries rather favour investors with limited ethics. Moreover, the attraction of easy money leads to an increasing illegality in the forestry production systems. First of all, one must know how to define legality:

— There is an administrative delay in the authorization deliverances;
— There are bad management methods: small diameters, waste of wood, non-respect of the material;
— There is thieving which consists of logging in protected areas or in concessions owned by others: small thefts by a big number of small players, big thefts by a small number of big players.

Before this reality, the international community tries to react by the AFLEGT programme (African Forest Law Enforcement Governance and Trade) in cooperation with the producing States.

6.2. Attestation of Legality

Considering themselves as primary victims to these illegalities and consequently to the negative image of African wood on the markets, these serious industries, united in the IFIA, wanted to anticipate the AFLEGT procedure, the procedure demanding a long period of establishment. They are actually,

together with the big NGOs, making a "**voluntary certificate of legality and engagement in the forest concessions management plan process**". This certificate is expected to be operational in 2004.

7. Conclusion

If environmental protection has become important, for us, inhabitants of the rich countries, we must, in order to promote this northern priority in developing tropical countries, put it back in its context.

Sustainable management cannot be developed by oppressed contractors in an African environment of weak governance, galloping taxes and competition between the informal and the illegal. Moreover, these players operate in a national, regional and international competition, unconcerned of protecting the environment and not ready to suffer the direct and indirect costs of these additional expenses.

Thus it appears desirable that an international policy, especially European, takes these realities into account and leaves aside emotional and discriminating import measures.

That is why we propose that European governments should concentrate their ethical and environmental actions in concrete, efficient and cooperative aid, though with certain conditions. It can be bilateral or multilateral aid; it can also be by means of erasing the debt (often 40 % of the State budget), or even by carbon credits.

To make the international commerce bear promotion of sustainable management and ethics appears somewhat dangerous to us. It seems obvious to the African wood professionals that the increasing demand, not only in the European markets, but equally in the Asian markets (China, India, Thailand, etc.), added to the increasing constraints of the European markets, shatters not only the commercial exchanges but also the European investments, subject to ethical and environmental pressures in their own countries.

In the forest sector and local industrialization in Africa, these European investments have positive influences on a political, ethical and environmental level. At the same time they generate a demand of expatriate expertise and services and products of European consumption in the establishment countries. **The European presence is not only a factor of primary development but, thanks to our culture and our sensibility, a factor of sustainable development. No Gentlemen, when we compare the attitude of our investors to those in Asia and the Middle East, we need not have to be ashamed!**

But as we have seen, using commerce as a tool of pressure is not without danger.

Indeed, international commerce is like the wind that is born from two different pressure zones: it is the link between supply and demand. **Commerce does not like constraints and the currents of commercial exchange move with supply and demand and the facility to develop or to persist.**

When the constraints on the European markets only are added to the direct or indirect taxation pressure applied to the companies with formal management only, one realizes the great vulnerability of European investments in Africa.

Now that Africa needs serious and progressive forestry investors in social, environmental and ethical domains, the international community has the duty to question itself on the constraints of its policy, but also on the consequences of its aid.

Sustainable development is not the result of utopias, nor of pipe dreams. Sustainable development is the result of a progressive but realistic policy, and responsible field players.

NOTES

[1] The ATIBT presented the positive and negative roles of these infrastructures in a FAO co-edited handbook, which is available to the participatnts on demand.

[2] The native population rights kept an important place during the last World Forestry Congress in Quebec in 2003.

[3] On the certification related questions, see chapter 5.

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Wildlife Surveys in Rain Forest Concessions in order to Identify Protected Areas

by

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KEYWORDS. — Forest Management; Central Africa; Fauna Inventories; Game Management; Protected Areas.

SUMMARY. — In most of the cases, logging companies in Central Africa are now legally obliged to integrate a game management plan in their global management plans. The number of fauna inventories has increased rapidly. Fauna inventories make it possible to evaluate the relative abundance of animal species and their distribution, in order to define particularly valuable areas that should obtain a protected area status. However, logging companies often do not ensure a reliable coverage of their concessions. Moreover, inventory methods are not always reliable, which leads to a lack of precision and low representativeness of the results. It is absolutely necessary to use a pragmatic low cost methodology for fauna inventories, which considers the particular context of logging companies and which is able to guarantee a quite precise estimation of fauna densities.

Line transect sampling methods are currently considered as the best to monitor large and medium-size game species living within rain forests. Two methods make it possible to evaluate the abundance of fauna.

The so-called *distance sampling method* is used to estimate absolute density figures. Indicators of animal presence (observation of individuals for small primates, dung piles for duikers and elephants or nests within the case of gorillas) within sampling units well knowing that not all the animals will be counted. Distances between the indicators of animal presence and the transect line are measured. The distribution of the observations using distance classes makes it possible to draw a detection curve and to calculate an absolute animal density. The particularly critical stage in this method appears to be the moment when dung piles and nest densities have to be converted into animal density figures.

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Indeed, conversion factors such as production rates and degradation time of dung and nests are not exactly known and can vary a lot. This means that it is impossible to evaluate animal densities in a precise way.

The *Index of Kilometric Abundance* method calculates the number of inventoried observations over a certain distance without measuring the distance between the transect and indicators of animal presence. This method is easier to apply, but neglects the decreasing detection probability of objects in relation with the distance from the transect. It is possible to balance the Index of Kilometric Abundance obtained using a visibility coefficient. Some authors have shown that the IKA method is a reliable tool to monitor relative abundance of animal populations in rain forests. It allows to collect maximum amounts of data in a cheap and easy way.

Considering the fact that the main goal of fauna inventories within forest concessions is to define the most valuable zones for animal species in order to choose the areas that should be protected, it is not necessary to estimate an absolute density. It is even not justified to do this, as it costs a lot to open new transects. Moreover, opening new transects should be avoided as much as possible, as they attract hunters.

Fauna inventories make it possible to define the most interesting areas for fauna conservation. While defining these areas in order to protect them, the following parameters should be considered: global fauna densities; densities of threatened or vulnerable species; the importance of human activities (hunting in particular).

It is necessary to standardize these parameters in order to give them the same weight. For each inventory plot, values for animal abundance and densities of threatened species have to be added up. Afterwards, the value for hunting has to be subtracted from the sum of the first values. The index obtained is called "conservation potential". Using software such as ArcView and its extension Spatial Analyst makes it possible to extrapolate the results obtained and to apply them to the whole forest concession.

The botanical interest of the inventoried plots should also be considered through different parameters (species richness, diversity, vulnerable species, chorology) in order to produce a global index.

Fauna inventories do not stand alone, but have to be considered as a basic tool to set up a sustainable game management. They have to be used to develop actions to preserve animal species, such as the creation of a protected area. They can also make it possible to monitor animal populations in order to evaluate the effectiveness of developed actions dedicated to reduce pressure on fauna.

Introduction

Although a number of socio-economic reasons may explain the increasing pressure on the Central African wildlife populations, the impact of forest exploitation practices must also be considered (WILKIE *et al.* 2000, WHITE 1998). The construction of road networks, necessary for this exploitation, gives access to previously unreachable areas and allows hunters to install their campsites and hunt in these areas without any control by the authorities.

Moreover, the exploitation phase is usually followed by a colonization phase leading to an increasing demand of game meat by the local population and thus an increasing number of hunters, especially during periods of economic crisis (DELVINGT 1997).

The recent evolution of the Central African forestry acts forces logging companies to conceive and to implement a forest management plan that takes the protection of ecosystems and the conservation of biodiversity into account. However, the details of this recent legal obligation remain undefined.

One can assume that the requested conservation measures will be executed in different stages. First, surveys have to be conducted in order to assess the abundance and distribution of wildlife. As logging companies only invest small budgets and huge areas are to be prospected, it is essential to apply an efficient and cheap survey technique allowing a relatively accurate demarcation of zones that are important wildlife habitats. Some of these zones can later be integrated into a conservation "core" area, clearly defined in the management plan. Finally, a number of recommendations should be made to adequately manage hunting outside the conservation core area.

In this document, we aim to define a survey and analysis technique intended to identify the wildlife conservation core area. The example of the Unit of Forest Management (UFM) 10 030 allocated to the Pallisco company, assisted in South-East Cameroon, is used. The area of the UFM is 79,757 ha and is located between N 3°01'-3°25' and E 14°05'-14°31'.

This study has been carried out in the framework of a convention between Pallisco and the project "Partenariats pour la gestion durable des forêts de production en Afrique Centrale" (B7-6200/01/391/TF), provided by the European Union.

Identifying a Method

THE TRANSECT SURVEY

In order to estimate the volumes of timber resources in their concessions, logging companies usually establish, within the framework of their management plan, a systematic network of linear tracks, known as line-transects, which are usually separated from each other by a distance of one or three kilometres. These transects are divided into georeferenced plots; they cover the entire forest concession and can be used advantageously for wildlife surveys. Sampling using line-transects is indeed considered by some authors as

the best method to monitor large and medium-sized mammals in tropical rain forests. The techniques based on the inventory of indirect track counting are generally promoted because of the relatively low visibility and the difficulty to approach most of the species in tropical forests (TUTIN & FERNANDEZ 1984, BUCKLAND *et al.* 1993, PLUMPTRE 2000).

IS IT NECESSARY TO ASSESS ABSOLUTE DENSITIES OF WILDLIFE SPECIES?

The line-transect method makes it possible to estimate animal densities by means of direct observations (visual contact) or even indirect observations (counting of dung piles, nests, etc.).

This estimation is based on the fact that the probability of detecting an animal decreases with the distance (perpendicular) from the transect (fig. 1). The implementation of this method requires four hypotheses to be respected (BUCKLAND *et al.* 1993): (1) all the animals present on the transects are seen (detection probability should be equal to 1); (2) the animals do not move before being detected; (3) distances are measured accurately; (4) the observations are independent events.

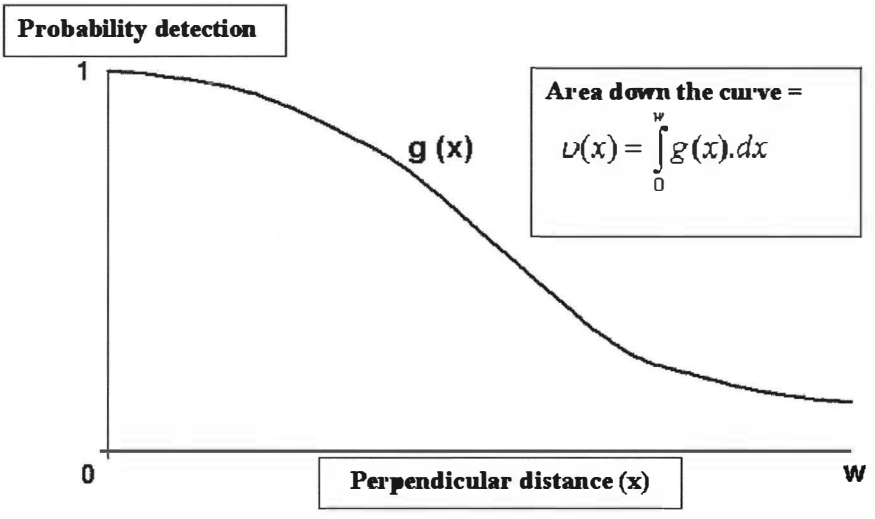

Fig. 1. — Example of a detection function showing the probability to detect an animal track as a function of the distance from the centre of the transect.

The density estimation along a line-transect can be obtained using the following formula (BUCKLAND *et al.* 1993):

$$Dc = n/2L\upsilon\ (x) \text{ with } \upsilon\ (x) = \int_0^w g(x).dx$$

where **Dc** is the density, **n** is the number of observations, **L** is the length of the transect, **g (x)** is the detection function, **w** is the width of the track and **υ (x)** is the effective width of the transect, that is the integral calculus of g (x) on the width of transect (fig. 1). This function characterizes the evolution of the detection probability according to the perpendicular distance to the transect's axis.

The major problem when analysing the data is the detection function **g(x)**. The number of observations needed to model this detection function is comprised between a minimum of 25 and 40 (BUCKLAND *et al.* 1993).

Considering the fact that direct observations of animals in rain forests are rather rare, the total distance to cover on the transects seems to be too great. As a result, the estimation of animal densities in tropical rain forests can only be achieved by means of indirect counting procedures (estimation of faeces or nest densities). Indeed, animal density can theoretically be obtained thanks to estimations of conversion factors, such as the production and degradation rate of faeces and nests. The resulting relationship is the following: D=Dc/(Td.Tp), where D represents the animal density, Dc the density of faeces or nests on the transect, Td the mean decay rate of faeces or nests, Tp the mean production rate (WHITE & EDWARDS 2000).

The coefficient of variation of the animal density is approximately estimated by the following formula (PLUMPTRE 2000):

$$CV^2\ (D) = CV^2(Dc)+CV^2(Td)+CV^2(Tp)$$

where CV(x) is the coefficient of variation of the variable x.

Keeping in mind that the different conversion factors vary a lot in time and space, the coefficient of variation of the animal density usually reaches values that are too great to allow an accurate density estimation (PLUMPTRE 2000, WALSH *et al.* 2001). This is the reason why the resolution, which is the minimum variation that can be detected between two independent studies, remains very high (WHITE 1992). Moreover, the variability rate of observations per transect is potentially very high, resulting in a low level of accuracy of the wildlife monitoring and spatial comparisons.

The results of KOSTER & HART (1988) are generally used to calculate the densities of *Cephalophus monticola* and *Cephalophus dorsalis* from the estimated defecation rates. These rates are respectively estimated at 4.9 and 4.4 faeces per day, with a coefficient of variation of 26.5 % and 29.5 %. The

variability of these conversion factors is therefore much too high to guarantee any level of accuracy when estimating a density. Even if the production and degradation rates of elephant (*Loxondonta africana*) dung are better known, CHIFU NCHANJI & PLUMPTRE (2001) showed the great variability of these conversion factors depending on different variables: climate, biological activity, faeces morphology, sun conditions, forest cover, etc.

PLUMPTRE (2000) also showed that a few hundred of chimpanzee and gorilla nests had to be observed in order to detect a change of 20 % in a studied population. This is also the case for smaller primates where even a greater number of direct observations is required.

In a more concrete way, the distances covered, the number of indicators counted and the data relating to the conversion factors are often too succinct to allow accurate animal density estimations, at least for the surveys carried out in forest concessions.

It is worth noting that the estimation of absolute animal density figures requires the opening of new transects in order to obtain reliable results. The old transects used during management surveys are indeed frequently used by a great number of species, which leads to an overestimation of population densities.

Furthermore, the opening of new transects should be avoided as much as possible as it increases the hunting pressure by giving a new access to hunters.

KILOMETRIC COUNT INDEX: A SIMPLE AND EFFECTIVE METHOD TO ESTIMATE A RELATIVE DENSITY

We are forced — considering the previously mentioned reasons — to collect a maximum amount of data with minimal effort and thus to only consider the indicators of animal presence without converting them into an animal density.

The Kilometric Count Index method (KCI) or Index of Kilometric Abundance (IKA) simply consists in calculating the number of observations per kilometre: KCI total = N/L where N is the total number of observations per transect and L is the transect's length in kilometres.

Calculating a KCI is easy but its main disadvantage is that is does not take into account the fact that the probability to observe anything decreases with the distance from the transect's axis.

The task is even more difficult when the undergrowth is dense because it makes it harder to detect any indicator, which means that a decreasing KCI might be due to a decrease in visibility. Nevertheless, GENET (2002) showed

that the visibility in the undergrowth does not significantly influence the value of the KCI. The KCI seems to be a stable and reliable indicator in order to estimate a relative abundance of animal populations in rain forests. It allows the collection of a maximum data in a cheap and easy way.

However, in order to guarantee a certain level of reliability, the KCI method should require a repeated visit of each transect (two to three times) in order to reduce the variability due to weather conditions and other parameters.

Within the framework of the UFM 10 030 survey, the technique consisted in walking on the line-transects at a constant speed, between 500 and 1,000 metres per hour. The distance between transects was three kilometres, each of them consisting of 250 metres plots. One plot out of two was inventoried. The survey team, composed of four people, took note of the presence of faeces, tracks, nests, rests of meals, damage, wallows, burrows and any visual observations and vocalisations. Only certain species were taken into account, especially rare species or species that are particularly threatened by logging activities (tab. 1). Indicators of hunting and logging were also recorded (cartridge cases, snare lines, tracks, skidding tracks, logging gaps).

Table 1

List of species and signs of human activities considered during the wildlife surveys

Direct and indirect observations	**Only direct observations**
Elephant (*Loxodonta africana cyclotis*)	Small primates (Cercopithecidae)
Sitatunga (*Tragelaphus spekei*)	
Yellow-backed duiker (*C. sylvicultor*)	
"Red" duikers (*C. dorsalis, C. leucogaster, C. callipygus*)	**Indicators of hunting**
Black-fronted duiker (*C. nigrifons*)	Hunting camp
Blue duiker (*C. monticola*)	Cartridge cases
Red river hog (*Potamochoerus porcus*)	Snare
Gorilla (*Gorilla gorilla gorilla*)	Human tracks
Chimpanzee (*Pan troglodytes troglodytes*)	
Leopard (*Panthera pardus*)	
Giant pangolin (*Smutsia gigantea*)	
Tree pangolin (*Phataginus tricuspis*)	
Bongo (*Tragelaphus eurvceros*)	
Water chevrotain (*Hyemoschus aquaticus*)	
African buffalo (*Syncerus caffer*)	

Hunting Impact

Other parameters make it possible to evaluate the hunting pressure. For instance, the evolution of the ratio between the number of red duikers (*C. callipygus, C. dorsalis, C. leucogaster*) and the number of blue duikers (*Cephalophus monticola*) gives an indication of the impact of hunting on wildlife. *Cephalophus callipygus* is very vulnerable to human activities whereas *Cephalophus monticola* is known for its anthropophile character while *Cephalophus dorsalis* has an intermediate character.

The proportion of red and blue duikers is thus an indicator of the degree of disturbance of the environment (Jeanmart 1997, Delvingt 1997): the larger the proportion of blue duikers is, the more disturbed the environment is.

Identifying the Conservation Core Area

The different parameters to be considered in order to determine the most important zones for the conservation of wildlife are: (1) the abundance of wildlife in general (A); (2) the abundance of threatened and vulnerable species (B); (3) the importance of human activities, especially hunting (C).

In order to give these three variables the same weight, we have to standardize them: $vs_i = (v_i - m_v) / \sigma$ $(i = 1,.....n)$ where vs_i is the standardized value of the i^{th} plot, v_i is the value of the considered variable, m_v is its arithmetic mean, σ is its estimated standard deviation.

For each inventory plot to be surveyed, we will add the standardized value of the animal abundance to the standardized value of the threatened species abundance from which we will subtract the standardized value of the hunting activity (A + B – C). The obtained index will be called "Wildlife conservation potential". A Geographical Information System (GIS) will then be used to extrapolate the information to the whole UFM, on the basis of the information collected with the systematic sampling method.

In this case, we used the software ArcView and its extension Spatial Analyst. This extension allows to spatially extrapolate information according to the Kernel method. It gives a spatial view of the relative densities distribution (Environmental Systems Research Institute, 1996).

The vegetation in areas with high wildlife conservation potential should be evaluated in order to confirm their interest in terms of global biodiversity. Parameters to consider for such an evaluation are given by Doucet (2003).

Results

Table 2 shows the global results (direct and indirect results together) of the wildlife survey based on the KCI method in the UFM 10 030.

Table 2
Total indices (for 238 kilometres) and Kilometric Count Indices (KCI) calculated for the wildlife in the UFM10 030

Scientific name	Common name	Total indices	KCI
Cephalophus callipygus, C. dorsalis, C. leucogaster, C. nigrifions	"Red" duikers (Peter's duiker, Bay duiker, white-bellied duiker, black-fronted duiker)	3,097	13.03
Cephalophus monticola	Blue duiker	2,177	9.16
Cephalophus sylvicultor	Yellow-backed duiker	427	1.80
Cercocebus agilis	Agile mangabey	70	0.29
Cercopithecus cephus	Moustached monkey	89	0.37
Cercopithecus neglectus	De Brazza's monkey	1	0.004
Cercopithecus nictitans	Putty-nosed monkey	120	0.50
Cercopithecus pogonias	Crowned monkey	302	1.27
Colobus guereza	Guereza colobus	38	0.16
Gorilla gorilla gorilla	Gorilla	256	1.08
Hyemoschus aquaticus	Water chevrotain	52	0.22
Lophocebus albigena	Grey-cheeked mangabey	224	0.94
Loxodonta africana	Elephant	290	1.22
Smutsia gigantea	Giant pangolin	133	0.56
Phataginus tricuspis	Tree pangolin	35	0.15
Pan troglodytes troglodytes	Chimpanzee	51	0.21
Panthera p. pardus	Leopard	2	0.01
Potamochoerus porcus	Red river hog	696	2.93
Syncerus caffer nanus	African buffalo	35	0.15
Tragelaphus spekei	Sitatunga	155	0.65

The global distribution of wildlife and human activities is presented on figure 2. In general, we can conclude that fewer indicators of animal presence are found in the western part of the UFM, which is a zone that has already been exploited. To be more accurate, it is the extreme south of the UFM and even more the base of the UFM's tip that extends in a north-eastern direction that is the most important for wildlife conservation. We can also observe that in this latter zone, we find the greatest cumulated densities

of vulnerable species (gorilla, chimpanzee, African buffalo, elephant, waterchevrotain, Guereza colobus).

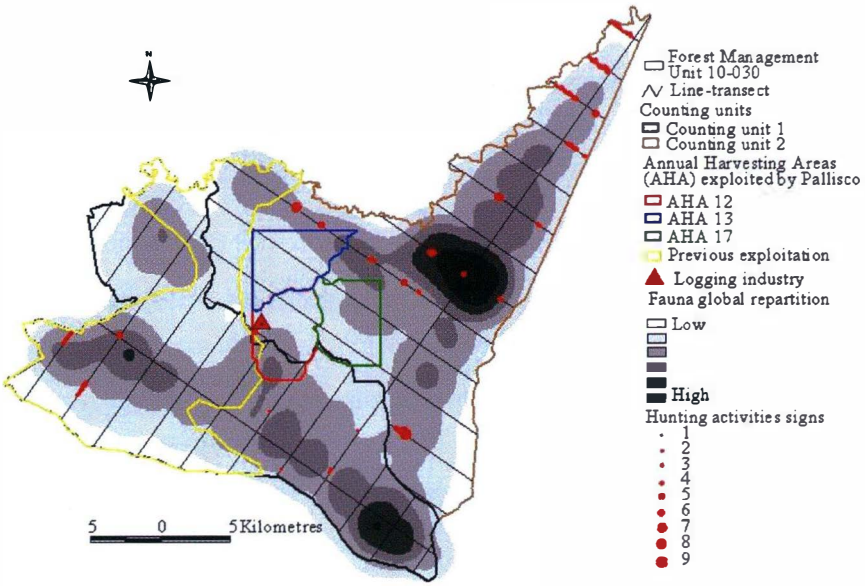

Fig. 2. — Wildlife distribution and human activities in the 10 030 UFM (Cameroon).

To take an example, figure 3 shows the evolution of the ratio of red and blue duikers within the UFM 10 030. We notice the negative impact of hunting activities (presence of snares, hunters' villages, cartridge cases) on wildlife, especially on duikers. We can observe a decreasing proportion of red duikers compared to blue duikers in the zones where more hunting activities take place.

Finally, figure 4 shows the zones that need to be protected in regard to their wildlife potential.

Discussion

Certain factors may influence the quality of the results obtained: the size of the survey team, the time interval between the opening of a transect line and the survey, the season and its associated availability of food, the number of times that a transect has been visited to monitor animal presence.

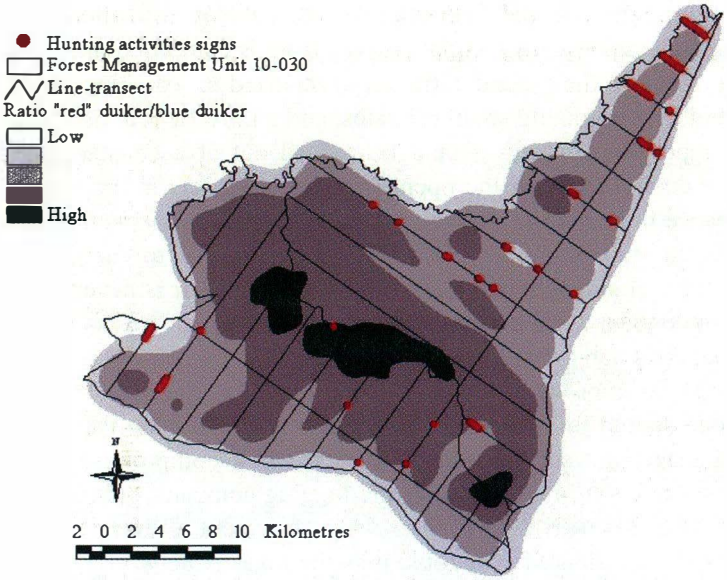

Fig 3. — Relative evolution of the proportion of blue and red duikers in the UFM 10 030 (Cameroon). The larger the proportion of blue duikers becomes, the more disturbed the studied area is.

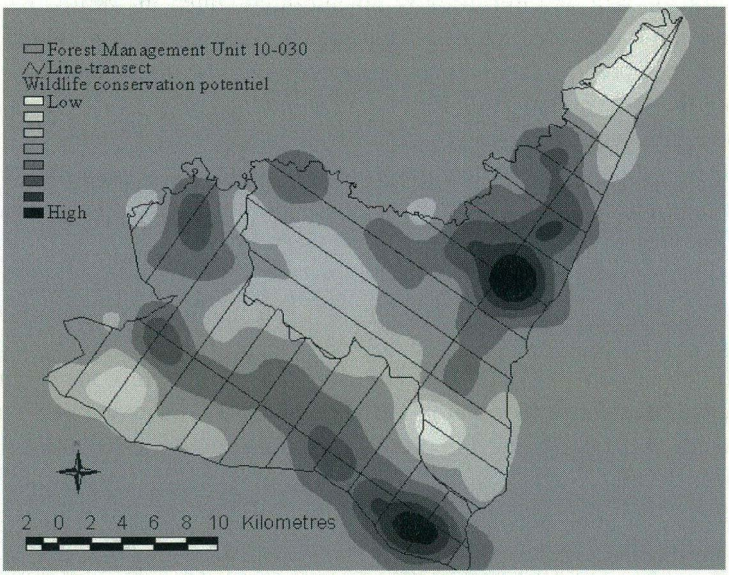

Fig. 4. — Relative evolution of the wildlife conservation potential within the UFM 10 030 (Cameroon).

It is therefore essential to standardize the developed methodology in the logging concessions. An adequate survey team is composed of a tracker collecting tracks on the ground, a tracker specialized in searching for primates' nests and in recognizing small primates, and a third field assistant in charge of the reporting. Surveys should be carried out at a constant period (for instance one week) after the opening of line-transects in order to limit the disturbance linked to the opening and to allow the comparison of the results of different studies. Finally, it would be preferential to carry out surveys during the wet season when tracks are more visible. It is nevertheless interesting to conduct surveys during the dry season as this makes it possible to study season-bound changes in animal behaviour.

In order to improve the representative aspect of the results, a high sampling rate should be obtained. A systematic sample using the old transects from management surveys seems to be the best compromise between the objectives and the investments by the logging companies (JEANMART 1999, GENET 2002, MATHOT 2003). The survey of one out of every two inventory plots can be considered as an option as the transect network from the management surveys is very dense. On the other hand, the survey of one transect out of two decreases the covered area and the obtained data can therefore not be considered as representative.

As the goal is to identify an area as a potential conservation core area, the estimation of absolute densities is not required. Such an estimation is an intensive job that is too expensive and for which both the sampling rate and the number of presence indices are much too low. We would therefore rather promote the determination of KCI or KIA that are pragmatic, efficient and not too expensive methods.

KCI indeed have the advantage of being simple and seem to be relevant and stable indicators of animal population in rain forests. The investments and efforts required per distance unit are very low compared to the density estimation method, which will probably lead to a greater sampling rate. Moreover, the KCI tally with the objectives of wildlife surveys carried out in logging concessions as they mainly attempt to localize interesting areas for the conservation of wildlife. The three parameters to consider are the abundance of wildlife in general, the abundance of threatened and vulnerable species and finally, the importance of human activities, hunting in particular. Once these variables are standardized in order to give them the same importance, the standardized values of animal and threatened species should be added resulting in a number from which the standardized value of hunting activity should be subtracted. The index obtained is called "wildlife conservation potenial". The decision to be taken concerning the delimitation of

a wildlife conservation zone will then be a compromise between economic and environmental interests in the studied zones.

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Local Exploitation

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Building Regional Capacity for Sustainable Use of Tropical Rainforest in Latin America: Experience and Challenges of the South-South Cooperation

by

Luis ARAGON*

KEYWORDS. — Tropical Rainforest; Amazon, Deforestation; ACTO; UNAMAZ; South-South Cooperation.

SUMMARY. — Despite all controlling efforts made by governments, multilateral agencies, NGOs, and many other institutions and organizations, the trends of deforestation show a clear tendency to increase in Latin America and especially in the Amazon Region. Several studies identified two main reasons for these phenomena: (1) the causes of deforestation have remained the same for the last fifty years, and (2) the lack of initiatives to tackle the problem in a cooperative way. This paper deals with the experiences of the Organization of the Amazon Cooperation Treaty (ACTO), the Association of Amazonian Universities (UNAMAZ) and the South-South Cooperation Programme for Sustainable Development as important tools to build regional capacity for sustainable use of tropical rainforests, with emphasis on the Amazon.

Introduction

When the National Institute of Spatial Research (INPE) announced, in June 2003, the deforestation of 25,500 km^2 in the Brazilian Amazon between 2001 and 2002, which represented an increase of 40 % in relation to the previous period, the reaction of scientists, NGOs, the media, and even politicians was one of indignation, and debates, conferences, discussions and other events occurred at different levels and in different parts of the country. Shortly, the government announced a Plan of Action to Prevent and Control Deforestation in the Amazon (PR 2004). Actually this is not a new story in Latin America. For the last fifty years governments have announced many plans to control deforestation of the tropics, but very few, if any, have succeeded. Why?

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One of the reasons appears to be weak local capacity to induce change. This paper summarizes some causes of the increase of deforestation in Latin America, especially in the Brazilian Amazon, pointing out the importance of South-South Cooperation to build regional capacity as a key factor to mitigate the problem.

Increase of Deforestation in the Brazilian Amazon

The domain of the Amazon humid tropical forest covers an area of more than 7 million km^2 and its population is approximately 28 million people. The region covers areas of Bolivia, Brazil, Colombia, Ecuador, Guyana, French Guiana, Peru, Suriname and Venezuela. Along history the region has suffered pressure to be settled generating a population ring around the region (GUTIERREZ *et al.* 2004).

In Brazil, Amazonia is defined by law. Legal Amazonia was created by Law 1806 of 1953 and covers the present states of Pará, Amapá, Tocantins, Amazonas, Roraima, Mato Grosso, Rondônia and Acre, and Maranhão, west of 44th Meridian. This area represents about 60 % (5 million km^2) of the Brazilian territory and about 12 % (21 million people) of the population of the country.

According to the INPE's report, the increase of deforestation between 2001 and 2002 mentioned above amounted to 631,369 km^2, the total deforested area of the Brazilian Amazon, or 15.7 % of the area of the region. Some 25 % of this area is abandoned or sub-utilized and in many cases degraded, and deforestation is mainly made without legal authorization. Only 14.2 % in 1999 and 8.7 % in 2000 of the total deforested area had authorization of IBAMA (*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renovávels*) (PR 2004).

According to that source (PR 2004), most of the deforestation occurs along an area that goes from southeast of Maranhão, north of Tocantins, south of Pará, north of Mato Grosso, Rondônia, south of Amazonas to southeast of Acre, named *the arc of deforestation* (fig. 1). Between 2000 and 2001 approximately 70 % of deforestation in Legal Amazônia occurred in some fifty municipalities of the States of Mato Grosso, Pará and Rondônia. In some of these municipalities deforestation reaches 80 or 90 % of their total area. But new fronts of deforestation have emerged in adjacent areas of the arc of deforestation and even in previous isolated areas.

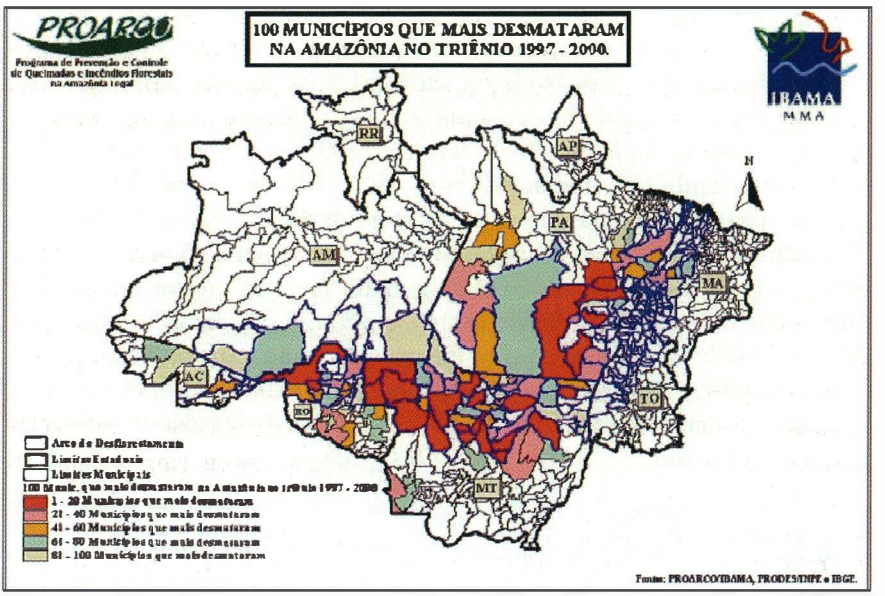

Fig. 1. — Legal Amazônia: the 100 municipalities with the highest deforestation between 1997 and 2000. States: MA: Maranhão; PA: Pará; AP: Amapá; TO: Tocantins; MT: Mato Grosso; RO: Rondônia; AM: Amazonas; RR: Roraima; AC: Acre. (*Source*: Presidência da República/Casa Civil/Grupo Permanente de Trabalho Interministerial para a Redução dos Indices de Desmatamento da Amazônia Legal. Plano de Ação para a Prevenção e Controle do Desmatamento na Amazônia Legal. Brasília, 2004, p. 10.)

Causes of Deforestation

The main causes of deforestation in Brazil, as well as in Latin America in general, have basically remained the same for the last half century: deep social inequalities, ignorance of poor farmers, biased and inefficient judiciary systems, primitive public institutions and lack of law enforcements, abuses in the application of the free market economy, and corruption (Dourojeanni 1999).

More specific causes of deforestation in the Brazilian Amazon include: cattle breeding, soybean cultivation, timber exploitation, building of infrastructure, failure of policies of rural settlements, slow process of demarcation of conservation units and Indian lands, and fire.

Cattle Breeding

Cattle breeding is responsible for some 80 % of the total deforested area of Legal Amazonia, and this economic activity is concentrated along the arc of deforestation. According to Margulis (2003), some 600,000 km^2 are dedicated to cattle-breeding activities in the region. Great profits have been appointed as the main reason for the increase of the activity in the Amazon. The number of cattle heads increased in the region from 26.5 to 57.4 million between 1990 and 2002, and expectations for an even greater increase are high, since the number of heads in the Amazon is still small in relation to the more than 170 million heads in the country. Land is cheap in the region, which stimulates deforestation of new areas for expansion of the activity. It is estimated that cattle breeding gains some 75 USD/year/ha of deforested land in the Amazon.

Soybean Cultivation

The area cultivated with soybeans increased by 57.31 % between 1999 and 2001 along the arc of deforestation, and is still expanding to new areas, especially in Mato Grosso, Pará and Amazonas. During the same period, the cultivation of rice and corn decreased by 11.44 % and 1.94 % respectively along the arc of deforestation (PR 2004). The area cultivated with soybeans is still small in the Amazon, some 34,500 ha in 2003, which represents less than 0.16 % of the total cultivated area of the country with that crop (21,119,900 ha), although another 20,000 ha are expected to be planted by the end of 2004. Expressive increase in the cultivation of soybeans principally occurred around Querência (Mato Grosso), Humaitá (Amazonas), Paragominas (Pará) and Santarém (Pará). In 2003 the State of Mato Grosso alone produced 15 million tons of soybeans, which represents 30 % of the total production of the country. Ten years ago this State produced only five million tons. Climatic conditions, correction of soils and scientific research on genetic improvement allowed Mato Grosso to collect 3.1 to 3.2 t/ha of soybeans, while the national average is 1.5 t/ha (Osava 2004).

Cultivation of soybeans is a controversial issue because of the particular characteristics of the species for correction of the soil in degraded areas. Some estimate that soybean cultivation can recuperate in the future some 60 million ha of degraded areas in the country, without the need of deforesting the Amazon (Osava 2004). Expansion of the cultivation of soybeans in already deforested areas, "is pushing" agriculture of other products to new areas.

Timber Exploitation

Ninety percent of the wood exploited by the timber industry in the Amazon is made on unsustainable bases. Total production in the Amazon is estimated 30 million m^3/year, with an average production of 30 m^3/ha. About 1.6 million ha/year are deforested in the region for wood production, generating some 48 million m^3/yearly, but 18 million of them are lost by bad management (PR 2002). Illegal opening of roads to cut the trees, little use of other products of the forest and bad techniques of exploitation contribute to deforestation. According to a study in the Paragominas area in the State of Pará, for each tree cut, another fifty trees of ten centimetres of diameter were destroyed or damaged (Johns *et al.* 1996).

Building of Infrastructure

Building of infrastructure, especially roads, has been and still is one of the main reasons for deforestation in the Brazilian Amazon. 75 % of deforestation in the Amazon between 1978 and 1994 occurred along a zone within 50 km around paved highways. Building of infrastructure anticipates valorization and occupation of new areas.

Failure of Policies of Rural Settlements

Failure of rural settlement policies and inconsistency of land reform produced intense urbanization and occupation of new areas in the region. More than 60 % of the population of 21 million today live in urban areas, creating new demands. In rural areas small landholders sell their lands enlarging the size and capacity of deforestation of large landholders, or in many cases small landholders penetrate further, deforesting new areas.

Slow Process of Demarcation of Conservation Units and Indian Lands

Conservation Units and Indian Lands are important obstacles to deforestation, even in those areas of intense expansion of agriculture and timber industry, such as in the State of Rondônia. Still, those lands have received intense pressure by mining activities, timber industry, and illegal occupation of land. This process is facilitated by the slow process of demarcation and legalization of conservation areas and Indian lands.

Fire

Fires in the Amazon are concentrated along the arc of deforestation and are associated with activities related to cattle breeding, agriculture and clearing lands for speculation.

Recent seats were registered in areas considered isolated and even in Conservation Units in Acre, Amapá and Amazonas States (PR 2004).

Building Regional Capacity

Several authors agree that the causes of deforestation in Latin America have remained unchanged for the last fifty years, and that the plans to prevent and control deforestation have introduced little innovation or actions that tackle the real causes of the problem: poverty, social inequities, ignorance, quick profit and environmental misperceptions.

At the macro level new policies are needed that recognize that the forest is much more valuable remaining standing than cut off, and induce actions to implement them.

At the local level there are experiences that can contribute to such policies. Regional capacity means the capability of local actors and institutions to induce change related to regional development (Aragon 1994). The Association of Amazonian Universities (UNAMAZ), the South-South Cooperation Programme and the Organization of the Amazon Cooperation Treaty (ACTO), are examples of South-South Cooperation mechanisms to build regional capacity in the Amazon region.

The Association of Amazonian Universities (UNAMAZ)

The Association of Amazonian Universities (UNAMAZ) was created in 1987. It is a network of more than fifty universities and research institutes of the Amazonian countries with significant training, research and extension programmes related to the Amazon. The idea is to join efforts to implement cooperative initiatives to build scientific capacity within the region.

Among its activities are graduate courses, scientific meetings, publications, and comparative research. Those activities are mainly supported by international agencies.

One of the members of the Association, the Federal University of Pará, offers, through the Center for Advanced Amazonian Studies (NAEA), an interdisciplinary international training programme on sustainable development

in the humid tropics, with masters and doctorate degrees. Students from several Amazonian countries have participated in the programme. Theses and dissertations have been produced focusing on sustainable use of tropical forests.

The South-South Cooperation Programme on Environmentally Sound Socio-economic Development in the Humid Tropics

The South-South Cooperation Programme on Environmentally Sound Socio-economic Development in the Humid Tropics is an initiative of the UNESCO/MAB Programme, the United Nations University and the Third World Academy of Sciences. The Programme was created in 1992 in a UNAMAZ Conference organized as a follow-up of UNCED.

The purpose of the Programme is essentially to identify scientific capacity in the South, to foment its growth and enhancement, and to facilitate exchange and international cooperation following the principles of Agenda 21 and other declarations of the United Nations' World Conferences.

In relation to sustainable use of humid tropical forests, the Programme focused on the comparative analysis of the biosphere reserves as a model for development in the humid tropics. Conferences, meetings, fieldwork, comparative studies and publications were made. The Programme is being revised enlarging its scope.

The Organization of the Amazon Cooperation Treaty (OTCA)

The Amazon Cooperation Treaty was signed in 1978 by the eight Amazonian countries: Bolivia, Brazil, Colombia, Ecuador, Guiana, Peru, Suriname and Venezuela. The purpose of the Treaty is "to undertake joint actions and efforts to promote the harmonious development of their respective Amazonian territories in such a way that these joint actions produce equitable and mutually beneficial results and achieve also the preservation of the environment and the conservation and rational utilization of the natural resources of those territories."

The Amazon Cooperation Treaty Organization (ACTO) was created in 2000 as a multilateral agency with permanent secretariat in Brasília, responsible for the formulation and coordination of the Programme of the Treaty. In September 2004, all countries approved the Strategic Plan of the Treaty for 2004-2012 (fig. 2). This programme reflects a new approach of development valuing the forest, biodiversity, cultural diversity, water resources and many other factors in search of sustainable development. One of the main areas of the programme refers to forests, soils and protected natural areas (ACTO 2004).

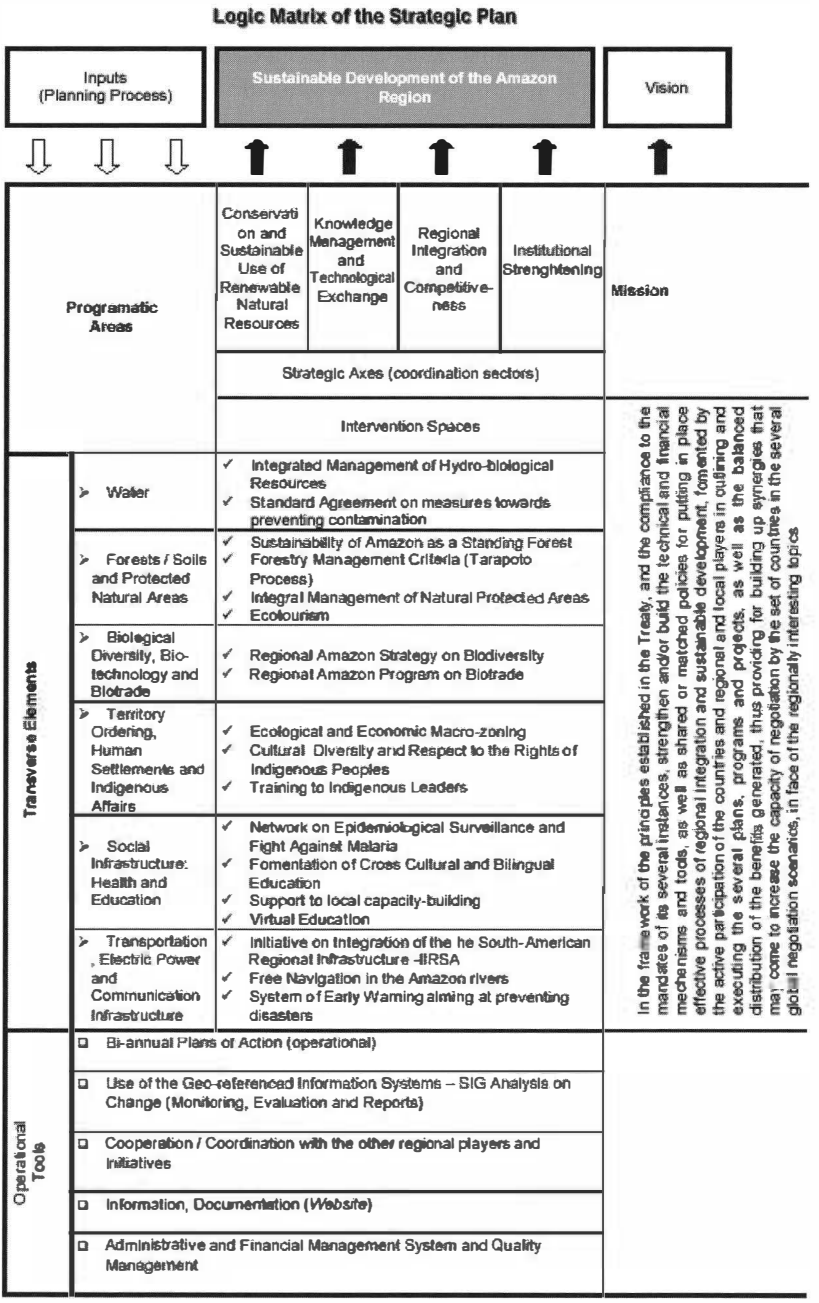

Fig. 2. — Strategic Plan of the Amazon Cooperation Treaty Organization (2004-2012). (Amazon Cooperation Treaty Organization 2004.)

Conclusions

What can we conclude from this paper? The following are some basic conclusions and recommendations for future studies and public policies:

— Deforestation of the humid tropics will continue unless radical changes occur in public policies and attitudes.
— The forest represents more than trees.
— Biodiversity is the richest element of the forest.
— The forest can be used in sustainable bases.
— Efforts should be made to develop economic activities in already deforested areas, instead of deforesting new ones. In this regard the concept of biosphere reserves is a good alternative.
— Building regional capacity is an important factor to implement sustainable use of humid tropical forests.

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Conservation and Sustainable Use of Non-Timber Forest Products in Favour of Local Communities within Integrated Forest Management in Central Africa

by

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KEYWORDS. — Integrated Forest Management; Lowland Rain Forest; Non-Timber Forest Products (NTFP); Dja Reserve; Cameroon.

SUMMARY. — Recently adopted reforms of forest legislation in Central African countries take into account the interests of local communities. As organizations of different kinds have been promoting this aspect, all stakeholders of the timber sector are compelled to consider it. However, the practical implementation of this aspect often remains undefined.

For vegetal NTFPs, the existing studies are typified by either a purely descriptive (ethno)botanical approach (lists of species used by an ethnic group) or by processing studies (transformation, conservation, economic value and commercialization of products) or by inventories defining the densities of certain species. Only a few studies examine the productivity of certain species.

Within this context, one can conclude that there is a lack of studies that monitor the pressure exerted by local communities on the available products. The forest manager remains destitute while trying to monitor the level of exploitation of the ecosystem, while implementing a sustainable exploitation of the available resources or when he tries to set up conservation measures.

This study aims at solving this problem. At first, a quantitative follow-up of the pressure exerted on vegetal NTFPs by a local Badjoué community living at the border of the Dja Reserve (Cameroon) is presented. This community of hunters and farmers (317 inhabitants) can be considered as representative of the way of life of many ethnic groups in rain forests. Pressure exerted is defined in terms of consumed quantities of each product and during several seasons. The consumed quantities are then converted into numbers of fructifying trees.

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Main results are twofold: on the one hand, the consumption of major exploited NTFPs can be expressed in terms of consumed quantities per habitant and per day during a certain period. On the other hand, we were able to calculate the number of tree stands that should be available to cope with the demands of the local community (with about 300 members). We could conclude that it is necessary — for our Badjoué community — to have 26 fructifying *Irvingia gabonensis* trees, 17 *Baillonella toxisperma* trees, 7 *Ricinodendron heudelotii* trees and 71 *Trichoscypha spp.* trees.

Such research allows forest managers to consider the needs of local communities. Finally, the example of the Moabi (Baillonnella toxisperma Pierre) is chosen to illustrate the usefulness of this kind of approach for forest management planning.

Introduction

Taking into account the interests of local communities in Central African forest management plans is nowadays a legal request in a number of countries that have ratified the recent reforms of the forestry acts. Promoted by different NGOs, this concept is starting to be accepted by numerous actors of the forest exploitation sector. However, its practical implementation still has to be defined.

As far as Non-Timber Forest Products (NTFP) are concerned, studies that exist on this matter are characterized either by a botanical or ethnobotanical descriptive approach or by a study of the "survey and density of the available resource" type. Only few studies also consider the productivity of species. In this range of studies, quantitative approaches related to the pressure exerted by local communities on the available resource are quite scarce. The forest manager is currently deprived of any information about the degree of dependency of a local community of its ecosystem. This means that forest managers are not able to define a sustainable exploitation of the available resources nor to apply specific conservation measures.

In the present article, we try to deal with this deficiency. At first, we present the total quantitative monitoring of the pressure exerted on non-timber forest products by a local *Badjoué* community, in the vicinity of Dja Game Reserve in Cameroon. The results are presented in a way which highlights the quantitative trends and temporal context of the village's harvest. It is followed by an attempt to convert, for some species, the consumption in a number of tree stands. Finally, the example of the Moabi (Baillonnella toxisperma Pierre) is chosen to illustrate the usefulness of this kind of approach for forest management planning. This species is the typical example of a "coveted" resource. On the one hand, local communities seek this species for its oil (cooking qualities), especially for its high palmitic acid content (Fotso 1995). On the other hand, logging companies look for and exploit this species for the quality of its wood. The moabi is thus a great example of a species to manage for which a preliminary assessment of the local community needs should be made.

The village chosen for the quantitative monitoring of the NTFP is the village of Kompia, situated in the Eastern province, in the Haut-Nyong department, in the Messaména district. Kompia is a village that stretches over 5,3 km. It is divided in 5 hamlets where 39 households live. 317 persons are living in the village on a permanent basis (50,1 % of men), all members of the *Badjoué* ethnic group.

The forest concession selected to confront the needs of the local community with logging practices is the UFM (Unit of Forest Management) 10 039 allocated to the Pallisco company, also situated within the Haut-Nyong department. The population composed of the *Badjoué* or *Nzimé* ethnic groups, is estimated at 2,803 people living in 15 villages in the area adjoining this concession (NKOLONG 2003). An area of more than 16,000 ha, allocated to the agroforestry practices, is situated between the UFM and the road along which the villages are situated (HUBERT *et al.* 2004).

Methods

A monitoring and systematic quantitative recording of all NTFP reaching daily each household was carried out during more than eight months (20th of July 1997- 30th of April 1998) by 3 surveyors visiting the 39 familial units. The equipment used consisted of a weighing scale of 5 kg and another one of 10 kg, and a data notebook. For all collected data, the following parameters were recorded: *Badjoué* name of the product, kind of product (oil, bark, fruit, seed, kernel, leaf,...), state (wet, dry), weight (in grams) or volume (in litres). We are thus talking about absolute numbers and not sampling followed by inferences.

A number of constraints limits the representativeness of this study: (1) this study does not cover an annual cycle (eight months out of twelve), but nevertheless encompasses the main harvesting period (DOUCET & KOUFANI 1997); (2) data only concern a single year, a year of massive fructification; the collected data can thus be considered as representative of the local population's needs; (3) the accuracy of the weighing equipment "selects" only the quantifiable products, most of the vegetal products meant to be used in traditional medicine are only collected occasionally and in small quantities; a list of these products is presented by FANKAP *et al.* (2001); (4) a number of products are consumed in the forest and never reach the village; (5) considering the last two remarks, this study only presents the products of which the weight is measurable (harvest greater than 500 g) and that occur several times (at least 5 times during the eight survey months).

Finally, it is important to note that the number of tree stands required to meet the needs of a local community is based each time on indirect methods which can bias the results; the obtained results should thus be used with an associated security coefficient.

Results

General Overview of the Temporal Context and Quantitative Data Measured

Table 1 presents the respective importance of the main products collected at Kompia during the study period, with the exception of oil products. It shows that diverse forms of Baillonella toxisperma (kernel and seeds) represent 47 % of the total biomass collected, whereas Ricinodendron heudelotii represents 20 % and the secondary products of Irvingia gabonensis 16 %. In total, these three products, in any form, represent 83 % of the total biomass collected during eight months.

Table 1
Total biomasses of the products collected at Kompia during the study period

Species	Collected part	Observed harvest peak	Biomass (kg)
Aframomum sp.	Fruits	September – December	4.0
Anonidium mannii (Oliv.) Engl. and Diels	Fruits	September – October	109.0
Baillonella toxisperma Pierre	Dried kernels	October – November	30.0
Baillonella toxisperma Pierre	Fresh seeds	August – Mid-October	1,086.0
Baillonella toxisperma Pierre	Dried seeds	Mid-July – November	778.9
Gambeya lacourtiana (De Wild.) Aubr. and Pellegr.	Fruits	August	4.5
Garcinia kola Heckel	Bark	All months	237.0
Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill.	Fresh kernels	Mid-July – Mid-October	588.6
Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill	Dried kernels	August – September	77.6
Ricinodendron heudelotii (Baill.) Pierre ex Heckel	Kernels	October	1.4
Ricinodendron heudelotii (Baill.) Pierre ex Heckel	Fruits	September – Mid-December	805.0
Trichoscypha abut Engl. and Brehmer, T. cf. oddonii De Wild.	Fruits	July – September	107.6
Trichoscypha acuminata Engl.	Fruits	July – October	228.0
Tertrapleura tetraptera (Schumach. and Thonn.) Taub.	Fruits	December	7.2

Certain products were collected during the whole study period (case of Garcinia kola bark), whereas other products presented high-harvest peaks (in some cases, almost the totality of the product's biomass was collected during one month). Our research allows to confirm that for almost all products the main harvest period ends in December, while it lasts from August to November, corresponding to a short dry season and a short wet season.

This first analysis (temporal and quantitative) thus gives us the possibility to distinguish three product categories: (1) products subject to regular harvests (case of the Garcinia kola bark); (2) products subject to short harvests but important nevertheless on a quantitative basis (case of Irvingia gabonensis and Baillonella toxisperma kernels); (3) the products presenting low harvest frequency and of small quantity (case of Myrianthus arboreus).

The first two categories are considered as the main products and only these are mentioned in this paper.

The Main Products

Irvingia gabonensis

It is a hermaphrodite species, sought by the Badjoué population mainly for the kernel of its fruit. The fibrous fruit's pulp is sucked, whereas the drupe is split in order to extract the kernels. These are dried, baked and then crushed into a paste that is stored under the name of "cake", which will itself be used to thicken the sauces (Fankap *et al.* 2001).

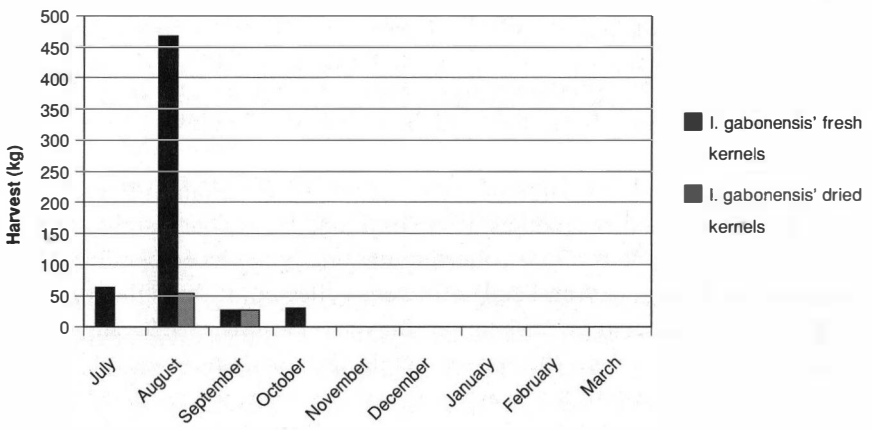

Fig. 1. — Irvingia gabonensis 'kernels' harvest in the Kompia village (Cameroon) in 1997 and 1998.

In 1997, the production started half July and the harvest monitoring can thus be considered as exhaustive. Figure 1 shows the monthly harvest levels.

The major part of the collected kernels of Irvingia gabonensis are transported to the village in a fresh state, the quantities of the previously dried kernels are relatively small and come from the semi-permanent villages dispersed in the cacao fields. The harvest of kernels is an extremely time-bound activity; we noticed indeed that more than 60 % of the kernels were collected during the first fortnight of August. In total, 589 kg of fresh kernels were collected by 317 inhabitants, corresponding to 1.9 kg/person/year. These 589 kg represent an estimated value (conversion coefficient of 21.8 suggested by DOUCET & KOUFANY 1997) of 12,812 ± 1,921 kg (standard deviation) of fruits.

Concerning the dried kernels, 77.6 kg of these were brought to the village within a period of two months, representing 0,24 kg/person/year. These 77.6 kg of dried kernels correspond to an estimated biomass of 149 ± 38 kg of fresh kernels (conversion coefficient of 1,92) or a biomass of 3,248 ± 838 kg of fruits.

Almost sixteen tons of Irvingia gabonensis non-shelled fruits were handled by the local community within a period of three months.

While considering the average biomass of fruit produced per tree suggested by FANKAP (1999), being 561 ± 295 kg, we find that 29 trees with a diameter (dbh) superior to 30 cm are needed in order to cope with the villagers' demands of Irvingia gabonensis fruits.

With the kernels brought to the village or to the semi-permanent villages, a total of 75 kg of "cake" was produced during 6 months.

Ricinodendron heudelotii

It is a dioecious tree producing fruits with 2 to 3 seeds. Kernels, extracted from the decomposed fruits that had been boiled previously, are used in sauces.

Figure 2 presents the temporal trend of the Ricinodendron heudelotii's harvest. As for the other products, it shows a time-bound harvesting scheme. In total, if we exclude the 7 kg collected marginally in December, 798 kg of raw fruits of Ricinodendron heudelotii were collected in three months. The total biomass collected is 2.54 kg/person/year. FANKAP (1999) suggests a linear regression between the seed's weight and the fruit's weight (seed's weight = 3,77 + 0,305 fruit's weight). Using this basis, the estimated seed's biomass is 249 kg. He suggests an average rate of extraction (kernel's weight on seed's weight ratio) of 37.9 %. This rate leads us to estimate the edible kernel's biomass, before drying, at 94.4 kg.

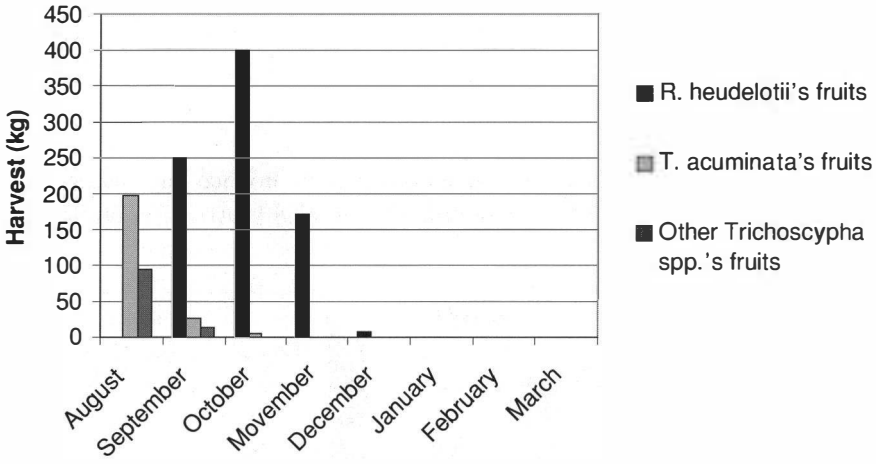

Fig. 2. — Ricinodendron heudelotii and Trichoscypha spp.'s harvest in the Kompia village (Cameroon) in 1997 and 1998.

Finally, it we refer to the average biomass of fruit produced per tree (122 ± 34 kg), calculated by the same author, approximately 7 female trees are needed in order to meet the actual consumption levels of Ricinodendron heudelotii at Kompia.

Trychoscypha spp.

The Trychoscypha spp. are dioecious species that produce fruits with a sweet pulp. Different species are concerned: T. acuminata, T. abut and T. cf. oddonii. Figure 2 presents the temporal trend of Trichoscypha spp.'s harvest in the Kompia village.

During the study year, a certain amount of fruits had already been collected before the start of the study and it is thus not possible to suggest any inference.

In total, if we exclude the 5 kg of residual fruits collected in October, 223 kg of Trichoscypha acuminata were collected in two months, representing 11.5 g/person/day and 108 kg of T. abut and T. cf. oddonii were collected during two months, representing 5.6 g/person/day.

On the basis of the productivity table (10.3 kg/ha) suggested by DOUCET & KOUFANI (1997), it is possible to estimate at 71 the number of productive tree stands (diameter of at least 5 cm) needed to meet the villagers' demands. This value probably underestimates the reality, given the fact that

the harvest had started before the monitoring and part of the fruits had been consumed on site.

Garcinia kola

The bark of this species is collected in order to produce palm wine. The average quantity collected per month is 29.7 ± 12.8 kg (fig. 3). While it is

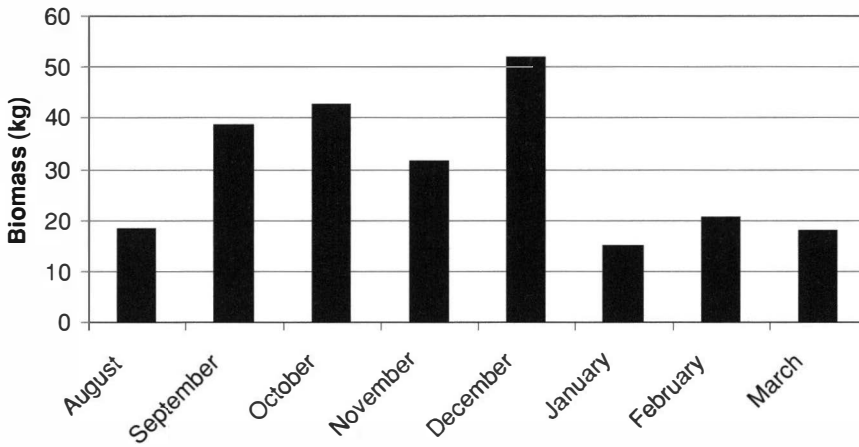

Fig 3. — Garcinia kola's harvest in the Kompia village (Cameroon) in 1997 and 1998.

not the case for the other products, the collection of bark is harmful to the trees, it often causes its death. It is impossible to define the number of trees used for their bark, as trees of very different diameters are used.

Baillonella toxisperma

Figure 4 shows the harvest's temporal trend related to the products derived from the moabi, during the study period.

Figure 4 illustrates once again a time-bound harvesting scheme: August and September for the seeds reaching the village in a fresh state and August to October for the seeds previously dried in the forest. The moabi's kernel is almost never shelled; shelled kernels would only be found later on the season. We esteem that the fact that kernels are shelled is linked to the specific activities that take place and is mainly originating from the semi-permanent villages in the forest.

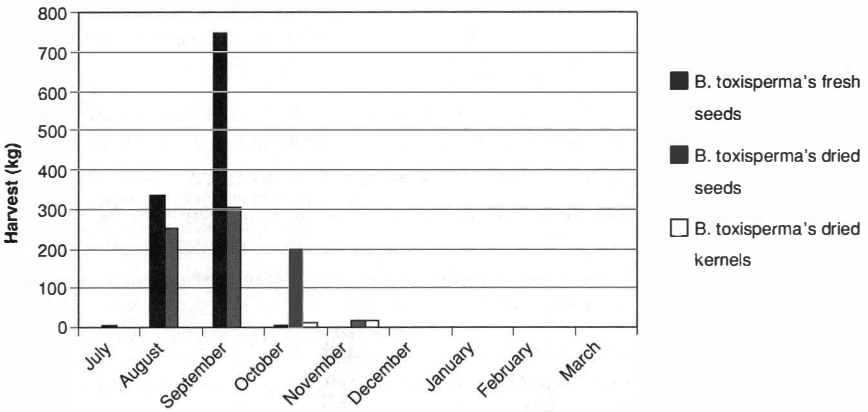

Fig. 4. — Baillonella toxisperma's harvest in the Kompia village (Cameroon) in 1997 and 1998.

If we analyse the period of fructification of the moabi, studied over three years by DEBROUX (1998), this would last from June to September, with a peak in July-August. Taking into account the fact that the villagers do not mention a harvest before mid-July of the study year, the annual cycle of harvest can thus be considered as totally monitored.

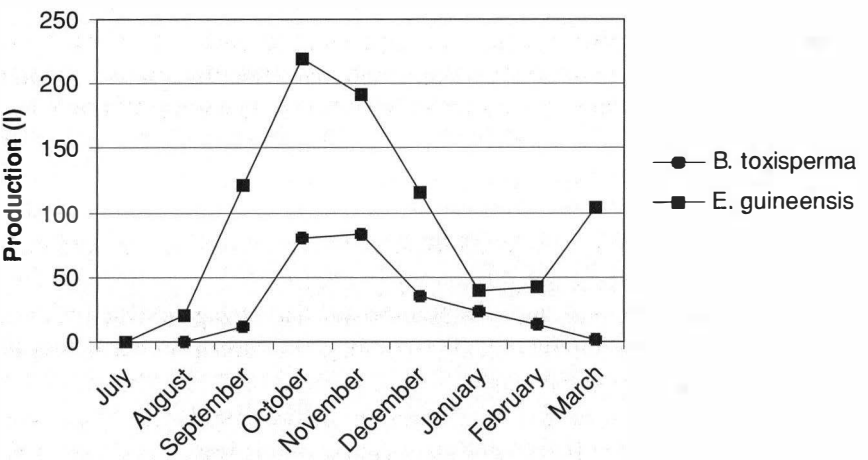

Fig. 5. — Palm (Elaies guineensis) and moabi (Baillonella toxisperma) oil production in the Kompia village (Cameroon) in 1997 and 1998.

Concerning the fresh seeds, almost a ton arrived to the village in two months, representing 3.4 kg per inhabitant over the year. Concerning the dry seeds, they represent 2.5 kg/person/year.

Figure 5 presents the monthly oil production for the 39 households of the village; the palm oil production (Elaeis guineensis Jacq.) is given on a comparative basis.

A production peak, simultaneous for the two oil products, situated in October/November/early December must coincide in terms of production calendar with a period when women have only few agricultural tasks to carry out (VERMEULEN 2000).

In total, 854 l of palm oil were produced in eight months, representing 11 ml/person/day. Concerning the moabi oil, 240 l were produced in 6 months, representing 4.1 ml/person/day.

In order to assess the number of tree stands needed to cover the actual village demand, it is possible to infer it either from the seed and kernels quantity that end up at the village or from the quantity of oil produced.

Starting from the weight of fresh seeds that arrived at the village (1,086 kg), and by using the fresh seed's mean weight, suggested by DEBROUX (1998) (23.6 g), we can estimate at 46,016 the number of fresh seeds that arrived at the village. DEBROUX (1998) considers that an average seed bearer (tree with a diameter between 70 and 240 cm) produces 6,000 seeds every three years, representing an average of 2,000 seeds per year. By using this estimation, a theoretical number of 23 tree stands would be needed, producing 2,000 seeds in a year, or 7.7 tree stands producing 6,000 seeds per year of high yield (considering the fact that during the two years of lower yield, the village's demand will not be met).

The demand of dried seeds (779 kg collected within a period of three months) should be added to the one in fresh seeds. FOTSO (1995) puts forward 13 g as an average weight for a locally dried seed. An estimated 59,915 dried seeds can be put forward, which would be produced by 30 seed bearers producing in theory 2,000 seeds per year, or an average of 10 tree stands producing 6,000 seeds every three years.

In total, if we exclude the dried kernels (considered as a small production), we would thus need, in order to meet the demand in seeds (fresh and dried) 18 seed bearers producing 6,000 seeds every 3 years or 53 seed bearers producing 2,000 seeds per year.

Finally, to produce 240 l of moabi oil using the mechanical press improved by NGUEDJIO (1995) and the coefficient of conversion suggested by this author, 1,200 l of crushed kernels would be needed, corresponding to a need of 110,400 seeds. If we consider once again the mean seed

bearer as a reference, as suggested by DEBROUX (1998), and if we keep in mind that the level of local oil extraction efficiency is low, we would need 55 seed bearers producing 2,000 seeds per year, or 18 seed bearers producing 6,000 seeds every three years to meet the production of the Kompia village.

One can remark the concordance between the number of seeds (105,931) (fresh and dried) estimated using the weight data and the number of seeds (110,400) estimated to produce 240 l of oil, both obtained via different sources and approaches.

TO INTEGRATE THIS INFORMATION IN THE FOREST MANAGEMENT PLAN: THE MOABI EXAMPLE

The population survey realized in the fifteen villages adjoining the Unity Forestry Management (UFM) 10 039 inventoried a population of 2,083 persons, corresponding to 8.84 times the Kompia population. According to the estimated values put forward in the previous paragraphs, the needs to cover the demand of the population living next to the UFM would be met by an estimated population of 156 seed bearers producing 6,000 seeds in three years or 468 moabis producing 2,000 seeds per year of low yield.

The management plan of the UFM 10 039 (sampling rate 1,29 %) realized by logging company Pallisco (HUBERT *et al.* 2004) shows the estimated composition of each diameter class of the moabi population. All trees having a diameter of more than 100 cm will be cut; the trees that are supposed to meet the demand of the local community should therefore be found in the 70 to 100 cm class. The survey showed that 729 seed bearers are included in that class and will not be exploited. This corresponds to 1,6 times the estimated need of the local community.

Moreover, moabi trees situated in the agroforestry zone outside the UFM, reserved to the local communities, will not be exploited, increasing the availability of resource for the villagers. Surveys realized in the agroforestry zones show an average density of moabis (more than 70 cm of diameter) of 0,019/ha, representing an average of 314 tree stands for the agroforestry zone next to the UFM 10 039 (PFC, 2003a, b, c).

It is worth pointing out that the distribution curve of the species per diameter class, presented in the UFM 10 039 (HUBERT *et al.* 2004), tends towards a decreasing exponential showing some humps reflecting a temperament typical of semi-heliophilous species (DOUCET 2003). The moabi shows a satisfying level of regeneration in the UFM, safeguarding the future of this species for the local communities' benefit.

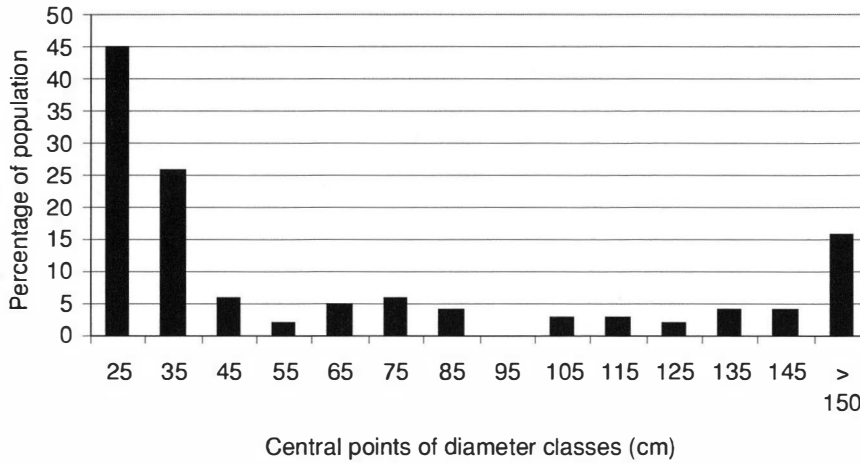

Fig. 6. — Population Structure of Baillonella toxisperma in the UFM 10 039 (Cameroon).

As a result, although the calculation of availability and population's needs with regard to moabi products relies on a double estimation, the obtained values lead us to assume that the demand of the fifteen villages adjoining the UFM 10 039 will be met thanks to the remaining tree stands in the UFM, even though all the moabis of a diameter greater than 100 cm are to be exploited by the company. All the remaining moabis in the agroforestry zone can be added to these tree stands.

Discussion and Conclusion

Although the description of non-timber forest products used by different ethnic groups for ethnomedical or nutritious purposes improves, quantified information related to the product's harvest is often lacking. The translation of these data in terms of reliance upon the ecosystem is almost non-existent. As for the outcome of our analysis, we now have a first quantified idea of the most valued products harvested for the *Badjoué* community.

The analysis of the results suggests that all collected products (Irvingia gabonensis, Ricinodendron heudelotii, Baillonella toxisperma), except for Garcinia kola and Trichoscypha spp., can be considered as part of one year of harvest. Data about product collection in kg/person/year for these products are therefore available (tab. 2).

Table 2
Collected biomasses and number of producing trees needed to satisfy inhabitants of SW of Cameroon

Species	Collected part	Biomasses (kg)/ person/year	Number of trees/person/year	Number of producing trees for 300 persons
Baillonella toxisperma	Fresh seeds	3.43	0.073	22
Baillonella toxisperma	Dried seeds	2.46	0.095	28
Baillonella toxisperma	Global		0.167	50
Irvingia gabonensis	Fresh seeds	1.86	0.072	22
Irvingia gabonensis	Dried seeds	0.24	0.018	5
Irvingia gabonensis	Global		0.090	27
Ricinodendron heudelotii	Fruits	2.54	0.021	6

The conversion of the village's harvest in terms of a number of productive tree stands to maintain, seems to be a promising method to take into account the local communities' needs in the forest management plan. The outcome of this study provides the manager with the number of tree stands of tree species needed to meet the demand of a village of 300 inhabitants on a sustainable basis. The example of management plan for the UFM 10 039 of the Pallisco company shows the direct utility of this number.

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Gestion de la faune sauvage et commerce du gibier en Afrique centrale

par

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MOTS-CLES. — Afrique centrale; Chasse intensive; Commerce du gibier; Faune sauvage; Gestion durable.

RESUME. — En absence de l'application de la réglementation sur la chasse et le commerce du gibier, une forte pression des communautés rurales s'exerce sur les ressources fauniques des forêts d'Afrique centrale. Cette pression se traduit par des prélèvements de plus en plus intensifs, non sélectifs, des ressources fauniques en dépit de conventions, lois et des règlements en matière de chasse.

Le commerce du gibier étant une source importante des revenus d'un grand nombre de ménages des communautés rurales, les interventions dans ce secteur doivent évaluer les besoins économiques de l'ensemble de la population de la région forestière. Dans ces conditions, les stratégies à adopter pour contrôler et régulariser la chasse et le commerce de viande de brousse devraient être réalistes, compréhensibles, exécutoires et biologiquement complètes pour une gestion durable des ressources fauniques.

Les pays de la sous-région ont un défi à relever, c'est celui de disponibiliser les populations actuelles de faune sauvage pour les générations futures.

Introduction

En Afrique centrale, la survie de la faune sauvage est menacée par plusieurs facteurs, dont le seul commun à tous les pays de la sous-région est la chasse illégale ou le braconnage (STUART *et al.* 1999), qu'on désigne aussi souvent sous le nom de la chasse commerciale.

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Le gibier a toujours été un aliment prisé des communautés rurales et aussi bien récemment des communautés urbaines de la sous-région. L'évolution de la consommation rurale traditionnelle en usage urbain régulier hautement commercialisé peut s'expliquer par la crise économique, le processus d'urbanisation, la pression démographique, l'attachement culturel et symbolique, l'exploitation forestière et les contraintes institutionnelles, tout comme par une stratégie politique. Tous ces éléments traduisent la montée en flèche de la consommation de viande de brousse en ville (BAHUCHET & MARET 2000).

La chasse intensive constitue une réelle menace pour la pérennité de la biodiversité, surtout la chasse des grands mammifères à reproduction lente, comme l'éléphant ou le gorille: ces animaux sont primordiaux pour la biodiversité. En absence de ces animaux, plusieurs espèces de plantes connaîtraient de sévères modifications des aires de dispersion de leurs graines et certains arbres disparaîtraient localement.

Le commerce du gibier a considérablement augmenté au cours de ces dernières années en raison de certains facteurs macroéconomiques. Avec la baisse de prix du cacao et du café, à laquelle s'ajoute la dévaluation du franc CFA en 1994, dont dépendent les économies des pays de la sous-région, le secteur de l'exploitation forestière devient concurrentiel et les routes ont été construites dans les zones profondes des forêts pour l'exploitation du bois d'œuvre. Ceci a permis à son tour à la population d'accéder à la faune dans sa recherche désespérée du revenu quotidien. La faune est considérée comme une ressource accessible à tous. N'importe qui peut chasser quand il veut. Surtout que cette activité exige un faible capital d'investissement tout en créant des emplois pour beaucoup de chômeurs. En même temps, les problèmes économiques rencontrés par les pays de la sous-région ne permettent pas aux gouvernements de mettre un budget consistant à la gestion du secteur de faune; dans certains cas, ce budget est inexistant (SABTALA 2002).

La viande de brousse est principalement obtenue par le piégeage ou par le fusil. Les indigènes utilisent parfois les flèches, les filets de chasse, les chiens. Les fils métalliques utilisés dans les pièges sont non sélectifs et, en outre, ils endommagent également un bon nombre d'animaux qui pourrissent emprisonnés dans les pièges et ne sont pas consommés. Certains animaux attrapés aux pièges mais qui réussissent à s'échapper, perdent leurs membres et d'autres meurent un peu plus tard. Les fusils sont dans la théorie plus sélectifs quoi que certains animaux fusillés au cours de la chasse se perdent dans la forêt.

La chasse et le piégeage des animaux sauvages assurent la plupart des besoins en protéines animales des peuples de la forêt qui ne peuvent pas élever le bétail pour des raisons écologiques. Le type de chasse qui nous intéresse le plus est la chasse commerciale, intensive, souvent appelée le bracon-

nage. Ce type de chasse s'est spectaculairement développé ces dernières années. Par exemple, 3 tonnes de viande de brousse entrent journellement dans Yaoundé, au Cameroun (LOVEVA 1998), 4,5 tonnes sont consommées chaque mois dans Malabo, en Guinée équatoriale (MALONGA 2004), environ 500 tonnes sont annuellement vendues dans Libreville, au Gabon, et 400 tonnes sont annuellement vendues à Bukavu, en RD Congo (NGANTOU & M'BAZOA 2001). MUSIBONO & MONSEMBULA (2004) ont évalué le nombre de crocodiles et d'alligators qui quittent les marchés de Inongo (lac Maï-Ndombe en RD Congo), 22 221 individus ont été dénombrés en 30 mois. Sur ce chiffre, 70 % d'individus capturés sont des femelles et/ou des jeunes. MARACTHO (2002) a recensé après une enquête de 3 mois dans les différents ports de Kinshasa, 6 931 pièces dont la moyenne variant entre 3 à 4 kg.

En ce qui concerne la valeur économique du gibier du chasseur aux vendeurs, NOSS (1998), WILKIE *et al.* (2000), GALLY & JEANMART (1996), DETHIER (1995), NGNEGUEU & FOSTO (1996) déclarent que les chasseurs commerciaux et les vendeurs gagnent entre 250 et 1 100 $ US par an. La chasse commerciale lie le vendeur sur le marché au chasseur dans les villages par divers intermédiaires. Selon LOVEVA (1998), plus la filière est longue, plus le coût du produit final est élevé au niveau du consommateur (tab. 1).

Tableau 1
Coût et prix d'achat de quelques viandes de gibier

Nom commun et nom scientifique des espèces (1)	**Prix du chasseur**	**Prix du revendeur**	**Prix du consommateur**
A. africanus	$ 1,30-1,70	$ 5,80-7,50	$ 10,00-14,20
T. swinderianus	$ 1,30-1,70	$ 5,80-7,50	$ 10,00-14,20
M. trucuspis	$ 1,30-1,70	$ 5,80-7,50	$ 10,00-14,20
C. monticola	$ 1,70-2,50	$ 2,50-3,30	$ 5,80-6,70
S. cafer (10 kg)	$ 5,80	$ 8,30-10,00	$ 15,00
L. africana (10 kg)	$ 5,80	$ 8,30-10,00	$ 15,00

(1) *Atherurus africanus; Thryonomys swinderianus; Manis tricuspis; Cephalophus monticola; Syncerus cafer; Loxodonta africana.*
Source: LOVEVA 1998, modifié.

Avec la croissance démographique de plus en plus élevée, l'élevage des animaux domestiques sur lequel les espoirs étaient fondés n'arrive pas à satisfaire la demande en protéines animales.

En conséquence, dans les milieux où l'exploitation du gibier était très forte, le contrôle de la chasse était cependant ignoré. L'exploitation continue du gibier couplée avec la forte pression exercée sur leurs habitats, exterminent une majeure partie des espèces animales. Cela entraîne une modification négative de la biodiversité de ces habitats.

Travaillant autour de la réserve de biosphère de Dja au Cameroun, NGNEGUEU (1998) a observé qu'en utilisant le camp ou le village des chasseurs comme zone de chasse, les populations ainsi que les structures de faune changent en terme d'espèces, de types et de nombres en se déplaçant plus loin des villages. Il attribue ces changements à deux facteurs: types de pression et de végétation de chasse (tab. 2, 3). Les résultats consignés dans ces tableaux montrent que les ongulés représentent environ 75 % de l'ensemble du gibier et que le succès de chasse augmente lorsque le chasseur s'éloigne du champ ou du village. Le nombre le plus élevé des animaux et quelques espèces rares sont attrapées dans la forêt primaire située loin des villages, suivi de la forêt secondaire et puis des champs qui sont habituellement les plus dérangés. Le *Cephalophus monticola* est l'espèce d'ongulé la plus souvent attrapée dans les champs, tandis que le *Cephalopus callipygus* prédomine dans la forêt primaire. Ces résultats prouvent que les grands ongulés sont habituellement affectés par la modification de leurs habitats et par la pression de la chasse.

Tableau 2
Distribution des animaux capturés par rapport à la distance au village

Nom scientifique des espèces (2)	**Poids moyen d'adulte** (kg)	**0-5 km du village**	**5-10 km du village**	**Plus de 10 km du village**	**Total**
C. calipygus	18,00	9	75	235	319
C. dorsalis	18,00	12	33	69	114
C. monticola	7,00	21	62	76	159
C. nigrifons	15,00	2	11	14	27
C. leucogaster	17,00	0	4	36	40
C. sylvicultor	63,00	0	3	5	8
H. aquaticus	13,00	0	1	7	8
T. spekei	85,00	0	0	1	1
P. porcus	83,00	1	2	7	10
A. africanus	3,00	15	9	20	44
C. emini	1,50	3	3	0	6
G. servalina	1,50	2	0	0	2
N. b*inotata*	2,70	1	5	0	6
P. aurata	14,00	0	0	3	3
B. nigripes	?	2	7	9	18
H. naso	3,50	2	3	9	14
C. obscurus	1,30	1	0	1	2
M. tricuspis	2,50	0	0	4	4
M. gigantea	33,00	1	0	0	1
Nombre total des animaux capturés		72	218	496	786

(2) *Cephalophus callipygus; Cephalophus dorsalis; Cephalophus monticola; Cephalophus nigrifons; Cephalophus leucogaster; Cephalophus sylvicultor; Hyemoscus aquaticus; Potamochoerus porcus; Atherurus africanus; Cricetomys émini; Genetta servalina; Nandinia binotata; Profelis aurata; Bdeogale nigripes; Herpestes naso; Crossarchus obscurus; Manis tricuspis; Manis gigantea.*
Source: NGNEGUEU 1998, modifié.

Tableau 3
Distribution des animaux par types de végétation par rapport au village

Noms communs scientifiques des espèces (3)	**Poids moyen d'adulte** (kg)	**0-5 km du village**	**5-10 km du village**	**Plus de 10 km du village**	**Total**
C. calipygus	18,00	9	75	235	319
C. dorsalis	18,00	12	33	69	114
C. monticola	7,00	21	62	76	159
C. nigrifons	15,00	2	11	14	27
C. leucogaster	17,00	0	4	36	40
C. sylvicultor	63,00	0	3	5	8
H. aquaticus	13,00	0	1	7	8
T. spekei	85,00	0	0	1	1
P. porcus	83,00	1	2	7	10
A. africanus	3,00	15	9	20	44
C. emini	1,50	3	3	0	6
G. servalina	1,50	2	0	0	2
N. binotata	2,70	1	5	0	6
P. aurata	14,00	0	0	3	3
B. nigripes	?	2	7	9	18
H. naso	3,50	2	3	9	14
C *C. obscurus*	1,30	1	0	1	2
M. tricuspis	2,50	0	0	4	4
M. gigantea	33,00	1	0	0	1
Nombre total d'espèces		72	218	496	786

(3) Cephalophus callipygus; Cephalophus dorsalis; Cephalophus monticola; Cephalophus nigrifons; Cephalophus leucogaster; Cephalophus sylvicultor; Hyemoscus aquaticus; Potamochoerus porcus; Atherurus africanus; Cricetomys émini; Genetta servalina; Nandinia binotata; Profelis aurata; Bdeogale nigripes; Herpestes naso; Crossarchus obscurus; Manis tricuspis; Manis gigantea.

Rôle de l'exploitation forestière

L'exploitation forestière a une influence directe sur la chasse intensive. Des zones difficiles d'accès auparavant sont ouvertes par les exploitants forestiers, ce qui permet aux chasseurs d'accéder à des secteurs encore riches en gibier. Les exploitants sont eux-mêmes les principaux consommateurs de gibier (les villageois chassent à leur demande) et jouent ainsi un rôle important dans le transport du gibier vers les villes (BAHUCHET & MARET 2000). Certains ouvriers employés par ces compagnies achètent des armes qui leur donnent l'accès facile à la chasse. En outre, avec une main-d'œuvre

toujours abondante, les exploitations forestières augmentent non seulement la demande en gibier mais facilitent également le trafic du gibier vers les marchés urbains.

Strategies a envisager pour une chasse durable du gibier en Afrique centrale

En Afrique centrale, les efforts de conservation de faune et d'une utilisation durable du gibier doivent se focaliser sur les villages, base de la chasse, et sur le secteur informel d'utilisation des ressources fauniques. Les stratégies spécifiques visant un développement rural doivent se concentrer sur d'autres alternatives fixes d'approvisionnement alimentaire et sur la création d'emplois à revenu stable pour les communautés locales.

En outre, ces stratégies de gestion de faune visant la protection de l'environnement et des ressources naturelles doivent également considérer la demande de la viande de brousse comme nourriture en Afrique centrale et en conséquence, elles doivent combattre la pauvreté et la faim. Les interventions dans le commerce du gibier doivent viser tous les acteurs concernés: chasseurs, intermédiaires, restaurateurs, commerçants et consommateurs. De telles stratégies, systémiques et complexes, sont difficiles à mettre en application. Cependant, elles peuvent contribuer à une utilisation durable du gibier dans la sous-région.

Commerce du gibier

Les recherches sur le trafic de viande de brousse sont très récentes en ce qui concerne l'Afrique centrale. Dans les forêts d'autres continents, au contraire, le problème a été mieux exploré. Les travaux effectués ces dernières années s'efforcent d'évaluer l'impact de la chasse ou du piégeage sur les populations animales, en relation avec la viande de brousse et le taux d'accroissement de la faune. Le point de vue qui transparaît dans ces études est plutôt celui de la population animale que celui du villageois (Bahuchet 2000)!

Le commerce de la viande de brousse est un problème complexe avec peu ou pas de solutions de rechange, car la viande est considérée, en Afrique centrale, comme un aliment apprécié, un produit facile à obtenir avec des gains garantis. L'accès facile aux ressources fauniques, l'évacuation facile de la viande de brousse vers les centres urbains et son importance économique sont des facteurs communs qui encouragent la chasse du gibier en

Afrique centrale. Bien qu'illégal, le commerce de la viande de brousse est pratiqué ouvertement, et, à une très grande échelle dans tous les pays de la sous-région et constitue une importante source de revenus pour bon nombre de citoyens au détriment des pouvoirs publics qui enregistrent un manque à gagner inestimable.

Benefice economique a court terme

La baisse globale des prix du cacao et du café, le taux élevé du chômage, l'effondrement des réseaux routiers ne permettant plus l'évacuation des produits agricoles, la construction des routes par les exploitants forestiers ayant favorisé l'accès des chasseurs aux parties des forêts isolées, et le coût faible du transport du gibier vers les marchés urbains rendu possible grâce aux camions d'exploitation forestière, ont offert à des peuples ruraux démunis, une source de revenu lucratif, à si court terme (Eves & Ruggiero 2000).

Lorsque la faune est abondante, Noss (1996) rapporte que les chasseurs-piégeurs dans la forêt de la réserve sud-ouest de Dzanga-Sangha au Cameroun gagnent entre 400 et 700 $ US par an. Gally & Jeanmart (1996) ont rapporté que les retombées économiques des produits de chasse de six chasseurs au Cameroun s'étendaient annuellement entre 330 et 1 058 $ US, un chiffre bien au-dessus de la moyenne nationale. Au Congo, Dethier (1995) a prouvé que les chasseurs ont gagné entre 250 et 1 050 $ US par an par la vente du gibier. Près de la réserve de biosphère de Dja au Cameroun, Ngnegueu & Fotso (1996) ont montré qu'individuellement, un chasseur pouvait produire par la vente du gibier, pas moins de 650 $ US par an. En six mois d'étude, 30 chasseurs travaillant dans un même secteur au mois de novembre (une saison de pluies pendant laquelle la faune est abondante) ont produit 9 500 $ US par la vente du gibier. Muchal & Ngandjui (1995) ont estimé le revenu mensuel de 18 ménages obtenu par la vente du gibier. Ce revenu s'élevait à 1 500 $ US, ce qui correspond à 83 $ US par mois.

Gally & Jeanmart (1996) ont évalué les bénéfices obtenus par un chasseur, un commerçant et d'un restaurateur du gibier à partir de la vente de 3 singes tués par un fusil de chasse. De leur évaluation, le chasseur a obtenu 6,30 $ US de la vente des singes (bénéfice de 30 %), le commerçant a gagné 10,20 $ US (bénéfice de 19 %) et le restaurateur a gagné 20,60 $ US (bénéfice de 21 %). De même, dans une étude, Loveva (1998) a trouvé une situation similaire. En effet, si l'on considère la filière la plus commune qui passe respectivement du chasseur au collecteur, du collecteur au vendeur, puis de ce dernier au consommateur, on observe qu'à chaque niveau un gain énorme était obtenu (tab. 1).

Le commerce transfrontalier du gibier

En Afrique centrale, la diversité des niveaux de vie entre les pays, comme l'habitat hétérogène, où alternent des zones densément peuplées et des espaces de forêt inhabités, influencent fortement les communes transfrontalières, notamment en ce qui concerne la viande de gibier. Le fait que les mêmes ethnies vivent souvent de part et d'autre des frontières le favorise également. Au niveau de la chasse, les chasseurs frontaliers viennent chasser dans les zones forestières peu peuplées du pays voisin; par exemple au Sud-Est du Cameroun, où viennent les Congolais de souanké; le nord du Gabon, qui attire les chasseurs camerounais de Djoum. Les chasseurs professionnels de Guinée équatoriale viennent s'installer pour tenter leur chance dans les forêts sous-peuplées du Gabon (Bahuchet 2000). Les Congolais (RDC) de Boma traversent le fleuve Congo de l'autre côté de l'Angola pour chasser des grands mammifères.

Au niveau du commerce, plusieurs échanges se font à travers les pays de la sous-région. La viande de Ouesso est achetée par les commerçantes de Kinshasa à Brazzaville au marché hebdomadaire de Bouemba, ou le long du fleuve Congo dans les bateaux en provenance de cette province. Un marché spectaculaire de la viande angolaise se passe dans la ville portuaire de Boma (au niveau du marché Fisher) en RDC. Le pays riche qu'est le Gabon draine la viande de la Guinée équatoriale. Bahuchet (2000) signale le trafic du gibier africain vers l'Europe, destiné à des fins alimentaires. Toutefois, l'ampleur de ce trafic et des volumes qu'il concerne est marginale.

Legislation de la chasse et du commerce de gibier

Notre article met en exergue les faiblesses et les forces dans l'application des lois en matière de faune sauvage. Il relève aussi l'absence de cadre législatif adéquat à la question de viande de brousse. Cette activité est presque illégale dans presque tous les pays de la sous-région, cependant les pouvoirs publics restent impuissants et le commerce de la viande de brousse se pratique en toute liberté au bénéfice uniquement des braconniers, causant un manque à gagner aux économies nationales. Les textes législatifs sont inadéquats et incohérents quand ils existent et présentent beaucoup de lacunes. Aussi, il se pose un problème institutionnel: les structures actuelles en charge de la gestion de la faune manquent de dynamisme et sont étouffées dans une administration dont la priorité est l'exploitation forestière et où la faune apparaît comme une ressource marginalisée (Agnagna 2002).

Pour résoudre ce problème, les chasseurs, les intermédiaires et les commerçants devraient se regrouper en syndicats identifiés par l'administration; par exemple, le MINECN en RDC, qui déterminera la saison de chasse, les marchés et fixera les prix du gibier. En conséquence, toute viande de brousse vendue dans un marché non reconnu sera considérée illégale; la viande saisie et les coupables punis selon les lois en vigueur (existantes). De cette façon, les montants des impôts, des taxes et des permis pourront alors être affectées à la gestion de la faune, à combattre le braconnage et à payer les gardes.

Trouver les solutions de rechange a la viande de brousse

Les efforts des experts visant à contraindre l'approvisionnement en gibier sur les marchés et à imposer les lois qui interdisent des échanges commerciaux du gibier pourront faire diminuer, à court terme, la quantité de gibier disponible sur les marchés. Cependant, si les produits de substitution du gibier sont inexistants et que la demande de viande s'élève, les prix du gibier pourront probablement augmenter et de ce fait, inciter les populations à chercher des moyens pour contourner le contrôle.

En conséquence, les solutions éventuelles à la crise du gibier doivent inclure et s'assurer que les consommateurs auront accès aux sources alternatives des protéines animales; par exemple, l'élevage des espèces de faune socio-culturellement acceptable et l'importation des différentes variétés de viandes congelées qui ont un goût agréable et peuvent être acceptées compétitivement avec le gibier par les consommateurs. S'il n'y a pas de solutions de rechange économiquement viables, les gens continueront à exiger la faune comme source accessible et savoureuse de viande.

Encourager la cooperation sous-regionale

L'approche de la coopération sous-régionale en matière d'éducation et de recherche sur la faune aura un impact direct sur la conservation et la gestion, la faune étant une ressource commune.

Afin de réaliser cet objectif, il sera nécessaire d'harmoniser les programmes des instituts de recherche et de formation dans le domaine de la conservation et de la gestion durable de la faune dans la sous-région.

Renforcer les strategies de communication entre les Etats de la sous-region

Les menaces de la faune sont de portée internationale et ont besoin d'efforts concertés des pays de la sous-région pour les combattre. C'est ici que

les décideurs ont un rôle primordial à jouer depuis la prise de décision politique au niveau local, national et surtout international en vue de réconcilier la compensation entre la surexploitation de faune pour des gains économiques à court terme et la perte irremplaçable de faune.

Conclusion

La viande de brousse est un aliment très apprécié avec peu ou pas de produits de substitution bon marché; le commerce de gibier est une option économique importante pour les ménages ruraux qui tirent une ressource médiocre de cette activité, toute intervention doit impérativement évaluer les besoins économiques de l'ensemble de la population des zones forestières dans la sous-région.

Il est vrai que la chasse commerciale fournit le revenu principal de ceux qui la pratiquent, qu'elle touche un nombre d'espèces animales très limité et qu'elle excède les capacités de reproduction de la plupart des espèces. Pour les plus couramment consommées, notamment les ongulés et les primates, le seuil critique est dépassé et une chasse se poursuivant avec la même intensité conduit à une diminution des populations sauvages.

Les efforts visant à contraindre l'approvisionnement en viande de brousse en imposant des lois interdisant les échanges commerciaux de gibier, et en encourageant les compagnies forestières à interdire le transport de gibier par leur véhicule vers les marchés urbains, peuvent à court terme entraîner la pénurie du gibier sur les marchés. Cependant, il est impératif de reconnaître la contribution de la faune sauvage à l'approvisionnement alimentaire des habitants des zones forestières. Cela signifie que toute mesure d'interdiction devra être accompagnée de substitutions. En outre, si la demande de la viande est élevée et que les produits de substitution n'existent pas, la pénurie de viande entraînera une hausse de prix qui aura comme conséquence d'inciter les gens à contourner le contrôle.

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Knowledge Generation on Tropical Forest Products: a Model from Nepal

by

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KEYWORDS. — Chepangs; *Diploknema butyracea*; Nepal; Non-timber Forest Products; Participative Research.

SUMMARY. — A sound management of forests compulsory needs scientific information to ensure a sustainable production of goods and services. Such information is often lacking in the tropics and cannot easily be obtained through routine short-term investigations. On the other hand, a large amount of informal knowledge resides among the communities of indigenous people living in or close to the tropical forests. The question arises how science and indigenous knowledge could benefit from each other.

This topic is being addressed in the context of an integrated development project among the Chepangs, an indigenous people living in the central hills of Nepal. Living among and working intensely with the Chepangs for many years made clear that their knowledge about plants and animals is vast and exceedingly detailed, contrasting with the poor scientific information on this matter. One particular tree appeared to be one of the most interesting and important resources to the Chepang people: *Diploknema butyracea*.

The approach confirmed that the massive indigenous knowledge about the tropical forests is most probably a much stronger foundation for the definition of future research priorities in the domain of tropical forests than the rather vague directives of current northern science policy.

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Introduction

Tropical forests and their management remain a controversial topic on many political, economic and scientific forums. Some people support the idea of management as a means for conservation. Others believe that continued exploitation is a threat for the survival of forest biodiversity and that a successful conservation policy should exclude any management except putting guarded fences to reduce as much as possible anthropogenic pressure. While it is being increasingly recognized that there are very few, if any forests that have not been subjected to some degree of human presence for thousands of years, a net distinction is often being made between a so-called "hard" management where forests are being logged (by "timber mining" companies) and a "softer" extraction of non-timber forest products preferentially done by indigenous people. "Hard" management is supposed to provide the international market with precious wood, whereas "soft" management should be incorporated into local or regional economies.

In any case, a forest management aiming at a sustainable production of functions and goods presupposes the availability of relevant information on the structure and functions of the ecosystem, including the effects of human actions. This should be the fundamental principle of both "hard" and "soft" management, as well in the industrialized North as in the developing South. Such information is most often of a formal scientific nature, as far as forests on higher latitudes are concerned. It is the result of a procedure of statistical sampling of the vegetation: the measuring of trees and stands, but also the quantitative and qualitative assessment of anthropogenic pressures like recreation. Whereas any manager of these northern forests would certainly be happy with additional information to more firmly underpin his management plans, much basic information is already available before logging intensity is determined. This is by no means the case in the tropical forests where essential information about species composition, age structure and ecosystem carrying capacity is most often lacking completely. The importance of past forest surveys carried out for pure scientific purposes cannot be overestimated: they should be acknowledged as the basis for most of the actual understanding of tropical forests. However, if forest inventories for non-scientific objectives were made in the past, this was done with the predominant aim to estimate the quantity of commercial timber that could be logged. The underlying and implicit thought was that there was no resource shortage at all given the extension of primary tropical forests with high-quality logs.

For many reasons (logging is only one of the minor ones) countless primary rainforests have been destructed especially in Asia, but also in western and eastern Africa and the Amazon region. To halt deforestation in the tropics a ban on tropical timber was advocated during quite convincing campaigns by the end of the twentieth century. Nowadays the opinion of most of the end users, the civil society both in the North and in the South and an increasing number of governments, tends towards accepting a restrictive use of tropical timber. A main condition is that utilizing tropical wood has to be justified by a management plan aiming at sustainability. It is rather evident to extend this principle to other forest products since any item is susceptible to overexploitation which could eventually contribute to forest destruction.

To establish such a management plan, many open ecological questions concerning the internal functioning and the structure of the tropical forest are lingering. The same is true regarding the often very complex relationship between the forest ecosystem and the communities using or interested in this forest, as well those who live in or close to the forest as those from remote continents.

Collecting scientific information in a tropical context deals with many problems. First of all, although the importance of tropical forests and forest products is obvious, the available research budgets are just a tiny fraction of the money that is being allocated for research and development of artificial or biological systems at higher latitudes. There is also a tremendous and even rapidly growing gap between the predominant scientific paradigm on one side and the reality of a development country on the other side. Scientific production and quality for instance are being measured more and more on the basis of peer reviewed articles published in international journals. Most frequently this presupposes a high investment of staff, equipment and time. Moreover, it is clear that scientific research in the tropics is being carried out predominantly by research teams from industrialized states, often without any partner in the country concerned. The results of a scientometric study (DAHDOUH-GUEBAS *et al.* 2003) show that in 70 % of the cases research carried out in the least developed countries is being published without co-authorship of local research institutes. Indeed, top-level research relies on expensive equipment that has to be updated or replaced after a fairly short term. This research relies more and more on the joined forces of teams that might count many members. Laboratories in the least developed countries lack the modern equipment and most of the researchers have to work rather individually. At the same time they often have diverse responsibilities in the field of education and commission work which interfere with

their possibilities to concentrate on research topics. While high-standard research is most frequently the result of a time investment that is much more important than common nine to five jobs permit, the time occupation of academic people in a developing country should take into account much more attention for vital personal needs and those of their extended family.

Whereas the tropical forest is poorly studied by the scientific community, research does not necessarily have to start from scratch: it is often being demonstrated that indigenous people have an immense body of knowledge about their forest. The question arises how indigenous knowledge accumulated through age-old experiments of trial and error could be validated in a sustainable forest management.

At first sight the gathering of local knowledge seems to be straightforward: ethnobiologists should simply ask the local culture bearers what they know. But cross-cultural problems will probably arise very soon. Inquiries are being challenged by questions like: "Who knows what?" (Often there is no consensus in a local community); "Are there ethical objections to use indigenous knowledge?" (The case of patents and intellectual rights); "Can local people formulate their knowledge precisely enough?" (People are not necessarily familiar with expressing in words what they know); "Does with the interviewing investigator understand what people tell him?"; "How much information is being lost by each translation step (from informal, implicit or intuitive knowledge to the local language, from the local language into the education language and from the education language into scientific English)?"; "Which part of the indigenous knowledge is relevant to be formally translated into management plans?";... Further on, the question arises how the research objectives should be discussed and who should participate in this discussion: is it ethically justifiable that scientists continue to define their objectives themselves against a background of rather vague priorities formulated by their administration and science policy? Is a classical timescale of a common research project imposable for a successful study of indigenous knowledge on tropical forest ecosystems?

Such questions had been addressed in the context of an integrated development project among and with some of the Chepang communities living in the central hills of Nepal. The Chepangs are one of the sixty-one indigenous groups recognized by the Nepalese government. They account for some 0.25 % of the total population and are living scattered in the rugged terrain of the Mahabharat hills of Central Nepal in the frontier zone between the districts of Makwanpur, Dhading, Chitwan and Gorkha. The example of the Chepangs is chosen because of the strong dependence of this people on a

tropical forest which extension is gradually being reduced and because they form an indigenous people that is discriminated in one of the least developed countries of the world. An overview is given of some substantial information on a main non-timber forest product accumulated during intensive field work. Further some principles of participative research in a tropical forest are being discussed.

Methods of Knowledge Generation

The research on the relation between the forest and the Chepang community was part of a resource enhancement programme that began in 1993: the Seacow project (School for Ecology Agriculture and Community Works). The project focused on the principle of learning by doing. People were involved in both the planning and the actions.

The methods of information gathering all involve facilitating a meaningful communication between the local people and the investigators. This implicates the bridging of the borders between local-inside and scientific-outside knowledge: informing the scientists about the people and ethnographic findings is considered to be a key principle, as well as informing the locals about the scope of science and what it might offer (BHATTARAI *et al.* 2003).

— In order to know the people, the project staff went to the different clusters of villages and lived with the local population. After some time literacy classes have been organized which evolved towards the concept of "Chisa Kruskaisa". This is basically an indigenous discussion forum: a short meeting to learn.
— Several product processing experiments have been organized in the villages, but a lot of information on that item has been gathered from what people told the investigators from earlier attempts: people reported on what they tried in the past and what worked well and what did not.
— A continued dialogue with the villagers appeared to be of utmost importance.
— Much indigenous information appeared to be recorded in songs.
— Workshops, drama and study tours have been organized, on the occasion of which valuable information has been obtained.
— Continuously posters and slides have been produced to inform people about their own knowledge.
— The area that is being studied covers the upper catchments of the Lothar River and adjoining village clusters. The area is mostly inaccessible by motorized transportation.

Formal and Traditional Landownership: the Importance of Chiuri

Considered as one of the most marginalized people in Nepal, the Chepangs are believed to have practised hunting-gathering until 100-150 years ago, which means that their dependence on agriculture is a rather recent phenomenon. The current agricultural activities include slash-and-burn and shifting cultivation systems that occupy about one fifth of the arable land. The agricultural production is only adequate to cover the needs of 6-8 months a year. For the rest of the year, this is typically between February and June, people have either to fall back on the forest for gathering wild food or to borrow money. Some people leave their village to look elsewhere for a job during this time of the year. The extreme poverty of the Chepangs makes them victims of village money lenders and road head merchants. It is estimated that over 50 % of the people have debts. In 1999, the average annual cash income was found to be under US$ 130 per family in the Lothar district.

All the forests of Nepal were nationalized in 1957. Any land without trees and with sufficient proof of use is being considered as private entitled land. By law, unentitled land is considered as forest, even if there are no trees on it. This narrowly thought policy is one of the primary reasons of deforestation in Nepal: to obtain private land it was sufficient to deforest an area. Because of a certain fear of high taxes and a lack of understanding of the state mechanisms, much land in the Chepang area still remains unentitled. This means that most of the people are practising slash-and-burn agriculture on land that is not their own, but in the state forests. Because of their extreme disadvantaged position and because of the remoteness of their settlements, they have, however, not been hindered by state officers until now. Further down to the south in the Chitwan valley, propelled by external aid, the government clear-felled the forests and triggered the resettlements of people from the hills. These people have been entitled their land whereas Chepang people practising shifting cultivation are being denied their traditional rights. The current legal provisions of the community forestry system give room for managing parts of the forests collectively. But still the ownership of the Chepang land is not recognized formally.

Almost every Chepang household has de facto its own forest patch. The ownership of forest patches is, following the Chepang tradition, determined by the slash-and-burn shifting cultivation practices, called *khoriya*, and the presence of a particular tree named in Nepalese and Hindu *Chiuri*. Called *yoshi* in the Chepang language, *Chiuri* (*Diploknema butyracea* (Roxb.) H.J. Lam) is a member of the Sapotaceae family. This large deciduous tree is known in English as the "Indian butter tree" for its rich oily seeds. As

a multipurpose tree, it is commonly found within the sub-Himalayan belt from Uttar Pradesh in India and further eastwards into Nepal through North Bengal, Sikkim and Bhutan at altitudes of 700 to 1,500 m. Usually, a forest area without Chiuri trees (for example with Sal (*Shorea robusta* Gaertn.) or pine *Pinus roxburghii* Sarg.) does not belong to any household and is considered as common forest.

According to their tradition, the Chepangs can privatize individual bee and hornet hives and Chiuri trees. The boundaries for the grazing land are naturally determined by the daily movement of the animals. However, people are not as keen on animals as the big majority in Nepal (*e.g.* the Brahmin casts): the Chepangs are not yet familiar with the techniques of animal husbandry and the integration of cattle into their agricultural system. Moreover, keeping large cattle is often problematic in the Chepang area because of the very steep hills. As a consequence, people still depend to a lesser extent on hunting for meat in the dwindling forests. Generally, the burning of forests for cultivation does not meet any opposition until one encroaches too far into the land of somebody else.

A Chiuri tree is owned by the person who spots it for the first time in the forest and continues to take care of it. This person carves the tree at breast height to indicate that it is already claimed. Even after somebody clears the forests for cultivation, the tree will belong to the parental property inherited from father to child (sons and daughters!). When a family splits, there is an equal distribution of the Chiuri trees among the family members.

The owner of a tree has rights over hunting the bats and birds that are foraging or perching on their trees. A distinction is being made between forest Chiuri and Chiuri that is actually growing outside the forest. Forest Chiuri, separately named as *Ban Yoshi*, could as well be considered as an individual or as a collective property: the right of the individual owner to harvest fruits and seeds is reserved up to *Saun masanta* (mid-July), after which it becomes a common property and everyone can harvest. Arrangements among households are made for sharing these fruits. Chiuri on agricultural crop land is named *Rang Yoshi*. These trees are being considered as domesticated, but the owner of the tree is not necessarily the owner or user of the surrounding field. Chiuri trees can be exchanged, sold or acquired independently of the land on which they grow. A legend survives that a Chiuri tree used to be given as a dowry to daughters for their wedding.

People do not worship Chiuri trees: no parts of Chiuri are needed for *Pande*, the religious rites and ceremonies. However, Chiuri trees receive sometimes a treatment comparable to those for human beings from the *pandeys*, the traditional healers.

Chiuri products are being sold and are an important source of cash. Next to Chiuri, the most promising non-timber forest products are *Terminalia chebula* Retz. (chebulic myrobalan), *Terminalia bellirica* (Gaertn) Roxb. (belleric myrobalan), *Phyllanthus emblica* L. (emblic myrobalan) and *Tinospora sinensis* (Loureiro) Merrill (Gurjo). Because of the absence of information and alternative sale options, people have been selling their products significantly underpriced. Since the demand is predominantly externally instigated, there is a risk that some of the plant populations will become depleted. Yet people did not seem to be concerned collectively about the protection of forests until recently. Nonetheless, their insights on different species and how they interact give valuable information for managing the forests.

The Chepang Knowledge on Chiuri Botany

Because the Chepangs depend so much on the forests for their survival, it is not surprising that they accumulated a significant body of knowledge on forest products from different species. Especially their knowledge on *Diploknema butyracea* is vast compared to what could be found in the scientific literature. Continuous communication with the Chepang community provided following information.

The ecological amplitude of *Diploknema butyracea* is rather big: Chiuri does not necessarily require good soil to grow. It occurs on limestone as well as many other types of soil in the altitudinal range between 700 m and 1,500 m. Chiuri grows well on poor rocky ridges where the roots go deep into the clefts. It has the reputation to live longer on poor soil rather than on good soil. It grows better on southwest-facing slopes. On south-facing slopes, Chiuri occurs up to the highlands. On north-facing slopes it does not occur so high. Seeds from ripe fruits germinate within two weeks. Seeds from the fruits eaten by jackals, bats, wolves, etc. also germinate well. Chiuri seedlings grow best in shaded sites. Artillary plant (*Pilea symmeria* Wedd. Urticaceae), Currant (*Ribes takare* D.Don Grossulariaceae), Mugwort (*Artemisia indica* Willd. Compositae) are strongly associated with the presence of Chiuri. Chiuri cannot grow well if vines such as Emetic nut (*Xeromphis spinosa* (Thunb.) Keay (Rubiaceae)).

The ripe fruit has sweet edible pulp and the flowers and fruits can be used to make jaggery. The fruit provides a dietary supplement during the critical period of food shortage. The major economic use of this multi-use species is, however, *yosati*, the edible oil from the seeds. After removing the pulp, the seeds are cleaned and then sun-dried and steamed. The oil is manually

extracted by pounding and macerating between two wooden planks, yielding up to 25-30 % of oil. It is white in colour and has a pleasant taste and odour. It remains solid up to 48 °C and does not deteriorate in hot weather. It is used for cooking and is reportedly an ingredient for manufacturing margarine and chocolate in India. Most of the production is confined to small-scale villages or household level. In Nepal a small-scale commercial trade has developed.

The wood is not durable. In external use it lasts for 2-3 years only. It is susceptible to termite attacks. It is well suited for firewood mainly because the fire does not extinguish quickly and it does not give much smoke. Moreover, the smoke is not irritating for the eyes. Chiuri does not give a good timber but it can be used to make furniture. Because people live simple lives almost without furniture and in small houses much timber is not needed: trees that are left on rocky uncultivable slopes are sufficient to cover the timber needs so far.

The resin from the bark can be mixed with the resin of other trees (Tallow tree (*Sapium insigne* Trimen (Euphorbiaceae), Monkey Jack, *Artocarpus lakoocha* Wall. ex Roxb.-(Moraceae)) to produce a glue that is being used to trap birds, but also house flies are being caught.

Milking cows and buffaloes fed on Chiuri leaves are reported to give more milk. A big advantage is that the leaves are available during the driest months (March, April) and that buffaloes, cattle and goats like it very much. In these months the animals even eat the bark of the branches, where they do not eat the new shoots at the start of the growing season. In other months when plenty of leaves and grasses are available they in general do not feed on chiuri fodder. The leaves are also being used as plates to serve foods. The leaf-plates are soft and the inner surface is smooth and glossy. Almost anything, including hot meals and drinks, can be served in Chiuri leaf-plates.

Diploknema butyracea that is growing on poor, infertile soil bears small bunches of flowers whereas growing on good, fertile soil it bears larger bunches. The flowers have large amounts of nectar that is enjoyed very much by the people. The nectar is being collected with a locally made spoon-shaped device to make a sweet syrup. The syrup is being mixed with tobacco and used as chewing gum. The nectar also attracts birds, bees and bats. Birds (king-crows, eagles, doves, pheasants and owls) suck the Chiuri nectar. Bees sometimes get stuck in the flowers. Bats eat the nectar while hanging on the bunch of flowers. Five types of bats — black, brownish grey (the largest one), grey, small black (meat does not taste good) and *Dhangkacha* (does not eat the nectar, but the insects associated with them) — forage on Chiuri trees. Goats and even dogs and wild animals as jackals eat flowers that fell on the ground.

Only few fruits ripen completely on the tree. Most frequently the fruits are being attacked by fruit flies and fall rotten on the ground. Also birds eat the ripe fruits and cause them to fall. A few fruits fallen on the ground are a sign that the harvesting time approaches. To check whether the fruits are ripe, the seeds can be broken easily. Fruits are being harvested on sunny days. Rainy days are avoided because this hampers the ripening after harvest and the trees are too slippery to climb. Before climbing up to the tree people pray that the tree would not make them fall. They do so because they believe that the Chiuri tree has his own self. Fruits are hand-plucked using a long hook, a long rope and a bamboo basket. When only the oil is of interest, they could also been bashed of the branch. Branches in the lower part of the tree bear more fruits with good taste and a higher yield of oil than those in the upper part of the tree.

Nowadays there is an obvious decreased production of fruits in the area basically because of the excessive dropping of immature fruits infested by fruit flies. Next to fruit flies there are two other kinds of pests: stem borers and defoliators. It seems that *Diploknema butyracea* is suffering from increased winter drought, soil erosion and pest attacks. Many Chepangs view it in a different way. They believe that the problem is due to the incompetent Pandeys of the new generation who have been unable to treat Chiuri trees and make them bear fruits. Since the fruits ripen at the time of food scarcity, the pulp supplements and sometimes substitutes staple food.

Unripen fruits ripen out of the wind under a mat of straw, leaves of Camel's foot (*Bauhinia vahlii* Villar-Fabaceae) or current (*Ribes takare*) for about a week. Fruits can be eaten without special treatment. The consumers need to know how to press the fruit in the mouth so that only the juice is sucked and swallowed. Precautions are taken not to swallow the *Ladi* (the fibrous and gummy part of the fruit flesh) because it may cause stomach-ache.

Chiuri juice is considered to give energy to the body. It also has intoxicating properties. The consumption of large amounts of Chiuri juice on the other hand causes sleepiness and also diarrhoea. People do not drink juice if they suffer from diarrhoea and coughing. Many Chepangs believe that, if a pregnant woman drinks Chiuri juice, a white substance will cover the baby and make it difficult to give birth.

Pigs and goats are keen on the fruit residue (*Chhokra*). Pigs fed on Chhokra gain rapidly weight.

Seeds collected from the forest ground or obtained after consumption of fruits are firmly hand-washed with water in order to remove the inner part of the mesocarp, which is closely wrapped around the seed. Drying the seed is done by hanging a two-storey bamboo basket called *Bhar* 1 m-1.5 m above

the fireplace. The fresh seeds are dried first in the lower storey during four-five days and then in the upper storey during one month. The dried seeds are being kept in a bamboo basket or jute bag. Seeds should be sound (not germinated and rotten) and dried properly to produce good quality butter.

The dried seeds are crushed to flour by using a local rice huller (*Dhiki*). The flour is kept in an earthen pot with holes at the bottom (locally known as *Fungsi*) and heated until the steam comes out of the flour. It takes nearly twenty minutes to steam the flour. This steamed flour is poured immediately into a bamboo basket (locally known as *Pyar*), placed as soon as possible in between the two wooden planks of the expeller (locally known as *Chepuwa*) and the basket is pressed between them with the help of a leather rope (locally known as *Nara*) that fastens the wooden planks together. Pressing is done several times, working from the top to the bottom of the basket, until the oil stops flowing out. The oil is collected in a container. The cake from the first extraction is again pressed a second time following the same procedure as above: crushing, steaming and pressing. The oil is poured in a wooden container or bamboo basket lined with the leaves of *Bauhinia vahlii* Wight & Am. to solidify. The butter is stored in the same container used for the solidification of oil.

The butter is locally used as cooking oil. It can also be used as an illuminant as it burns with a bright light without smoke or smell. The oil is mixed in traditional medicines to treat rheumatism, wounds and chapped skin. Surplus quantities of butter are sold at the nearest road head (30-40 Nepalese rupees per kg). The road head merchants supply the butter to soap manufacturers.

The cake should be kept away from rain and moisture because it becomes sticky and unusable when it is wet. It is crushed to flour in a rice huller (*Dhiki*) after which it is ready for use as fish poison or as manure. To use it as a fish poison, a part of the river has to be dammed. The cake is thrown into the water, normally in the morning after when it can affect/kill fishes for five hours. Other water organisms do not seem to be affected.

The cake has also pesticidal properties. It can be applied in rice (paddy) fields, paddy nurseries, millet fields, etc. It adds nutrients to the soil and kills many insects and pests as cricket, leaf roller, patero, etc. It is traded at the rate of one quantity of cake for one quantity of paddy.

Discussion: Lessons for Development and Research in a Tropical Forest

When research priorities in the domain of tropical forests and forest products are being discussed, relevance to development is often considered as an

important criterion for funding. Moreover, the question arises whether the research projects themselves should not benefit from a close collaboration with a development project.

After ten years of developmental activities in the Chepang villages in the Midhills of Nepal, some important changes are obvious: the landscape is definitely greener and the people's moral is boosted. In the margin of developmental activities a wealth of research hypotheses could be formulated, concerning the effects of shifting cultivation on the carrying capacity of the ecosystem, the botany of *Diploknema butyracea*, the phytopathology of this tree,... Without any doubt research hypotheses rooted in development projects of this kind, are much more relevant for poverty alleviation than those being discussed on academic levels at higher latitudes.

Moreover, it has been proved by the Seacow approach that in the margin of developmental activities extremely detailed information that is new to science could be obtained about the local ecosystems and their components. Probably the concept of the development project itself is important for an optimal information gathering. A relationship characterized by mutual confidence between the indigenous people and the project staff is of the utmost significance and is probably conditional for success of any activity among indigenous people. Apart from this, at least a few general lessons could be drawn from the Seacow concept. First of all it is quite obvious that giving alone is not enough. A development project should presuppose a commitment, not only from the side of development workers, but also from indigenous people. To assure the loyalty of indigenous people and marginalized groups, it is the experience of the Seacow project that there should be a strong focus on two key development areas: the means of production (especially food production) and the education. Equivalent to this experience, there is the understanding that marginalization has two dimensions that often form a vicious circle: a material one and a mental one. Indeed, when people lack basic material comfort, they do not feel confident. As a consequence they are not motivated to improve their situation which worsens gradually. Opposite to that, when the self-belief of people rises, they will be motivated to improve their material conditions. It is apparent that production and activities focusing on awareness need to go hand in hand.

Another key to success of development projects, but also of research projects in a development country, is to work with committed people in the project staff, both in the sense of being dedicated and competent. The project staffs have as a main responsibility to draw the big picture: during education activities they should in the first place explain the wider context of the situ-

ation of poverty. It is very important that they should not start from what people lack. Parallel to that, for the activities focusing on the improvement of the material situation, they should work with the locally available resources. They should keep in mind that starting below replicates better than the reverse do: it is more efficient to focus on the singular households than trying to convince people on the governmental level.

The data on the applied botany of *Diploknema butyracea* have not been collected through a classically designed approach of experimental research during a typical four-year project. Formularizing of the extremely detailed knowledge that indigenous people have about their environment presupposes a long-term investment of the investigators. Probably this investment does not easily fit into a standard research project. However, much of the ecological knowledge on tropical ecosystems, which is nowadays available, has been collected in a fairly analogous way. Obviously the indigenous knowledge should not be discarded by the scientific communities. On the contrary, scientific approaches probably will benefit a lot when building on the fundaments of indigenous knowledge and their relevance to development can be guaranteed when the scientific hypotheses are being confronted with indigenous communities.

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Systèmes de croyances Niominka et gestion des ressources naturelles de mangrove

par

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MOTS-CLES. — Réserve de Biosphère du Delta du Saloum (Sénégal); Mangrove; Niominka; TEK.

RESUME. — Le concept de «savoirs endogènes» constitue actuellement l'un des axes majeurs de la réflexion autour de la problématique de la conservation de la biodiversité.

En effet, on se rend de plus en plus compte que l'activité de conservation de la diversité biologique, qui met à contribution les organisations locales, les structures étatiques et les ONG environnementales, ne peut pas seulement s'appuyer sur les connaissances scientifiques. La réflexion autour des savoirs écologiques locaux (*Technical Ecological Knowledge* [TEK]), et leur valorisation, apparaît comme une solution pour une gestion durable et viable des écosystèmes marins et côtiers, en particulier pour les forêts de mangrove du Siné-Saloum.

Au Sénégal, l'ensemble du littoral subit depuis plusieurs décennies les effets de la désertification. Les initiatives se multiplient dans la Réserve de la Biosphère du Delta du Saloum [1]*** (RBDS) pour réhabiliter les écosystèmes côtiers. Il serait intéressant de voir quels peuvent être les apports des savoirs locaux, ceux des Niominka et Socé, dans la dynamique globale de conservation de la biodiversité écologique.

Au moment où des plans de gestion de la mangrove [2] sont en train d'être conçus, il serait bon d'intégrer les savoirs écologiques endogènes dans le processus de leur conception et de mise en œuvre. En effet, dans le jeu des interactions entre communautés locales et ONG, donc intervenants extérieurs, il peut arriver que des réactions de rejet se manifestent. S'il en est ainsi, c'est parce que les ONG sont parfois porteuses d'initiatives qui ne tiennent pas compte des manières de penser, des

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*** Les chiffres entre crochets [ ] renvoient aux notes, p. 328.

rapports qui lient la nature aux populations autochtones, des systèmes de conception, de représentation et d'occupation de l'espace ou d'appropriation des ressources.

Chez les Niominkas du Siné-Saloum, il existe des croyances et perceptions qui ont eu un impact positif sur la protection de l'environnement.

Selon l'anthropologue sénégalais Massaer Diallo [3], «si ce que l'on appelle aujourd'hui "le respect de l'environnement" et la "gestion durable des ressources naturelles" *a des cas équivalents* dans des cultures et sociétés dites traditionnelles (régies par des logiques endogènes et anciennes), c'est parce que ces dernières étaient fondées sur une conception, des règles et valeurs qui impliquaient voire édictaient un rapport harmonieux ou équilibré avec la nature (physique, animale et végétale)». En voici quelques illustrations.

La sacralisation de Jiffa, Péthiamak, chez les Sérères de Djilor, fait que ces sites — même si ce n'était pas l'objectif recherché — sont aujourd'hui les moins agressés dans la communauté rurale [4].

L'injonction du génie protecteur du Loog, Laga ndong, de ne parler que le sérère dans la zone de pêche Niamokine — dans un pays où l'écrasante majorité parle wolof — a favorisé le contrôle du bolong par les Niominkas et la limitation de l'exploitation de ses ressources aux autochtones.

De plus, l'islamisation des sociétés traditionnelles sérères a introduit un rapport de type nouveau entre l'homme et la nature parce que le fait de couper un arbre ou tout simplement des feuilles d'arbres sans en avoir besoin est associé à un péché. Celui qui abuse de la ressource végétale est selon le Coran un pécheur. En planter, c'est attirer la miséricorde divine sur soi, dit-on dans le texte sacré des musulmans.

Ces représentations religieuses ont donc des incidences sur l'équilibre de la nature. Les savoirs écologiques locaux présentent un intérêt bien particulier mais il faut se garder de faire de l'ethnologisme.

Et puis, il y a chez les Niominka une forte croyance selon laquelle la mangrove est un don de Dieu. Par conséquent, la pérennité des ressources qu'elle génère est garantie par une divinité. Quelle est la place de ces croyances dans le processus de désintégration des forêts de mangrove dans le Siné et le Saloum?

Le présent article tente de fournir des éléments d'appréciation sur la place des savoirs locaux dans la conservation de la diversité biologique chez les communautés Niominka de la RBDS.

Introduction

L'importance écologique du Delta du Saloum ainsi que ses multiples usages, font jouer à cet écosystème un rôle-clé dans l'économie du Sénégal. Ses richesses forestières et halieutiques ont attiré un nombre croissant d'exploitants, au moment même où les conditions de l'environnement se dégradaient du fait de la péjoration climatique des années septante et quatre-vingt. Depuis quelques années, l'écosystème mangrove du Delta s'inscrit dans le cadre de la Stratégie Mondiale de la Conservation de la Nature et fait l'objet d'attentions toutes particulières de la part de l'Etat sénégalais et de ses partenaires non gouvernementaux. De nombreuses conventions internationales ont

été signées en impliquant des institutions telles que l'UNESCO, la CEE, l'UICN afin de prendre un certain nombre de mesures pour la protection de ce patrimoine naturel, érigé en Réserve de Biosphère du Delta du Saloum (RBDS) en 1981. La recherche s'est alors orientée vers des approches pluridisciplinaires afin de mieux comprendre les interactions existantes entre la mangrove et les populations locales qui y vivaient.

Malgré toutes ces mesures de conservation, les diagnostics socio-environnementaux effectués au niveau de la RBDS mettent en exergue les menaces qui pèsent sur les ressources naturelles de cet écosystème. Le système de production des populations locales apparaît en pleine mutation. Délaissant l'agriculture, les populations ont transformé leurs prélèvements halieutiques de subsistance en une activité commerciale de rente. L'exploitation illégale du bois de mangrove et des ressources halieutiques occupe donc aujourd'hui la majeure partie des activités insulaires. Ces pratiques sont en outre amplifiées par l'apparition de technologies nouvelles inadaptées (four de fumage) diffusées par des allochtones guinéens.

Cette situation interpelle les gestionnaires du milieu. Bien que les perspectives de la décentralisation de 1972 offrent aux populations locales de nombreuses possibilités de prendre en main la gestion de leur environnement, celle-ci n'est pas encore au rendez-vous. S'il est un lieu commun que le succès d'une gestion durable des ressources naturelles implique la participation des insulaires concernés par l'utilisation de ces ressources, les modalités pratiques restent encore à définir. La présente communication a pour ambition de contribuer à cette gestion participative en identifiant les modes d'accès et d'exploitation aux ressources naturelles des *Serer Niominkas*, entendus comme bases d'une potentielle gestion durable.

La Réserve de Biosphère du Delta du Saloum (RBDS)

De tous les milieux littoraux intertropicaux, la mangrove constitue la forme la plus évoluée d'interpénétration des milieux océaniques et continentaux. La RBDS, située dans la partie estuarienne du bassin hydrographique du Siné-Saloum au Sénégal, couvre une superficie de 334 000 ha (UICN 2003). Elle protège cet écosystème exceptionnel menacé tant par l'évolution climatique que par les activités anthropiques. Subissant en effet une péjoration climatique, les normales pluviométriques dans le Delta du Saloum sont passées de 600 à 900 mm pour la période 1931-1950 à moins de 400 à 600 mm dans les années nonante (UNESCO 2000). Les conséquences les plus remarquables de ce déficit pluviométrique sont la sursalinisation des

eaux marines, la baisse des nappes phréatiques, la salinisation et l'acidification des terres ainsi que des eaux souterraines. Il en résulte une dégradation des mangroves et des formations forestières qui, à certains endroits, connaissent une évolution régressive. Par ailleurs, cette situation climatique a provoqué une crise de l'ensemble des systèmes de production agricole (UICN 2003).

Les inventaires effectués dans le Siné-Saloum et la comparaison d'images satellites de 1976 à 1991 montrent clairement la diminution des surfaces de mangroves (SOUMARE 1992, DIOUF 1996). A ces causes de dégradations s'ajoute la perturbation des régimes hydriques, de submersion (DIOP *et al.* 1989, DIOUF 1996) et de sédimentation (SOUMARE 1992, DIOUF 1996). La pression humaine et les mesures de gestion inadéquates accélèrent encore le processus au lieu de le stabiliser. Au nombre des activités anthropiques, l'exploitation ligneuse et la pêche comptent parmi les plus préoccupantes.

L'exploitation ligneuse peut se diviser en trois catégories: l'usage traditionnel du bois de chauffe à titre domestique, l'exploitation commerciale des perches et l'approvisionnement des fours de séchage. Les perches de palétuviers, du fait de leur durabilité, font l'objet d'une forte demande pour la construction des cases, des clôtures, des tables de séchage des produits halieutiques ou encore pour les échafaudages des entrepreneurs. Outre la consommation locale, une importante demande émane de la ville de Kaolack, en amont du fleuve Saloum. Un marché informel approvisionne ce grand centre urbain (L'HOIR & PIRARD 2002).

Le secteur de la pêche procure divers produits halieutiques dont les plus commercialisés sont les poissons à l'état frais et à l'état sec. Ces poissons font aussi sur le plan local l'objet de troc contre les produits agricoles (mil, arachide) (NDOUR 2003). La production halieutique dans la région en 2000 était estimée à 5 642 tonnes ou 4,304 milliards de FCFA (JICA 2002). Parmi les espèces pélagiques, les ethmaloses (*Ethmalosa fimbriata*) et les mulets (*Mugil cephalus*) constituent 66 % des captures (NDOUR 2003). Ce secteur est actuellement en pleine expansion suite à l'apparition des fours de fumage.

LE FUMAGE DE L'ETHMALOSE (*ETHMALOSA FIMBRIATA*)

La transformation des produits halieutiques, et plus particulièrement de l'ethmalose dans les îles du Saloum, est une activité dont les prémisses remontent à plusieurs dizaines d'années. Aujourd'hui, elle ne cesse de gagner du terrain et de l'ampleur dans la RBDS. Elle a fait son apparition dans la réserve par l'intermédiaire de certains ressortissants de la sous-région (Guinée-Conakry, Burkina Faso, Sierra Leone) qui se déplacent vers les zones riches en bois combustible ou en poissons. Les étrangers basés

dans la zone investissent beaucoup dans cette activité de fumage et en détiennent d'ailleurs le monopole. Malheureusement, les insulaires ne profitent que très partiellement de ce commerce (NDIONGUE 2003).

Le bois utilisé pour fumer l'ethmalose dans la réserve est bien sûr le bois de palétuvier qui fait également l'objet d'un commerce illégal. En principe, l'exploitation de bois de *Rhizophora* ne devrait concerner que le bois mort. Dans la pratique, les tas de bois qui s'amoncellent auprès des fours sont de plus en plus constitués de bois vert. Les autorités ne disposent d'aucune information sur l'activité du fumage, sur les quantités de bois et de poissons mobilisées régulièrement. Ils ne sont donc pas en mesure d'estimer à long terme les menaces sur l'environnement que cette activité pourrait générer.

LES PLANS D'AMENAGEMENT

Face à ces menaces, les gestionnaires du milieu tentent de répondre par des plans d'aménagement de l'écosystème. Depuis 1998, la Direction des Parcs Nationaux du Sénégal, avec l'assistance de l'UICN, a lancé l'élaboration d'un «plan de gestion de la RBDS» sur base de nombreuses études écologiques et socio-économiques et en concertation avec les divers acteurs de la RBDS (ONG, association, élus locaux, administration). Partant d'une cartographie réalisée par le CSE, une carte d'occupation des sols et un découpage de la RBDS ont été réalisés en tenant compte des principes des zonages propres aux Réserves de la Biosphère de l'UNESCO. Par ailleurs, un projet japonais actuellement en cours tente également de proposer un plan plus forestier. Ces plans présentent cependant la faiblesse de ne pas reposer sur les conceptions locales de l'espace et sont de ce fait difficilement intelligibles aux personnes les plus concernées.

Les *Serer Niominka*

ETHNOGRAPHIE

Si la population de la zone était d'environ 600 000 habitants en 1997, avec des densités comprises entre 21 et 61 habitants au km^2 selon les arrondissements, on estimait en 1988 que l'ensemble de la RBDS avait une aire globale d'influence s'étendant sur plus d'1,3 millions de personnes (UICN 2003). Mais pour le domaine insulaire, ces valeurs démographiques sont trompeuses car elles ne laissent pas transparaître la situation réelle. En effet, les villages se concentrent sur de faibles surfaces et correspondent donc à

des zones de surdensité. Ce phénomène explique la pression anthropique qui s'exerce alors sur le milieu naturel, sans compter que les départements voisins (Kaolack et Fatick) sont également demandeurs de ressources naturelles. Il se pourrait que ces derniers soient les principaux responsables de la surexploitation de la mangrove (WERNER 1995).

Cette population est caractérisée par sa jeunesse (55 % ont moins de 30 ans), sa mobilité et sa grande diversité ethnique (les groupes ethniques dominants sont les Sérères Niominka, objet de notre analyse, et les Mandingues, qui cohabitent avec les Wolofs et les Toucouleurs).

Bien que l'ethnie majoritaire de la région du Siné-Saloum soit sérère, les îles du Saloum sont divisées en deux ethnies. Au nord du Diombos, dans les îles du Gandoul, vivent les Sérères Niominka. Au sud du fleuve, dans les îles Socé, vivent les Socé, ethnie sans doute d'origine mandingue, c'est-à-dire venue du Mali avec les envahisseurs venus islamiser la population (GRANDCOLAS 1997). L'islamisation des Sérères étant assez récente, ils sont encore influencés par l'animisme qui se base sur la croyance aux *pangool*. D'après les populations locales, les *pangool* sont les esprits de la brousse qui vivent dans un «arbre sacré». L'arbre est donc considéré comme lieu de cérémonie rituelle (JICA 2002).

NOTIONS DE TERROIRS VILLAGEOIS

La place des terroirs villageois dits «traditionnels» ou «coutumiers» au sein des aires protégées et de leur légitimité ne cesse, ces dernières années, de conduire à des débats passionnels aux fondements fort peu scientifiques. Aux vues conservationnistes de la gestion des aires protégées s'oppose actuellement un courant où indigénistes et spécialistes des sciences sociales dominent (VERMEULEN & KARSENTY 2001).

En Afrique de l'Ouest, différents travaux témoignent de l'ancienneté et de la diversité des formes d'appropriation des espaces aquatiques, de leur dynamique mais également des rapports de force qu'elles engendrent entre autorité locale coutumière et autorité nationale, et entre usagers (PLIYA 1981, VERDEAUX 1981).

Le terroir est l'espace constituant le fondement de l'existence des communautés, il est le reflet de leurs structures sociales, il témoigne des relations de pouvoir entre les lignages et entre les individus, il constitue la référence identitaire des membres d'une même communauté qui se différencient d'abord des «autres» par rapport aux terroirs limitrophes. Cette force du lien social vis-à-vis de l'espace explique l'intensité des conflits que provoque son usage partagé ou son accaparement (LAZAREV & ARAB 2002).

Le systeme foncier en Afrique

La colonisation et la monétarisation de l'Afrique lui ont inévitablement infligé l'épreuve du foncier. Ce qui pose problème en vertu de la logique «moderne» (marchande et étatique) reçoit une réponse dans la logique communautaire (Le Roy *et al.* 1996).

Au Sénégal, il existe deux systèmes fonciers: le système traditionnel régi par les coutumes et le système moderne réglementé par le droit écrit. D'après les coutumes, c'est le premier occupant qui obtient la propriété des terres découvertes. L'affectation de terre se fait rarement par donation et normalement, elle se réalise sous forme de transfert du droit d'usage. Le droit d'usage est reconnu essentiellement pour une seule génération. Cependant, avec l'augmentation de la population et sa recherche de nouveaux espaces, il est rare de constater des cas où la terre affectée est rendue (JICA 2002).

Par ailleurs, toujours selon JICA (2002), en dehors des terres affectées par le premier occupant que chaque famille utilise comme champs et parcelle d'habitation, il y a dans un village des espaces communautaires. Ces espaces sont constitués par les zones de parcours, les bosquets villageois, les mares, la mer, les bolongs, etc. En principe, les villageois peuvent utiliser ces espaces librement.

Pour la gestion des ressources naturelles, on décrit surtout celle des ressources foncières, halieutiques et forestières.

Les modes d'accès aux moyens de production permettent de décrypter les logiques de solidarité déterminantes et en particulier celles des unités micro-socio-économiques impliquées dans l'accès aux espaces et ressources naturelles renouvelables (Dahou & Weigel 2003).

Les modes d'accès aux espaces halieutiques deltaïques diffèrent selon les acteurs et les espaces. On assiste à un phénomène de «déterritorialisation» de ces espaces incorporés aux terroirs autochtones. Le contexte juridique et institutionnel n'a d'ailleurs pas été sans effet sur ces dynamiques migratoires puisque la loi sur le domaine national [5] atténue de facto la logique de terroir dans les activités liées à la pêche. Ce manque de régulation des ressources halieutiques par les populations autant allochtones qu'autochtones, est un stade qui évoluera inévitablement vers un épuisement du milieu déjà surexploité (Dahou & Weigel 2003).

La theorie des maitrises foncieres

Si le droit foncier intéresse le fond, il concerne aussi les éléments qui s'y rattachent. Sur un plan foncier, la ressource ne peut être dissociée de son support, sur un plan juridique, l'emprise sur la ressource nécessite presque toujours une maîtrise préalable sur l'espace. Toute forme de prélèvement [6]

transite par un accès et toute exploitation d'une ressource par une exclusivité de l'espace ressource. Nous devons alors distinguer les maîtrises foncières selon qu'il s'agit d'espace ou de ressource. Pour l'espace, la maîtrise sera indifférenciée ou exclusive, tandis que pour la ressource elle sera prioritaire, spécialisée ou absolue. La maîtrise sur la ressource implique donc très souvent une maîtrise sur l'espace (LE ROY *et al.* 1996).

La théorie des maîtrises foncières (LE ROY *et al.* 1996) permet de rendre compte d'une graduation des modes de contrôle des choses et des biens (les «objets de maîtrise»), ainsi que des rapports entre les hommes qui les contrôlent (les «sujets de maîtrise»). Elle permet de dépasser le cadre dichotomique classique de l'opposition privé-public (deux sujets de maîtrise parmi d'autres) ou propriété-accès libre (deux degrés de maîtrise parmi d'autres) (KARSENTY *et al.* 1997).

Il s'agit d'un modèle spécialement conçu pour rendre compte, à côté du mode africain d'organisation du rapport foncier, des innovations introduites par l'Occident en voulant généraliser le droit de propriété (LE ROY *et al.* 1996).

Le tableau 1 présente les différents modes de régulation de l'homme à la terre et aux ressources naturelles. Nous allons l'employer pour structurer les maîtrises développées par les *Serer Niominka.*

Tableau 1

Régulation des rapports de l'homme à la terre et aux ressources naturelles par les maîtrises foncières (LE ROY *et al.* 1996)

Modalité d'appropriation	**Maîtrise indifférenciée** Chose	**Maîtrise prioritaire** Avoir	**Maîtrise spécialisée** Possession	**Maîtrise exclusive** Propriété fonctionnelle	**Maîtrise exclusive et absolue** Bien
Modalité de cogestion	Droit d'accès	Droit d'accès et d'extraction	Droit d'accès, d'extraction et de gestion	Droit d'accès, d'extraction, de gestion et d'exclusion	Droit d'user et de disposer donc d'aliéner
Public Commun à tous	A1	A2	A3	A4	A5
Externe Commun à n groupes	B1	B2	B3	B4	B5
Interne-externe Commun à deux groupes	C1	C2	C3	C4	C5
Interne Commun à un groupe	D1	D2	D3	D4	D5
Privé Propre à une personne	E1	E2	E3	E4	E5

La théorie des maîtrises foncières a déjà été utilisée par VERMEULEN & CARRIERE (2002), pour donner des propositions d'aménagement adaptées au système foncier coutumier d'essarteurs en Afrique centrale forestière, les *Badjoué* de l'Est-Cameroun.

Nous trouverons en annexe le lexique des maîtrises précisant le contenu de chacune des vingt-cinq cases ou maîtrises du tableau.

Tableau 2
Identification de la nomenclature sérere des espaces et des ressources

Type d'espace et d'espace-ressource	**Appellation sérère**
Espace habité	
Village	Saate
Campement (permanent ou temporaire)	Akad
Débarcadère (lieu où une pirogue peut accoster)	Ndangan
Espace de pêche	Rhapalan darhe
Zone de pêche	O faland
Océan	Doxaan
Bolong / petit bolong	A kal / o ngal
Mer (océan + bolongs)	Maag
Zone inondable peu profonde sans mangrove (pêche au mulet et au tilapia à l'épervier)	A pas
Vasière ou banc de sable / petite vasière (pêche, ramassage des mollusques, émergée à marée basse)	A sare
Zone profonde (cuvette de 10-15 m de diamètre) où convergent des bolons (pêche au thiof, carpes, barracuda, tilapia)	I rad
Banc de sable	Kenie
Rivage — plage	Berham
Mare formée par une dépression lors du retrait de l'eau	Yawand
Canal navigable du bolon (partie toujours en eau à marée basse)	Yoon
Chenal de drainage des eaux dans la vase (ruisseau à marée basse)	O sor
Mangrove	
«Mangrove haute»	Njas djig
«Mangrove basse»	Njas rahoub
Mangrove dégradée	Njas rhon
Avicennia africana	Fugand
Bois de chauffe	Tchou atchawir
Bois de service	Sarpagne
Sel	O jem
Zones insulaires	
Brousse	A kop
Zones interdites	Onbing oguama foutiel
Rizière	I mbara
Tanne vif ou herbacé	O tan
Puits	Ngas
Chemin	dat

Mode d'accès, d'appropriation et de régulation traditionnelle des espaces-ressources chez les Niominkas

Cette deuxième partie aborde l'étude des modes d'accès et d'appropriation des espaces-ressources chez les *Serer Niominka* et leurs éventuelles pratiques de gestion de la mangrove. La connaissance des ressources exploitées par les communautés villageoises étudiées implique tout d'abord l'identification des différents espaces-ressources. Le tableau 2 dresse la liste de quelques espaces et espaces-ressources de première importance. Il intègre les appellations locales propres à la zone, reflétant ainsi les concepts utilisés par les populations locales.

L'intérêt de recenser les noms locaux réside dans le fait que les aménagements peuvent ensuite être construits sur base des notions développées et vécues au quotidien par les populations locales. Les aménagements leur deviennent alors lisibles et accessibles.

Pour chacun des espaces et pour chaque ressource naturelle qui s'y rapporte, nous allons maintenant détailler les représentations locales et le type de maîtrises qui s'y rapportent.

Les espaces halieutiques

Les différents types d'espaces halieutiques rencontrés et exploités par les insulaires sont l'océan, les bolongs, les «passes» ou zones inondables à marée haute et les vasières où s'effectue aussi la collecte des mollusques. L'exploitation des ressources halieutiques chez les populations *Niominka* des îles du Saloum est en principe empreinte de sacralité. L'abondance ou la faiblesse des captures, les accidents, les malheurs qui s'abattent sur des pêcheurs ou sur leur progéniture, la pêche de certaines espèces dépendent du type de rapport que les *Niominka* entretenaient jadis avec le sacré. Il semble qu'il existait au sein de leur système ethnique, un mécanisme de prélèvements organisé par des forces supérieures vénérées et écoutées par les populations autochtones qui leur dictaient, défendaient et autorisaient les prélèvements dans leur milieu.

Les «passes» sont situées à l'interface entre les îles et les formations de mangrove; ce sont d'anciennes zones de pêche traditionnelles. Les villageois tendaient leurs filets à marée haute le long des berges pour piéger les poissons s'alimentant dans ces «passes». Si ces espaces sont situés sur un îlot habité, ils font l'objet d'une maîtrise exclusive, réservés aux villageois de l'île. Comme cette technique est actuellement délaissée en faveur des

techniques modernes de capture beaucoup plus efficaces, les traditions se perdent.

En se référant au tableau des maîtrises foncières de Le Roy *et al.* (1996), nous pouvons attribuer à ces espaces une maîtrise indifférenciée publique. En effet, aucune gestion ou exclusion n'est de mise en ces lieux considérés comme espaces communautaires à toutes les populations locales présentes.

La peche

Les différentes techniques de pêches traditionnelles délimitaient autrefois des espaces de pêche dans lesquels nous pouvons distinguer certaines maîtrises. Les limites de cet espace pour la pêche à la crevette dans la CR de Djirnda par exemple, se situent à travers le Saloum au niveau de l'île aux oiseaux. Ces limites sont valables pour les terroirs de la CR situés en amont de l'île, elles partagent en quelque sorte les espaces de pêche au sein du Saloum, et sont encore respectées par les usagers traditionnels. Cette tradition est cependant en pleine mutation. Les pêcheurs de crevettes d'aujourd'hui proviennent de partout et ne reconnaissent pas ces limites; ils utilisent des filets non réglementaires et surexploitent la ressource.

Les techniques de pêche utilisant des flotteurs ne sont par ailleurs soumises à aucune réglementation traditionnelle. La ressource étant autrefois abondante, les villageois respectaient toujours un périmètre fixé arbitrairement. On parlera donc de maîtrise indifférenciée publique pour ces zones de pêche.

Pour les autres types de pêche traditionnelle (filets dormants ou dérivés), on parlera de maîtrise exclusive interne. Ce type de pêche se pratique en général le long des berges, souvent proches des villages et incluses dans les maîtrises spécifiques au terroir terrestre. Ces maîtrises sur les terroirs de pêche sont rares et ne s'appliquent qu'à un nombre limité d'espaces.

Les huitres

La récolte des huîtres se caractérise par une maîtrise prioritaire publique. L'exploitation de cette ressource s'arrête en hivernage, saison pendant laquelle le mollusque se reproduit.

Les mollusques de vasieres

Ces lieux de récolte sont en général sollicités par les femmes d'un même village s'organisant en fonction des pirogues disponibles. Cette activité se

déroule lors du jusant, aussi bien pour les huîtres que pour les pagnes, seule période de la journée où l'accès aux vasières et aux racines échasses est possible.

L'accès aux vasières, hormis celles situées le long des grands axes de circulation comme le Saloum, est parfois régulé par un groupe de femmes d'un même terroir villageois. Ces femmes disposent donc de prérogatives sur les vasières limitrophes au terroir villageois sur lesquelles nous pouvons donc avancer une maîtrise indifférenciée externe.

Discussion

Suite à la nouvelle législation, les espaces halieutiques sont considérés comme partie intégrante du domaine national et donc comme domaine public. De nombreux pêcheurs allochtones sont attirés par les ressources halieutiques du Delta, ils ne respectent aucunement la régulation traditionnelle, troublent du coup les insulaires qui se sentent dépossédés de leurs ressources; l'équilibre entre celles-ci et le prélèvement s'en trouve menacé.

Les embouchures se caractérisent par une concentration très importante de différents types de pêche et des différentes communautés, c'est pourquoi de nombreux conflits d'appropriation de l'espace s'y déroulent. Ces conflits d'une ampleur encore relativement limitée, impliquent des pêcheurs allochtones ou autochtones, et sont souvent dus aux incompatibilités qui relèvent des emmêlements de filets. Ce type de cogestion publique constitue dans l'immédiat un procédé permettant à tous les exploitants de la zone d'acquérir rapidement d'importantes sources de revenus mais à long terme, la surexploitation des ressources halieutiques entraînera un inévitable et profond déséquilibre. La gestion territoriale de la pêche a donc échappé aux villageois, les territoires se chevauchent et les populations locales ont décidé d'en tirer profit en s'adaptant rapidement à ces nouveaux modes de prélèvement. Le besoin de réguler les captures est urgent au vu des déprédations accélérées sur le milieu suscitées par ce phénomène.

Les rares systèmes de régulation actuels, tels que le repos biologique préconisé par les ONG environnementales et les organismes internationaux actifs dans la conservation de la biodiversité de la RBDS, ont pour but de diminuer la pression sur les ressources halieutiques. Ils peuvent trouver des équivalents dans les pratiques traditionnelles des *Niominka*. Ces dernières portent par exemple la fermeture de bolongs à certaines périodes de l'année, la limitation des captures ou encore le système de pêche collective, pratiqués dans certains villages.

Les ressources ligneuses

Concernant la régulation de l'accès aux ressources forestières, la situation est là encore très variable selon les villages et selon les ressources qui font l'objet d'une exploitation. L'accès proprement dit y est, comme pour les espaces halieutiques, libre à tous. La maîtrise indifférenciée publique qui en découle doit être nuancée selon la situation locale, les villageois les plus proches présenteront une priorité sur l'espace sans pour autant le gérer ou prétendre le droit d'exclure les gens d'autres villages.

Les ressources ligneuses exploitées au sein de la mangrove concernent le bois de palétuvier sur pied, vert ou mort. En droit traditionnel, la coupe de bois «mort» à usage domestique est sous un régime de maîtrise prioritaire externe: son accès et son extraction sont communs à plusieurs villages. Avec la raréfaction actuelle de la ressource, la multiplication des usagers et le développement de l'exploitation commerciale du bois, la distance de collecte augmente et la maîtrise se dilue. Les figures 1, 2 et 3 ainsi que le tableau 3 présentés par GHYSELS (2004), illustrent l'augmentation des distances parcourues et des volumes exploités.

Tableau 3

Comparaison des zones de coupes

Usages / Propriétés	Bois de chauffe domestique	Bois de fumage
1. Distances parcourues	Rayon de prospection de 9,5 km	Plus de 36 km au Sud
2. Localisation dans la RBDS:		
Zone tampon,	Oui	40%
Zone F anthropisée,	Oui	50%
Zone f anthropisée,	Non	} 10%
Zone centrale et PNS,	Non	
En dehors	Oui	0%
3. Etendue des zones prospectées	la zone d'exercice des droits d'usage s'étend sur environ 13.559 ha	Toute la RBDS, autrement dit 180.000 ha !
4. Quantités de bois nécessaires	1580m³ pour satisfaire pendant un an les besoins domestiques des populations	2463,5m³ pour approvisionner une campagne de fumage.

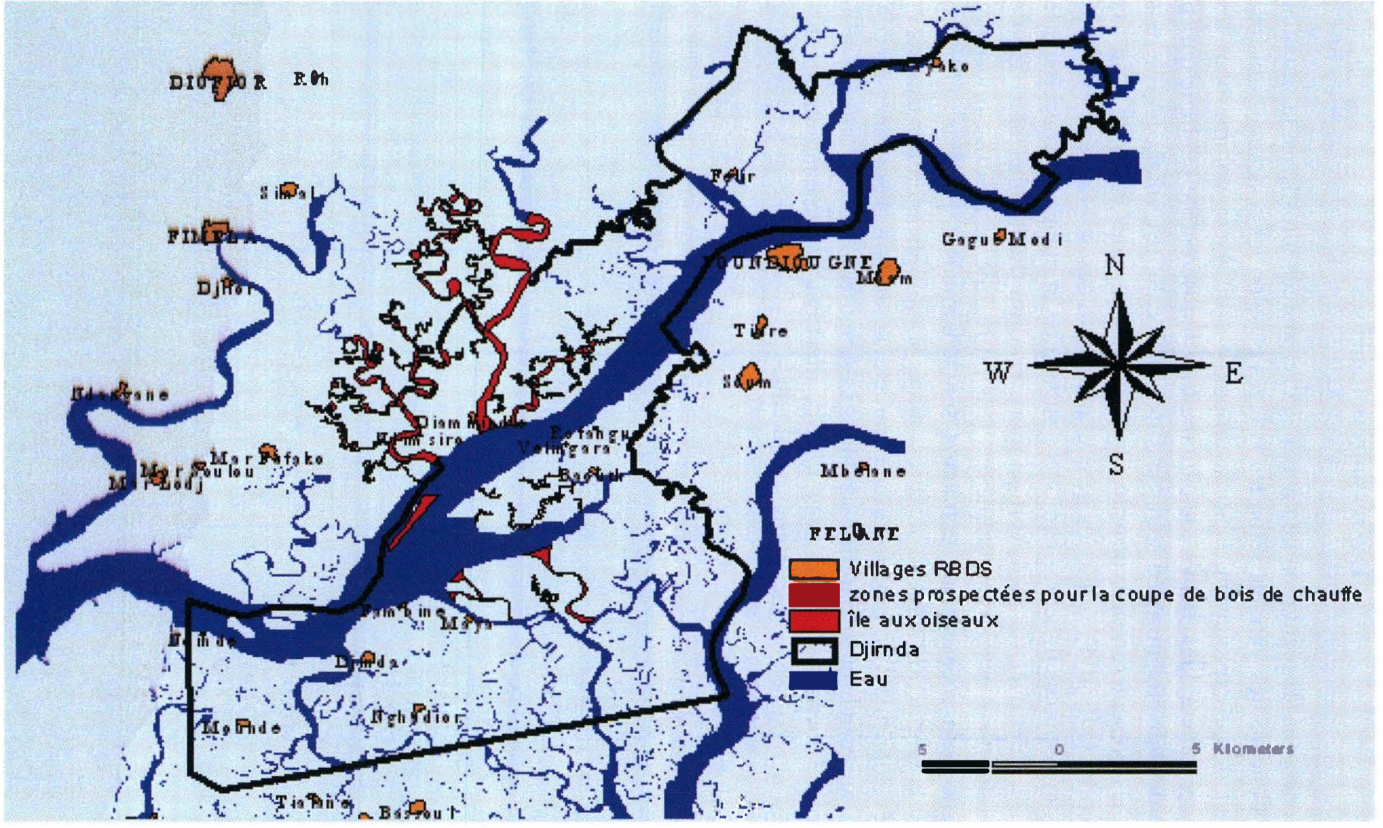

Fig. 1. — Cartographie des zones d'exercice des droits d'usage: coupe de bois 'mort' de palétuvier pour les besoins domestiques.

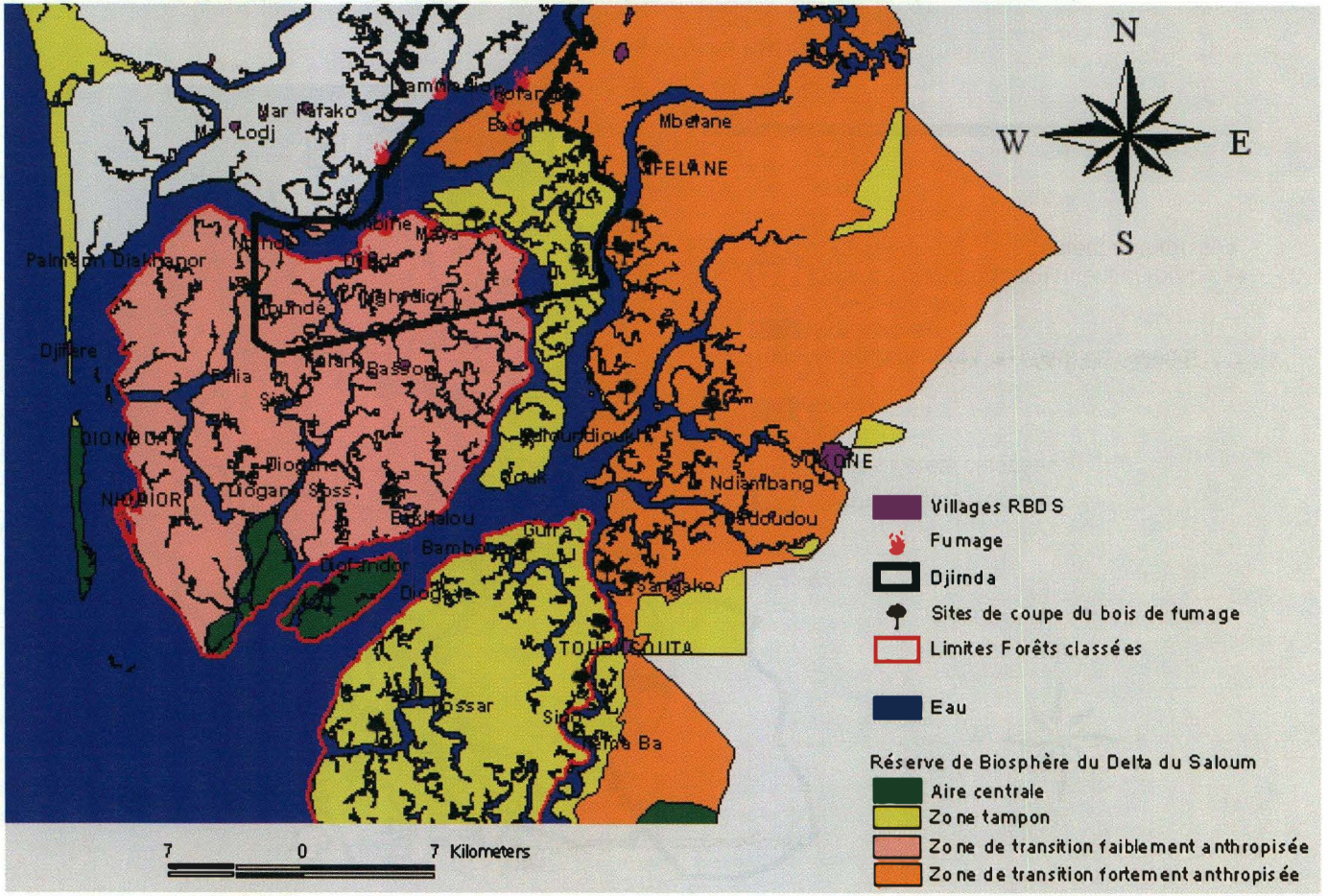

Fig. 2. — Cartographie des zones de prélèvement à titre commercial: bois de fumage.

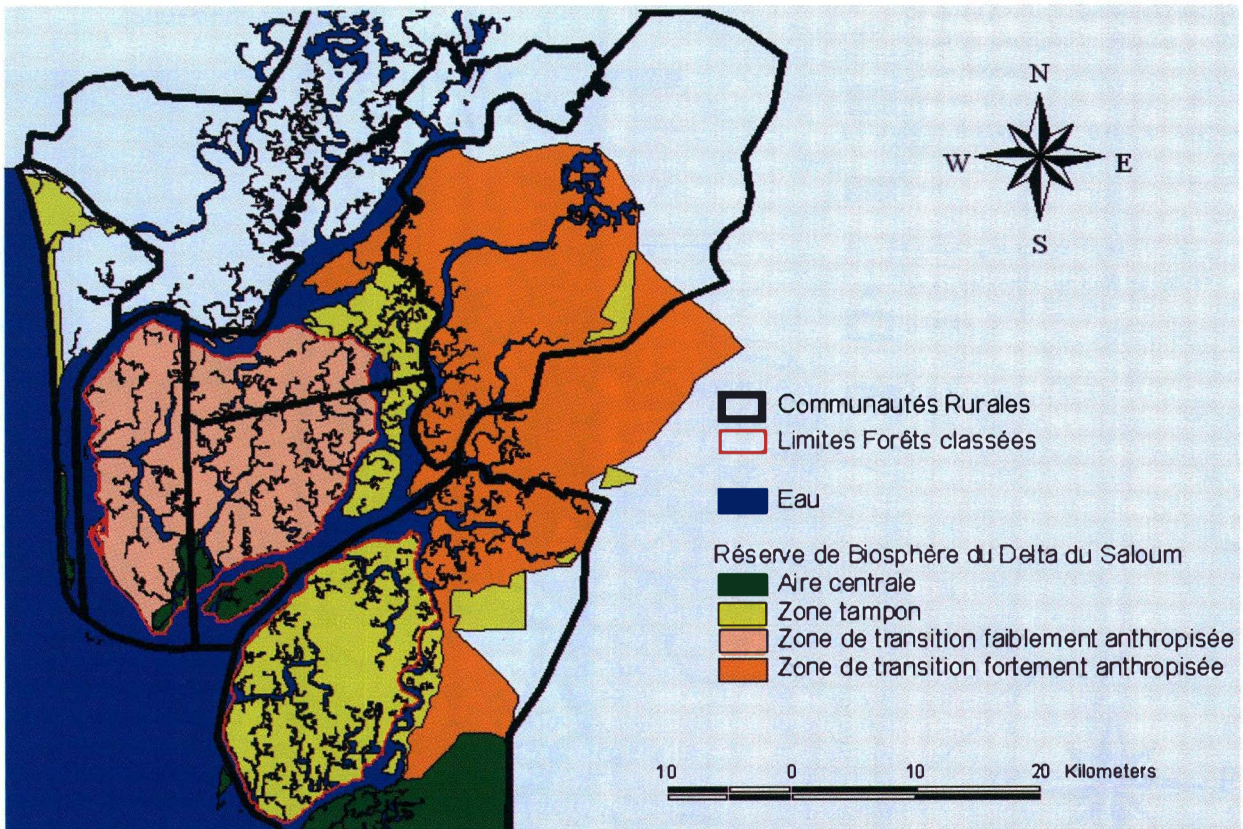

Fig. 3. — Localisation RBDS.

Espace insulaire

Les principales zones constituant l'espace insulaire sont les brousses, les tannes vives ou herbues, les amas coquillés et les marigots. Parmi ces zones, certaines sont reconnues comme «zones sacrées» par les *Niominka*. Les modes d'accès et la réglementation traditionnelle qui s'y appliquent sont assez particuliers.

Brousses

Dans le cas des brousses, les droits d'usage sont habituellement partagés entre plusieurs villages. Certaines personnes avaient néanmoins un droit d'usage prioritaire sur les brousses ou, en termes d'espace, une maîtrise exclusive interne sur ces brousses. Celui-ci proviendrait des rites qu'entretenaient ces gens avec la nature. Il existe, en brousse, des baobabs hiératiques appartenant à d'anciennes familles matrilinéaires ou *Tim*, cette appropriation étant encore reconnue à l'heure actuelle par la plupart des villages avoisinants.

Selon les coutumes, ces familles se voient tributaires des libations et sacrifices qu'on accordait aux *pangols* ou esprit de la brousse ayant élu domicile dans ces baobabs «sacrés», dans le but d'obtenir d'eux protection et faveurs. Ces rites se pratiquent encore exceptionnellement par certaines familles qui ont gardé d'incontestables traditions animistes.

En contrepartie, elles ont la maîtrise spécialisée interne sur les feuilles et fruits de ces arbres, c'est-à-dire que toutes les familles *Tim* de même nom ont accès aux baobabs sacrés, même si elles sont de villages différents. De plus, elles détiennent sur les autres familles un droit d'exclusion. Ces dernières gardent cependant un droit d'accès et de récolte. Pour ce qui est de l'aliénation, seules les *Tim* ont traditionnellement le droit de vendre les produits récoltés. Ces antiques maîtrises se trouvent en opposition à la loi sur le domaine national de 1962 qui fait de l'Etat l'unique propriétaire foncier, déniant tout droit de propriété aux propriétaires lignagers ou aux chefferies villageoises. Il existe aujourd'hui dans la législation moderne, une autorisation à titre commercial que les populations doivent se procurer auprès du service des E&F, afin de pouvoir vendre ces produits forestiers non ligneux.

Notons que ces familles matrilinéaires étaient également héritières et gestionnaires des rizières, mais avec l'islam, ces pratiques se sont rectifiées en faveur du patrimoine paternel. Cette riziculture est cependant en perte de vitesse en raison de la péjoration climatique.

Enfin, la paille reconnue sous les noms de *Ndouïe* et *Sindin* est encore récoltée dans ces brousses pour la construction des toits de cases. Elle relève d'une maîtrise prioritaire publique. Plusieurs *pangols* protègent d'ailleurs les fagots laissés en brousse par les propriétaires. L'accès aux brousses était donc régulé par la présence de rizières ou de *pangols*.

Sites sacres

Les *pangols* ou esprits de la brousse, sont des représentations mythiques, des croyances religieuses traditionnelles qui perdent aujourd'hui beaucoup d'adeptes, suite à l'influence de l'islam. Cela dit, dans la vie quotidienne, on assiste encore à de nombreux renvois à ces traditions ancestrales.

Il existe des brousses ou bolongs dans lesquels tous respectent certaines règles. L'accès y est régulé par des génies bons ou malfaisants. Un exemple-type ressort des entretiens menés auprès des populations locales, il témoigne de la présence de l'esprit *Laga* maléfique résidant dans un baobab sacré à proximité du village de Soum [7]. La zone d'influence de cet esprit s'étend à tous les espaces environnants (mangrove, bolongs, vasières et amas coquilliers). L'accès y est formellement interdit aux Wolofs, aux personnes vêtues de rouge et nul ne peut y prélever les fruits de son territoire hormis la famille bienveillante, qui y dispose donc d'une maîtrise exclusive interne. A ces croyances, nous ne pouvons pas associer de réels modes de gestion. En effet, la vision occidentale associe bien souvent à tort cette «sacralisation» comme étant un système de conservation des ressources naturelles. Il est vrai que la sacralisation de certains espaces, la vénération de certaines espèces et la limitation des jours de captures ont sans conteste eu des effets positifs sur la conservation de certaines ressources. Il faut cependant éviter tout discours de type déterministe, les interdits ayant souvent plus pour objet d'affirmer la place sociale d'un groupe privilégié que le réel souci de gestion de l'écosystème.

Discussion

L'intérêt de pouvoir visualiser les zones d'influence de ces croyances religieuses traditionnelles parfois maléfiques réside dans l'importance qu'elles prennent aux yeux des populations insulaires. Il est primordial dans un contexte de conservation et de mise en aménagement participatif de tenir compte de tous ces espaces sacrés. L'implantation d'une forêt communautaire par exemple ne pourrait se concevoir en ces lieux, vu la crainte qu'ont

les villageois de s'y rendre. *A contrario*, ces croyances pourraient appuyer certaines mesures de gestion modernes, comme le repos biologique de certains bolongs.

Structuration des maîtrises et propositions de gestion

Nous allons maintenant synthétiser dans le tableau des maîtrises foncières l'ensemble des maîtrises que les *Niominka* appliquent aux espaces et aux ressources naturelles. Signalons cependant d'emblée que le type de maîtrise sur un objet peut varier en fonction de l'usage économique qu'on en fait, de son emplacement et de l'individu ou groupe qui le prélève, qui l'exploite ou le gère. La théorie des maîtrises foncières se complique et s'adapte en fonction du temps, de la succession des acteurs, de la situation ou de l'usage, ces deux facteurs additionnels étant des éléments essentiels à considérer. Les maîtrises peuvent présenter des évolutions rapides, adaptations locales aux changements environnementaux et institutionnels.

Le tableau 4 présente l'ensemble des régulations possibles des rapports que les *Niominka* de la communauté rurale de Djirnda entretiennent avec les espaces-ressources qu'ils exploitent. En caractères gras, figurent les espaces, les ressources étant représentées en style normal.

Du point de vue d'une éventuelle gestion des ressources naturelles, nous pouvons distinguer chez les *Niominka*, comme l'ont montré Vermeulen & Carriere (2002) pour d'autres groupes ethniques, deux types principaux d'espaces-ressources:

— **Contrôlés par un groupe restreint répondant à des entités de gestion** (individu, famille) **facilement identifiables**: essentiellement les éléments de la tenure foncière agricole, les rizières, les arbres à *pangool*, les sites sacrés, et les espaces halieutiques exploités par les anciennes techniques de pêche. L'amélioration de la gestion de ces ressources s'adressera à ces acteurs précis. Il s'agit des maîtrises exclusives internes et privées.

— **Libres, ouverts à des utilisateurs divers qui peuvent même ne pas appartenir au groupe *Niominka*,** dont le contrôle est inexistant, tels les espaces halieutiques concernés par la pêche commerciale, ou la ressource ligneuse située dans la mangrove au large des villages.

C'est vis-à-vis de cette dernière catégorie de ressources qu'une gestion locale paraît la plus aléatoire et qu'un contrôle extérieur au groupe est nécessaire si une surexploitation de la ressource apparaît.

Tableau 4

Type de maîtrises appliqué aux espaces et aux ressources naturelles dans la CR de Djirnda

Modalité d'appropriation	**Maîtrise indifférenciée** Chose	**Maîtrise prioritaire** Avoir	**Maîtrise spécialisée** Possession	**Maîtrise exclusive** Propriété fonctionnelle	**Maîtrise exclusive et absolue** Bien
Modalité de cogestion	Droit d'accès	Droit d'accès et d'extraction	Droit d'accès, d'extraction et de gestion	Droit d'accès, d'extraction, de gestion et d'exclusion	Droit d'user et de disposer donc d'aliéner
Public Commun à tous	**Espaces halieutiques: océan; bolongs; territoire de pêche aux flotteurs; vasières de grands axes; mangrove.**	Poissons; huîtres; mollusques de vasières; sable; pailles de brousse; bois mort et bois de service dans les espaces éloignés.			
Externe Commun à n groupes	**Certaines vasières**	Bois mort et bois de service dans la mangrove villageoise.			
Interne-externe Commun à deux groupes					
Interne Commun à un groupe	**Mangrove villageoise.**	Bois mort de brousse.	Feuilles et fruits des arbres à *pangool.*	**Certaines passes; territoires de pêche** (à la crevette, aux filets dormants et aux filets traînés); **certaines brousses; anciennes rizières.**	
Privé Propre à une personne					

Discussion et conclusion

Il apparaît donc que, paradoxalement, les insulaires *Niominka* ne développent traditionnellement que des maîtrises faibles sur les espaces halieutiques en général et toutes les ressources de mangroves en particulier; lorsque celles-ci se précisent, ces maîtrises ne concernent que les espaces aquatiques proches des villages. Cette situation traduit probablement, d'une part, l'arrivée tardive de ces populations dans la zone et, d'autre part, un système de production jadis plus tourné vers l'agriculture. Plus prosaïquement, et en toute logique, ce système comprend des règles précises pour des ressources jadis rares et prisées (la terre) et des règles plus lâches, voire inexistantes, pour des ressources jadis abondantes.

La mutation des systèmes de production locaux, leur monétarisation croissante et l'apparition d'allochtones prédateurs des ressources naturelles, n'en est donc que plus dramatique, car elle se développe donc dans un «vide juridique» coutumier. Qui plus est, les *Niominka* cherchant tout autant à tirer parti de cette nouvelle donne, ils sont peu enclins à faire respecter les anciennes pratiques.

Comme le soulignaient DAHOU & WEIGEL (2003), «les modes d'accès aux espaces terrestres ou aquatiques (fluviaux, estuariens ou maritimes) connaissent une évolution liée à l'accroissement démographique, aux changements environnementaux et institutionnels. Ceux-ci affectent en particulier les terroirs villageois et les modes d'accès aux divers espaces halieutiques deltaïques, ce qui conduit à s'interroger sur l'amorce d'une "déterritorialisation" des espaces halieutiques».

Il semble donc que, pour un grand nombre de ressources présentes dans cette zone, et particulièrement celles éloignées des villages, la gestion participative axée sur les pratiques locales *Niominka* ne soit qu'une utopie. D'abord parce qu'elle reposerait sur une base conceptuelle peu solide, ensuite parce qu'elle ne serait partagée que par une partie seulement des acteurs (les allochtones ne reconnaissant aucune de ces maîtrises). Seuls les espaces-ressources proches des villages pourraient faire l'objet de tentatives d'aménagement ciblées reposant sur les pratiques et maîtrises anciennes.

Pour les espaces-ressources éloignés, sur lesquels les comportements prédateurs commerciaux s'exercent en dehors de tout cadre coutumier, la première des mesures de gestion semble bien de renforcer tous les types de contrôle étatiques et extérieurs. C'est seulement à ce prix que l'écosystème pourra encore fournir les services qu'il rend actuellement aux communautés locales. Par la suite, une approche participative de type classique, fondée sur des groupes d'utilisateurs des ressources, pourrait être initiée, avec

l'enregistrement d'un nombre précis d'utilisateurs par site et par ressource et l'établissement de quotas de prélèvements sévèrement contrôlés. Ce type d'approche serait doublé de zones en repos biologique et d'une approche par rotation des zones exploitées.

NOTES

[1] Un plan de gestion de la Réserve de la Biosphère du Delta du Saloum a été élaboré.

[2] C'est le cas du projet d'«Appui à la gestion communautaire des ressources naturelles des forêts de mangrove dans la Réserve de Biosphère du Delta du Saloum», exécuté par les ONG belges ADG et Nature Plus, une ONG sénégalaise, WAAME, et par la Direction des Parcs Nationaux du Sénégal (DPN), grâce au soutien de la Commission Européenne.

[3] Séminaire sur les «pratiques éclairées» en vue du développement durable des régions côtières et des petites îles, Dakar, Sénégal, 14 mai 1998.

[4] Circonscription administrative qui regroupe plus d'une vingtaine de villages.

[5] La loi sur le domaine national de 1962 fait de l'espace maritime la propriété de l'Etat.

[6] Le prélèvement se distingue de l'exploitation par le fait qu'il consiste en un acte de prédation, sans aucun souci de gestion. En revanche, l'exploitation intègre la gestion de la ressource, un intérêt direct à la maintenir afin d'en pérenniser le profit. L'accès à l'espace implique le prélèvement de la ressource sur cet espace tandis que l'exclusivité de l'espace génère l'exploitation de la ressource (Le Roy *et al.* 1996).

[7] Village localisé au Nord de la RBDS dans la CR de Djilor.

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ANNEXE

Lexique des maîtrises

A1: Maîtrise indifférenciée et publique: elle porte sur une chose, autorise un droit d'accès et implique une cogestion, commune à tous.

A2: Maîtrise prioritaire et publique: elle porte sur un avoir, autorise l'exercice d'un droit d'accès et d'extraction des ressources et son mode de cogestion est commun à tous.

A3: Maîtrise spécialisée et publique: elle porte sur une possession, autorise l'accès, l'extraction et emporte un droit de gestion dans le cadre d'une cogestion commune à tous.

A4: Maîtrise exclusive et publique: il s'agit d'une propriété fonctionnelle impliquant droits d'accès, d'extraction, de gestion et d'exclusion des tiers dans le cadre d'une cogestion, commune à tous.

A5: Maîtrise absolue et publique: il s'agit de l'exercice d'un droit de propriété absolu emportant l'accès, l'extraction, la gestion, l'exclusion et l'aliénation dans le cadre d'une cogestion, commune à tous.

B1: Maîtrise indifférenciée et externe: elle porte sur une chose, emporte un droit d'accès et implique une cogestion entre quelques groupes limitativement énumérés.

B2: Maîtrise prioritaire et externe: elle concerne un avoir sur lequel s'exerce les droits d'accès et d'extraction; sa cogestion est commune à quelques groupes limitativement énumérés.

B3: Maîtrise spécialisée et externe: elle porte sur une possession, autorise les droits d'accès, d'extraction et de gestion et son mode de cogestion est commune à quelques groupes limitativement énumérés.

B4: Maîtrise exclusive et externe: il s'agit de l'exercice d'un droit de propriété fonctionnelle emportant droit d'accès, d'extraction, de gestion et l'exclusion des tiers dans une perspective de cogestion entre quelques groupes limitativement énumérés.

B5: Maîtrise absolue et externe: il s'agit de l'exercice d'une propriété absolue emportant droit d'accès, d'extraction, de gestion, d'exclusion et d'aliénation en vue d'une cogestion, commune à quelque groupes limitativement énumérés.

C1: Maîtrise indifférenciée et interne-externe: elle porte sur une chose et emporte droit d'accès dans une perspective de cogestion limitée à deux groupes en relation d'alliance.

C2: Maîtrise prioritaire et interne-externe: elle concerne un avoir sur lequel s'exerce les droits d'accès et d'extraction et son mode de cogestion est commun à deux groupes en relation d'alliance.

C3: Maîtrise spécialisée et interne-externe: elle porte sur une possession, autorise l'exercice de droit d'accès, d'extraction et de gestion dans le cadre d'un mode de cogestion, commun à deux groupes en relation d'alliance.

C4: Maîtrise exclusive et interne-externe: l'exercice d'un droit de propriété fonctionnelle emporte droits d'accès, d'extraction, de gestion et d'exclusion des tiers dans le cadre d'un mode de cogestion, commun à deux groupes en relation d'alliance.

C5: Maîtrise absolue et interne-externe: il s'agit de l'exercice de la propriété absolue emportant droit d'accès, d'extraction, de gestion, d'exclusion et d'aliénation dans le cadre d'une cogestion, commune à deux groupes en relation d'alliance.

D1: Maîtrise indifférenciée et interne: elle porte sur une chose, emporte droit d'accès et se réalise dans une cogestion au sein d'un groupe «en corps» (corporate group).

D2: Maîtrise prioritaire et interne: elle concerne un avoir sur lequel s'exercent les droits d'accès et d'extraction dans le cadre d'une cogestion, commune à un groupe «en corps».

D3: Maîtrise spécialisée et interne: elle porte sur une possession, autorise l'exercice de droits d'accès, d'extraction et de gestion dans le cadre d'une gestion commune à un groupe «en corps».

D4: Maîtrise exclusive et interne: il s'agit de l'exercice d'un droit de propriété fonctionnelle emportant droits d'accès, d'extraction, de gestion et d'exclusion dans le cadre d'une cogestion, commune à un groupe «en corps».

D5: Maîtrise absolue et interne: il s'agit de l'exercice de la propriété absolue emportant droit d'accès, d'extraction, de gestion, d'exclusion et d'aliénation dans le cadre d'une cogestion, commune à un groupe «en corps».

E1: Maîtrise indifférenciée et privée: elle porte sur une chose, autorise un droit d'accès et bénéficie à une personne physique ou morale.

E2: Maîtrise prioritaire et privée: elle porte sur un avoir sur lequel s'exercent les droits d'accès et d'extraction au bénéficie à une personne physique ou morale.

E3: Maîtrise spécialisée et privée: elle porte sur une possession, permet l'exercice de droits d'accès, d'extraction et de gestion au bénéficie à une personne physique ou morale.

E4: Maîtrise exclusive et privée: il s'agit de l'exercice d'un droit de propriété fonctionnelle emportant droits d'accès, d'extraction, de gestion et d'exclusion des tiers au bénéficie à une personne physique ou morale. Cette définition correspond à celle de *property right*.

E5: Maîtrise absolue et privée: «le fait de pouvoir jouir et de disposer des choses de la manière la plus absolue à condition de respecter les lois et règlements en vigueur» (article 544 du code civil) dénomme au profit d'une personne physique ou morale que le Code civil dénomme «le particulier» et l'anglais juridique l'*owner*.

Sans prétendre généraliser les enseignements de cette matrice à des situations caractéristiques des économies développées, tant sur le plan juridique qu'institutionnel, tentons d'en apprécier les implications dans les sociétés africaines.

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Potential of High-resolution Wood Anatomy and Stable Isotope Measurements for Tropical Dendrochronology: a Case Study on a Kenyan Mangrove Tree Species

by

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KEYWORDS. — Kenya; Mangrove; Spectral Analysis; Tree Rings; Tropical Dendrochronology.

SUMMARY. — Mangroves are unique tropical and subtropical intertidal forests with a high ecological, as well as socio-economic value. However, in many tropical regions, mangrove forests are disappearing at an alarming rate, mostly due to direct anthropogenic influences. Furthermore, sudden die-off of mangrove trees has been reported in several countries. In order to protect these valuable ecosystems, there is an urgent need to identify the possible causes of the observed degradation and to define indicators of ecosystem health, which would allow early detection of the degradation of the forests in the future. Dendrochronology or tree ring analysis offers a potential tool to study changes in environmental conditions and provide insight in the vegetation history and forest ecology. However, like many tropical trees, mangrove tree species have often been reported to lack annual growth rings, which restrains dendrochronological investigation. The aim of this study was to investigate the potential of *Rhizophora mucronata* wood as a proxy for changes in environmental conditions.

Using cambial marking, as well as trees of known age (plantation trees), annual growth rings were discovered in this mangrove tree species. The growth rings are composed of a low vessel density earlywood, produced during the long and short rainy season and a high vessel density latewood, produced during the dry season. The growth ring boundary is indistinct and is characterized by a gradual change in vessel density. The annual growth rings provide information on the age and the growth rates of the trees. However, ring width time-series failed to synchronize, indicating that the interannual variability in tree growth could not be related to a

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common external (environmental) factor and consequently, that ring width cannot be used as a proxy to study changes in environmental conditions at an annual resolution. Therefore, the potential environmental information stored in the wood anatomy and in the stable carbon and oxygen isotope ratios of the tree rings was investigated.

Intra-annual variability in vessel density and size revealed a trade-off between hydraulic efficiency (large vessels) during the rainy season and hydraulic safety (small, more numerous vessels) during the dry season. In addition to this annual earlywood/latewood signal, a semi-annual signal was also discovered after Fourier transformation of the high-resolution vessel density and diameter profiles. The annual and semi-annual signal was also observed in the Fourier spectra of the precipitation and relative humidity and is related to the bimodal distribution of the rainfall in Kenya, resulting in a long and short rainy season (semi-annual signal) and one distinct dry season (annual signal). The similarity in the Fourier spectra of the climate data and the vessel features offers strong additional evidence for a climatic driving force controlling the vessel density and diameters, either through changes in the relative humidity or through changes in the pore water salinity caused by precipitation, or both.

High-resolution stable isotope profiles revealed a clear annual cyclicity with minima and maxima occurring in the vicinity of the latewood/earlywood and earlywood/latewood boundaries, respectively. The presence of this annual cyclicity offers a high potential for identifying growth rings in tropical trees that lack visible anatomical growth rings. In addition, the presence of a conspicuous pattern in the isotope signal in the El-Niño year, 1997, in all three trees analysed indicates that years with extreme climatic events ("event years") are archived in the wood and can possibly be used for crossdating the tree rings. However, the driving forces behind the annual cyclicity could not be identified using our current knowledge on mangrove physiology and the current models on isotope fractionation in C_3 plants. Similarity between the high-resolution isotope profiles of the mangrove trees and temperate tree species suggests that the annual cyclicity is the result of a climatic signal superimposed on the signal caused by post-photosynthetic processes.

This study demonstrates the potential of *R. mucronata* wood as an environmental proxy, however, also highlights new directions further research should take. In addition, the techniques developed during this study offer potential to the field of tropical dendrochronology as a whole.

1. Dendrochronology and its Importance

1.1. Introduction to Dendrochronology

Tree rings or growth rings are a well-documented phenomenon in trees of temperate, semi-arid and arid (alpine and arctic) regions. They are produced as a result of the cessation of the cambial activity (dormancy) during the colder and/or drier months and are characterized by an abrupt transition in wood anatomical features from the latewood of the former year to the earlywood of the present year, or by the formation of a boundary layer such as terminal or initial parenchyma (Carlquist 1988). In the presence of distinct

growth rings (a term used to define the abrupt anatomical change at the growth ring boundary, IAWA 1989), ring width data provide a direct measurement of the annual wood produced by the tree and are therefore an indication of the growth conditions the tree has experienced. These ring width measurements are the basis of dendrochronology (from the Greek words dendron = tree, chronos = time and logos = 'word' or 'the science of'), which is defined, *sensu largo*, as the study of radial growth patterns in trees.

In temperate regions, ring width data have been found to correlate well with climate, in particular with temperature and precipitation. Because all trees in one region experience the same large-scale climatic conditions, ring width patterns are similar in the different trees of that region. By a process termed cross dating, the ring width patterns obtained from different trees can be matched and synchronized to construct a tree ring chronology (a ring width curve, produced from the average of ring width curves obtained from a number of trees in one region). Chronologies covering several centuries have been obtained from cross dating living as well as dead and fossilized wood from archeological sites.

Therefore, dendrochronology is a powerful tool for detecting changes in environmental (including climatic) conditions, which can lead to a better understanding of the observed degradation of many forests. In addition, the study of radial growth patterns in trees offers a very strong basis for silvicultural practices.

1.2. Introduction to Tropical Dendrochronology

Unlike trees of temperate regions, tropical trees have largely been excluded from dendrochronology. Despite early reports on the identification of annual growth rings in tropical trees (Coster 1927, 1928; Berlage 1931), dendrochronologists felt that the lack of seasonality in tropical regions hampered the application of their science (Jacoby 1989). Due to the absence of a clear dormancy of the cambial activity, many tropical trees fail to produce distinct growth rings (Detienne 1989, Sass *et al.* 1995), which restrains dendrochronologists from using the classical dendrochronological method of ring width measurements (Worbes 1990). Furthermore, when distinct growth rings are present, the periodicity of the growth rings is not necessarily annual (Detienne 1989). The formation of false (Priya & Bhat 1998), missing and merging rings (Trouet *et al.* 2001) as well as the formation of seasonal rings (Gourlay 1995) has been reported for several tropical species and can seriously influence the outcome of dendrochronological studies. Moreover, when annual growth rings are identified, they

cannot always successfully be cross-dated and related to climatic records (MUSHOVE *et al.* 1995, FEBRUARY & STOCK 1998).

In spite of these difficulties, many successful tropical dendrochronological studies have been published over the past two decades. Distinct annual growth rings have now been identified in a large number of tropical trees (DETIENNE 1989) and their formation has been linked to seasonality in rainfall (VETTER & BOTOSSO 1989, WORBES 1995), periodic occurrence of floods (WORBES 1989) or seasonality in the phenology of the tree (JACOBY 1989, KILLMANN & HONG 1995, BORCHERT 1999). Ring width values have further been shown to synchronize with temperature, precipitation and/or the Southern Oscillation Index (DUNWIDDIE & LAMARCHE 1980, STAHLE *et al.* 1998, WORBES 1999, LARA *et al.* 2001, TROUET *et al.* 2001).

However, official chronologies from tropical regions submitted to the International Tree Ring Data Bank (ITRDB) remain extremely low as compared to those for Northern Hemisphere regions (ITRDB 2004). The longest Southern Hemisphere chronologies have been established for the southern Andes using *Fitzroya cupressoides* (3,622 years, LARA & VILLALBA 1993), for Tasmania using *Lagarostrobus franklinii* (3,600 years, COOK *et al.* 2000) and for Southern Africa using *Widdringtonia cedarbergensis* (413 years, DUNWIDDIE & LAMARCHE 1980). However, those regions are not characterized by a tropical climate. Chronologies from regions within the tropical belt go back as far as 1796 for *Pterocarpus angolensis* D.C. (Zimbabwe, STAHLE *et al.* 1999), 1574 for *Taxodium mucronatum* Tenore (Mexico, THERRELL *et al.* 2002) and 1481 for *Pseudotsuga menziesii* (Mirb.) Franco (Mexico, THERRELL *et al.* 2002) (see ITRDB 2004 for additional examples).

1.3. IMPORTANCE OF TROPICAL DENDROCHRONOLOGY

Increasing concern over tropical forests calls for the establishment of management plans to preserve the high biodiversity in these regions as well as to ensure sustainable wood production. Developing indicators of ecosystem health and monitoring changes in ecosystem health are of utmost importance to establish these management plans. Furthermore, the determination of the age, growth rates, yield and age-related yield of trees are necessary basic information for establishing sustainable silvicultural practices. Tropical dendrochronology offers a powerful tool to obtain this information.

In addition, tropical dendrochronology can also be expected to provide data on past climate change. High-resolution temporal and spatial data and reconstruction of regional climate are necessary to understand the extreme global climate events of the past decades. Therefore, the integration of

regional climate data with global climate data became a priority of the research programme of the Intergovernmental Panel on Climate Change (IPCC 2001). However, the existing data on paleoclimate of tropical regions are insufficient (VERSCHUREN *et al.* 2000). Recent studies conducted in Africa have used ice-core records (THOMPSON *et al.* 2002) and lake sediments (JOHNSON *et al.* 2002) as proxies for climate variability. However, the environmental information archived in trees still provide the highest spatial and temporal resolution on the continent, constituting a wide and dense network of potential sensors and data loggers.

2. Mangroves as a Case Study

2.1. INTRODUCTION TO MANGROVES

Worldwide, mangroves have been estimated to cover a total area of 14.653 million ha occurring in 121 countries (FAO 2003). Although this surface area contributes less than 1 % to the total surface area of tropical forests, the importance of mangrove forests cannot be underestimated due to their high ecological and socio-economic role in coastal regions. However, in 2001, over 50 % of the world's population lived within 200 km of a coastline (UN 2002). The high population density in coastal areas results in a high demand of freshwater and marine products, an increase in wastewater production and pollution and a decrease in water quality, imposing an ever increasing pressure on both terrestrial and marine coastal ecosystems. The decline in mangrove forests in tropical regions belongs to the top ten concerns of marine scientists (UN 2002). Some causes of mangrove forest deterioration are well known and obvious: land reclamation, land conversion, clear-cutting, etc. The establishment of management plans in many countries aimed at mangrove conservation and restoration has now reduced the annual decline of mangrove forest area from 1.7 % $year^{-1}$, between 1980 and 1990, to 1.0 % $year^{-1}$, between 1990 and 2000 (FAO 2003). However, these values do not include the forest degradation caused by mangrove dieback reported for several countries (SPALDING *et al.* 1997). Mangrove dieback has been attributed to anthropogenically or climatically induced alterations in environmental conditions; however, causal relationships are hard to prove due to the lack of long-term data sets (CARDONA & BOTERO 1998, KOVACS *et al.* 2001). In order to protect this valuable ecosystem there is an urgent need for identifying adequate proxies that can provide information on past changes in environmental conditions (DIOP 2003).

2.2. Growth Rings in Mangrove Wood

Mangrove trees in general, and *Rhizophora* species particularly, have been reported to lack growth ring structures (Panshin 1932, Janssonius 1950, van Vliet 1976), excluding them from a dendrochronological investigation. However, *Rhizophora mucronata* Lam. samples collected in Kenya showed a clear alternation of dark and light brown bands. Microscopical investigation revealed that the coloured bands are a reflection of a change in vessel density (fig. 1), light bands exhibiting a higher vessel density than dark bands (Verheyden *et al.* 2004a). The annual periodic nature of these bands was tested using cambial wounding. Cambial wounding is a method by which a small wound is inflicted to the cambium, which then remains as a datable scar in the wood. After cutting the tree, the number of bands between the time of marking and the time of cutting can be counted (Mariaux 1967, 1968; Worbes 1995; Sass *et al.* 1995). Using this method, as well as trees of known age from a plantation, it was proven that *R. mucronata* from Kenya forms annual growth rings, which are composed of a low vessel density early wood (produced during the rainy season) and a high vessel density late wood (produced during the dry season) (Verheyden *et al.* 2004a). However, the growth ring boundaries are indistinct and are characterized by a gradual change in the vessel density.

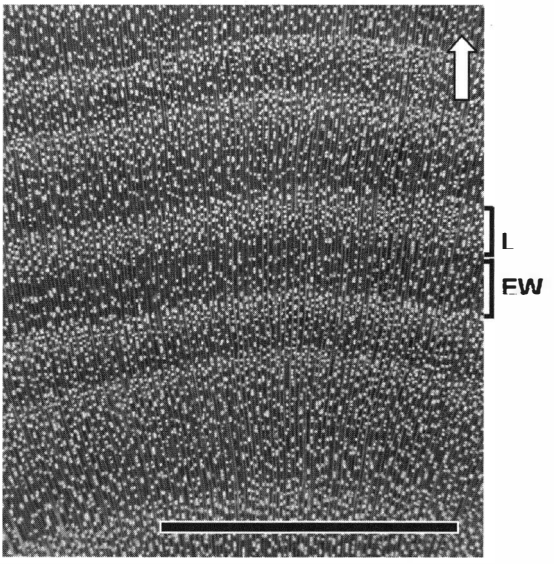


Fig. 1. — Growth rings in *Rhizophora mucronata* are characterized by a low vessel density earlywood and a high vessel density latewood. Scale bar represents 1 cm, the arrow indicates the growth direction. (Adapted from Verheyden *et al.* 2004a.)

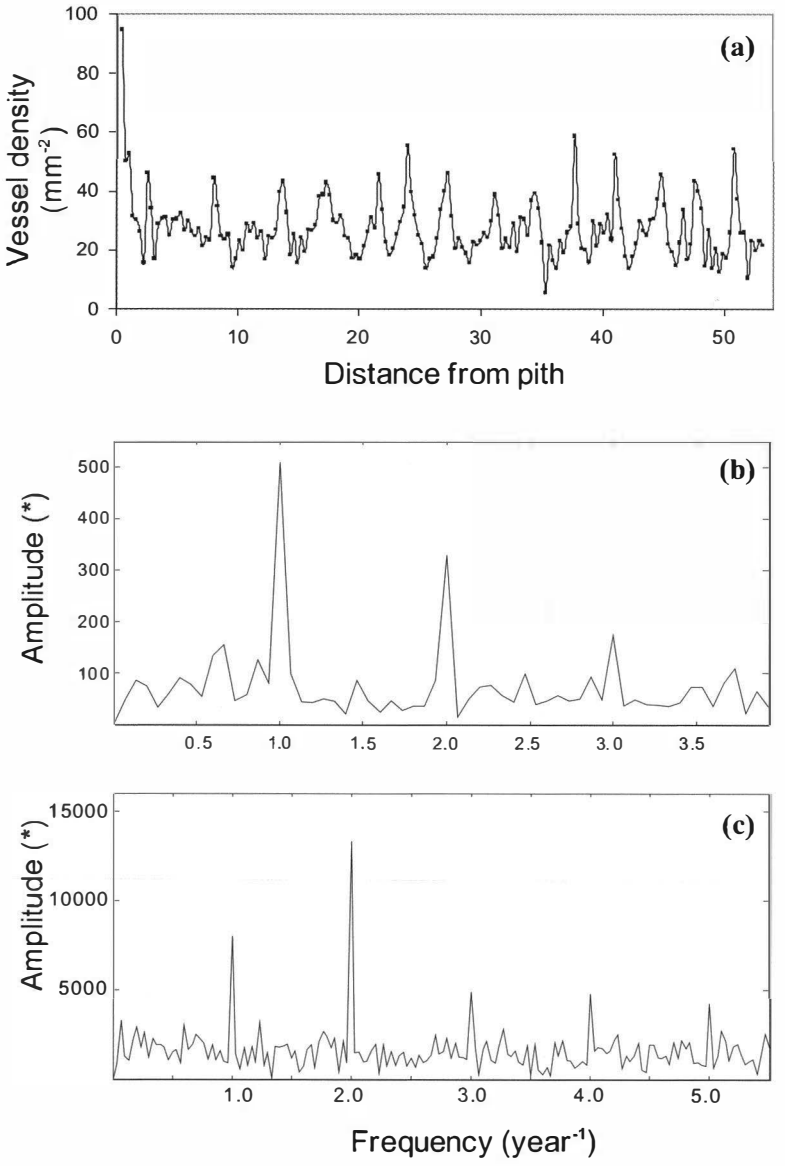
2.3. Mangrove Wood as a Proxy for Environmental Conditions

The indistinct nature of the growth rings does not allow ring width measurements (Worbes 1990), which is a common problem in tropical trees (see above). However, environmental information can be archived in the wood in a variety of other ways, such as in the wood anatomy, microdensity, stable carbon and oxygen isotopes or the inorganic composition of the wood. Due to the absence of a clear delimitation of the wood formed between separate years, measurements of these alternative environmental proxies at an annual resolution are prone to errors. Therefore, a high-resolution approach might be preferred.

In the mangrove *R. mucronata*, high-resolution measurements of wood anatomical features as well as of stable carbon isotopic composition ($\delta^{13}C$) were conducted. For the wood anatomical measurements this consisted of measuring vessel density along a transect from bark to pith, in adjacent windows of 300 μm height (Verheyden *et al.* 2005). For $\delta^{13}C$, the high-resolution approach consisted of measuring wood slivers of 20 μm thickness along a transect from bark to pith (Verheyden *et al.* 2004b). The results of this high-resolution approach are remarkable. Both wood features show a distinct periodicity in their high-resolution profiles (figs. 2, 3).

The periodicity in the vessel density was expected from the visual observations on the wood. However, after Fourier transformation (a mathematical algorithm, which allows the detection of periodic signals in complex functions), a semi-annual signal was detected in addition to the expected annual signal (fig. 2b). This semi-annual signal is also present in the Fourier spectrum of the precipitation data (fig. 2c) and is caused by the bimodal distribution of the rainfall along the Kenyan coast, which results in the presence of one distinct dry season (annual signal), but two rainy seasons (semi-annual signal). The similarity in the Fourier spectra of the precipitation data and the vessel density data strongly suggests a climatic driving force for the change in vessel density (Verheyden *et al.* 2005).

High-resolution stable carbon isotopic composition of the mangrove wood showed a clear annual periodicity with lowest values at the onset of the rainy season and highest values at the onset of the dry season (fig. 3, Verheyden *et al.* 2004b). A distinct annual periodicity in high-resolution profiles of $\delta^{13}C$ in wood has been reported for temperate tree species (Helle & Schleser 2004), but was unexpected in this tropical evergreen tree species. At this moment the $\delta^{13}C$ profile of *R. mucronata* cannot fully be explained with the current models on isotope fractionation in plants and/or our current understanding of mangrove physiology. Comparison of the iso-



(*) The unit of the amplitude is the same as the unit of the non-transformed data; however, the absolute values are multiplied by n–2 (with n = number of sample points) during the Fourier transformation in MATLAB.

Fig. 2. — High-resolution profile of the vessel density (a) and its Fourier spectrum (b), showing the annual (frequency = 1 year^{-1}) and semi-annual (frequency = 2 year^{-1}) signals. The Fourier spectrum for the total monthly precipitation data is also shown (c).

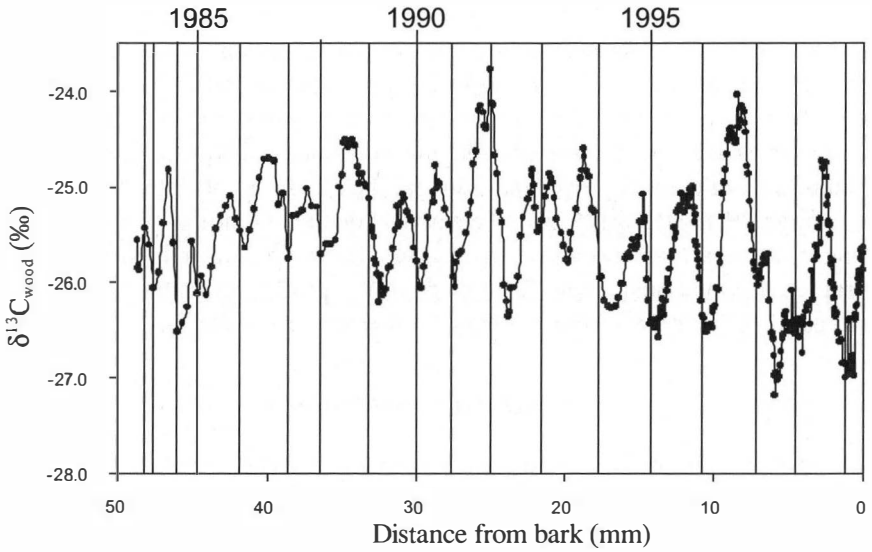


Fig. 3. — Annual periodicity in the high-resolution stable carbon isotope profile of *R. mucronata*. The vertical bars represent the indistinct annual growth ring boundaries. (Adapted from VERHEYDEN *et al.* 2004b.)

tope profiles of *R. mucronata* and the profiles available from temperate trees suggests that the stable carbon isotopic signal is influenced by environmental conditions as well as by post-photosynthetic processes (VERHEYDEN *et al.* 2004b). The results of the high-resolution wood anatomical features and chemical composition indicate the high potential of both wood features as a proxy for environmental conditions in *R. mucronata*.

3. The High-resolution Approach and its Potential for Tropical Dendrochronology

In addition to the high potential of the wood anatomical features and the stable carbon isotopic composition as proxies of environmental conditions in mangrove ecosystems, this study also points at the great potential of the high-resolution approach for tropical dendrochronology in general. As explained above, the lack of distinct growth rings in many tropical tree species severely hampers the use of classical dendrochronological methods (ring width measurements) for tropical regions. Despite the lack of macroscopical growth ring boundaries, distinct (annual) periodic signals might still be observed in

the wood anatomical features and the $\delta^{13}C$ profiles, as was found for *R. mucronata*. If our results can be confirmed for other tropical tree species, the high-resolution approach would offer the possibility to detect annual growth rings and allow further dendrochronological investigation in the many tropical tree species lacking distinct growth ring boundaries. The promising results obtained from the mangroves indicate that the key to tropical dendrochronology might be to step aside from the classical dendrochronological methods of ring width measurements and to investigate periodic signals in high-resolution profiles of wood anatomical features or in the profiles of stable carbon and oxygen isotopic compositions (VERHEYDEN *et al.* 2004b, 2005).

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Round Table

International Symposium
Tropical Forests in a Changing Global Context
Royal Academy of Overseas Sciences
United Nations Educational, Scientific
and Cultural Organization
Brussels, 8-9 November, 2004
pp. 349-350.

Tropical Forests in a Changing Global Context. Round Table Conclusions

by

Morgan De Dapper*

A round table, open to all participants, concluded the International Symposium "Tropical Forests in a Changing Global Context". Two major questions arose: What has changed for the last twenty years? What are the priorities?

As to the first question three major innovations have occurred:

— Decentralization of resource management;
— Creation of a network of protected areas;
— Sustainable management of forest concessions.

Despite the impression that the public concern for the fate of tropical forests, which was so vivid in the early eighties of the last century, has considerably weakened, there has been a growing awareness of tropical forests. Mass media and policy-makers have played a major role in this process. Public recognition, however, is not always translated in concrete results: in the Amazonian forest the deforestation rate is even worse than twenty years ago; in West Africa, deforestation rate is keeping up to 0.7 % while, on the other hand, in Central Africa it amounts to 0.4 %, an improvement due to political measures.

Local governments have played an increasing role by taking several initiatives such as improving education and developing ecotourism. However, corruption still hampers development. There is no need for new rules: an adequate set is available but in many cases they are not applied.

Although considerable amounts of money have been granted to improve the management of tropical forests, few real results are visible. Therefore, an institutional change is needed. NGOs can help to bridge the gap. Whereas

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international NGOs are strong in lobbying, they are often affected by politicalization leading to inefficiency. Local NGOs prove to be more efficient but often lack a broader view. NGOs can heighten public awareness but a certain degree of oversimplification (*e.g.* the role of logging by big companies) should be avoided.

As to priorities, the following recommendations were put forward:

— Working at the local level. The local or ethnoecological knowledge, for instance, is a powerful potential that must be developed.
— Laying emphasis on research (*e.g.* the ecology of species is still poorly understood). Hereby the value given to the work of young researchers should be increased. In this issue our Academy could play a coordinating role.
— Increasing sharing between North and South. Rich countries should accept to exchange the settlement of the International Debt for "nature services".
— Not just talking about priorities, but starting to apply them.