Biodiversity Planning Support Programme
Integrating Biodiversity into the Forestry Sector

Cameroon Case Study

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INTRODUCTION

Tropical forest ecosystems have multiple functions and therefore are great significance for the well-being of people. It is widely acknowledged that forests and trees simultaneously provide a wide range of socio-economic and environmental benefits and values to humankind. They deserve conservation and wise use for the benefit of rural people who are dependent on these forests and for the benefit of humanity in general. Unfortunately, the use of tropical forests has been undertaken with little care about their potential to fulfil many functions and also about their future.

Poor management systems, combined with an intensification of forest use, have led to the degradation and ultimately to the disappearance of forests at an alarming rate of million of hectares per year, as does their high specific diversity.

The different users, who can also be referred to as stakeholders, each has other an isolated perception of the use of the forest. This way of behaving leads to a conflict which is not always properly managed. Local dwellers rely mainly on forest products and on agriculture. Shifting cultivation and slash-and-burn are not only the most widespread agricultural systems in tropical forest (Jepma and Blom, 1992; Cleaver, 1992; Nounamo and Yemefack, 2000), but also constitute the major cause of their destruction. Most governments of developing countries depend on the export of tropical wood, but logging inadequately conducted, negatively affects the forest. Tropical forests are recognised as a real reservoir of biodiversity and other non-consumable benefits, but much still need to be done to preserve them.

As a matter of fact the conflicting interests are unavoidable and the task is to harmonise contradictory and unavoidable users' needs (Foahom, 1998). Land for agriculture, non-timber forest products, timber, biodiversity, wildlife, ecotourism and other non-consumable benefits are important components of sustainable development and also important to ensure equitable distribution of benefits and to address rural poverty.

Because of the ill-considered forestland use, the future of the tropical forests has become a major concern among people all over the world. More and more people are realising that there is an urgent need for sustainable forest management, in order to secure the aptitude of the forests to perform their multiple function, now and in the future. A major objective in any contemporary attempt to manage the tropical moist forest nowadays is the protection of the biological diversity (Poore and Sayer, 1991). Conserving biological diversity in the tropics has become an issue of increasing priority and urgency in recent years (van der Zon, 1995; Lammerts van Bueren and Duivenvoorden, 1996).

Cameroon as a producing member country of the International Tropical Timber Organisation (ITTO) is fully committed to achieve sustainable forest management in the overall context of sustainable development. How far has it gone in this respect? This is a key issue addressed in this report. In order to counter unsustainable use of its forest, the government has undertaken a certain number of actions, which will be discussed here. The report is prepared within the framework of UNEP's Biodiversity Planning Support Programme (BPSP). It aims at providing information on the process of integrating biodiversity into the forest sector in Cameroon, with special reference to forested zone of the country.

BRIEF DESCRIPTION OF CAMEROON

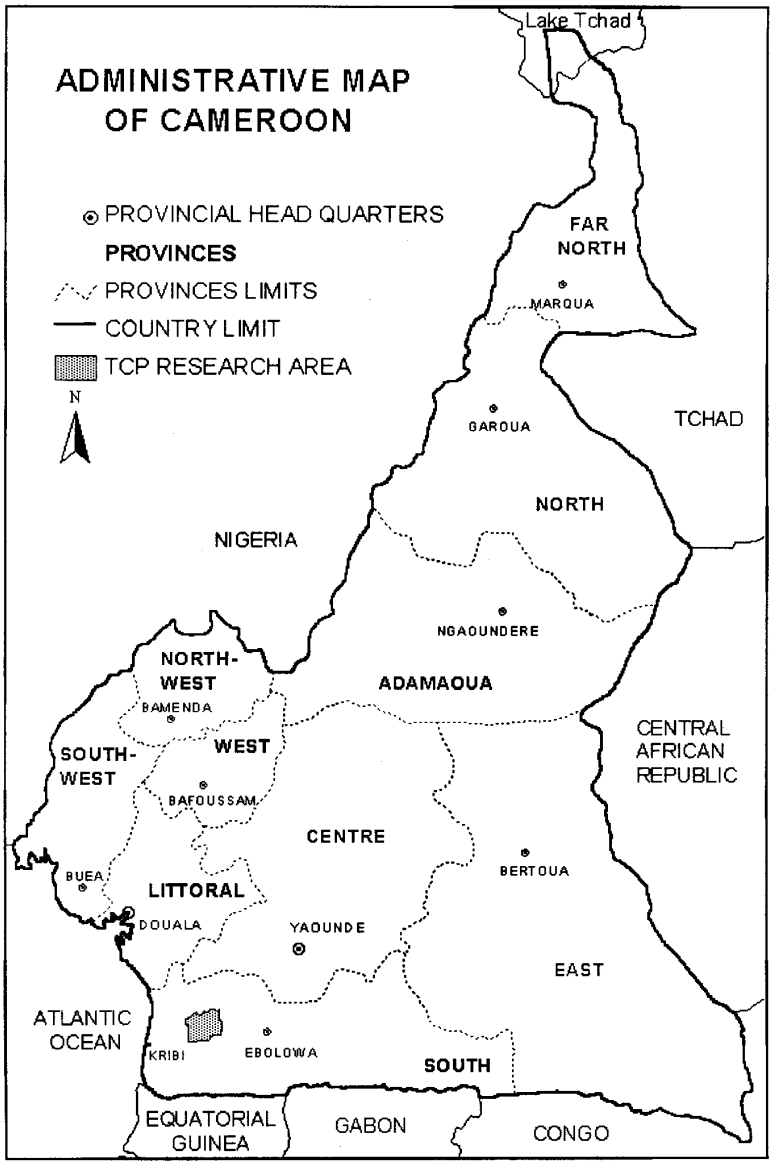
The country stretches out from 8° 30 to 16° 10 E longitude and from 1° 40 to 13° 05 N latitude. It is 475,000 square kilometres in area, and located where west and central Africa

meet, between Nigeria in the west, Chad in the north-east, the Central African Republic in the east, Congo (Brazzaville), Gabon and Equatorial Guinea in the south. In the southwest, it borders the Atlantic Ocean. The territory is administratively divided into ten Provinces (see Map 1). Six of the Provinces are located in the forest zone (Centre, East, Littoral, South, Southwest and West).

Cameroon has approximately 14,600,000 inhabitants (1997 estimates), with an annual population growth of about 3%. Population density varies considerably per region, from 90-100 persons per square kilometre in the West and Littoral Provinces to only five in the moist forest region (mean absolute density of about 32 person per km²). Almost 40% live in urban areas. There are about 200 ethnic groups, each of which has its own language or dialect.

Cameroon can be classified as a middle-income country, and it has a tradition of political stability. Economic development was encouraging until the mid 1980s, when decreasing prices for oil and other important export commodities resulted in an economic crisis. However, the economic situation of the country is improving gradually.

Map 1. Administrative map of Cameroon, showing the ten provinces (Fines *et al*., 2001)



STATE OF NATIONAL FOREST MANAGEMENT IN CAMEROON

The primary body responsible for the management of the forests in Cameroon is the State. Even if private companies perform the timber harvesting, it is the State which defines forestry sector policy, forest management regulations and grants logging rights. Efforts are been made to involve other stakeholders at different stages, but much still need to be done in this respect.

Cameroon's first forest law dates from 1974. This law was revised in 1981 (law N° 81-13 of 21 November, 1981) and completed by the 1983 application decree (decree n° 83-169 of 12 April, 1983). The law sets conditions to be fulfilled by physical or moral persons in order to enter the logging profession. Procedures for granting and renewal of licences, the control of exploitation by girth and species, and the various taxes were documented in a procedural guide entitled "*Cahier des procédures pour l'exploitant forestier*", published by the Forestry Department in 1988.

Forest exploitation licences were granted to private companies for a period of five years and were renewable. The concession areas were divided into working coupes of 2,500 ha called *"Assiette de coupe"*. After a coupe was closed, re-entry to harvest more timber was not permitted. The licensee nominated the coupes in advance for the coming year. He had to present, among others, maps showing the positions of harvestable trees and proposed forest roads, and the results of an inventory of commercial species. Some other types of logging permits existed and consisted of *"gré-à-gré"* and *"vente de coupe"* and conditions to obtain them defined in the law.

There were 45 species listed as obligatory for inventory purposes, and trees smaller than a diameter specified in the *"Cahier"* could not be felled. The minimum diameter varies from 50 cm to 100 cm, depending on the species. Average volume extracted per hectare was estimated at 5 m^3 out of a commercial volume of about 35 m^3 (Evans, 1990).

The writing of a Forest Management Plan was not a prerequisite to forest exploitation. Management plans were developed for some forests such as Deng Deng forest (in the semi-deciduous forest) and Melap forest (plantation forest in the savannah zone) but were never applied due mostly to institutional obstacles. Gazetted permanent production forest was almost non-existent, and timber production was in short-term concession of one to five years. Regulations concerning forest management (exploitation) were based on the 1981 law until the promulgation in 1994 of the current Legal Regulations on Forestry and Wildlife. The drawing of this recent law took into consideration the Cameroon government goal of achieving sustainable management of its forests.

Cameroon government efforts

The Cameroon forest sector has gone through profound institutional and legislative reforms, all of which complies also with many bilateral and multilateral conventions of which Cameroon is a party (Foahom, 1996). They include the Biological Diversity Convention signed on 14 June 1992. This has resulted in a certain number of actions that have significantly modified regulations governing the entire sector. A Ministry of Environment and Forest was created in 1992 (decree n° 92/069 of 9 April 1992). As compared to the former Institute of Agronomic Research, the newly created Institute of Agricultural Research for Development (decree n° 96/050 of 12 March 1996) put more emphasis on Forestry and Environment research. Apart from these institutional reforms, other reforms apply to legal regulation on forestry and wildlife, to designing a National Zoning plan and guidelines for forest management plan drawing.

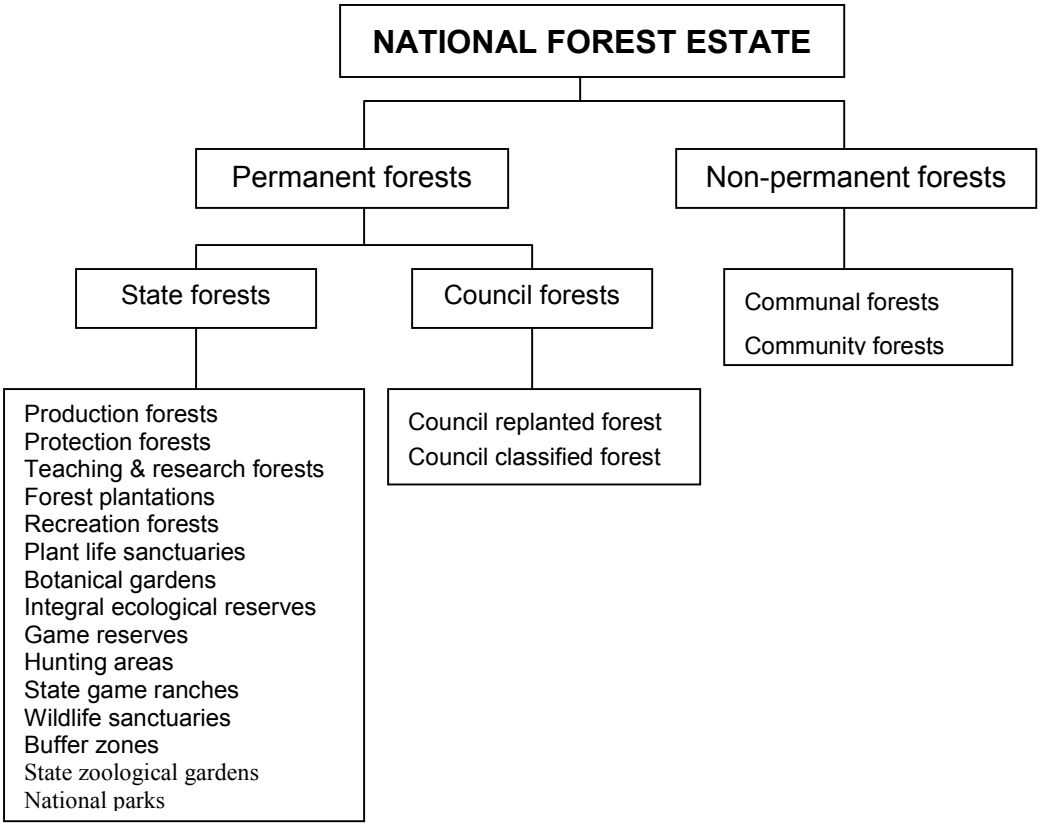
Legal Regulations on Forestry and Wildlife (Law N° 94-01 of 20 January 1994). It is the legal framework contributing to the implementation of the National Forestry Action Programme, as an integral part of the government strategy to ensure sustainable conservation and use of its forestry, wildlife and fisheries resources, and of the various ecosystems. It lays down regulations with a view to attaining the general objectives of Cameroon New Forest policy. Its implementing instruments are made of three specific regulatory (Decrees N° 95-531-PM, 95-678-PM and 95-678-PM) and three common (Decrees N° 86-230, 96-237-PM and 96-238-PM) instruments.

National Zoning Plan. The National Zoning Plan is an indicative framework for land use in the southern forested area. It acts as tool for the planning, orientation and exploitation of natural resources within the area. According to the provision of the Legal Regulations (Law N°94-01), permanent and non-permanent forests are distinguished, as illustrated in Figure 1. As a matter of fact, sustainable forest management implies the categorisation of the forest, as distinguished by ITTO guidelines (1990):

- Permanent forests, consisting of forests set aside for the preservation of animal and plant species and where logging is not allowed;
- Production forest, designated for sustainable production of timber and other forest products;
- Non-permanent forest, designated as conversion forest for other uses, provided that they are kept under forest until required, and harvested according to some guidelines as permanent production forest.

An indicative zoning plan has been developed for 14 million hectares, of which about nine million hectares are proposed to be part of the permanent forest estate (Côté, 1993).

Figure 1. Status of different categories of classified forests in Cameroon



Guidelines for the Drawing up of Forest Management Plan for Production Forests. Permanent forests shall be managed in order to sustain their production capacity. It is in this respect that the concept of Forest management plan is presented in the law. According to its Section 29, "A management plan shall be drawn up for State forests defining, in accordance with the conditions laid down by decree, the management objectives and the rules for each forest, the means needed to achieve the said objectives, as well as the conditions under which the local population may exercise their logging rights, in accordance with the provisions of the classification instruments".

The above mentioned guidelines were developed in order to guide the implementation of this section 29 provision. It falls within the framework of forest production strategy and goes a long way to boost the sustainable forest management. The procedure to draw the forest management plan as given by the guidelines includes:

- Data collection on biophysics of the forest;
- Study of the socio-economic environment of the forest;
- Evaluation of the state of the forest;
- Presentation of the proposed management system;
- Provisions for the participation of the populations to the forest management;
- Definition of the duration of the plan revision planning;
- Plan of operation;
- Financial and economic assessment of the management plan.

Forestry sector and national economy

For quite a long time, economic development strategies have not considered forestry as an important sector. But nowadays, there is a growing awareness that adequate integration of forest resources into the development process can considerably boost the development of the country in general and that of the rural population in particular. This gradually changing attitude is also reflected in the official forest policy that went through institutional and legislative reforms.

Apart from indirect sources of revenues which are not taken into account here, non-timber forest products (NTFP) are collected for commercial purpose. In this respect, a survey undertaken in forest zone of the country showed that for only four NTFP species (*Cola acuminata*, *Irvingia spp*., *Ricinodendron heudelotii* and *Dacriodes edulis*), commercial activities generated more than 90 million FCFA (Ndoye, 1995). Medicinal plants on their part are attracting more and more traders even from Northern countries. Forest products other than timber are therefore of great potential value for the national economy. However, reference is made mainly to the exploitation of timber.

In the case of logging industry then, its contribution to government revenues is provided through felling taxes (based on market values of different timber species), area-based taxes, export taxes and miscellaneous. These taxes, for the fiscal year 1994/95 contributed for 28.95 billion FCFA[1] in a total government budget of 660.2 billion FCFA, representing a relative contribution of 4.4% (Eba'a Atyi, 1998). A year later (1995/96), the contribution of timber harvesting to the Gross National Product was 6.7%, while the total export of timber products amounted to 160.53 billion FCFA, representing 19.8% of the total value of export from Cameroon (MINDIC, 1996).

With contributions of about 20% to the balance of payments and 7% to GNP, logging is of the industries influencing significantly the economic development of Cameroon.

[1] 1 FCFA = 0.01 FF (French Franc).

Logging activities (structure and distribution)

Seventy per cent of logging industry are owned by Cameroonians (Eba'a Atyi, 1998) but their success is usually ephemeral, leading to a large domination of the sector by foreigners who also have the largest timber processing units (Table 1).

Six out of the ten Provinces of the country are log-producing provinces. Their capacity differs from each other depending on the availability of desired timber species. The Eastern Province appears to be the one currently possessing the most important forest resources (timber). Table 2 presents the distribution of logging enterprises and the production capacity of the provinces over the country.

Table 1. Logging companies ownership and timber processing units

Nationality of entrepreneurs	Number of enterprises	Total log production (m3 per annum)	Timber processing unit (capacity in m3)
Domestic	78	997,952	55,000
Foreign	28	1 724,091	178,000
Joint venture	7	30,802	86,400
Total	**113**	**2,752,845**	**319,400**

Source: adapted from Eba'a Atyi (1998)

Table 2. Distribution of logging activities throughout log-producing provinces (1996)

Province	Number of logging enterprises	Log production (m3)	Share of national production (%)
Centre	96	447,404	16
East	5	1 600,163	57
Littoral	86	225,388	8
South	15	451,841	16
South West	12	81,134	3
West	6	0	0
Total	**220**	**2,805,930**	**100**

Source: adapted from Eba'a Atyi (1998)

Toward forest certification in Cameroon

Forest certification these last years has become increasingly important and has undoubtedly emerged as a key issue affecting timber trade in many markets around the world, especially in developed countries (Europe, North America). It originated from some environmental non-governmental organisations' ideas on how to improve forest management. To erase doubts in the minds of the consumers regarding the sustainability of their forest management, forest owners had sought certification as a method of demonstrating sustainable forest management practices.

At the earth Summit in Rio de Janeiro, many debates were focused on the issue of deforestation of tropical forests. This perception changed gradually over time after the Earth Summit for the focus of NGOs' and media shifted from deforestation to sustainable forest management. It became more and more evident that boycotting tropical timber was not an effective way to prevent deforestation and instead the need to encourage the sustainable management of the rainforests through other means including certification, emerged.

Cameroon is deeply involved in the process of certification. Since 1996, investigations are being undertaken, aiming at promoting the development of Criteria and Indicators (C&I) for sustainable forest management (SFM) of its forests, with the financial support of the European Union and technical support from WWF-Belgium.

In 1998, CIFOR published results of a test of criteria and indicators for sustainable forest management (Prabhu *et al*., 1998). The test was carried out with two main questions:

- To what extent would the "Iterative Filtering and Generation Method" used in previous tests still produce useful results if the duration of testing and the composition of teams were changed in order to lower costs?
- How would the results of a test of C&I in Cameroon compare with those of previous tests?

Identifying criteria and indicators that are objective, cost-effective and relevant to the sustainable management of the forests, based on tests of existing sets of sustainability criteria and indicators was therefore the objective of the test. These sets were the criteria and indicators developed by the African Timber Organisation (ATO), the Dutch Working Group on sustainability and a compiled set.

Ecologically speaking, the test came to the conclusion that C&I as proposed by Cameroon teams are a good platform for the assessment of impacts on the ecology of the forests (Prabhu *et al.*, 1998). However, there is need to further refine these C&I, especially with respect to verifiers and performance thresholds. The latter will probably require more specified research.

PRESENT STATE OF BIODIVERSITY IN CAMEROON

The Convention on Bio-diversity was one of the elaborated strategies and measures adopted in Rio de Janeiro by the United Nations Conference on Environment and Development (UNCED) (popularly known as Earth Summit), to halt and reverse the effects of environmental degradation in the context of strengthened national and international collaboration to promote sustainable and environmentally sound development in all countries. This Convention consisting of 42 Articles was one of the principal outcomes of the Earth Summit. It defined Bio-diversity or biological diversity as the variety of living organisms of all origins including, among others, land ecosystems, marine and other aquatic ecosystems and the ecological complexities of which they are part; this includes intra and inter species diversity and the diversity of ecosystems. Based on the above definition, the major components of biodiversity that can be distinguished are ecosystem, fauna and flora.

Geographically, Cameroon is located virtually at the centre of Africa and near the Equator. This location endows her with many biodiversity potentials. From south to north, there are various types of tropical mountain rain forests, humid savannah, forest galleries, and dry forests. Where the climate is drier, dry savannah, steppes and the *yaeres* prevail. Apart from these natural ecosystems, there are also man-made agro-systems made of large Rubber (*Hevea brasiliensis*), Banana (*Musa* spp.), Palm tree (*Elaeis guineesis*), Cocoa (*Theobroma cacao*) and Coffee (*Coffea robusta*) plantations.

What the present report is interested in is the biological flora diversity of land ecosystems of the Congo-guinean zone even if some aspects of fauna diversity of Cameroon are presented. Biological diversity is observed at three scales: ecosystems, species and genes.

Forest area and forest ecosystem diversity

The natural vegetation in humid south and southwest parts of the country consists of moist forest. This Congo-guinean floristic region (Letouzey, 1968; 1985) covers a total area of 22 million hectares (46% of the National territory) of which 17.5 million are considered as not or slightly disturbed, and 4.5 million of disturbed forest. The assignment of this forested zone is illustrated on Table 3 below.

Table 3. Land assignment of the forested area of Cameroon (Source: MINEF, 1998)

Total forest area	22,000,000 ha
Potential logging forest	11,000,000 ha
Attributed concessions	5,800,000 ha
Forest opened to logging	1,000,000 ha
Annual Coupes	350,000 ha
Protected area, including forest reserves, and National Parks	3,900,000 ha
Permanent forests planned (Zoning), including Production forest	9,000,000 ha

Forest ecosystems are referred to as clearly identifiable and distinct forest areas with all of the species and functional and abiotic components.

Rich and diversified ecosystems are found. They are characterised by a specific vegetation composition as a consequence of the physical environment and historical events. The main ecosystems distinguished are (Map 2):

- Mangroves dominated by *Rhizophora racemosa* and *Pandunus satabiei*;
- Evergreen forests including:
  - Transition forest;
  - Littoral Forests, characterised by *Lophira alata* and *Saccoglottis gabonensis;*
  - Biafrian Atlantic forests of *Ceasalpiniaceae;*
  - Forests in marshy and periodically flooded areas;
- Semi-deciduous forests also termed *Sterculiaceae* and *Ulmaceae* forests;
- Afromontane forests whose richness in endemic animal species has already been revealed.

Some of these ecosystems are among the richest in Africa, and even in the world. For example, the Korup dense humid evergreen forest, which is an ideal habitat for biodiversity is of those ecosystems.

Species diversity

Cameroon and two other Central African countries (Gabon and Equatorial Guinea) are considered as the main focus in terms of biodiversity conservation in Africa (Stuart *et al*., 1990; Doumenge, 1996; 1998). In effect, the total area of the three countries represents barely 2.5% of Africa and yet, they host 26% of all mammals in Africa and many endemic fauna and flora species.

For Cameroon alone, the fauna component totals 542 fish species of which 96 are endemic, above 15,000 butterfly species, 280 species of mammals including the world's largest and smallest animals, 165 reptile species of the 275 found in Africa, 3 crocodile species and 190 to 200 batrachian. In addition, some 900 bird species of which 750 are resident and 150 migratory are found. The flora component (high plants only) has 9,000 plant species of which 156 are endemic. For timber production, about 630 species of actual or potential commercial value have been identified. They are grouped into five categories, depending on their commercial value and their availability (ONADEF, 1991; MINEF, 1998a): 26 species of high commercial value (Group 1), 14 timber species currently found in local and international markets (Group 2), 49 timber species abundantly found in the forest and produced mainly for local market closed to the logging zone (Group 3), 522 timber species of sporadic commercial potential (Group 4) and 30 main introduced timber species (Group 5).

Genetic diversity

The study on genetic diversity is likely to provide insights in the level, structure of genetic variation and evolutionary processes associated with its development and maintenance.

Genetic diversity of a species can be assessed by the establishment of field trials such as provenance, progeny and clonal tests, or through genetic marker techniques such as isosyme and DNA analysis. In Cameroon, apart from study on *Lophira alata* (Ochnaceae) to determine its intraspecific variation all over the Congo-guinean zone, very few species underwent such investigations. Those investigations are particularly needed for threatened species (selective logging pressure) and for endangered species, most of which are not well known.

Biodiversity use and depletion

Apart from timber species and to illustrate the important use of forest resources, over 500 plants species and 280 animals species were identified as being used for household consumption within an evergreen forest zone of southern Cameroon (van Dijk, 1999), covering a total area of 170,000 ha and having about 15,000 inhabitants (Fines *et al*., 2001*)*. This is a good illustration of how important the Non-Timber Forest Products are for local populations. This highlights the necessity of adapting biodiversity conservation (and sustainable forest management in general) to socio-economic conditions in the region for which actions are undertaken in this respect.

The use of forest resources is not always rational and sustainable, thus constituting a threat to biodiversity. Current farming system (slash-and-burn agriculture and shifting cultivation) and logging are among the main factors. The annual rate of deforestation in the country was estimated by FAO (1992) at about 0.6%, corresponding to 122,000 hectares per year. The figures are unavoidably more important today. In addition, the estimated loss in biodiversity concerns about 2% of the total number of species each year (Eba'a Atyi, 2000).

PRESENT STATE OF BIODIVERSITY CONSERVATION AND PLANNING

The magnitude of the loss of tropical forest is subject to passionate debate. This results partly from the shrinking of tropical forests, that represent a great loss for humankind as these forests are the richest and the most diverse forest ecosystems on the earth (Poor and Sayer, 1991). Moreover, thousands of species are yet to be described. Keystone species[2] are not well known. Endangered and critically endangered species, vulnerable species are yet to be fully identified.

In 1993, ITTO produced *Guidelines on the Conservation of Biological Diversity in Tropical Production Forests* which are intended to promote the conservation of biological diversity in tropical production forests as an integral part of sustainable forest management. They are made of fourteen principles and twenty recommended actions, which constitute the international reference, standard for the conservation of biological diversity in tropical production forests. The formulation of New forest policy by Cameroon took reasonably into consideration the principles described in the guidelines, as indicated in its main policy documents.

[2] Any plant or animal species that if removed from the system would have a disproportionably large impact on processes in that system

Political commitment: New Forest policy

Forest policy and choices that are designed to govern the management of national forests are clearly stated. The statements aim at achieving five objectives to each of which is associated a set of action strategies. The objectives are:

1. to ensure the protection of Cameroon's forest heritage and to contribute to the safeguarding of the global environment and to the preservation of bio-diversity;
2. to improve the participation of local populations in the conservation and the management of forests so that forestry can contribute to raising their living standards;
3. to enhance the forest resources in order to improve their contribution to the Gross Domestic Product while preserving their productivity;
4. to ensure the regeneration of forest resources by plantations in order to perpetuate their potentials;
5. to revitalise the forest sector by setting up an efficient institutional framework.

The options for forest management are described in the following main policy documents, technically supported by a zoning plan approved in 1995:

- The National Forestry Policy statement written in 1993 and revised in 1995 (MINEF, 1993; 1995);
- The legal regulations on forestry and wildlife comprising the law and its decrees of implementation (MINEF, 1997).

How far did the government go in implementing this new policy? That will be discussed in the following paragraphs.

Institutional and legislative framework

The Conservation and Bio-diversity Management Programme (PCGBC) is the current denomination of Cameroon GEF[3] Bio-diversity Project, initiated in November 1994 as an implementation of Rio Summit resolutions, and started in May 1995.
The aim of the Programme is to guarantee ecological integrity of areas of high priority degree for the global bio-diversity conservation. The objectives are to:

- Support Cameroon government efforts towards sustainable management of its biological resources,
- Promote the participation of local populations in bio-diversity conservation,
- Encourage sustainable use of renewable natural resources and promote ecologically sound development around protected area.

Table 4. Main operational projects in the forest zone and other protected areas dealing with bio-diversity conservation

Project Name	Objectives and legal status	Location (Province)	Forest area covered (ha)
Tropenbos Cameroon Programme	Sustainable forest management, Research and sound land use planning	South	200,000
GEF/CGB	Conservation and sustainable management of biodiversity	East	680,000
Mount Kupe	Protected area for biodiversity conservation	South-West	22,000
Dja Reserve Programme	Protected area as natural reserve and SFM of surrounding area	South	240,000
Bakossi forest reserve	Forest reserve (Biodiversity protection)	South-West	55,200
Korup Project	Protected area for biodiversity conservation (NP) and SFM of surroundings	South-West	125,900

[3] Global Environment Facility

Mount Cameroon	Protected area for e*x situ* and *in situ* conservation, education	South-West	40,000
API Dimako	Protected area without special legal status Biodiversity conservation and sustainable timber production	East	
Mbam et Djerem	Protected area for biodiversity conservation, NP and SFM	East-Adamaoua	416,500
Lokoundje-Nyong Project	Protected area for SFM	Littoral, South, Centre	327,500
Douala-Edea Reserve	Protected area as natural reserve	Littoral	160,000
Bambuko Reserve	Forest reserve (Biodiversity protection)	South-West	266,800
GEF Campo-Ma'an Project	Protected area for biodiversity conservation, tourism (NP) and SFM	South	771,000
South-East Project (Nki, Lobeke, Boumba Bek)	Protected area for ecosystem protection (NP) and SFM	East	2,264,000

SFM = Sustainable Forest Management project
NP =National Park

The main achievements of the PCGBC are the publication of one volume of the Cameroon flora, the inventory of biological resources carried out in its six field operational structures, four of which are located in forested zone (Congo-guinean zone) of the Country. They are Mount Koupe, Mount Cameroon, GEF Campo-Ma'an and Southeast sites (Table 4)

The National Forestry Action Programme (NFAP), an implementing instrument of the New Forest policy, was published in 1995 (MINEF, 1995) with the aim of developing all the components of the Cameroon forest, thus achieving bio-diversity conservation and developing sustainable use of the forest. It completes the National Environment Management Programme of which it is an integral part. It was conceived in conformity with the various national planning initiatives likely to influence the management of forest resources, that is Forestry Research Programme and National Energy Programme. It complies with many conventions, to which Cameroon is a party, including Convention on Biodiversity signed on June 14, 1992. The revised Constitution[4] (law N° 96-06 of 18 January 1996), the Law N° 94/01 on forestry and wildlife provide room for an expression of the political commitment of the government, based on those regional and international engagements.

Operational activities: Some illustrations

It is well known the importance of *ex situ* and *in situ* conservation of forest resources as a dynamic strategy, which can be harmonised with both productive and protective forest management. It is in this respect and to prevent the effects of deforestation and forest degradation on forest genetic resources and biological diversity, (especially in the littoral zone of Cameroon where forest degradation is more important), that a pilot study in *in-situ* conservation was carried out by IRAD in close collaboration with FAO. Species concerned are those characteristics of the ecosystem and/or encountering logging pressure such as *Lophira alata.*

As an illustration of the ongoing execution of the NFAP of Cameroon, operational projects have been implemented or are under implementation (Table 4). The Tropenbos Cameroon Programme (TCP) can be mentioned. The TCP is a problem-oriented and interdisciplinary research Programme, whose implementation is expected to provide tools (methods and strategies) for sustainable timber production and services (Foahom and Jonkers,

[4] It states in its Preamble: "*Every person shall have a right to a healthy environment. The protection of the environment shall be the duty of every citizen. The State shall ensure the protection and improvement of the environment*".

1992). It is expected to generate information needed for a better understanding of the Cameroon rain forest, based on the assumption that we still need to know for example how it does react after disturbance or how does it recover after human being intervention? Some of its research questions or results aim at providing elements or material to fill a forest management plan framework (Foahom *et al*., 2001). Prior to the Forest Management Plan drawing, a pre-mediation version of a master Management Plan dealing with sound land use planning was developed (Fines *et al.,* 2001), in order to reduce the conflicting needs of forest users and to use the forest according to its capacity to fulfil its multiple functions.

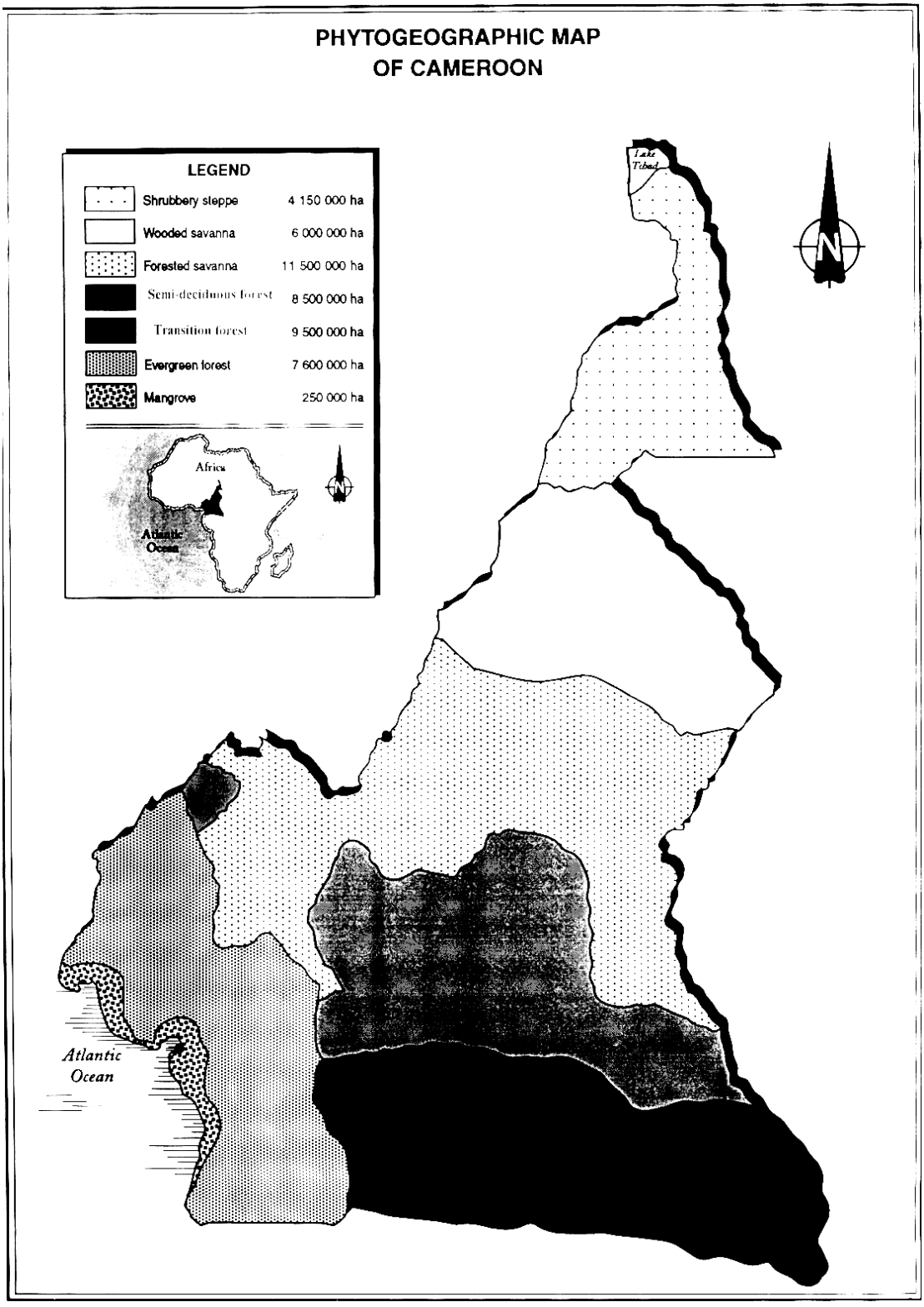
The Campo-Ma'an project is an operational unit (OU) covering a total area of 771,000 hectares. The project is executed within the framework of the PCGBC. The objectives of the OU deal with the conservation of bio-diversity, sustainable use of natural resources and contribution to the economic development of the area. Based on these objectives, a long-term strategic planning integrating the different dimensions of sustainable forest management was adopted. This approach led to the development of a master management Plan for the conservation and sustainable use of the OU forest resources. The following land use types were identified (Table 5), based on the potentials of the forest zone: a National Park for biodiversity conservation and for tourism, a Forest Management Unit for sustainable timber production and bio-diversity conservation and an Agro-forestry zone including large agro-systems made of *Hevea brasiliensis* and *Elaeis guineesis*.

Table 5. Land use types of OU Campo-Ma'an

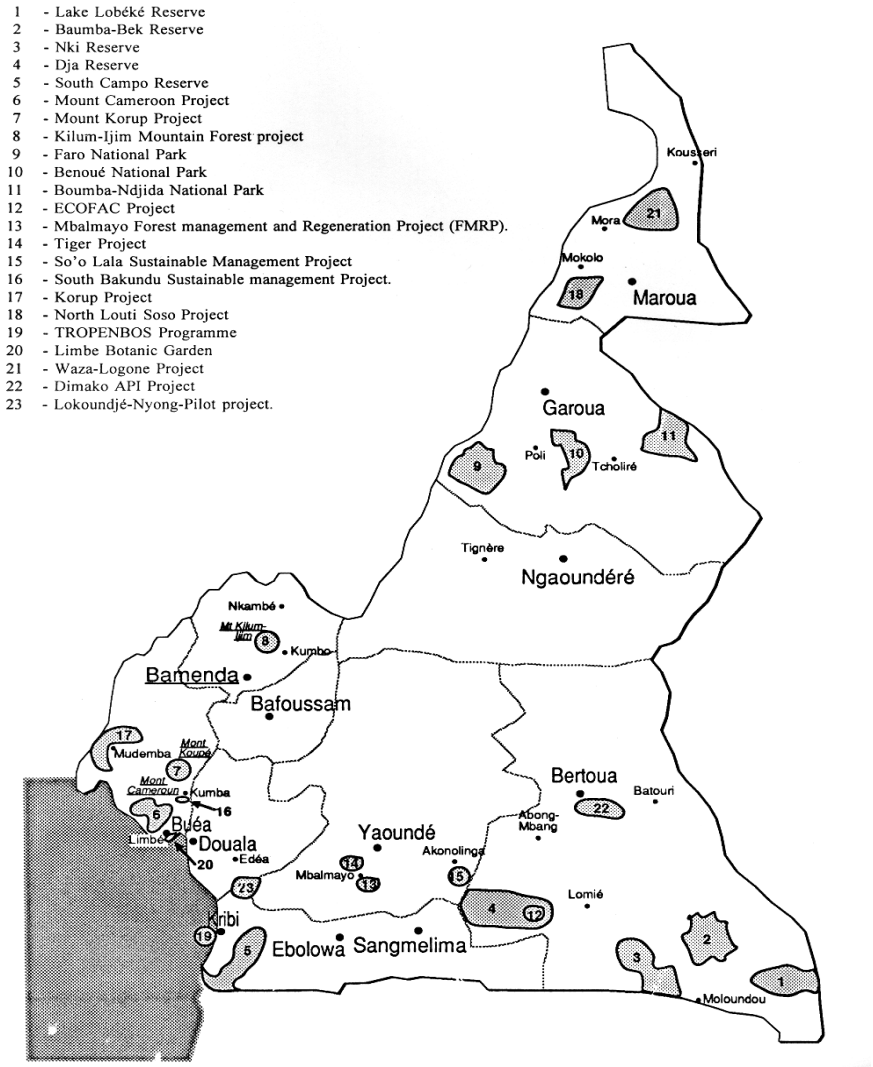
Land use	Surface (ha)	Percent of OU
Campo-Ma'an National Park	260,830	33.5
Forest Management Units	235,485	31.0
Agro-forestry zone	275,033	35.5
Maritime zone	320	-
TOTAL	771,668	100

(MINEF, 2001)

Map 2. Congo-guinean forest types in Cameroon (Forest ecosystems)



Map 3. Operational forest management projects (MINEF, 1995)



LINKS BETWEEN LOGGING AND BIODIVERSITY CONSERVATION AND PLANNING

Cameroon is one of the most important timber exporters worldwide (MINEF, 1998a). This position gives a clear idea of how important are logging activities in the country and consequently, their actual and potential impact on forest biodiversity. For quite a long time logging was concentrated on coastal areas. Nowadays, nearly all forest ecosystems of the Congo-guinean zone are more or less opened to logging activities or are designed for it.

For economic reasons, logging is at present the major management intervention in most tropical forest. In a scenario where timber is the only or the most important option to consider in forest management, this might be at the expense of other forest functions, including forest bio-diversity. Logging may either reduce or enhance species and intraspecific diversity, depending on its intensity and pressure on logged species, and the effectiveness of protection measures and management of the subsequent regeneration. In tropical conditions, logging generally favours fast growing species, with low to medium density timber, and may reduce the abundance of those species of very high value. Improper management for timber

production carries with it a risk of extinction of local endemics and those species particularly vulnerable to physical disruption of their habitats (Whitmore and Sayer, 1992).

Logging policy in Cameroon

Forest exploitation rights are granted only to natural persons resident in Cameroon, or to companies whose registered offices are in Cameroon and whose shareholders are known to the forestry services.

Exploitation contracts (EC), sales of standing volume (SV), permits (PE) and individual felling authorisation (IF) are the different forms of forest exploitation rights. They confer to their holders, over the surface area conceded, the exclusive right to collect the produce described in the exploitation document for a specific period. However, they confer no right of ownership over the corresponding land. Furthermore, the holder may not prevent the exploitation of produce not mentioned in this exploitation document.

- EC applies to Production forest (Figure 1). It is an agreement in which the Licence-holder is granted the right to collect a specific volume of wood from a forest concession, for long-term supply of his wood-processing industry. The volume granted should not exceed the *annual felling potential* for each of the forest management units (FMU) concerned. Forest exploitation contracts are concluded for a maximum renewable duration of fifteen years and are assessed every three years. They are executed in a forest concession of a total area not more than 200,000 hectares. The exploitation of forest products from any state forest including production forest is in accordance with its *forest management plan*.
- SV refers to an area not exceeding 2,500 hectares and to a specific volume of standing timber for sale. It applies to Communal and Community forests (Figure 1), but also to production forest, and does not exceed three years. In some cases, it is granted only to persons of Cameroon nationality.
- PE refers to exploitation or harvest in a given area, of specific quantities of forest products, firewood, poles for commercial ends, or timber whose volume does not exceed 500 gross cubic metres. It applies to non-permanent forest (Figure 1), including Community forests. It is attributed only to persons of Cameroonian nationality. It is granted for a maximum non-renewable period of one year.
- If is issued to a natural person to cut wood not exceeding 30 gross cubic metres, for personal, non-commercial use. Granted for a non-renewable period of three months, it is accessible to persons of Cameroonian nationality.
- In some particular cases and for State forest (permanent forest), forest can be exploited by the administration. This happens when there is need to recuperate the forest products concerned or in case of experimental projects. It can also be sub contracted in accordance with the management plan of the said forest.

Logging operations and bio-diversity

The late 1950s are the starting point of interest silviculturists' and forest managers' attach to the impact of logging on tropical forests. The use of heavy machinery for timber extraction is the reason of this interest. People are becoming more and more aware of the need to protect forest ecosystems' functions and to maintain biological diversity in production forest. The main question raised is whether timber harvesting can be compatible with other forest functions. This question has resulted in the promotion of *Reduce Impact Logging* (RIL), in order to reduce soil disturbance and impact on wildlife and damage to residual trees.

Prior to operations leading to log extraction from the forest, pre-harvesting activities are undertaken to collect essential biophysical data in order to plan the logging operations for the annual coupe. The work consists of inventory and topographic assessment. A tactical logging map and logging plan document are than constructed.

Direct impact of logging include effects related to damage to vegetation (change in microclimate and availability of food plants), reduction of genetic improvement potential of logged species and natural regeneration potentials: as a matter of fact, felling diameter is based empirically without any consideration on the physiology of the species. More specified research is required here. Seed trees are not always left aside. Trail construction is mostly from felling gap to felling gap and is seldom guided by inventory maps. The administrative forms for felling, skidding and transport are poorly harmonised, as tree and log numbers on the various forms do not correspond. Consequently, these records cannot be used for monitoring the production chain. Machine operators can set their own standards of work because supervision is lacking. As long as they produce enough logs, their supervisors are not in the field to take care of proper implementation of the different logging operations. Operators and supervisors most of the time lack environmental awareness and don't see the need for improved logging technique to reduce damage.

Even in a well organised logging area, 15% of harvestable timber are overlooked during forest inventory, while only 70% of the amount of timber felled are delivered at the sawmill (Jonkers and van Leersum, 2000; Foahom *et al.*, 2001)

In other respects, the impact of logging activities on the availability of certain non-timber forest products (NTFPs) is not negligible. Some tree species useful for local population are also timber supplier for logging companies, thus creating conflicting interest between the two stakeholders and increasing pressure on related species. Others tree species, threatened by commercial logging, causes also large animals to move away, and it may take many years before they return. Moreover, it stimulates hunting as logging tracks provide easy access to the forest and because demand for bushmeat increases due to the presence of logging personnel (van Dijk, 1999).

There is need for a better control of the harvesting and logging operations. In this respect, the extent to which reduced Impact Logging (RIL) can be applied in Cameroon have been assessed and provisions for improved logging techniques and increased logging efficiency were developed (Jonkers, 2000).

Constraints encountered

Logging activities tent to increase while sustainable forest management is yet to be fully engaged. For example Forest Management Plans which are a prerequisite for a forest to be opened for logging activities are available only for few concessions.

The Ministry of Environment and Forest is in charge of the administration of protected areas. But what may happen is the risk of focusing on forest exploitation (timber production) at the expense of other forest ecosystem potentials, including biodiversity protection. Moreover, there is lack of skilled and qualified technicians, financial means and appropriate equipment are other constraints.

The 1994 law on forestry and wildlife planned to raise permanent forest to 30% of the national territory. Since then, new protected areas have been created or some existing ones had their legal status enhanced (creation of National Parks). This is the case of Campo-Ma'an and Mbam and Djerem protected zones. Despite these efforts, the proportion of the national territory devoted to bio-diversity protection and protected areas status does not come close to meeting the above goal. Protected areas cover only 6.3% of the total lands. Moreover, much

still needs to be done, taking into consideration the diverse ecosystems to be considered and the pressure encountered by the national resources.

Protected areas in Cameroon are of many categories, some of which correspond to IUNC categories (II, IV and VI). They are National Parks (II), wildlife and related reserves (IV), Production forests (VI). The legal status of the others is not always clearly stated. An important number of them have a low protection status or an unclear temporary status. Related stakeholders are not yet fully involved in the management process. Competition and the absence of co-ordination between services in charge of managing protected areas and those responsible for allocating forest permits is not helping the situation (Doumenge *et al*., 2001). Management of the protected areas is not always effective, if not on sites with intensive management activities. Moreover, the protected area system is far from covering all ecosystems requiring protection: for example the humid coastal area (including mangrove) is not sufficiently protected.

The boundary of protected areas are not always materialised in the field and when it is the case, encroachment by local population or logging companies still occur. This highlights the need of integrating (implicating) all the stakeholders, especially the local population in the process of sustainable forest management.

Some efforts are made to diversify timber species. Unfortunately, three species still cover more than 60% of the total production. This pressure represent a threat for those species which run the risk if not to become extinct but to have at least their genetic improvement potential drastically reduced. Those species are *Triplochiton scleroxylon* (Sterculiaceae), *Entandrophragma cylindicum* (Meliaceae) and *Lophira alata* (Ochnaceae). More than 50% of the total harvest are still exported, in-spite of the forest policy strategy aiming at a 100% local transformation of harvested logs. According to the provision of section 71 of the law n° 94-01, seventy percent of the total production of each species of log shall be processed by local industry, during a transitional period of five years with effect from the date of enactment of the law, that is 20 January 1994. Thereafter, the exportation of log shall be prohibited and the totality of national timber production processed by local industry. The law n° 99/001 of 31 August 1999 amended this Section (71) in order to promote some timber species. For those species, log timber export was allowed to continue, provided that a special tax is paid. A substantial part of the total log timber production is still devoted to export.

Table 5. Log production and log transformation

Production and transformation	**1996**	**1997**	**1998**
Total production [1] (m3)[5]	2,805,932	3,000,000	2,895,000
Log export (m3)	1,266,021	2 016 042	1,411,579
Local log processing (% of [1])	54.8	32.7	51.2

It is known from recent studies that well planned and carefully implemented logging can be use to maintain a balance between the various stages of ecological succession, and to allow for maximum genetic diversity and conservation of genetic resources of tree species of different successional stages. Unfortunately, logging activities are still very far from well-planned and carefully implemented logging. Codes of logging practice have been developed (Dykstra and Heinrich, 1996) along with guidelines for RIL, which if properly applied can greatly diminish the impact of timber management on forest bio-diversity (Whitmore and Sayer, 1992).

[5] Three timber species *(Entandrophragma cylindricum, Triplochiton scleroxylon, Lophira alata*) represented more than 60% of the total log production.

STRATEGIES AND SOLUTIONS

What we know

Reduced Impact Logging (RIL) is considered as a strategy developed to contribute to sustainable forest management, in order to meet ecological criteria, including biodiversity conservation. As it was stated above, RIL was successfully tested in Cameroon within the framework of the Tropenbos-Cameroon Programme (Jonkers, 2000) and to some extent by API-Dimako project (Durieu de Madron *et al.,* 1998). However, it is yet to be widely applied. Its acceptance by logging companies is not fully guaranteed for many reasons. Among those are variation in market demand and changes in timber market price, which tend to fluctuate considerably and unpredictably. This is not in favour of the logging companies' objective to maximise profit for timber processing or timber sales, and which consequently are reluctant to accept RIL. As a matter of fact, conventional logging provide rooms to respond to poor market conditions by leaving unprofitable trees uncut, and return later when the market conditions have improved. This flexibility is incompatible with RIL's strategy. Consequently, efforts from tropical forest countries like Cameroon may be weakened by external factors beyond their control.

In other respects, in the course of pre-harvesting activities, the number of species obligatory to be included in inventory map is more than 45. Moreover, a revised MoreLKS[6] programme was designed to provide the Cameroonian timber sector with a powerful tool to promote timber (Zijp *et al*., 1999), in order to broaden the range of species harvested. Adding 26 lesser-known timber tree species from Cameroon and a number of end-uses relevant for local market in Cameroon and international market expanded it. Nevertheless, this does not lead to the harvest of even one tenth of actual and potential commercial tree species by the logging companies. For example, harvesting intensity in Cameroon is about 7 m3/ha (Eba'a Atyi, 1998). Such harvesting intensity is still low compared to major tropical timber producers. The average harvest varies from 50 to 80 m3/ha in Southeast Asia and 10 to 20 m3/ha in Brazil (Karsenty and Maître, 1994). This may lead to the conclusion that Cameroon forest is not overlogged. However, the low logging intensity is a consequence of the current selected logging system. Expressed in terms of area opened annually for logging (415,000 ha) and combined with the total area planned as production forests (6,024,608 ha) in the national Zoning plan (Côté, 1993), the current extent of logging may constitute a threat to sustainable forest management. Not only it is expected to produce more forest products on less land (by shifting from extensive harvesting system to intensive use of forestland), but also forestland use should be guided by long-term objectives, based on careful land use planning. This applies to all forms of land use, including timber production.

Where to go

Forest managers should consider the effect - actual or potential - of their activities on forest ecosystems to avoid unknown or unpredictable effects on them, on their functioning and consequently, on their values.

The achievement of sustainable forest management in general and biological diversity conservation passes through continuous work and intensive research. Among other interesting research topics is the perspective of manipulation of light in the rain forest to influence the natural regeneration, stratification and diversity of species. In this respect, gap size more than 1,300 m2 should also be avoided, in order to insure that the composition of the stand will remain the same, i.e. that valuable timber species are not replaced by fast growing secondary

[6] Matching of requirements of end-uses with lesser-known species is a software programme written for IBM compatible computer.

species (Bongjoh and Nsangou, 2001). Response of species and communities to all forms of forest use, environmental impact assessment are other key issues to emphasise on.

Four million five hundred thousand hectares of the Congo-Guinean zone of Cameroon are considered as degraded forests. The more severely degraded landscapes are found in the evergreen forest, especially in Littoral and Biafrian forest ecosystems (high logging intensity, population pressure, development of infrastructures, etc.). These areas will require some forms of human intervention or management to facilitate the recovery of their specific flora in some protected areas. It is in those areas that the contribution of forest restoration can be substantial to the conservation of forest biodiversity.

In Cameroon, as in many other developing countries, the population in urban areas is increasing and partly because of that, the quality of the urban environment is increasingly recognised to be a key ingredient of the social and economic regeneration of big cities. Trees species have an impact on the abiotic and social aspects of a city, provide recreational opportunities and increase wildlife. A good opportunity appears here to make urban and local councils take an important part in biodiversity conservation, through the creation of green space. In this respect, Arboretums, Botanical gardens play a crucial role in conservation of forest genetic resources, in particular through *ex-situ* conservation.

The dual aim of raising income of local people by increasing NTFP (non-timber forest products) extraction as well as enhancing forest conservation militate in favour of their domestication and integration in improved farming systems, thus reducing pressure on related species.

A protected area network, which appears to be the heart of any well thought sustainable development strategy, has been proposed as one of the key actions to preserve threatened bio-diversity of Central African region (Doumenge *et al.*, 2001)

Last but not the least is the development of funding mechanisms that can regenerate additional resources and to make them operational.

CONCLUSION

Planning efforts are quite recent in the Cameroon bio-diversity protection system. Nevertheless, those efforts are noticeable, particularly those dealing with integration of biodiversity conservation in the whole process of sustainable forest management.

Sustainable forest management for which the protection of biological diversity is a major objective cannot work in isolation from development policy in other sectors. It is possible only in the context of an overall strategy to promote sustainable development in all sectors of the economy. Chapter 11 of Agenda 21, one of the principal out-come of Earth Summit in 1992, supports this statement. SFM is one of the key frameworks necessary to reach sustainable use of forest biological diversity. In this respect, Forest Principles stress in paragraph "*Forestry issues and opportunities should be examined in a holistic and balanced manner within the overall context of environment and development, taking into consideration the multiple functions and uses of forests, including traditional uses, and the likely economic and social stress when these uses are constrained or restricted, as well as the potential for development that sustainable management can offer".* It is certainly in this light that while drawing up its NFAP, Cameroon made it a point of duty not only to shift emphasis from the tree to the entire forest and harmonise users' needs (sometimes contradictory), but also to make it coherent and complementary to national development plans of other sectors. It was therefore drawn in consultation with other related ministries.

However, even if Cameroon forests are relatively well preserved in comparison to those in other tropical countries, they are shrinking at a rate of thousands of hectares per year. Forest management plans are yet to be produced for the production forests. The few available are not properly followed. Consequently, conventional logging with its negative impact is still the one largely applied. ITTO's Year 2000 objective is far from being met. This objective specifies that all tropical timber for export should be produced from sustainably managed forests by the year 2000.

Political commitment backed by legislation should be the frame of more operational activities in the field. This cannot also go without the support of international funding agencies. In effect, the biological diversity protection does not have frontiers. Owners of this biodiversity are most of the time poor tropical countries but the enjoyment is planetary.

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