International Technical Tropical Timber Association

The requirements of a practical forest development plan for natural tropical African production forests

Application in the case of Central Africa

Volume One : Forest Production

Study of a Practical Forest Management Plan for Natural Tropical Production Forests in Africa

As applied to the case of Central Africa
Volume 1 'Forest Production'

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STUDY OF A PRACTICAL FOREST MANAGEMENT PLAN FOR NATURAL TROPICAL PRODUCTION FORESTS IN AFRICA

As applied to the case of Central Africa

Volume 1 'Forest Production'

The first edition of this work in 2001 was coordinated by Jean Esteve, former president of the ATIBT Forestry Commission.

The document has been revised by Nicolas Bayol (FOREST RESOURCES MANAGEMENT), Benoît Demarquez and Cyril Pelissier (TEREA).

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Preface

In 1996, the *European Foundation for the Preservation of African Forest Resources,* which groups key investors in the Central African logging and industrial timber sectors (with concessions covering a total of over 20 million hectares), decided to promote and enforce a Forest Management Plan that would direct the development of their concessions. The ATIBT has been designated to design, draft and publish a work intended to provide economic operators with a clearer understanding of the challenges and limitations linked to a sustainable management approach, and to clearly set out the requirements for drafting and implementing a practical plan to manage natural production forests in Central Africa. The French Ministry of Foreign Affairs and the European Foundation jointly funded a first volume on forest production, published in 2001. Volumes 2 (social aspects) and 3 (wildlife aspects) were published in 2005.

This work has been received enthusiastically by both forestry operators and other key players in sustainable forest management, mainly national and international NGOs and members of African forest administration bodies. It is also intended to form the basis for 'ATIBT forest management and management' training schemes to be run by our Association in Libreville, Kinshasa and then Yaoundé, and designed to school the various actors in sustainable forest management in how to develop, implement and monitor a Forest Management Plan. It was thus decided to reissue this volume, especially in view of major recent developments in the management of production forests in Central Africa. While the region's first certified forest management scheme only dates from 2000 (CEB in Gabon), today, 7 million hectares of natural production forest in the Congo Basin are covered by a certified Forest Management Plan, and another 24 million hectares are at various levels of the forest management approval stage. Given the considerable experience we have gained since the first publication, we decided it was necessary to issue a fully revised version of Volume 1 'Forest Production'. The technical content of the Forest Management Plan has thus been significantly expanded and several new chapters have been added dealing with sensitive topics such as training schemes, the monitoring and control of forest management initiatives and the allocation of responsibilities between the various partners.

It should be noted that the Forest Management Plan is the cornerstone of a successful sustainable forest management policy. It is designed to provide a key management tool for use in both day-to-day forestry operations and, in particular, to direct forestry company investment policies and general planning. This represents a complete turnaround of the former situation where the directions taken by forestry operators were mainly dictated by market forces. The only viable approach to sustainable forest management is to ensure that forestry operators work to fully preserve all ecological and socio-economic forest functions; in other words, production must be tailored to fit the forest and not the reverse. Clearly, this approach calls for companies to extensively rework their corporate culture, supported by a workforce trained specifically in these new management methods the deployment of which is a lengthy process, especially given the many obstacles along the way which include: logging restrictions imposed on the main commercial timber species in favour of secondary species that are currently less profitable, company staff who are unwilling to take on new working methods; difficulty in recruiting highly-trained workers concerning worksite jobs in particular, and the high cost of developing, setting up and monitoring a Forest Management Plan. Against this background, the ATIBT is seeking to use the results obtained by Foundation members to launch a study of the economic impact of setting up forest management plans. The results obtained could be the

subject of a new volume in our work on the practical forest management plan for natural tropical production forests in Africa.

We would like to sum up by drawing the reader's attention to the correspondence between the forest management plan approach, as illustrated by this work, and the management plan approach covering protected forest areas in Central Africa, in particular regarding the analysis both of resources and of the relationships between local communities and the entities managing the protected forest area or concession. This correspondence goes well beyond just the use of similar working methods, indeed, it is a clear indication of the strong ideological parallels existing between the managing entities of both types of area (protected or concession). These parallels have already been demonstrated in examples such as the Pallisco/Dja Animal Reserve, Wijma/Campo Ma'an National Park, Rougier Gabon/Ivindo National Park, CBG/National Parks, CIB/Nouabale Ndoki National Park and the Ifo/Odzala National Park. We can only hope that this group effort will gradually strengthen and expand, in particular by making it possible for concerned concession holders to gain certification, thus maximising the benefits for tropical forest ecosystems in Central Africa.

Dr Bernard Cassagne
President of the ATIBT *Forests* Commission

Willy Delvingt
ATIBT President

Introduction

In reviewing the situation following the Rio Conference, at the ATIBT Forum in Lisbon in November 1992, the President Henri MONTCERISIER stated:

"Logging activities in dense tropical forests must follow the principle of sustainable forest management, i.e. they must aim to maintain and, whenever possible, improve the forest's ability to best fulfil all its ecological, economic and social functions, while preserving its full potential for future generations.

Sector professionals are therefore seeking to govern their activities through specific management plans (or forest management plans) that, under long-term management-harvesting contracts, prescribe annual allowable cuts, species and dimensions authorised for harvesting, logging methods, road infrastructures, forestry initiatives supplementary to logging activities, forest regeneration initiatives, etc."

Since 1992, the concepts of sustainable management and forest management planning have been driven forward considerably on all fronts, such as with national forest administrations, financial backers, environmental NGOs and private sector companies. The social and ecological aspects have been extensively developed and are now a fully integrated component of the forest management approach in tropical areas. Incidentally, these aspects are dealt with in Volumes 2 and 3 of the ATIBT manuals, thus completing this Volume 1 which mainly deals with sustainable timber production.

In 2001, the International Tropical Timber Organisation (ITTO) defined forest management as "The planned development of forest products and services guaranteeing the long-term integrity of the forest environment, as well as its biodiversity and the well-being of its local communities."

In September 1999, in Milan, the main European groups, key investors in the logging and industrial timber sectors in Central and Western Africa, meeting under the aegis of the European Foundation for the Preservation of African Forest Resources, well aware of their decisive role in the economic and social development of the African countries in which they are based and of their responsibility to provide an exemplary model of and also to promote a sustainable management approach to the forestry sector as a whole and to small and medium-sized companies in particular, decided, among a number of other actions, to produce the first edition of this 'Study of a Practical Forest Management Plan for Natural Tropical Production Forests in Africa'.

In 2001, ATIBT published the first edition of this manual, funded jointly by the French Ministry of Foreign Affairs (MAE) and the Fonds Français pour l'Environnement Mondiale (FFEM).

This volume describes the technical aspects of the forest management plan, while providing a recap of the basic concepts underpinning the sustainable management approach. The content was based on the experience acquired in the field and developed in partnership with the main sector experts. As a major reference work on African forestry issues, both for professionals in the logging sector in the Congo Basin and for international financial backers and decision-making entities, this manual was the first to address the problems raised by sustainable forest management.

This study reflects the shared determination of Foundation members and all their partners (States, communities, financial backers, environmental organisations), supported by States and international development organisations, to demonstrate their commitment to a sustainable management approach by

setting up forest management plans; and to go beyond a simple enforcement of the standards required by law and national forestry regulations, to make the forest management concept their own and develop it into an effective tool for their technical and economic business management.

However, the new statutory context operating in several sub-regional countries (in particular, regarding the incorporation of the forest management plan into a number of national forestry legislative frameworks) coupled with the extensive experience gained over the last five years when drafting forest management plans (several forest management plans have now been approved and are currently being deployed in various countries, thus providing a wealth of direct field experience, along with opportunities to test and develop new technical itineraries and tools) now need to be factored in, thus making it essential to revise this work.

Volumes 2 (social aspects) and 3 (wildlife aspects) were published in late 2005; this updated version of Volume 1 thus completes them, providing professionals seeking to commit to a sustainable forest management approach with a series of practical manuals covering every aspect of forest management.

This revision was funded by the MAE, and supervised by members of ATIBT Commission I, the FRM, and TEREA, supported by ONF-I and CIRAD-environment and society department.

This new manual takes account of:

❶ Revised data

❷ History of forest management in Central Africa over the last ten years, and the new techniques and methods used

❸ Technical difficulties to be overcome, such as is the case for small and medium-sized forestry operators

❹ References, given throughout the manual, to new statutory developments in the various Congo Basin countries.

The work will examine three main chapters in order:

- Firstly, a recap of the main points of the forest management concept;
- Followed by an outline of the technical content of a practical management plan for production forests in Central Africa and of some of the challenges to be met in the coming years;
- And lastly, a proposal for allocating the technical and financial responsibilities between the various partners.

PART 1 THE CONCEPT OF SUSTAINABLE MANAGEMENT AND FOREST MANAGEMENT

Before addressing the technical aspects of the management of natural tropical production forests, it would be useful to briefly outline developments in the sustainable management and forest management concepts, both globally and in Central Africa.

I.1 BRIEF OVERVIEW OF THE FOREST MANAGEMENT PLANNING CONCEPT

I.1.1 The origin of the forest management planning concept

In Europe, the concept of timber resource management was first developed in regard to forests exposed to 'unsustainable' demands due to population growth. The scarcity in resources forced operators to seek ways of improving the organisation of their timber harvesting activities. The first management efforts were not documented, and were only visible in the field through the marking out of annual *'assiettes de coupe*' (or '*coupons'* - 'surface areas of annual allowable cut').

Etymologically-speaking, the original term 'mesnagement', taken from the linguistic root 'ménage', was first used in France as a forestry term in 1597. The 18th century saw the introduction of the word 'aménagement' in French (or its equivalent in English and German), with a meaning close to its present-day signification, along with important developments in the definition of management methods and the practice of silviculture, first in Germany, and then in other Western European countries.

So, as we can see, the determination to manage forest resources in a sustainable manner dates back several generations. The basic principle, which has always been focused on providing a sustainable yield, has gradually evolved and expanded over the centuries. Originally, the notion of sustainable yield was limited solely to timber production, then, at the beginning of the 1950s, the idea of using forest resources for multiple purposes other than timber production started to take hold, i.e. the supply of a greater number of products and services useful to society. In more recent times, this has led to expanding the historical concept of forest management to include all forest functions; the issue now is **forest management planning** or **sustainable management.**

I.1.2 History of forest management in Central Africa

Historically-speaking, management plannings in tropical environments were first directed towards artificial forests or natural single-specie forests. This was the case, for example, with Allapali forest in India, which would have started to have been developed as early as 1895, or the Matang mangrove swamps in Malaysia, which were developed in 1902.

So, despite what we have tended to believe over the last few years, the management of dense tropical moist forest in Central Africa is not really such a new concept at all. In colonial times, forest management plans were being implemented in French Equatorial Africa according to the decree dated 20 May 1945. This involved a simplified forest management plan based on a brief prospection and the establishment of a logging programme and a set of specifications to be complied with.

The sole purpose of these initial management plans was to 'regulate logging activities', i.e. they only applied to sustainable timber production. These provisions gradually ceased to be applied during the 1960s and 1970s, with forest management laws being simplified to consist of no more than a few simple rules such as compliance with Minimum Cutting Diameters, and, in some countries, a limitation on the size of available harvesting areas or on annual timber production volumes (in diverse forms).

In the 1970s, a number of projects evaluating available forest resources in the various forest areas prompted consideration of how best to valorise these resources. While there were some good-quality management plans prepared at this time (e.g. in the southern part of the Republic of Congo and in Gabon), none of these were effectively deployed in the field due to a general reluctance on the part of the various actors involved. We can thus conclude that no sustainable forest management initiatives were implemented in Central Africa before the 1990s.

It should be stressed though that the concept of sustainable management had, to varying degrees, already been integrated into previous forest codes, as demonstrated by law 01/82 in Gabon. However, the authorities took some time to set up the related enforcement orders, and once in place these were rarely applied to the specific area of forest management.

I.1.3 The new environment for sustainable forest management planning

At the end of the 1980s, the now visible effects of a failure to carefully plan use of the world's natural resources led to the promotion of a new concept - sustainable development, and also to a shared determination to preserve the world's heritage for future generations.

The 1992 Rio Conference legitimized the application of the sustainable development concept to forests, as at that time sustainable management was seen to provide an attractive solution to certain forestry issues, enabling a balanced approach to economic forest enhancement, as well as socio-economic forest development and conservation focused on protecting forest heritage and the needs of future generations.

In the middle of the 1990s, the main Gabonese forestry operators launched a series of sustainable management plan projects under the forest harvesting permits they had been granted. During this same decade, projects were developed in Cameroon, the Central African Republic and in Gabon to define the principles governing the 'modern-day' approach to the management of production forests in the Congo Basin, and to draft pilot forest management plans. Most of these projects owe a great deal to the involvement of forest concession holders; some projects benefited from the support of financial backers or research centres, and forest administration bodies also played a key role by incorporating the concept of sustainable management into their legislative framework. Despite the major difficulties involved, this

approach is gradually being introduced by other forestry operators in Gabon, Congo, Cameroon and the Central African Republic. The Democratic Republic of Congo, which is taking longer to deploy the new methods due to the recent war there, is currently in the early stages of putting its immense forest area under management planning. Finally, in the Congo Basin, Equatorial Guinea is so far the only country not to have followed the general trend.

This new generation of forest management plans differs substantially from previous plans in several respects.

- It is no longer just a question of pilot or experimental ventures; indeed, there is now evidence of a widespread commitment to enforcing forest management planning principles, as demonstrated by both the legal texts and the actions taken.
- Local actors, forest administrations and forest concession holders are gradually taking ownership of the new management approach and demonstrate a full understanding of the potential benefits, even though there still remains a great deal to be done. This work also involves in-process internal reorganisation in order to shape businesses to fit this new vision of forest management.
- The drafted forest management plans are effectively implemented.
- Forest management planning will henceforth cover every aspect of forest functions, and not just the timber production function.

The need for effective forest management is gradually making itself felt in every African Timber Organisation (ATO) member country and is set to come into sharper focus now that, despite the delay, the various actors and players have finally recognised that neither the forest resource nor the available area is unlimited. With the advent of new forest management planning methods, concession holders are switching from mining-style operations to a modern business management model that respects the environment and takes care to take account of the needs of local communities when planning their activities.

This new approach to forest management has been taken account of and promoted through international initiatives, in particular by the COMIFAC (Central African Forests Commission) and the PFBC (Congo Basin Forest Partnership).

In Yaoundé in 2000, the ministers in charge of the Central African forests adopted a convergence plan and agreed to launch sub-regional actions and work together on ten strategic directions (including the harmonisation of forest and fiscal policies, improved knowledge of resources, development of ecosystems, etc.). In 2004, this organisation was named the Central African Forests Commission (COMIFAC).

In 2002, the Johannesburg World Summit on Sustainable Management (SMDD) provided the occasion for forming the Congo Basin Forests Partnership (PFBC), an informal structure grouping twenty-nine governmental and non-governmental organisations. This organisation aims to facilitate the execution of the schedule approved during the SMDD.

I.1.4 Current progress in the management planning of production forests in Central Africa

The last fifteen years have seen the introduction of a range of new initiatives such as:

Gabonese Forest © Cyril PELISSIER

- The first forest management plan project feasibility studies conducted by forest concession holders in Gabon in 1995 and 1996;
- The development of management procedures through the deployment of pilot projects (Ngotto in CAR as part of the ECOFAC programme, the API-Dimako project in Cameroon, south-estuary Gabon, etc.) and the drafting of management plans by Forest Administrations, as in the case of ONADEF in Cameroon
- The approval of a first forest management plan developed by a private company in Gabon, that of CEB, in 2000, followed in 2002 by the approval of the forest management plan for the Haut-Abanga CFAD, and then by several other management plans over the next few years in Gabon;
- Generalisation of the forest management plan approach in Northern Congo, with the approval of a first forest management plan, the Kabo Forest Management Planning Unit (allocated to CIB) in March 2006 and the August 2006 filing of the forest management plan for the Ngombé Forest Management Planning Unit (allocated to IFO of the Danzer Group);
- Forest management planning initiatives in process covering the whole of the western forest area in the Central African Republic, coordinated by a national structure that supports private companies, with the approval of several forest management plans since 2005 (171 forest harvesting and management permits [PEA] allocated to the SCAD in 2005; 2 PEA allocated to the SEFCA in 2006);
- Generalisation of the forest management plan approach in Cameroon (30% of the permanent timber producing forest domain is already covered by a forest management plan);
- The start of the forest management plan process in the Democratic Republic of Congo, with the in-process preparation of technical forest management planning standards, and the 2005 launch of the first forest management plan project covering the concessions held by the NST Group.

Review of the management status of natural production forests in the Congo Basin

	Gabon ha	Congo ha	Cameroon ha	Central African Republic ha	DRC ha	Equatorial Guinea ha	Congo Bassin ha
TOTAL	6 965 000	7 485 000	4 348 000	3 947 000	9 680 000	55 000	31 526 000
Phase 1 : Preliminary etc.	1 906 888	1 724 422	79 442	1 440 986	2 977 527	0	6 965 119
	27%	*23%*	*2%*	*9%*	*31%*	*0%*	*22%*
Phase 2 : Forest management plan activities in process	2 027 250	3 088 253	727 699	1 328 237	6 702 112	0	14 007 262
	29%	*41%*	*17%*	*49%*	*69%*	*0%*	*44%*
Phase 3 : In-process negotiations/Forest management plan filed	117 606	2 302 160	338 771	0	0	54 990	3 521 474
	2%	*31%*	*8%*	*24%*	*0%*	*100%*	*11%*
Phase 4 : Forest management plan approved - logging operation assumed under sustainable forest management	2 913 242	370 160	3 201 879	1 178 197	0	0	7 032 500
as a % of the concessions committed to the forest management plan process	*42%*	*5%*	*74%*	*18%*	*0%*	*0%*	*22%*

Situation recorded in June 2006, source: FRM database
For the Central African Republic, source MEFCPE

I.2 DEFINITIONS OF SUSTAINABLE FOREST MANAGEMENT AND FOREST MANAGEMENT PLANNING

Several definitions of forest management planning have been proposed. Below, we have cited those that seem to best explain this concept. Note that these definitions apply to the management of all forests and not just to production forests.

"Forest management planning means deciding what we want to do with the forest based on what we can actually do with it, and then working out what we must actually do" (Bourgenot, 1970).

"Forest management involves the **planned development** of forest products and services guaranteeing the long-term integrity of the forest environment, as well as its biodiversity and the well-being of its local communities" (ITTO, 2001).

"Sustainable forest management can be defined as being the management of permanent forests targeting clearly defined goals concerning the sustainable production of the desired goods and services without adversely affecting their intrinsic value, or compromising their future productivity and without creating any negative impacts on the physical and social environment" (International Tropical Timber Advisory Council, 1991)

"Forest resources and lands shall be managed in an ecologically viable way in order to meet the social, economic, ecological, cultural and spiritual needs of current and future generations." (*Principes forestiers*, article 2b – CNUED, Rio de Janeiro, 1992.)

"Sustainable management means the management and use of forests and woodland areas where the manner and frequency of this use is designed to maintain their biological diversity, their productivity, their ability to regenerate, their vitality and their ability to meet, both at present and in the future, all their relevant ecological, economic and social functions." (Resolution H1 of the Helsinki conference, 1993)

We can also cite a few general definitions of **sustainable development**, which can also be applied to the concept of **sustainable forest management**.

Building a raft on Lake Tumba (Democratic Republic of Congo) © Vincent FESNEAU

"Sustainable development is a style of development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World commission on the environment and development, Brundtland report, 1987).

(In this Strategy), "we intend sustainable development to mean the action of improving the living conditions of human communities while staying within the limits of ecosystem carrying capacities." (Caring for the Earth - A strategy for sustainable living -UICN/PNUE/WWF, 1991).

I.3 FOREST MANAGEMENT PLANNING, DESIGNED TO COVER ALL FOREST FUNCTIONS

Today, forest management activities have to go well beyond the simple production of quantifiable values if they are to preserve the biodiversity and proper functioning of the whole forest ecosystem.
Forest management now also has to include a social dimension, which is a vital component of the concept where developing countries are concerned.

To sum up, forest management today has to ensure the sustainability of all forest functions as a whole. The key challenge facing the sustainable management of moist tropical forests lies in the multiplicity of functions to be preserved and balanced, while also preserving the management's economic balance.

Now let us briefly review the various functions of industrial production forests:

- **Ecological functions**
  - Preservation of biodiversity, the world's and humanity's heritage and a potential source of useful molecules,
  - Local weather regulation;
  - Protection against soil erosion;
  - Regulation of moisture regimes;
  - Regulation of global climate conditions through their ability to store carbon.

- **Socio-economic functions**
  - Production of timber for industrial use together with a host of economic benefits in rural areas;
  - Supply of other products to be used by local communities, referred to as non-timber products timber: for food, drugs, buildings, handicrafts, local trade;
  - Agricultural land reserves.

An important forest product, the 'Fumbwa' (Gnetum africanum), on sale here in Kisangani market © Nicolas BAYOL

- **Social and cultural functions**
  - Religious sites and cultures of communities closely linked to the forest environment;
  - Existence of holy sites, trees or species considered holy;
  - Interest of international public opinions for tropical forests; the beginnings of the development of ecotourism.

I.4 REGULATIONS GOVERNING SUSTAINABLE FOREST MANAGEMENT IN CENTRAL AFRICA

There are a number of international conventions that impact more or less directly on the sustainable management of forests; the following can be cited in particular:

- CITES (Convention on International Trade in Endangered Species);
- Convention on Biological Diversity, PNUE, Rio 1992;
- Convention on climate change;
- Convention on the fight against desertification;
- Ramsar Convention (convention on wetlands of international importance, in particular for water birds).
- COMIFAC Treaty

All Congo Basin countries are now equipped with a legal framework governing the forestry-timber sector, including:

- A 'forest code',
- A set of technical standards.

Over the last few years, every Congo Basin country has extended the scope of their regulations governing forest management planning. However, these same Congo Basin countries are currently at different stages in the process of standardising activities relating to the management of production forests. Moreover, it is absolutely vital to enforce the decisions taken and monitor their application. This requires strong institutions with the necessary resources to enforce all the players to comply with the rules. The level to which forest management policies are implemented also varies widely from one country to another.

Forest Codes currently in force in Congo Basin countries

Country	References of forest management laws
Gabon	Forest Code Act No. 16/01 (31 December 2001)
Central African Republic	Central African Forest Code Act 90/003 (9 June 1990) New Forest Code scheduled for 2007
Congo	Forest Code Act 16-2000 (20 November 2000)
Democratic Republic of Congo	Forest Code Act 011/2002 (29 August 2002)
Cameroon	Forests, Wildlife and Fishing Act No. 94-01 (24 January 1994)
Equatorial Guinea	LEY 1/1997, sobre el Uso y Manejo de los Bosques (Ley Forestal) /(Law dated 1/1997 pertaining to the use and management of forests (forest law))

The 'Forestry Forum', held in 2003 in the Central African Republic, underscored the extent to which the 1990 forest code was no longer relevant and led to the decision to draft a new law. In 2007, the various actors in the forestry sector are now at the stage of finalising the new forest code act.

Okoume at the border of the sampled surface area © ATIBT

Beyond the regulatory aspects, it is now generally accepted by nearly all the partners involved in forest management that successful management of forest ecosystems requires the co-existence of effectively planned and managed conservation forests and production forests. This has been demonstrated over the last few years in particular by the development of 'landscape' approaches. Landscapes housing conservation areas preserve the biodiversity of ecosystems, sites or species that are either threatened or considered outstanding natural features. Production forests supply local communities with goods and services and, through the resulting economic activity, are pivotal in driving local development. Forest Codes set out the conditions for allocating forest titles (also referred to as forest harvesting permits) within the State's permanent domain. With certain exceptions, these permits give their holders the right to harvest a given area for a given period.

Terminology relating to forest titles

Country	**Forest titles/management planning units**
Gabon	Forest Concession under Sustainable Management (CFAD) Forest Management Planning Unit (UFA)[1] Associated Forest Permit (PFA)
Congo	Forest Management Planning Unit (UFA)
CAR	Forest Harvesting and Management Permit (PEA)
DRC	Forest Concession Surface area under Management planning (SSA)[2]
Cameroon	Forest Management Planning Unit (UFA)
Equatorial Guinea	Contrato de arrendamiento por aprovechamiento forestall (Forest Management Lease)

[1] In Gabon the forest title (CFAD) may be quite separate from the forest unit covered by the forest management plan (UFA); one CFAD can contain several UFAs.
[2] In the DRC, the notions of Forest Title (Forest Concession) and Management Unit (SSA) are quite separate. The term SSA has been proposed, but not yet validated.

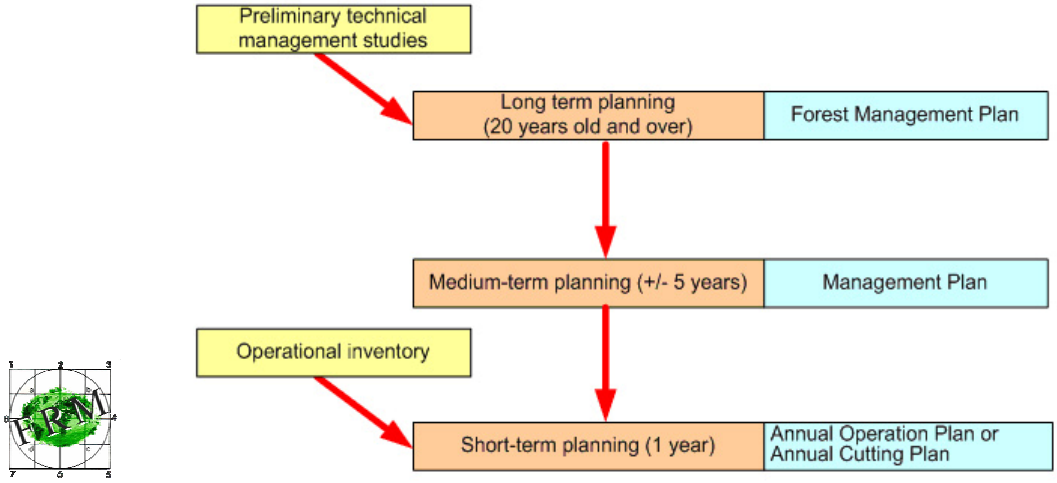
Main forest management laws currently in force in Congo Basin countries

Country	References of forest management laws
Cameroon	Guideline on developing management plans for production forests in the permanent forest domain of the Republic of Cameroon (January 1998)
Congo	National directives on the sustainable management of natural forests in Congo (February 2004)
Gabon	Law No. 689/PR/MEFEPEPN dated August 2004 setting out the technical standards for the sustainable management planning and management of registered State production forests. National technical guideline on the management and development of registered State production forests (in process).
Equatorial Guinea	No known law
Central African Republic (CAR)	National standards governing the drafting of management plans (April 2006)
Democratic Republic of Congo (DRC)	Ministerial order No. CAB/MIN/AF.F-E.T/262/2002 dated 3 October 2002 setting out the procedure for developing a forest management plan Order No. 036/CAB/ MIN/ECN-EF/2006 dated 5 October 2006 setting out the procedures for developing, approving and implementing management plans for timber producing forest concessions

Since 2005, the DRC has been engaged in a collaborative process aimed at establishing universally approved technical standards. This process is being steered by the WWF, in partnership with the Forestry Authority, the private sector, forest management planning agencies, NGOs, and representatives of civil society. Still in the DRC, work is underway to convert former forest titles into forest concessions (and management planning units) and should be completed in late 2006.

I.5 THE VARIOUS STEPS IN IMPLEMENTING THE FOREST MANAGEMENT PLAN PROCESS

The conventional approach to managing closed moist forests uses a three-tiered method that depends on the planning target date.



The 3 levels of forest management planning – section on timber production

In contrast to other continents, Central Africa has developed its 'long-term' management planning to a far greater level. It is essential to begin the process by conducting strategic thinking on the long-term outlook for a forest area, its potential, which harvests may be deemed sustainable, and on the range of services that it may provide. Next, these decisions can be converted operationally into a set of concrete and realistic short to medium-term actions in the field, which are designed to respect the environment.

It is absolutely vital to comply with the timing of these 3-levels of forest management planning. Currently, there is a tendency for operators to want to cut straight to the operational level, a risky trend given that one of the key priorities of the sustainability concept is to think carefully about how best to develop the forest ecosystem in the long-term. The timing of this planning also applies to the volumes dealing with the environmental and social aspects of forest management planning.

The overall process for developing a forest management plan follows the same logic the world over, and is based on a 4-phase approach:

- Phase 1 - study and compilation of information on the area to be managed;
- Phase 2 - analysis;
- Phase 3 - definition of the goals and directions of the management plan;
- Phase 4 - planning activities.

PART II TECHNICAL CONTENT OF A PRACTICAL PRODUCTION FOREST MANAGEMENT PLAN

The main purpose of managing a production forest is to ensure the balanced and sustainable harvest of forest products, based on the programmed and planned reduced-impact harvesting of a forest within a permanent forest area, while effectively preserving the forest's heritage as well as all its social and ecological functions.

Forest management planning is also the agreed outcome of a process of collaboration and arbitration between the various partners. The completion of this process is generally represented by a statutory order or ministerial decree effective against third parties.

Lastly, forest management planning involves a set of documents, used as reference and management tools that specify a practical and realistic programme of action in the short, medium and long-term concerning social, ecological, technical and financial plans.

The goals of the forest management plan can be transcribed in various volumes as shown in the following table.

The plan's groundwork starts with the description and analysis of the location and characteristics of the forest area to be managed, followed by presentations and analyses of the socio-economic environment and the features making up the natural environment.

At the same time, forest managers have to deliver a short-term analysis of local, regional and international markets coupled with a medium-term trends analysis that could be used to:

- List which forest species should be harvested and promoted and, in particular, which species should be managed;
- Define or specify the content or development of the industrial project.

These preliminary management plan studies, and in particular the results of the management inventory, will form the basis of the major forest management plan decisions, i.e. rotation period, forest potential (sustainable yield), social and ecological measures, etc.

Timber production is the primary feature that will orient decisions on the management plan methods and potential of a production forest. It will nevertheless be vital to factor in the conditions and needs of the socio-economic, ecological, wildlife and plant life aspects of the forest area to be managed, in order to take decisions and generate any related actions.

The document will also establish the bases for the location and scheduling of any such actions: the forest area to be managed will be divided up according to the specific purposes (assignments) allocated to its various parts. These subdivisions are referred to as 'series'; including the production series which forms the main topic of this study and which will be the only one dealt with in any detail.

This series is itself divided into blocks or management planning units, i.e. regional units generally forming one piece, with similar harvesting periods, variable surface areas, and with a relatively constant supply volume. These blocks will be covered by a management plan.

Each of these blocks will then be further subdivided into annual harvesting units often referred to as annual allowable cuts, which will be of variable surface area or volume depending on the relevant legislation.

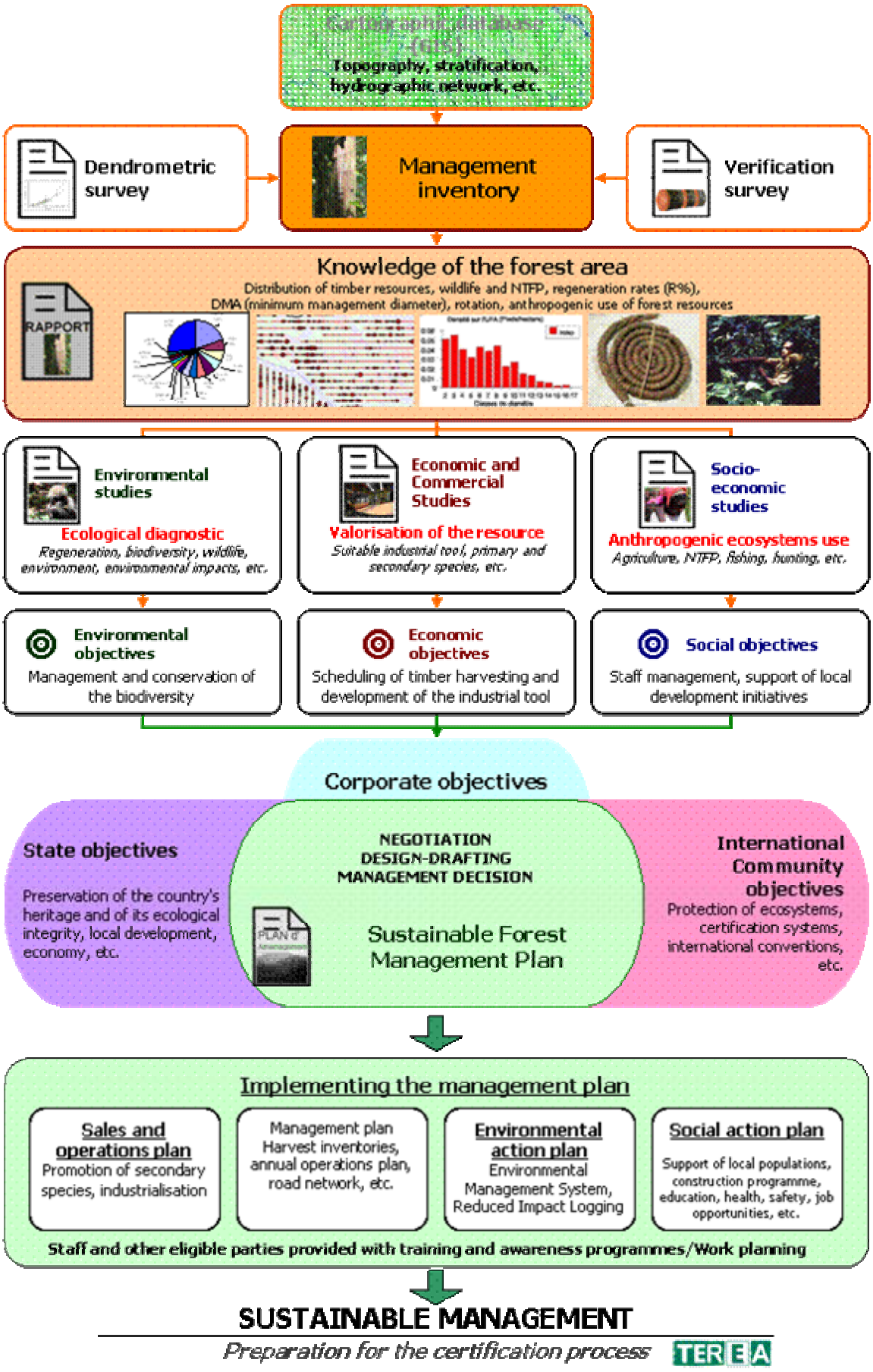
The plan's components will be listed in detail in three documents, for which a provisional template for the first two documents is given in annex:

- **Forest management plan**: Long-term strategic document generally open to review every five to ten years depending on the relevant laws, which sets out the decisions approved by the company and the public authority which will underpin the application of the forest policies of these two key actors.
- **Management plan**: medium-term strategic document (covering successive periods of 5 to 7 years), which sets out the management provisions covering the concession's subdivision into several separate management units.
- **Annual operations programme** (sometimes referred to as the Annual Operations Plan or Annual Cutting Plan): used to schedule and monitor the annual implementation of the management plan at the level of the Annual Allowable Cut. This is a short-term forest harvesting tool.

The forest management plan's master plan is developed following a certain number of operations, which could be considered as mandatory steps:

- Definition and marking out of the forest area or the concession to be managed;
- Review of the technical studies preliminary to the forest management plan process (management inventory, mapping, etc.);
- A consensus-building and decision-making phase;
- Drafting of the forest management plan and the initial management plan.

illustration of the forest management plan process



Operational inventory path © Benoît DEMARQUEZ

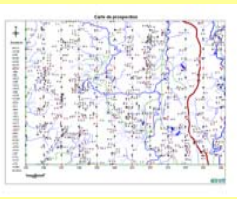
It should be stressed that forest management planning is a fully inclusive process. Every one of the above-mentioned operations is required to establish the management plan. None of the studies and fieldwork may be disregarded or cancelled irrespective of whether they are conducted by the logging operator at the level of the concession, or on a more general scale (i.e. for volume tables), as may be the case with small forest titles.

However, implementation periods and methods may vary according to legal requirements and the company's ability to integrate this new approach, which will require a certain amount of time.

Each company will obviously have to apply its own version of the forest management plan template. The differing socio-economic contexts, the individual aspects of the forests and surrounding environments, and the locations and access conditions specific to each forest area will combine to make each plan a unique work presenting a set of distinct features which will be the management planning officer's job to identify and translate into action.

The following chapters present the various steps in developing a forest management plan. This analysis will be kept fairly general however to make it easier to adapt it to as many situations as possible and also because a full description of the working procedures would take up whole books in themselves.

Note that our goal is to present a practical approach designed to provide businesses with a realistic and enforceable method, in social, technical and financial terms, by providing them with the tools for effectively managing their concession in the long-term without compromising either its sustainability or its financial profitability.

Forestry section	Industrial & Commercial section	Socio-economic section	Environment section	Organisation, Scheduling & Management section	Research & Development section	Training & awareness section
						
Acquisition of quantitative and qualitative knowledge of the forest resource: * mapping of the concession * management plan inventory * operational inventory * management plan parameters and decision-making • minimum forest management plan diameter • rotation • annual potential • definition of the division of	- Knowledge of the mechanical and machining properties of the various species. - Search for new industrial products - Marketing of secondary species - Industrial tool tailored to the resource - Product diversification - Secondary and tertiary processing	- Analysis of the local communities' socio-economic status - Improvement in the living conditions and general well-being of both rural communities and company workers - Upholding and enforcement of the customary laws of local communities - Support for the organisation and development of socio-economic activities - Compilation of information on hunting and poaching activities	- Knowledge of the forest ecosystem by taking regular surveys of fauna and flora - Gathering of knowledge on non-timber products, their sale and long-term use - Marking out of habitats warranting the enforcement of specific protective measures - Definition of special specifications aiming to improve the protection of both the environment and forest ecosystems - Setting up of	- Scheduling, programming and organisation of forestry and industrial activities - Setting up of tools for collecting, entering and analysing resource data (database, GIS) - Improvement of technical and financial competitiveness of forestry operators through enhanced resource development: forested and processed timber yields, use of new species - Setting up of an internal and external	- Understanding of forest regeneration and dynamics as applied to stands and individual species - Study of the impacts of forestry operations - Study of non-timber forest products - Study of animal populations warranting specific protection measures - Ecological studies on at-risk environments and habitats - Silvicultural studies on the enhancement	- Supervisory staff trained in how to apply the forest management planning approach - Training of the teams responsible for making the inventories - Training of field workers: felling, forwarding, botany, product, etc. - Training of management and IT staff - Staff are trained to understand the sustainable

Forestry section	Industrial & Commercial section	Socio-economic section	Environment section	Organisation, Scheduling & Management section	Research & Development section	Training & awareness section
land into compartments based on AAC of similar surface areas or similar volumes - Implementation of a reduced-impact forestry approach - Use of silvicultural procedures to improve natural forest regeneration			measures to regulate hunting activities and limit poaching, so as to ensure the sustainability of wildlife resources - Anti-pollution measures (hydrocarbon management, waste management, etc.)	monitoring and evaluation system covering each section - Setting up of an environmental management system	or regeneration of forest stands	management process and to develop respect for the environment

Remark: not all the measures outlined here will necessarily be implemented for each management project. The work programme will have to be tailored to fit the specific features of the forest to be managed. Neither are all these measures necessarily the responsibility of the logging operator (see table in chapter III.2.3).

I.6 GENERAL OUTLINE OF THE PLAN

Note that this first volume of the practical management plan mainly covers forestry issues relating to the management plan's production series. Social and wildlife aspects are dealt with in volumes 2 and 3 of the study of a practical forest management plan for natural tropical production forests in Africa.

As explained in the first section, the forest management plan is the outcome of an in-depth study of the potential of the forest areas to be managed, as well as of the risks that may affect the forest and its functions; this study is used to direct thinking on how best to develop the value of the forest area in the long term. The results of studies performed and decisions taken are recorded in the Forest Management Plan, which is the strategic document guiding the actions of forest managers and their partners for a period of 20 to 40 years. Naturally, the decisions taken are not always set in stone and may be subject to partial review. **Nevertheless, all the decisions recorded in the forest management plan must be followed-through, never losing sight of the need to apply them over the long-term.**

This Forest Management Plan is the fruit of a collaborative effort, set to become a contract between the State, which owns the forest, and the concession holder, who is thus entrusted with the forest management of their forest area.

All Forest Management Plans must :

- Describe the concession and its environment: physical environment, socio-economic context, timber resources, resident wildlife, ground occupation, biodiversity;
- Set out the decisions taken in terms of land allocation: the concession's definitive boundaries, marking out in series together with the goals for each series;
- Set out management plan decisions regarding the timber producing series, i.e. rotation period, list of managed species, Minimum Forest Management Plan Cutting Diameters (DMA);
- Schedule the harvest in terms of space and time: mark out the division of the land into compartments (multi-annual harvesting units) and establish harvest forecasts;
- Define the management measures governing the various timber series, i.e. reduced impact forest harvesting rules, management measures governing protection, conservation, or agricultural series, applied research programme, wildlife management measures, etc.;
- Direct industrialisation in relation with the available resource, and more generally, all the planned measures targeting enhanced resource development (loss cutting, development of timber of lesser quality that is not generally used, diversification of the range of harvested species, energy conversion of industrial waste, etc.;
- Establish an action programme for the socio-economic section: on-going collaborative measures, measures specific to living sites, measures promoting enhanced sustainable management by local communities, the part played by concession management in local development;
- Detail the procedures for monitoring and evaluating the management plan: the plan's chosen implementation procedure, enforcement period, options for review, etc.

An example of the possible content for a management plan is given in annex 2.

I.7 KNOWLEDGE OF THE FOREST AND ITS SURROUNDING ENVIRONMENT

Effective management, and thus effective operation and development, of an entity is only possible where there is the necessary in-depth information on and understanding of this entity. All decisions relating to forest management planning, management or operations require an in-depth preliminary study of the available resources, the surrounding environment and the people involved.

The various studies that need to be performed prior to establishing the management plan include:

- Management inventory;
- Forest mapping;
- Socio-economic diagnosis;
- Description of the concession's ecological nature;
- Study of the impacts generated by forest harvesting operations;
- Various forestry studies such as: setting (or validation) of volume tables, study of stand dynamics.

This knowledge mainly derives from technical studies, supplemented by the compilation of all the existing data (previous inventories, old maps, geological or pedological maps, weather surveys, population censuses, previous studies, etc.).

This is the most time-consuming phase in setting up the management process, which also serves to prepare the business to make the necessary adjustments in its working methods and structures.

I.7.1 Physical environment

This will be dealt with in a general way once all the available documentation that most closely applies to the relevant sector has been collected:

- Lie of the land (relief and hydrography),
- Weather,
- Nature of the ground (geology and pedology).

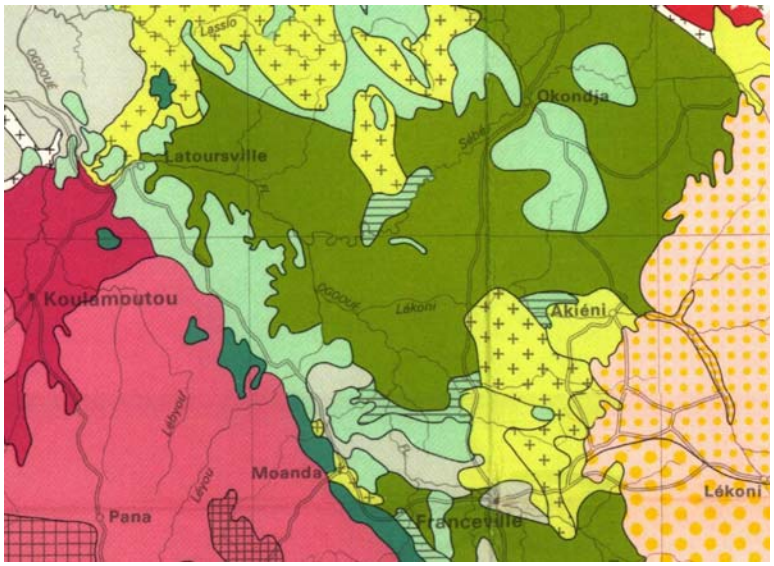
This understanding of the physical environment will be mainly based on existing documentation such as: geological and pedological maps and guides, meteorological records and surveys, etc.

It is important to keep in mind that the useful purpose of this natural environment analysis to working plan officers lies in the interactions between the natural environment and forest management procedures, with two main goals:

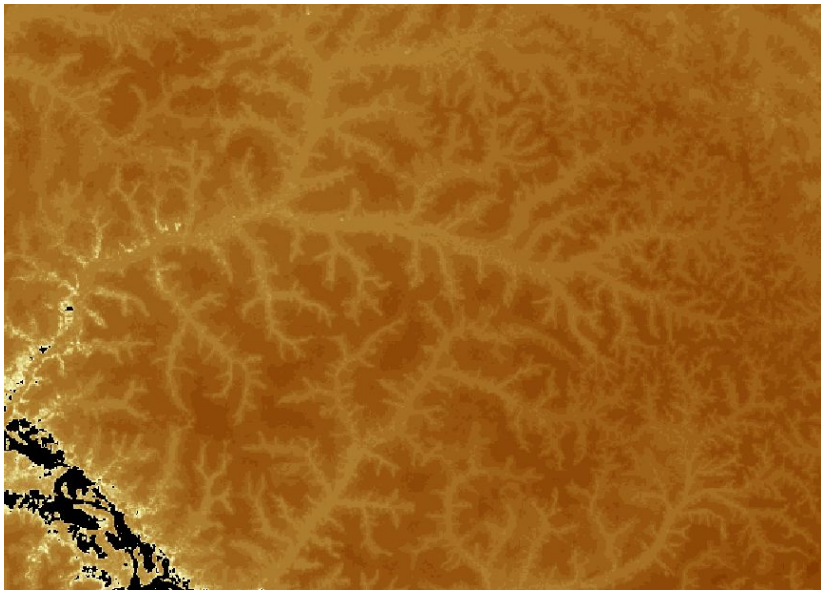
- To highlight forest management constraints, in order to factor them into management decisions,
- To identify and analyse the possible impacts of forest management on the natural environment, so as to work out measures aimed at limiting these impacts.

A basic map will be constructed to analyse the area's relief and hydrography, using existing maps supported by aerial photos (if available), satellite images and Digital Terrain Models. The aim here will be to:

- Identify areas with steep slopes, requiring the use of special management measures (that may include the decision to actually prohibit logging operations there), or the use of special equipment,
- Describe the main water courses (width, banks), so as to estimate and plan fording points and then organise the subdivision into management compartments,
- Highlight temporarily or permanently flooded areas that are unsuitable for harvesting, or that can only be harvested under certain conditions (during the dry season, according to specific harvesting rules, etc.).



Extract of a geological map



In terms of weather conditions, the following will be taken into account:

- Rainfall (annual or monthly averages, and also 'instantaneous' rainfall figures),
- Temperatures and sunlight,
- Changes in historical weather conditions and their impact on the dynamics of forest ecosystems.

Depiction of relief using a Digital Terrain Model with a resolution of 90 m

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I.7.2 Analysis of the socio-economic environment

This analysis is nevertheless one of the pivotal studies in the preparation of the forest management plan. The analysis has to factor in both the timber producing potential of the forest area to be managed and the relationships governing society-forest interactions, while also covering the concerns of all the actors involved. One of the main purposes of the analysis will therefore be to identify the conditions for integrating businesses and the forest management process within the current socio-economic context.

The socio-economic analysis is an integral part of the management plan, and as such is a vital component of a business's management approach in successfully implementing its industrial strategy within the local and regional socio-economic context, both smoothly and peacefully.

This consideration of the social environment is dealt with in greater depth in volume 2 of the study of the practical forest management plan for natural tropical production forests in Africa - social aspects.

This analysis will be used to draw attention to the characteristics, living conditions and activities of local populations, the sources of any possible conflicts and obstacles, and the features of the relevant use rights.

This analysis is based on the existing documentation (census, previous studies, data available from local authorities), and also on a socio-economic diagnosis.

Working plan officers must stay focused on the purpose of the socio-economic diagnosis, which is to provide action proposals and recommendations aimed at improving the integration of local communities into the forest management process, facilitating a joint social effort, negotiations on use rights and the business's social contribution.

The socio-economic diagnosis covers all local communities whose land use activities coincide with those of the concession, and all the people employed by the concession-holding company including all related eligible parties (i.e. wife and children living under the same roof). The expected outcomes of the socio-economic study include:

Swamp forest © Nicolas BAYOL

In work camps

- Identification of all eligible parties via a fully inclusive census,
- Review of the current situation and the needs to be covered for each type of management measure (health and safety, education, housing, etc.),
- Identification of contacts and of the organisation and management methods on which the company is going to base its approach.

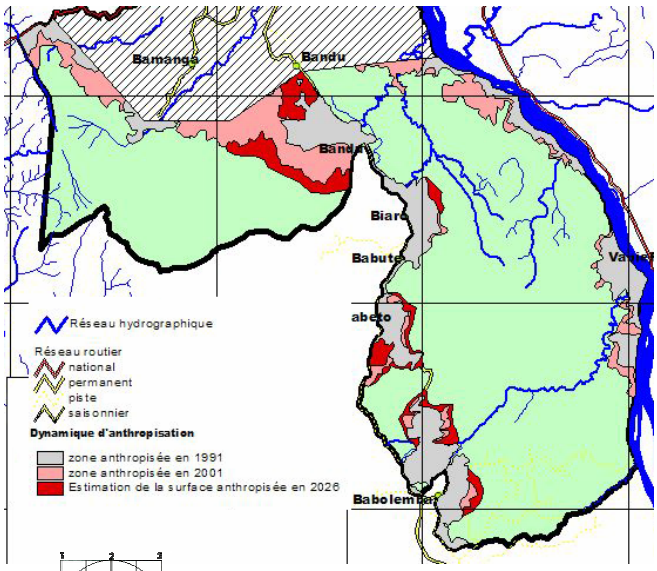
In villages

Village meetings in Congo
© Tom VAN LOON

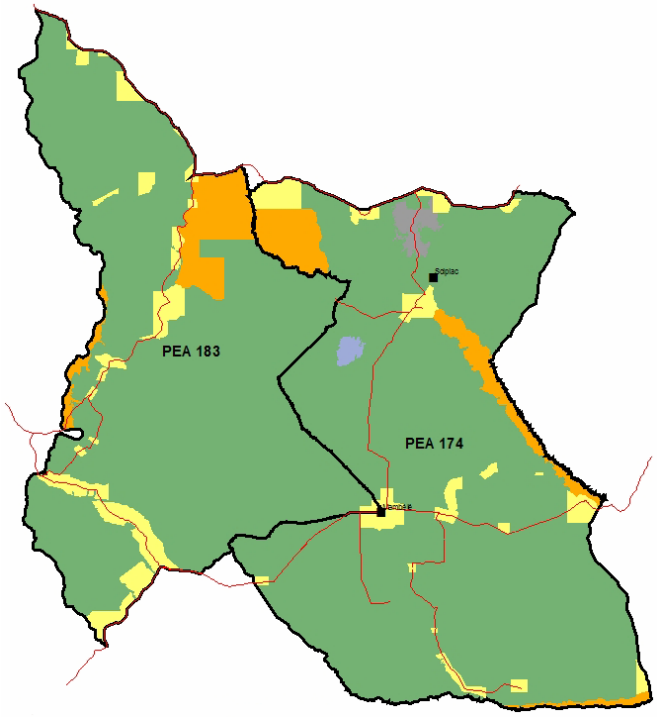
- Identification of permanently settled and mobile camps and villages within the forest concession together with a description of demographic trends based, in particular, on an assessment of farming land requirements, a study of the approximate boundaries of village territories, population origins and the reasons for any migratory flows,
- Identification of the designated representatives of the various interest groups and lobbies, and of the standard decision-making and organisational processes in view of the following steps,
- Identification of contacts likely to participate in facilitating or mediating with one or several interest groups during the following steps,
- Description and analysis of the various uses made of the forest concession's natural resources,
- Concerning the unsustainable use of resources, analysis of the local capacity for labour, organisation, and socio-economic investment in order to identify which types of local management support measures may be considered (in particular regarding economic activities that could replace the trade in bush meat),
- Identification of the actual and potential impacts of the industrial forestry industry on the well-being of local communities and the extent to which their needs in space and natural resources is met,
- Preliminary inventory of the locations, and animal and plant species subject to access or use rights that are exclusive of or in direct competition with forestry operations such as a holy site, long-established villages, tree species used as totems or for a specific use sought by the local community, etc.),
- Identification of any possible land conflicts over land rights or use rights relating to access to timber resources and forest species,
- Identification of local sources with the potential for supplying a company's eligible parties with farm produce, meat and fish, and that do not compete with the needs of local populations and are well-suited to the sustainable management of natural resources,
- Identification of the local labour potential, particularly in qualified personnel, in order to optimise the management of a company's human resources in line with its changing needs, and bolster the company's insertion into the local economic fabric,
- Identification of the key social, local and land management needs of the community local to the forestry concession; these data, and the full socio-economic diagnosis, will be used by

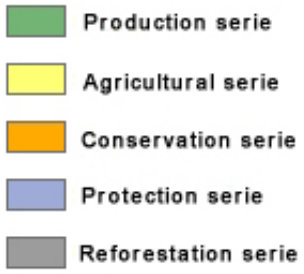
Traditional fabrication of a Pygmy bow in DRC
© Jean-Gaël JOURGET

local authorities to schedule and implement social programmes, especially those financed by decentralised forestry taxation.



Extract of a map modelling the development of agricultural land clearing, used to redefine the boundaries of a forest concession in DRC





Example of the marking out of agricultural development series in the management plan for two Harvesting and Management Permits in CAR

I.7.3 History of the operations conducted in the forest area to be managed

The Management Plan will retrace earlier interventions that may have modified the forest environment or impacted on its development. Based on the available information, the plan will describe former forestry operations (giving the locations for permits, operating methods, species and volumes harvested, etc.), as well as the methods for managing the forest area (previous management or development plans).

The plan may also record forestry activities traditionally exercised by local populations, as well as any event that has had an effect on the forest environment. For instance, several concessions in CAR were victims of forest fires in the 1980s.

I.7.4 Mapping

Mapping is one of the key forest management tools, providing reliable knowledge not only of the managed forest, but also of field operations as a whole during the preliminary phase of the management plan and later during its implementation. This mapping is not fixed, and the resulting cartographic database will be regularly updated.

The use of mapping software such as Geographic Information Systems (GIS) has now become a central component of the forest management process. These databases now boast formidable data processing capacities, and can be used to publish a variety of thematic maps on request. Therefore, it is now possible to publish resource distribution maps with differing scales, and to schedule forestry operations (calculation of distances, slopes, etc.).

Three different mapping levels are used depending on the need:

- Overview of the forest area and of the concession's surrounding environment (neighbouring concessions, network of the main forest tracks, towns, etc.)
- Production of the basic map and the area's forest stratification map, used to schedule and monitor operations within the forest area as well as all the necessary thematic maps showing, for example, the distribution of timber species, wildlife species, and human establishments and activities;
- Provision of a working tool for land managers (the published map has a scale of between 1:2000 and 1:20000), pinpointing the position of harvestable trees. For more details on micro-relief, these maps could be usefully supplemented by large-scale information (rocks, unfordable marsh creeks, cliffs, etc.) recorded on operational inventory compartments.

The data used to build these maps includes:

- Existing maps (printed): topographic maps or basic maps and thematic maps (geological, pedological, vegetation, demographic, etc.). Unfortunately, the cartographic knowledge available prior to commencing the management process is often extremely limited, which makes forest management mapping work even more important. In particular, there are only a few basic maps with a scale of 1:50000 covering Central Africa. These maps can be integrated by scanning and image geo-referencing, or by converting to digital format (into a vector file);
- Existing vector data: these data can be fed directly into the GIS and can be overlaid onto other data created during the management process;
- Land surveys, especially surveys made using GPS (Global Positioning System), and any surveys made during the various studies (management and operation inventories, socio-economic studies, etc.);
- Aerial photos, although unfortunately these provide only limited coverage and are usually out of date. These aerial photos provide a view of the relief and an accurate identification of the various vegetal formations;
- Satellite images, which are now considered key documents for ground occupation analyses. There are a number of different satellites taking pictures using various resolutions and using differing 'spectral

bands'; the current trend is to use SPOT and LANDSAT images, while future trends will probably favour ASTER images;

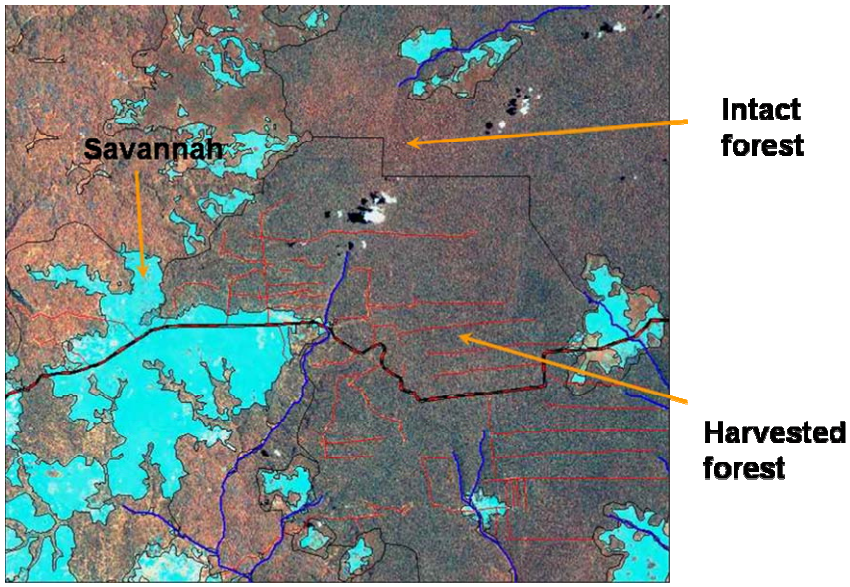
- Digital Terrain Models, which provide information on relief and altitudes.

Digitizing a photo-interpretation model on a digitizer table
© Vincent FESNEAU

Example of information taken from a satellite image

It is now standard procedure to use GIS to process this complex set of cartographic data. Theoretically, it is now possible to manually create all the maps published as part of the forest management process. However, Geographic Information Systems (also referred to as Geomatics) offer a number of advantages:

- Option of superimposing on a given map all the desired layers of information according to the need,
- Ease of reproducing, correcting or modifying maps;
- Rapid performance of the various processing treatments: calculations of length and surface area, 'geoprocessing' (combination of several layers of information), interpolation;
- Ease of integrating GPS surveys.



Various GIS software are used in forest mapping. The most widely used software include:

- Arcview 3.3;
- ArcGis 9 (or an earlier version, 8);
- Mapinfo.

Cartographic products to be supplied with the Management Plan include but are not limited to the following:

- General Permit location map;
- Administrative map;
- Business history map;
- Basic map of the Permit showing boundaries;

- Pedological and geological maps;
- Human occupation map; local villages or villages situated within permit boundaries, mapping of village lands, in particular the farming and harvesting and/or hunting lands;
- Maps of areas with agricultural issues;
- Wildlife distribution maps;
- Maps showing the distribution of the dynamics of the regeneration of the main timber species;
- Distribution maps of non-timber forest products;
- Infrastructure maps (roads, bridges, etc.) and equipment (schools, hospitals, etc.);
- Map of management series showing multi-annual management units.

I.7.5 Photo-interpretation and stratification of the forest area

Here we will take a more detailed look at a use example of forest mapping: the stratification of ground occupation.

Stratification consists in identifying, marking out and grouping under a single name the forest stands with similar features: strata.

The final stratification will be made following completion of the inventory's cruising phase; the information collected in the field will be used to check and validate the photo-interpretation or the interpretation of satellite images.

The description of the strata is based on a set of simple criteria used to identify and mark out the main types of terrain and the forest stands covering them. These are:

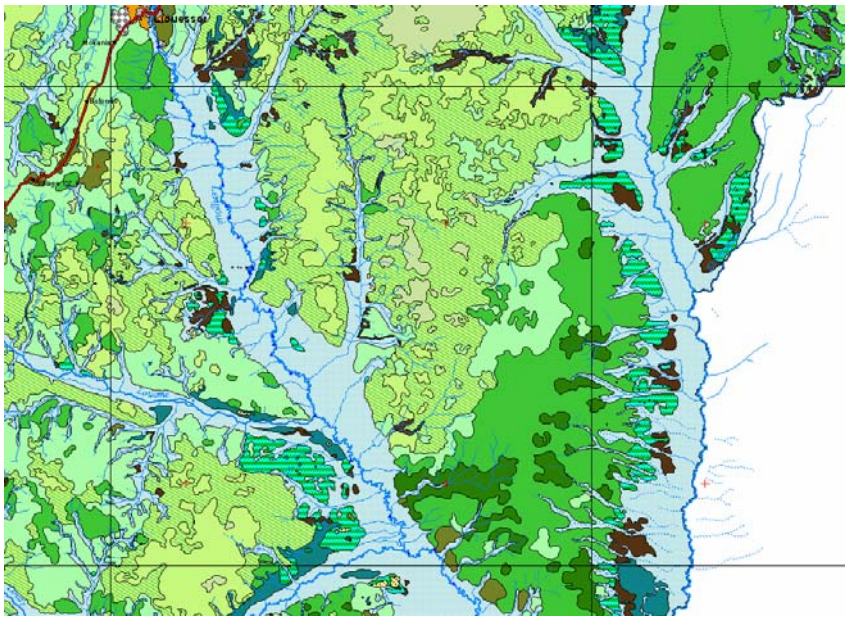
- The environment: distinguishing features of formations on firm ground, formations on ground liable to flooding or on swampy ground, and formations on steep slopes;
- The nature and density of vegetation cover. We generally recognize:
    - Intact closed forest divided into two or three classes according to the coverage density of the main stratum;
    - Degraded forest occasionally differentiated into secondary and regenerated forest;
    - Open woodland formations;
    - Non-woodland ecosystems: savannas, prairies, water lots, rocky outcrops, baïs (swampy clearings), etc.;
    - Non-woodland terrains (croplands, villages, etc.)

Naturally, this list is not comprehensive. Other criteria can be used such as the behaviour of foliage, density, the size and height of the crowns, stand disturbance, etc.

When determining the stratification, we will also seek to identify and map the topographic conditions that may impact on the setting up of infrastructures, and roads in particular:

- Zones of fairly or exceptionally uneven terrain, on which forest operations would require the use of specific measures, and would even be impossible in certain extreme cases;

- Swamps and terrain liable to flooding;
- Crossing points that are mandatory or impossible (rivers, cliffs, deep talwegs, etc.).



Extract of a ground occupation map

I.7.6 Prelimenary and management inventories

Strictly speaking, the purpose of a forest inventory (cruise) is to provide a silvicultural diagnosis of the state of the forest in order to programme which interventions to make. Today, the sustainable management of production forests means that these inventories are no longer limited to the simple collection of data required for estimating silvicultural parameters. The taking account of the local population's use of the forest and its products, the study of long-term forest stand dynamics and the monitoring of ecosystems have made it necessary to develop a new multidisciplinary tool:

Inventory row © Jean-François CHEVALIER

The management inventory

The **management inventory** is the cornerstone of the forest management process. It is also the most cost-intensive part, as it mobilises several tens of people and a major logistics set up over a period of several months, or even several years for very large forest concessions. This involves heavy technical and financial investments that have to be budgeted for in the same way as purchases of equipment, the construction of main and secondary roads, work and living camps, etc. and which must be amortized over several years on the balance sheet

The regulations in most Central African countries require operators to follow forest management cruising standards.

Management inventory objectives

The management inventory covers the whole surface area within the concession initially considered as harvestable and has the following **general objectives**:

- **Location and evaluation of the harvestable timber potential in the short, medium and long-term**, based on the knowledge of the structure and composition of the stands to be managed;

- *This is the key objective of the management inventory: it enables the manager to establish a long-term forest harvesting schedule, and therefore determines the size of the sampling device.*

- **Performance of a preliminary ecological analysis of forest ecosystems and of their human use**, based on the collection of environmental data (ground, vegetal strata, etc.), wildlife, non-timber forest products (NTFP), biodiversity and signs of human activity.

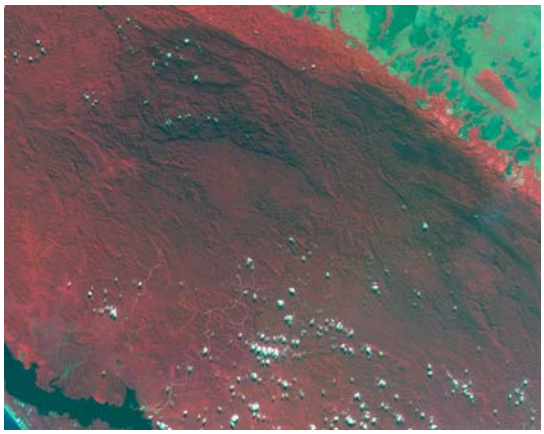
Meanders and Mosaic, forest /savannah, southwest Gabon © Cyril PELISSIER

The various types of work to be carried out for the management inventory can then be separated into three main categories:

- **Preliminary mapping and remote sensing**;
- **Forest sampling**;
- **Data entry, calculation and processing**.

Prelimenary forest stratification

The main aim of the preliminary remote sensing work (interpretation of aerial photos and/or satellite images) and mapping is to build a **forest stratification map** of the forest area (see chapter II.2.4.). This involves identifying the various types of vegetal formation and strata covering the concession in order to define a sampling device suited to each stratum.



Extract of a satellite image

In practice, as stratification work is a time-intensive process, and as the management inventory, being the longest phase in the forest management plan process, needs to be started as quickly as possible, it is not possible to complete forest stratification work prior to starting the cruise.

Marantacees Forest © Benoît DEMARQUEZ

Furthermore, a full forest stratification, used in scheduling harvesting operations and preparing the management of a concession, is far too detailed to be used for determining a sampling device. A preliminary stratification analysis is generally required in order to define the management inventory sampling device.

The main purpose of preliminary stratification analysis is to mark out which areas will definitely not be concerned by forestry operations (and therefore do not require an inventory of their timber resources) such as savannas, plantations, and swamps, and to identify which forest formations require modification of their sampling devices (for example: harvested/unharvested forest, Marantaceae forests in the Republic of Congo, etc.).

Preliminary stratification analysis should also enable the definition of preliminary cruising areas (see next chapter) and facilitate the marking out of possible access roads for different areas of the concession to be managed.

The cartographic plotting of this interpretative work must integrate river and road networks in order to facilitate the establishment of cruising devices in the field: preliminary inventory followed by the management inventory.

Forest inventories

Principle

Management inventories or cruises performed in Congo Basin production forests involve **systematic samplings made along parallel and equidistant forest paths**. The sampling unit is the compartment (or sampling compartment): **the compartments are adjoining and centred on the forest path**.

The variable statistics studied concern the timber potential. This generally means the number of harvestable stems, on the one hand, and, the future of the main species harvested by the company on the other hand, or even their volume when volume tables are available.

Size of the compartments

For closed humid forests in Central Africa, it is generally decided to conduct management inventories on compartments with a surface area of 0.5 ha. This surface area can, however, be adjusted and can vary in line with the selected sampling arrangements and the size of the concessions, thus occasionally permitting operators to minimise inventory costs.

However, it may be possible to set up a sampling device with several compartment sizes (of the 'nested compartments' type), with compartments of 0.5 ha for 'large trees' (for example with dbh = 40 cm) and

smaller 'sub-compartments for trees of lesser diameter (for example with a diameter of 20 cm = dbh = 40 cm), or for inventories of 'regeneration' or 'gaulis' (trunks with dbh < 20 cm diameter). Indeed, as greater accuracy is required for harvestable trees, it may be possible to select two different sampling rates for these two categories of trees.

For practical reasons, compartments are rectangular and centred on the forest path axis. Generally, while it is not mandatory, these compartments are 25 m in width (12.5 m on either side of the central axis) and 200 m in length (giving a surface area of 0.5 ha). If a distinction is made between 'small' and 'large' trees, 'small' trees are then inventoried on a sub-sample of the compartment, for example over the first 100 meters, or on just one side of the forest path. Lastly, a special device has to be selected for the regeneration cruise, when this is performed at the same time as the management cruise. This regeneration cruise may be dealt with in a separate study. One of the chosen options may involve sampling compartments measuring 10 m x 10 m (or 4 x 25 m) set up at the beginning of each compartments.

Sampling rate

The sampling rate represents the ratio between the surface area actually sampled and the total surface area of the area to be inventoried. To determine the number of compartments to be sampled, it is first necessary to know the reference surface area and accuracy for which we wish to estimate the relevant variable(s). Most management standards for the sub-region require a minimum accuracy level of 10%, with a probability threshold of 95% for the concession to be managed. An accuracy level of 15% is generally sought for five-year blocks (i.e. UFP [Forest Production Unit] or UFG [Forest Management Unit]).
Thus, for example, an error of 10% with a probability threshold of 95% for a volume estimated at 1000 m^3 means that we can state that the actual volume comprises between 900 and 1100 m^3 with a 95% "chance of not getting it wrong".

Based on previous experience, optimal sampling rates are usually under 2% depending on the type of stand and its harvesting history with regard to reference surface areas (those for which a high level of accuracy is required) of over 50,000 ha. The laws of the country may require a minimum sampling rate, as in DRC for example, where the minimum rate is set at 0.5% for concessions of over 50,000 ha and 1% for smaller concessions.

Preliminary management inventory

The preliminary inventory is used to evaluate, for each identified stratum, the **variation coefficients** for the variables studied with the highest possible level of accuracy. These estimates can then be used to **optimise the management inventory's** sampling plan. Forest managers are strongly advised to perform this preliminary inventory given that it is an effective means of improving the quality of the work and cutting operational costs.

The preliminary inventory consists in taking 'ballpark' samples in each of the main forest formations identified during the preliminary stratification phase, the analysis of which will be used to estimate the variation coefficients for each stratum. Based on the variation coefficient thus determined and the accuracy objectives required by the management inventory, it is then possible to set out the sampling plan for each stratum to be inventoried.

The implementation methods for this preliminary inventory - sampling device, protocols - are identical to those of the management inventory (see section **Erreur ! Source du renvoi introuvable.**). Based on the experience gained in the sub-region, the preliminary cruise is performed within areas of a few thousand hectares (marked out within the main strata). It is also recognised that sampling performed on 100 to 150

sample compartments of 0.5 ha is sufficient to come within a acceptable distance of the variation coefficient.

Analysis of the results of previous cruises, or of management cruises performed in neighbouring UFAs with similar features, can replace this work in part, provided that the data are sufficiently reliable.

Okoume, Mondah forest in Gabon © Benoît DEMARQUEZ

Performing a management inventory

Field cruises can be broken down into two phases: tracing of forest paths followed by tallying; both require qualified personnel (see Box below).

Tracing forest paths

Tracing forest paths consists in physically representing the previously mapped sampling plan on the terrain, through openings in vegetation cover and by chaining the distance travelled in order to mark out the tallying compartments.

The data recorded on 'forest path' forms during the tracing of forest paths, mainly concern:

- Slopes.
- Types of vegetal formations encountered;
- Topography and hydrography;

Roads, tracks, and traces of previous harvesting operations.

Other designations may also be selected, the important thing is to have consistent records for the whole inventory.

Staff training

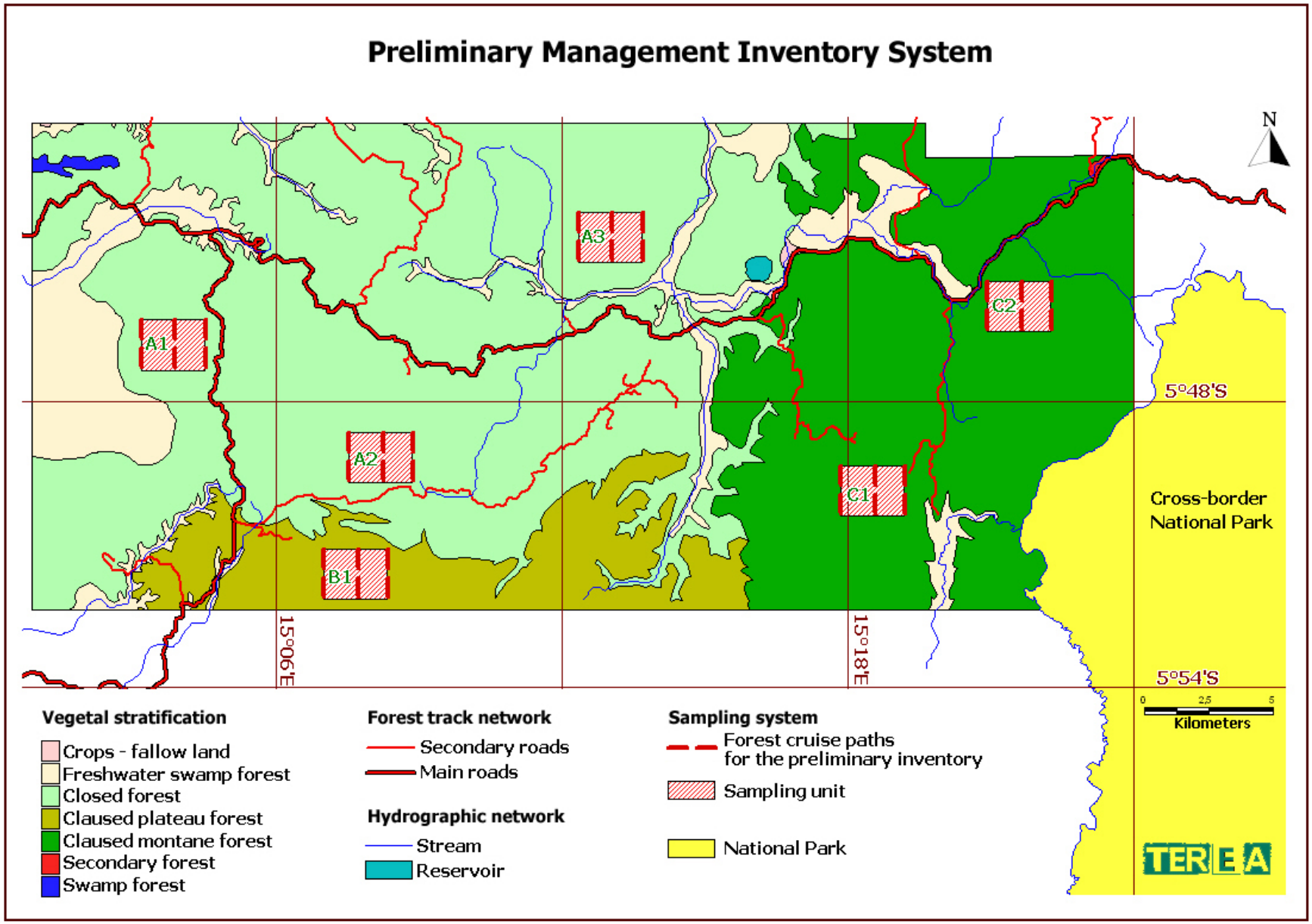
The training of staff required to perform field operations is a key step to achieving a successful forest management inventory. This step is mandatory if the inventory is performed by the company, rather than being subcontracted to a company with recognised expertise in the field.

Training first focuses on schooling **plant tallyers**, supported by recognised experts in the field. This is the most complex training programme. The second key step is to train **tree caliper operators** and chaining teams, in order to obtain the required accuracy when tracing cruising paths. Lastly, training sessions on how to conduct 'biodiversity' surveys (NTFP, wildlife) should be organised. Staff from a neighbouring Protected Area for example, NGOs present in the area, may be asked to participate in this training. As far as possible, in order to minimize the costs, it is advised to organise group training sessions with neighbouring companies committed to the same process.

Training programmes then focus on coordinating all team elements and the cruising protocol itself.

ATIBT training programmes include a 'forest management inventory' module that also provides instructors with the knowledge needed to organise a management inventory.

It is vital that all staff keep in mind that quality control remains the key priority, even if this means a lesser yield.



Exemple de dispositif de pré inventaire d'aménagement

Forest tallies

This phase mainly consists in the botanical identification of trees (based on the common name, which is then translated into its scientific name) and their measurement. As mentioned previously, several categories of tree are characterised according to their diameter:

- Trees (generally with a diameter greater than 10 or 20 cm);
- Acquired regeneration (generally with a diameter of between 5/10 cm and 10/20 cm);
- Regeneration (of forest tree seedlings – h = 50 cm – to 5/10 cm in diameter).

Additional tallies, sometimes referred to as the 'biodiversity inventory' are also performed. They include in particular wildlife and NTFP surveys (see volume 3 of the ATIBT manuals). Human activities (hunting, fishing, farming, gathering, etc.) are also listed.

Tree Tallies

These tallies are performed over the whole inventory compartment. Tree tallying procedures are designed differently according to national standards, and concern the diameters and species under review. These choices impact strongly on the cost of the cruise, the qualification of the personnel and the time required to train said personnel.

It is nevertheless recommended to tally all species, as from a diameter of 10 cm to 20 cm (several different sampling rates may be used according to diameter class), for the following reasons:

- There are substantial benefits for the biodiversity and forest ecosystem (for example measurement of stand basal area and calculation of biodiversity indexes, highlighting of diseased areas).
- Changes in market trends are inevitable leading to the harvesting of new species, especially if the cruise has highlighted their abundance.
- This prevents anything being overlooked, as prospectors have to try and identify every stem.
- The additional cost in relation to tallying trees using a short-list is fairly low (it is better to try and make gains on sampling rates, for example, by varying them by diameter class).

During the management inventory, each tree is identified botanically (according to the legal requirements), and its diameter must be systematically measured. It is advised to take measurements using tree calipers: these save time and provide accurate measurements. Depending on the prospectors level of knowledge and the specific diversity of the closed moist tropical forest, several species may remain unidentified: it is therefore recommended to bring a sample back to the office in order to make a botanical identification. However, several species may still remain to be identified; these are then grouped in an 'unknown' category.

It is also advised to set up a reference plant specimen collection at the management unit.

Taking a tally of acquired regeneration

The term acquired regeneration generally designates stems with a diameter of between 5 and 10 cm and the tally diameter of 'large trees' (20 to 30 cm). This tally stays optional and only covers a fraction of the compartment, the size of which varies according to the chosen protocol. There are several ways of sampling acquired regeneration. Regeneration tallies must be limited to the main species (the list must be

drawn up previously). This tally can be performed by a separate team from that responsible for performing tree tallies.

Regeneration inventory

Here, regeneration means all seedling stems up to a diameter of between 5 cm and 10 cm according to the case. Knowledge of the regeneration potential of the main species is pivotal to the sustainable forest management approach. The regeneration inventory may be conducted as a specific study in its own right; however, it may be useful to couple this inventory with the management inventory, thus benefiting from the whole logistics set-up and from the possibility of inventorying regeneration over the whole area to be managed. This inventory nevertheless remains optional, and this issue can be studied at a more general level, in particular for small concessions.

This cruise must be carried out by a separate team of 2 to 3 people (1 pointer/botanist, 1 to 2 botanist helpers). The cruise is performed on a sub-sample of the compartment, the size of which may vary according to the stated objectives. It is advised to use 10 m x 10 m squares (or 4 m x 25 m rectangles, as in DRC for example) at the beginning of each compartment. However, depending on the type of forest involved, it is also important to adapt the size of the regeneration sample compartment and of the standing trees according to the progress made by the tree tally team, so that all the teams progress together.

Additional ecological surveys

These surveys target signs of human activity (hunting, fishing), wildlife, the environment and NTFPs.

The last points are developed in the 'Wildlife and Hunting Management' and 'Social Aspects' modules.

These cruises are generally performed by separate teams from those in charge of tree and regeneration tallies. However, it may be decided to pair acquired regeneration tally teams with the NTFP surveys.

Inventories of non-timber forest products generally involve presence/absence type cruises, but with no quantification of a NTFP within the compartment. The product quantity will be determined by the frequency, i.e. number of compartments where the inventoried product is present or absent.

Other Information Collected

The management inventory also provides an occasion to record other information on the whole concession, such as roads, tracks, traces of previous harvesting operations, etc.

Checking

Checking tallies of the compartments should be performed on a random basis, in order to confirm the quality of the work. The aim is to redo a tally of 2% to 5% of the compartments, either using an independent team, or by having one team tally the compartments previously tallied by another team.

It may be useful to have a permanent checking team, which could also be tasked with further staff training (re-training, training of new prospectors following resignations, etc.).

Based on the results of the checks, the inventory manager decides whether or not the area warrants another tally. It is therefore important to perform these checks on a regular basis to avoid a build up of poor quality work that would then have to be redone.

Additional studies

Establishing volume tables

Forest inventories, i.e. the *management inventory* or *operational inventory*, provide an estimate of the number of standing trees per species and per diameter class. These results are used to estimate the volumes of standing trees for a given species or group of species based on **volume tables**. This means the volume of the bole, measured at the level of the root buttress (or from 1.3 m) up to the first large branch or the first major defect.

The volume table provides a diagram, table or formula giving an estimate of the average volume of a tree according to its diameter measured on the bark at a height of 1.3 m or just above the buttresses (for single-entry volume).

More specifically, a volume table gives the average volume per stem of a group of trees according to the reference diameter. These tables cannot be used to determine the volume of single trees.

The data required to establish the tables are gathered at three levels:

- Measurements of the standing tree terrain (Bitterlich relascope study);
- Measurements of the felled tree terrain;
- Bibliographic data.

Taking a sighting with the Bitterlich relascope
© Benoît DEMARQUEZ

Volume tables do not necessarily have to be constructed at the level of the concession. This work can be conducted on a more general scale, either when several concessions are granted to a single logging operator, or for small forest titles. It may be useful to favour a regional approach.

Verification studies

The aim of the verification study is to **calculate the harvesting coefficients**, in order to determine the volumes that can be effectively used by the company.

Management inventories provide the gross number of standing trees, per species and per diameter class. Following the application of volume tables, these inventories can then be used to determine the gross or harvestable volumes, but cannot under any circumstances provide the company with information on the volumes that could be effectively processed.

The purpose of the verification studies is to use the verification coefficients to convert raw data into useable data

This involves:

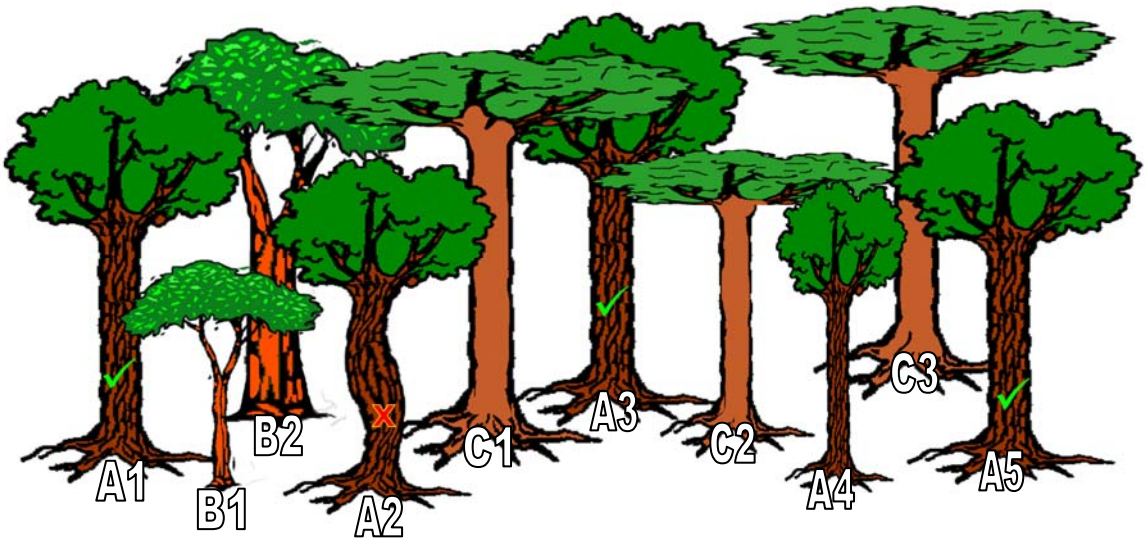
- ✓ **Harvesting coefficients**

The inventoried resource is not fully harvested. Despite the great diversification in the number of species harvested over the last few years, not all species can be used due to unsuitable mechanical properties. Furthermore, some trees of marketed species do not meet either the quality criteria required by the timber market or the profitability criteria. This **percentage of rejected standing trees** can be considered as constant for a given species, at a given site and at a given 'market status' (i.e. at a given moment). This therefore varies mainly according to forest type (changes in stem conformation, natural defects, previous harvesting operations, and accessibility), the company's marketing strategy (market criteria, demand stability, sales dynamics) and processing capacities (possibility of local processing enabling the valorisation of second-quality timber). The distances between the logging site and the processing plant, and also the distance to local marketing and export locations (port) play a key role in the valorisation of the felled timber (as in the north of the Republic of Congo, where companies have to transport timber products by road over more than 1,000 km).

The harvesting coefficient therefore represents the percentage of harvestable standing trees for a given species in a given context. This coefficient can be obtained either by conducting a field study (tracking of harvesting inventories, comparing a compartment before and after harvesting, etc.) or by analysing management inventory quality records.

Applying the harvesting coefficient to raw numbers of standing trees taken from the management inventory data thus gives the **number of harvestable standing trees** per species.

illustrating the harvesting coefficient



Harvestability coefficient for species A :

A1 Harvestable
A2 Non-Harvestable
A3 Harvestable
A4 Ø < MCD (not taken into account)
A5 Harvestable

3 harvestable trees / 4 trees with ∅ > MCD

Harvestability coefficient = 75 %

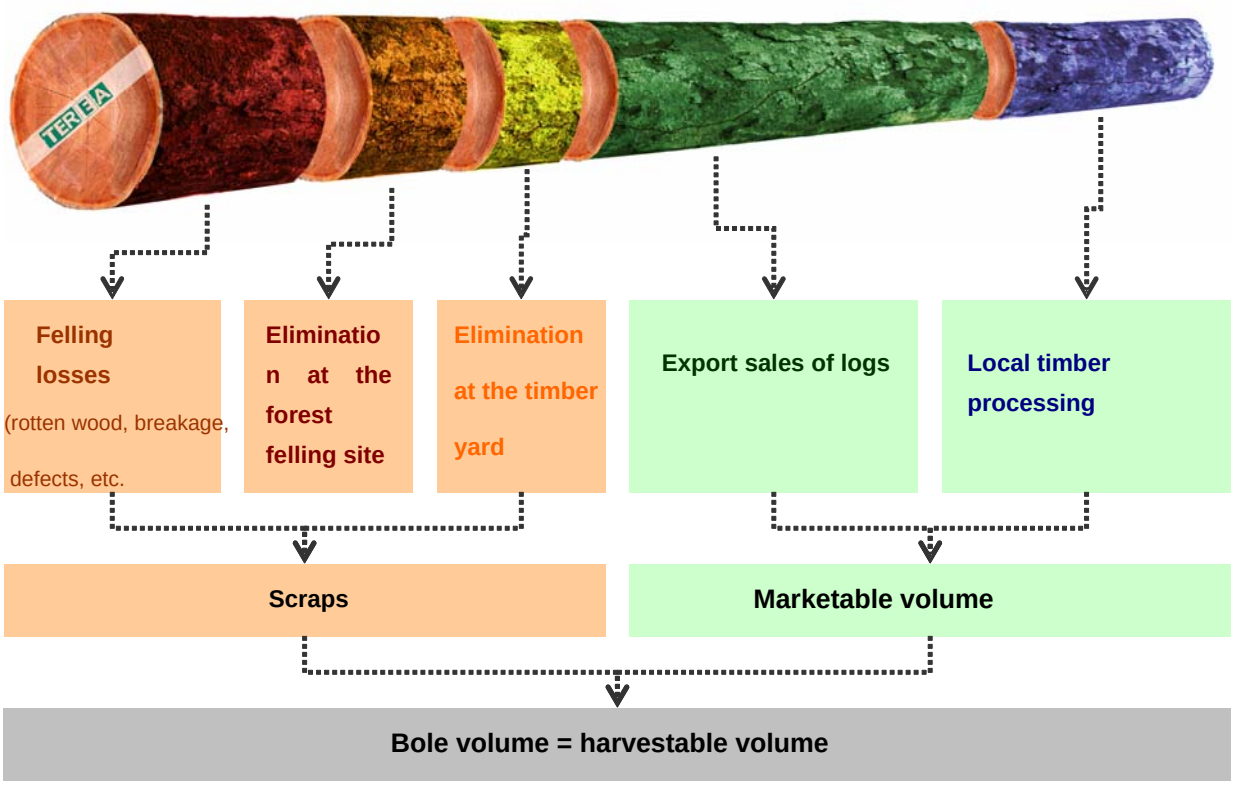
TEREA

✓ **Marketing (or valorisation) coefficients**

The monitoring of felling and sawing operations up to the removal of the timber or its processing is used to evaluate the percentage of abandoned timber (in forests or at the stockyard) and to estimate the amount of timber that can be recovered by improving work practices.

This monitoring of the bole up to its sale or processing is also used to estimate, per species or per group of species, the amount of timber that will actually be sold, and therefore also to **estimate use coefficients for logs and/or for processed timber products**: this coefficient is referred to as the **marketing coefficient .**

Felled boles are sawn at each stage of the harvesting process, thus leading to timber losses. This process can be illustrated by the following figure.



Timber losses during the various steps in the operational process

Staff training and qualification are a vital part of the process as they are largely responsible for ensuring the best possible valorisation of the felled tree.

Cutting (chain sawing) is another very important step in timber valorisation which must be supervised by an experienced logging manager. In fact, the search for high-quality logs may result in the bole being cut into rounds which in the end represents a waste of timber which could have been used at the plant.

Felling losses are also strongly dependent on the forestry feller's level of training and motivation. Modern cutting methods (Reduced Impact Logging - RIL) currently recommend the removal of all buttresses prior to cutting (wedging), which enables not just the use of this part of the bole, but also minimises felling shakes, thereby recovering several metres of useable bole.

Lastly, the choice of log cut depends strongly on the company's sales policy (adapted industrial tool, prospected markets, etc.).

Valorisation of off-cuts, CEB site
© Benoît DEMARQUEZ

Data processing

The collection, entry and processing of data results in the drafting of an **inventory report**. This document describes the field cruise, with **maps, diagrams and tables** illustrating the distribution of the standing resource in terms of **quality and quantity**. This must act as a genuine decision-making support tool that can be used, together with other studies, to develop the cutting programme for the whole rotation period.

Entering data

Inventory data are preferably entered using software designed specifically for this purpose, i.e. the whole inventory is parametered, and various security procedures are included to avoid as far as possible any erroneous entries. Compartments must be geo-referenced. The data is then exported to a GIS and a Database Management System (DMS) to perform the analysis.

It is also vital to schedule a check by sampling the data entry operations.

Data analysis

Management inventory data are analysed either using other software designed specifically for this purpose, this software being paired with a GIS, or directly by a GIS. This second option is not recommended however, being a tedious process that makes it tricky to adjust the parameters during the felling planning simulation phase.

The software used must provide for constructing resource distribution maps (numbers of standing trees, volumes or basal-areas) and building results tables.

Statistical error calculations are performed automatically and are used to evaluate the quality of the results obtained prior to their interpretation.

All the data collected following the inventory analysis can be illustrated in terms of stem density or numbers, volumes or basal-areas.

Each datum can be presented either at the level of an individual hectare, or globally (by cumulating the value over the whole study area).

Calculation parameters

The inventory analysis uses the following parameters:

- **Lists of species**: to make the results easier to read, they can be presented by grouping species according to their current or potential commercial importance. These groupings are sometimes required by law;

- Formula selected to calculate statistical error: **the reading of the management inventory results must always include the statistical error**: a hectare density of 0.1 stem ± 8% is not the same thing as a hectare density of 0.1 stem ± 50%.
- **Volume tables**: these are used to convert numbers of standing trees into volumes.
- **Harvesting and marketing coefficients**: these are used to convert gross numbers of standing trees or volumes into the number of standing trees or volumes that can actually be harvested and/or marketed.
- **Minimum cutting diameters (MCD)**: these are factored into the data analysis so that the data reflects the actual status of forest operations. This minimum diameter is required by the forest law in each country. It can then be adjusted when drafting the management plan (increased or occasionally decreased), according to the dynamics of the species and its diametric structure. It is then referred to as the Minimum Management Diameter.
- **Stratification**: analysing the management inventory by strata, or by uniform stand types should provide for reducing variation coefficients, thus giving more accurate results.

Calculation of volumes, densities and basal-areas

Volumes, densities and basal-areas are calculated both for the whole area to be managed, and also for the different strata.

These data are generally calculated using specific software (see figure below), which generates data tables, and calculates the statistical errors governing the results' reliability.

Resource distribution maps

These maps are used to directly illustrate inventory results. They are constructed:

- According to density, volume or basal-area, per hectare or for the whole area;
- For a given species or group of species;
- For given diameter categories.

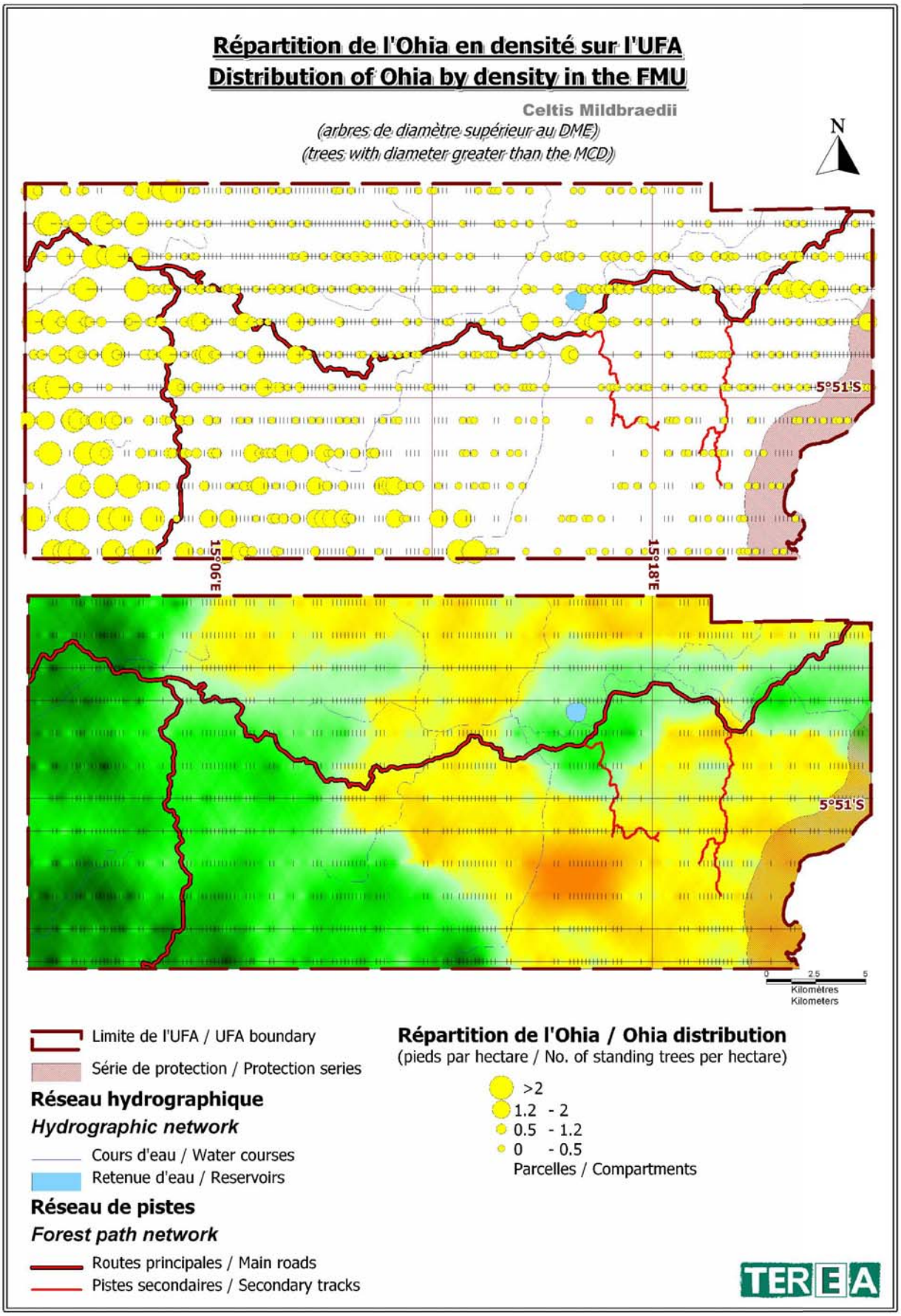
These maps are based on the interpretation of the data for each inventoried compartment. The results can be presented in two different ways, as shown in the figure below:

- Each compartment is assigned a value; circles of varying sizes illustrate inventory results compartment-by-compartment; this type of map can be used to illustrate the actual results, but not to extrapolate beyond the level of the inventory compartment;
- A spatial analysis (interpolation) is used to analyse the values obtained within a given perimeter (of variable size depending on the simulations) by averaging the values for the compartments within this perimeter, and then extrapolating the inventory results to the whole area. Although this provides a more detailed picture of stand resources, this is a high-precision analysis that should be interpreted with care.

Ideally, resource distribution maps should be constructed for every inventoried species, or at least for those most represented, and those with the greatest commercial value. These maps are used to build up a 'resource catalogue', which forest managers can consult when working on the valorisation and promotion of new species.

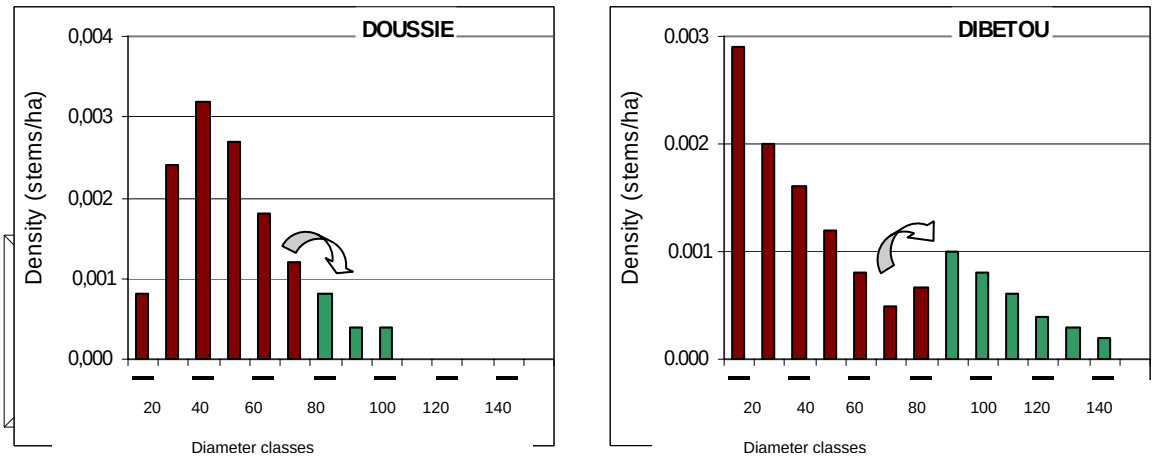
At this stage of the management process, the GIS is an absolutely vital tool that makes an enormous contribution to forest inventory analyses, providing a visual interpretation that is a key component in developing the company's forest management strategy.

Resource distribution map based on two types of illustration



Diametric structures

The interpretation of the management inventory provides a picture of the diametric structure of the inventoried species. This structure can be illustrated using histograms, the interpretation of which is a fundamental part of the management process. These histograms identify which species do or do not show a regeneration deficit, and provide a good overview of the renewal capacities of the managed species, as well as of their growth behaviour, which might later direct their management.



Example of diametric structures

In this example, the Dibetou demonstrates a far higher level of regeneration (stems of diameter 20-40 cm) than the Doussié. Its reconstitution rate will nevertheless be lower as there will be fewer stems with a MCD diameter of 10 cm and 20 cm.

Regeneration indexes

The best way of ensuring the sustainability of a forest stand is to take steps to guarantee its regeneration following any forestry operations. This regeneration is evaluated on the basis of two criteria: time, and stand structure and composition.

For forests being harvested for the first time, it has to be accepted that the regenerated forest stands will not resemble their original structure. This is a much discussed, and often misunderstood, topic relating to the 'sustainable management of primary tropical forests'. In fact, this type of forest still contains trees with extremely large diameters. Their advanced age (at least a hundred or even several hundred years old, in particular for shade-tolerant species), goes well beyond the human time-scale selected for the implementation of a timber production management plan (which is just a few decades). When evaluating regeneration times, forest managers must therefore focus on preserving the stands' diversity and balanced structure without seeking to 'reproduce' large diameter trees. Conversely, working plan officers must, as far as possible, seek to preserve the stand structure obtained after the first rotation period (this is where the country's Administration plays a decisive monitoring role).

The following table summarises the set objectives:

Stand regeneration objectives

Stage	Objective
First rotation (exploitation of a primary forest)	Preservation of specific diversity Preservation of a balanced structure Regeneration of a harvestable potential that meets production requirements
Following rotations	Regeneration of the stand resulting from the first rotation (similar structure and composition, harvestable potential).

It is advised that companies do not cut trees with a basal diameter greater than 200 to 250 cm. Not only would the height and size of the crown present a high risk of splitting the trunk, but also the weight and diameter of the bole would make transportation and industrial use both costly and difficult. Trees left standing will be excellent seed-bearers and are part of a forest heritage that strongly merits conservation.

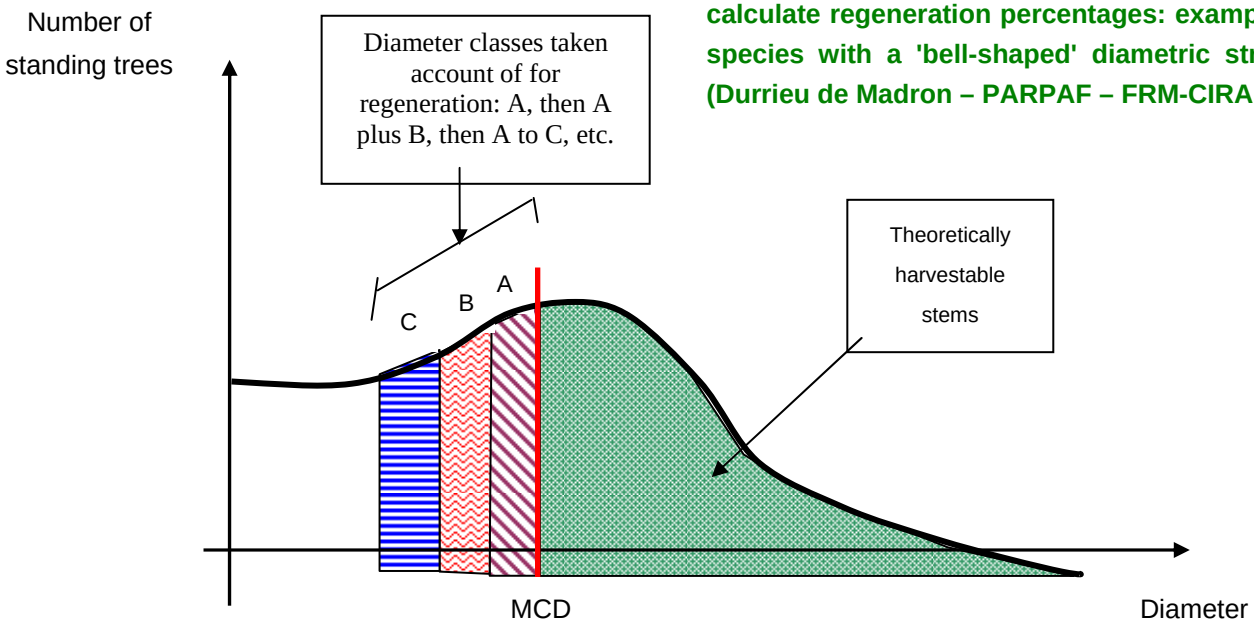
Gabon has issued a ministerial order that sets the maximum cutting diameter at 200 cm.

Calculating regeneration indexes

(Based on Durrieu de Madron.)

This calculation is performed for each species managed, for which a diametric growth figure in mm/year has to be selected as well as a mortality rate and a percentage of loss due to logging damage. The calculations are made by taking the first class below the MCD, then the two first classes, followed by the three first classes (classes A, then A plus B, then A to C, etc. Each time the regeneration percentage for the number of initially harvestable stems is determined.

Factoring in the number of first class standing trees with diameters under the MCD in order to calculate regeneration percentages: example of a species with a 'bell-shaped' diametric structure (Durrieu de Madron – PARPAF – FRM-CIRAD)



Inventory report, decision-making support tool

All the analyses are summarised in an **inventory report**. This document:

- Provides a recap of management inventory methods (selected standards, implementation, etc.);
- Presents analysis results;
- Provides an interpretation of the results to be used as **a decision-making support tool** by forest managers.

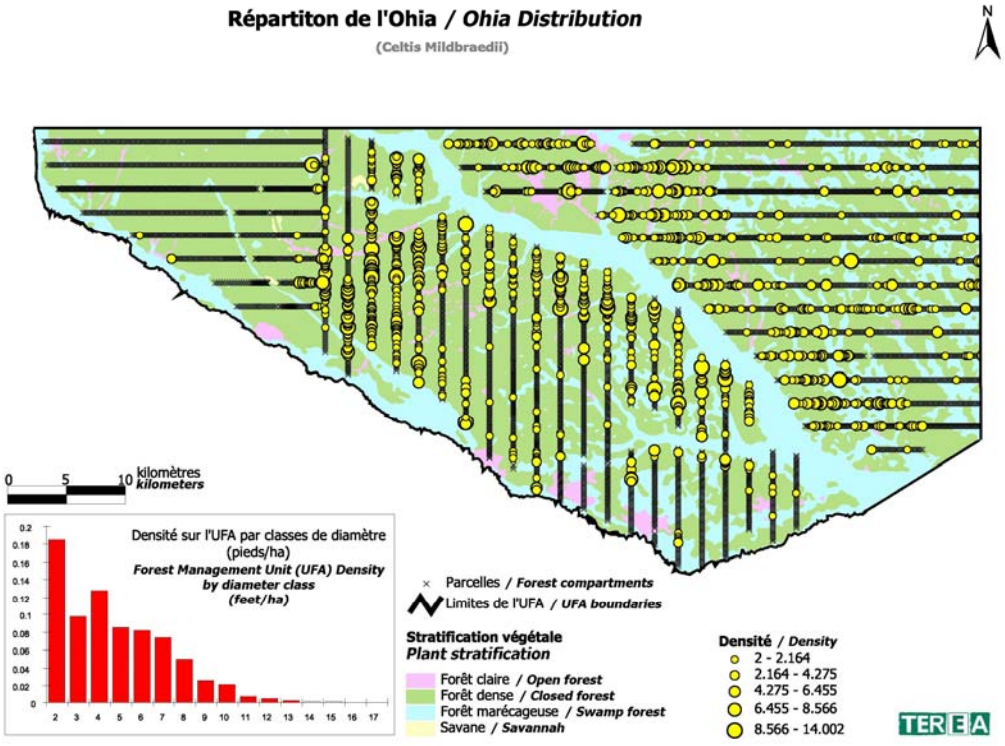
The inventory report is illustrated with maps, diagrams and tables used to provide the best possible picture of the inventoried concession. It presents the results of inventories of timber species together with other data on wildlife, NTFP, human activities, etc. collected during the inventory.

The species distribution map, together with the species diametric structure, instruct thinking on the how to plan logging operations in line with the company's objectives. This map may be supplemented by a decision-making support form summarising all the information collected for the species under study.

All these results are decisive in **selecting the future management strategy**. From an environmental and social perspective, the inventory report can be used to highlight areas with a high cultural sensitivity, identify areas where plant and animal biodiversity has special features that need to be taken into account, and thus initiate the division of the concession into management series and set up the array of selected protective measures that will have to be taken into consideration.

For the logging company, the inventory report provides an estimate of the profitability of its venture, through an improved knowledge of the harvestable potential, and helps to define the nature of its industrial timber processing tool (sawing, rotary veneering, slicing, etc.).

The inventory report also has a commercial use as it can be used to search the market for new species, whose presence and abundance have been revealed.



Map showing the distribution of the resource and diametric

I.8 MANAGEMENT PROPOSAL

The management proposal is based on the preliminary studies on social aspects, the environmental analysis, forest analysis, etc. The management inventory report is in this sense a key support tool in the decision-making process. It must, however, be supplemented by a certain number of studies, among which we can cite (see figure p.23)

- Socio-economic diagnosis (see ATIBT volume II);
- Environmental studies (impact study, ecological studies, etc.);
- Studies on wildlife and hunting activities (see ATIBT volume III);
- Dendrometric studies (log volumes, checking);
- Mapping;
- Applied forest research (stand dynamics, study of annual growth rings, phenology, etc.);
- Etc.

All the information and data required to develop the management strategy must be collected during the field studies and work.

This is a key step that requires careful thinking on the part of the owner, the working plans officer and the logging operator: the opinions of the various stakeholders have to be taken into account to ensure that the final management document strikes the right balance between the economic, social and environmental requirements of the sustainable management process. It is absolutely crucial to ensure the forest manager's forceful participation in these negotiations: the economic viability of a forest management programme is a key condition of its effective implementation and success. The State, NGOs and community representatives must also be involved in this decisive management step.

I.8.1 Forest management objectives

One of the purposes of forest management is to ensure the sustainability of the forest and all its different functions by meeting three main objectives:

- **Economic objectives**: ensure a sustainable timber resource in order to secure the company's supply of timber and guarantee long-term revenues for both the State and the company;
- **Ecological objectives**: preservation of the ecological functions and biodiversity of the forest;

- **Socio-economic objectives**: contribution to local development; meeting the needs of local communities in terms of the use of the forest and its products, and an improvement in the living and working conditions of company staff.

All the decisions set out in the Management Plan, and the division into series in particular, must be focused on achieving these objectives. Each Forest Management Plan must state these 3 general objectives as specific objectives assigned to the relevant management unit.

This step must follow on from the preliminary management studies. **All the stakeholders must have been identified and consulted** in order to define a set of management objectives fitted to the context of the area to be managed. It is vital that this process takes account of all the constraints (restrictions, prohibitions, plus any geographic, socio-economic and legal constraints, etc.) that may impact on the forest area.

Forest management objectives defined under a management plan in the Republic of Congo – CIB/TEREA/MEFE - management of the Kabo Forest Management Unit (UFA).

Objectives for sustainable timber production

The forest management plan must ensure the sustainable production of timber in both quantity and quality.

- The volumes removed during the logging operation must ensure the operation's economic sustainability and profitability in the long term.
- Reduced impact logging must not irreversibly compromise either the diversity and productivity of forest stands, or the regeneration potential of the various species.
- Logging operations, based on a permanent forest area, must be programmed and planned, in terms of both space and time.

Industrial objectives

The management plan must guarantee the medium to long-term supply of a forestry industry, tailored to fit both forest potential and market requirements.

- The company's industrial objectives target the development of modern plants equipped to handle primary, secondary and tertiary timber processing activities, tailored to forest potential.
- This industrial development is anchored in a comprehensive knowledge of the resource that ensures regular plant supply in the long-term and the development of a range of new high-performance, custom-made timber processing tools.
- Developing these industries provides for increasing harvests of secondary species and diversifying the range of species harvested.

Social and development objectives

The management plan has to ensure the sustainable coexistence of the various uses of forest resources, and contribute to local and national development.

- The rights and duties of all the involved parties must be clearly defined and acknowledged.
- The forest management plan has to acknowledge and specify the use rights of local communities.
- Forest management must play a role in preserving and improving the long-term social and economic well-being of company staff and local communities.
- The forest management plan must be designed and implemented with the aim of meeting the needs of local communities in terms of a range of diverse forest products and farming land.
- The use of forest resources must contribute to reducing poverty (directly by improving local living conditions, and indirectly by the payment of taxes that feed the State budget) and creating jobs (in particular via industrial development).

Environmental objectives:

Forest management must preserve biological diversity and its associated values, water resources, and soils as well as fragile ecosystems, so as to protect the ecological functions that guarantee the forest's integrity.

- Regions containing ecosystems existing within the UFA will be set aside, and no logging operation will be carried out there during the whole term of the management plan.
- The impacts of logging activities on forest structure, biodiversity (fauna and flora) and the surrounding environment will be alleviated by a raft of specific measures to be implemented in the field.
- Agricultural clearing areas shall be clearly outlined and their expansion controlled.

Research objectives

An applied research programme will have to be set up jointly with national and international research institutes, in particular concerning the study of the dynamics of harvested species and the monitoring of hunting and poaching activities.

Social and wildlife objectives are dealt with in detail in volumes II and III of the ATIBT manuals.

As part of the environmental objectives, the Forest Management Plan must also provide for preserving the quality of air, and surface and ground waters, in particular through effective management of industrial and domestic waste.

I.8.2 Forest management period and rotation

It is important to distinguish between the rotation period (time between two harvests), and the validity period of the forest management document and its review frequency.

National legislations generally set Forest Management Plan enforcement periods at between 20 and 40 years, while the plans are usually reviewed at five year intervals.

*In the Republic of Congo, Article 56 of law 16/2000 states: "The forest management plan is approved by ministerial decree, for a period of between ten and twenty years as indicated by said decree and will be reviewed on termination of said period." However, (**Article 55 of the same law),** states "[…] The forest management plan may be subject to early review to be decided by the Minister of Water and Forestry or by the logging operator whenever justified by the occurrence of unforeseen events such as fire, forest dieback or changes in the market."*

In Gabon, **Article 26 of the Forest Code states** "The forest management plan may be reviewed every five years. Any request for review must state the new constraints or data justifying such a request and must be accompanied by an amendment."

- **Selecting the rotation period:**

Rotation is defined in Gabon under law 16/01 which refers to the Forest Code in Article 34: **"**The **rotation** period corresponds to the period required between two successive harvesting operations on the same compartment. The rotation period is never less than twenty years [i.e. Gabon]." Generally speaking, the rotation period is a compromise between ecological requirements, which would tend to stipulate extended rotation periods, and economic realities. The rotation periods selected in Central Africa vary between 20 and 40 years (see section on the duration of the rotation period).

I.8.3 Dividing the UFA into management series

When developing the management strategy, the concession is divided into series based on the allocations assigned to the various identified territories. The subdivision into different series, each with its own distinct set of management objectives (production, protection, rural development, etc.) must provide for setting the company's main strategic directions for each standardised unit of the forest area to be managed.

These series must be demarcated on the basis of a forestry licence whose limitations have been validated or redefined to take account of certain features that government limitations often fail to embrace such as the existence of large urban centres, proximity to protected areas or the inconsistency of certain limitations. The whole area covered by the concession must ultimately form one coherent block, the management of which will be entrusted to its licensed owner, **who will therefore be responsible for managing both the timber producing series and the other series.**

Once they have been determined with the approval of the authorities and the village communities, these series will be used to determine taxes based on production series surface areas (surface area tax).

The objectives assigned to the various management series are governed by National Directives in the Republic of Congo. They are given here as an example.

The following diagram illustrates the division of a CFAD into management series, five-year management units and annual allowable cuts.

Management objectives for various series – National Forest Management Directives in the Republic of Congo

Management objectives for the production series

Production series objectives are:

- *Ensure a sustainable production of timber;*
- *Develop local industries by ensuring they have a consistent supply of timber;*
- *Boost the income generated by the sustainable forest management process for the various partners (State, private businesses, etc.).*

Management objectives for the conservation series

Conservation series objectives are:

- *Ensure the sustainability of forest species;*
- *Protect wildlife and plant habitats;*
- *Preserve the landscape;*
- *Use natural resources in a sustainable manner.*

Management objectives for the protection series

Protection series objectives are:

- *Guarantee the protection of endangered species and endemic species;*
- *Protect fragile soils, springs, swamps, mangrove forests, wetlands, riverbanks;*
- *Protect areas with steep slopes or that are susceptible to erosion;*
- *Protect biological diversity.*

Management objectives for the research series

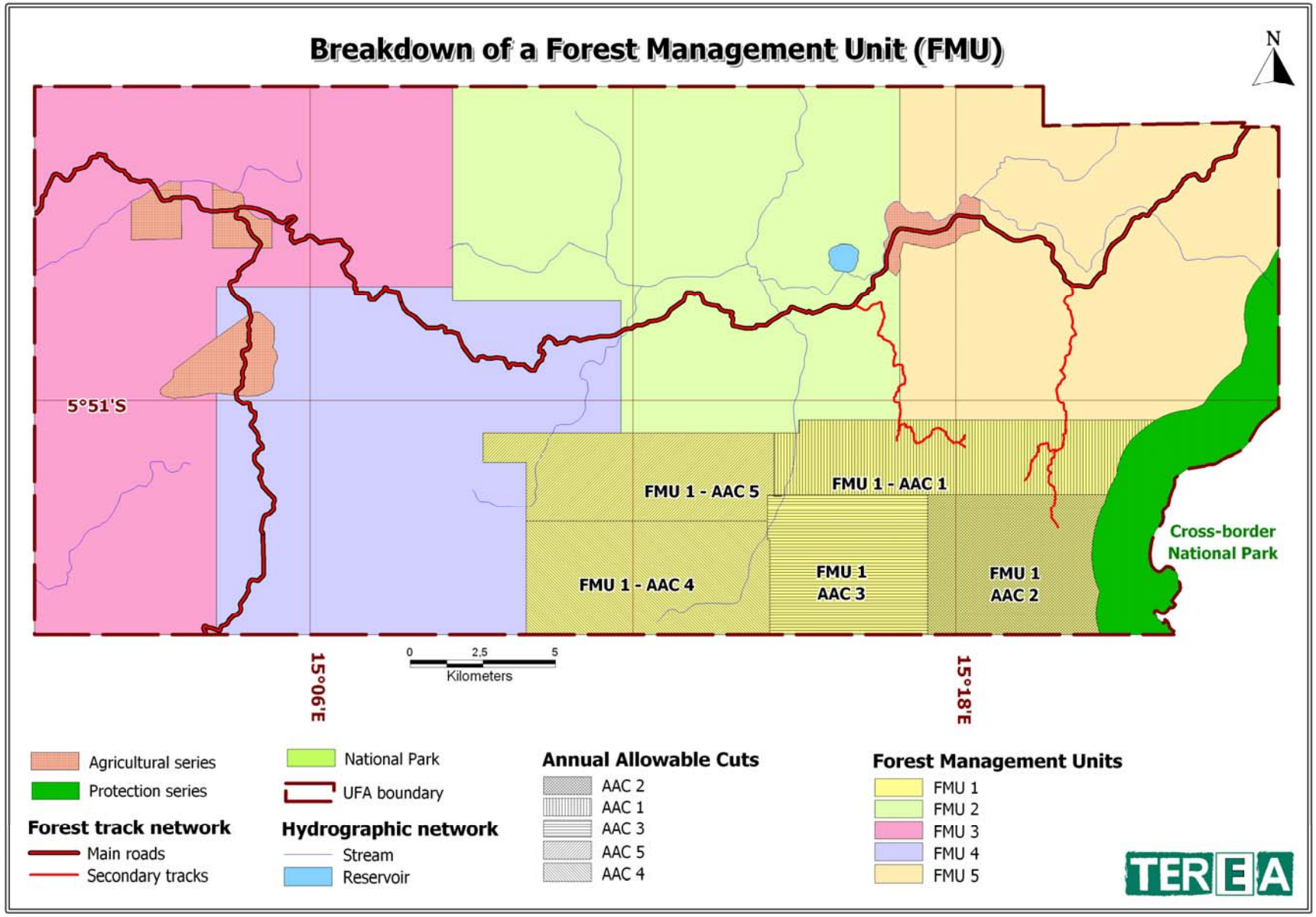
The research series objectives are to build knowledge of genetic and biological resources in order to:

- *Develop rational use techniques;*
- *Regenerate renewable resources;*
- *Keep track of the dynamics of biological resources;*
- *Determine the impact of human activity on wildlife, plants, soils, water and other natural resources.*

Management objectives for the community development series

The overall objective is to meet the needs of local communities in terms of forest products and to boost their income. The specific objectives are:

- *Exploit and manage forest resources for the benefit of local communities;*
- *Improve agroforestry and farming production systems to drive the sustainable development of rural community economies;*
- *Promote and develop artificial village forests;*
- *Enhance the knowledge and skills of local populations;*
- *Fight against poverty.*



Subdivision of a Forest Management Unit (UFA) – case of Gabon

It is not always easy to differentiate between conservation series and protection series. It is therefore important that, when drafting the management plan, the working plans officer sets out the

I.8.4 Management of the conservation and/or protection series

Management measures for conservation and/or protection series must be defined in the forest management plan. The measures that may be proposed are detailed in chapter II 4.4

I.8.5 Management of the agricultural series

Most forest concessions in Central Africa allocated in view of sustainable timber production enclose several villages and work camps. Based on the preliminary management studies, and in particular on the socio-economic diagnosis, the boundaries of the allocated concession may be redrawn, so as, for example, to demarcate community forests or lands to be excluded from the concession for a purpose other than that originally recommended. This is the standard procedure in Cameroon, where the demarcation of UFAs is reviewed prior to drafting the forest management document.

However, whether the boundaries are redrawn or not, several villages and work camp generally still remain within the concession. Village communities mainly support themselves through slash-and-burn agriculture, and need to have a land reserve in order to extend their crop farming activities. Furthermore, forestry operations carried out close to fields can damage crops locally, and sometimes significantly.

This is why forest management plans include an "agricultural series" (or referred to as a "community development series" in Congo, or an "agroforestry series") which is demarcated on village outskirts. The limits of this series must be defined jointly with the local communities, using tools such as a GPS to mark out crop-farming and fallow areas, participatory mapping to outline areas of village influence, and satellite imaging to identify the expansion of crop areas. This demarcation can be validated at a workshop where the forest management plan is presented to the communities, such as was done for the PARPAF project in the Central African Republic.

The "community development" series also concerns the outskirts of forest campsites, or even in certain cases small towns within the concession to be managed.

A few simple rules have to be remembered when demarcating this series:

- Take account of the village population and the assumed demographic growth;
- Identify farming methods, estimate the surface areas farmed per family and the periods when fields lie fallow;
- Take account of the communities' use of the harvested species (Sapelli caterpillars, fruits of the Moabi and Safoukala, etc.);
- Maximise the use of natural boundaries, which the local populations find easier to understand and which are easier to maintain than artificial boundaries;
- Identify holy areas, areas of cultural or religious importance, etc. located in the vicinity of the village;
- Possibly, make an inventory of the area surrounding the village (such as an operational inventory)

to ensure decisions are backed up by a comprehensive knowledge of the available resource;

- Lastly, as a precautionary measure, make sure the boundaries are large enough.

The company under sustainable management must agree not to cut any tree within the agricultural series, unless this has been approved by the local communities. Logging companies may enter into agreements with local villages in order to harvest the resource according to clearly defined income sharing rules and silvicultural procedures (i.e. protection of a given species, record the MCD of a given species, etc.).

This is therefore a sensitive process that requires long periods of collaborative work, and that has to be performed whenever logging operations come within the vicinity of villages. This dialoguing phase is further complicated by the fact that some villages won't actually feel the effects of the logging operations until 10, 15 or even 30 years hence!

In this case it would be better to proceed by stages:

- Jointly mark out the agricultural series for the logging operation's first five-year period;
- For the purposes of identification, mark out the agricultural series for the other villages based on their size and the information obtained par satellite imaging, then refine the subdivision when implementing the management plan, in line with the progress made by logging operations.

Cultures within a concession

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The communities living within this agricultural series could organise the setting up of community projects that they will then be able to submit to the regional decision-makers for their possible backing.

Local NGOs and associations need to be involved to make sure that village communities have properly understood the system, and to provide support in compiling the necessary technical and administrative dossiers.

I.8.6 Management of the production series

The pivotal part of the proposal concerns the **management of the production series**, i.e. the part of the forest area mainly dedicated to logging activities. Note that the latter can also be involved (often, however, attached to a set of special specifications) in series dedicated to other key purposes such as the agricultural series, buffer zone, sensitive zone, etc.

In future, the calculations used to convert the standing tree potential of a forest into a determination of its production capacity will coalesce and interconnect. **Regeneration indexes, Minimum Forest Management Cutting Diameters and Rotation Periods are all closely interlinked and interdependent in the iterative yield determination approach**.

This means taking the key decisions that may or may not guarantee sustainable forest production:

- Regeneration of harvested species;
- Selection of a rotation period;
- Determination of new MCD (DMA);
- Selection of species to be managed.

Lastly, the establishment of multi-annual harvesting blocks (generally five-year) and of the primary road network based on the management potential (i.e. harvestable volumes) will enable managers to define the order in which the forest area is to be logged.

It is, however, necessary to be very clear here: once the forest has been logged, the goal is not to recreate a forest that is the same as the original. A harvested forest, even one under sustainable management, does not present the same features as a virgin forest. This truism should not, however, prevent operators from doing their best to maximise the renewal of harvested species.

The data gathered during the management inventory enables the working plans officer to model changes in forest stands according to the proposed forest harvesting methods.

This modelling is used to calculate regeneration indexes which are no more than indicators for the working plans officer. Beyond these indicators, the selection of forest management parameters involves an in-depth analysis of the dynamics of forest stands and the different species they contain, according to their structure and ecology.

Management parameters

The species to be managed

The selection of target species is a pivotal step in the forest management process. These species, selected as species for management, will be used to calculate regeneration indexes as well as to set up the yield determination calculation. This selection must be decided jointly by the working plans officer and the logging operator, in compliance with the relevant legal framework.

It must factor in the species' ecological parameters, and also be based on a market survey, correlated with the company's industrial investments strategy.

Generally, there are about 20 to 30 target species with a stronger focus on 4 to 5 main species.

It is nevertheless important to select a wide range of species, due to occasionally surprising changes in the marketing options for some species that had up till now been disregarded.

Regeneration indexes

The parameters evaluated to define forest productivity will be used to calculate the regeneration index of the forest stand and of each species following harvesting and resting of the compartment during the rotation period. This regeneration estimate must guarantee the forest manager a minimum harvest volume during the following harvesting operation.

Obviously, a stand that is harvested and managed under optimum sustainability conditions will preserve all its forest functions, maintain the integrity of the biological process and will be capable of regenerating within reasonable times; this regeneration will not however resemble the species make-up or diameters of the original forest, or, therefore, the volumes.

The stand's original structure will be modified by the disappearance of large-diameter trees of marketable species, and, regarding harvested species, it would be delusional to imagine that, in just a few decades, we could regenerate the standing stock amassed by nature over centuries and felled during the first harvesting period. **Later cuts will only harvest the volume regenerated during the management rotation period. This is the fundamental principle underlying the concept of sustained yield or sustainability.**

Moreover, a **full regeneration of the number of stems and, especially, of the harvestable volume prior to harvesting is practically inconceivable** as this would result in an excessive increase of the rotation period which would be incompatible with the production target. Legislators generally set the **regulatory regeneration rate**, in stems or in volume that they consider desirable for each individual species, or more generally for the main group of managed species.

The methods for calculating regeneration rates are given in the chapter describing data processing of the management inventory analysis.

Selecting Minimum Cutting Diameters (DMA or DME per UFA)

It is a generally accepted fact that the calculated **Minimum Forest Management Cutting Diameters** (DMA) may differ from national MCD (Minimum Cutting Diameters). This means operators have to seek to optimise the rotation period by pairing the determination of the DMA relating to the diametric distribution structure of each species with the calculation of the rotation period. Rotation periods decrease according to a corresponding increase in DMA. Changes in minimum cutting diameters (generally of 10 by 10 cm) often have a greater impact on regeneration rates than do variations in rotation (generally of 5 in 5 years).

Minimum fruiting diameter (based on Durrieu de Madron & Daumerie 2004)

When drafting forest management plans it is very useful to have data on fruiting diameters as they are a key criteria in selecting minimum cutting diameters. Effectively, felling trees of a given species before they have been able to fruit will eventually lead to the disappearance of this species.

Phenological data for closed African forests are available (i.e. on the flowering and fruiting period), but there is little reliable data on the fruiting diameter of trees supported by a sufficient number of samples per diameter class and per species. It is not just a question of determining whether a given species is able to fruit at a specific diameter, but also of determining the proportion of trees that actually fruit in this class. Furthermore, it is necessary to distinguish between the terms 'flowering' and 'fruiting', as trees can flower without producing any fruits.

Knowledge of the optimal fruiting diameter, otherwise known as the "Effective fruiting diameter", with an arbitrary threshold set at 80% of fruiting trees, corresponds to a value which would seem to guarantee a production of seeds distributed over most of the seed-bearing tree potential. To be on the safe side, the selected minimum cutting diameters should be at least 10 cm larger than the optimum tree fruiting diameter for each species, thus ensuring that trees have sufficient time to produce seeds before their eventual cutting. This type of measure is seemingly far more effective and simpler to control than just leaving seed-bearing trees in the forest every 10 hectares or so, for example, a measure that takes account of neither the density of the species nor its ability to fructify and regenerate.

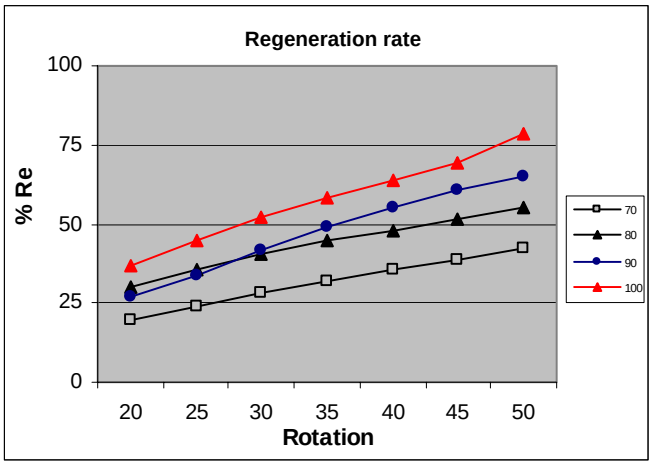
Selecting the rotation period (cutting cycle)

Selecting a rotation period also means selecting new minimum cutting diameters, which will then be referred to as Minimum Forest Management Cutting Diameters (DMA or DME/AME, or DME/UFA). Thus, by increasing the rotation period, we can decrease DMAs and vice-versa. This balance will be determined by analysing different scenarios based on regeneration index studies.

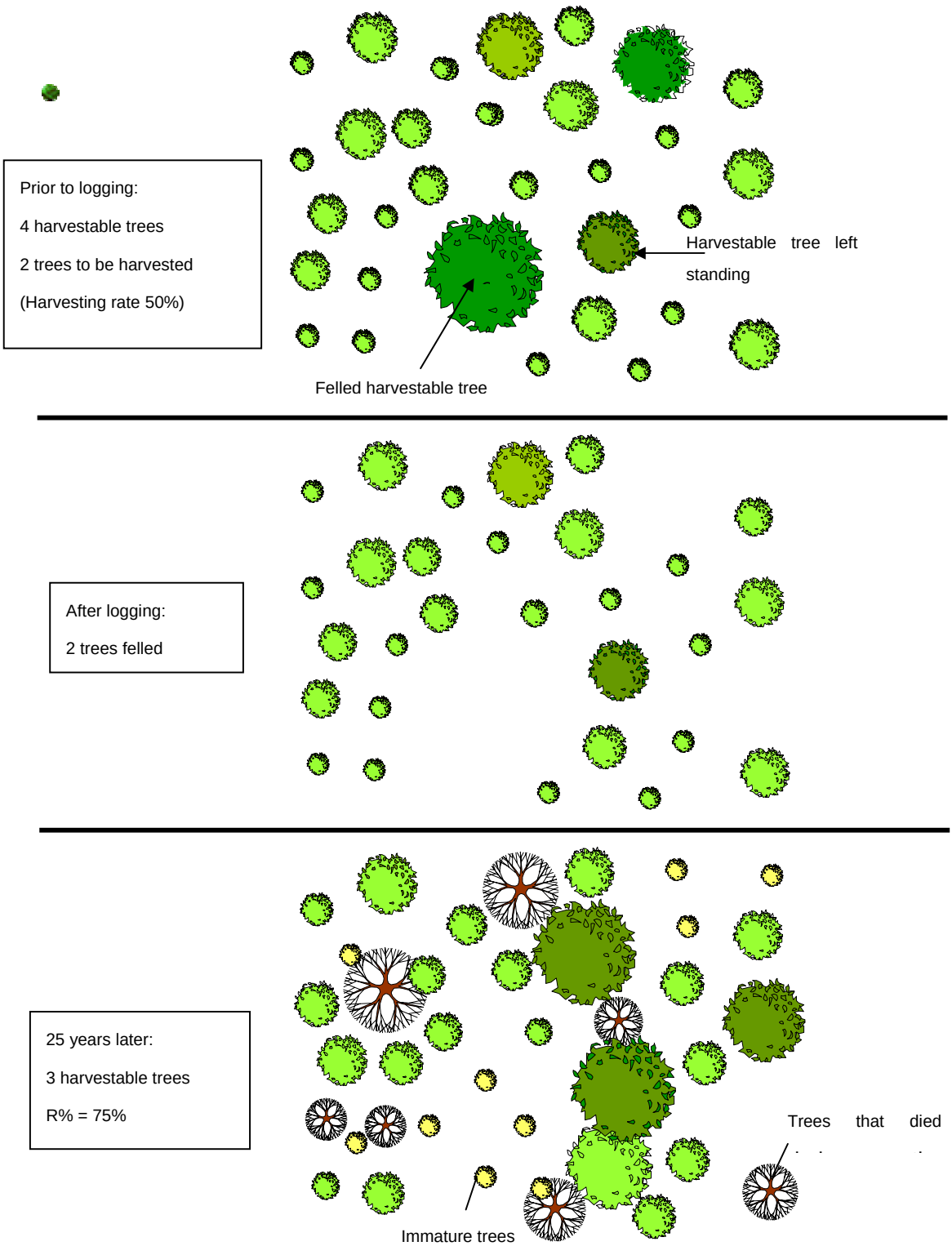
Provided that it does not fall below a certain threshold (which varies from one country to another, and is usually around 20 to 30 years) the logging operator will be allowed to make the final decision on the rotation period (and therefore on the new DMA).

The figure below clearly illustrates that under certain conditions it is impossible to fully regenerate a harvested species, the Padouk in this example, even by increasing both the rotation period and the MCD. This is the case for many other species with a natural regeneration deficit.

Therefore, the rotation period has to be selected by seeking a balance between the various potential regeneration indexes, based on the DMA, while bearing in mind that:



Change in regeneration rates according to the minimum cutting diameter and rotation period



Simplified illustration of the meaning of the regeneration index

- Poor regeneration sometimes results in a "natural" reduction in the number of individuals of a given species. This is often what happens with pioneer, heliophilous species, whose populations gradually decline as the plant succession evolves from secondary forest into mature forest; a typical example of this is the changes in the Okoume population in old secondary forests in Eastern Gabon, where we will eventually witness the natural disappearance of the species;
- Removal coefficients should improve as time goes by (a greater number of harvested species, less waste, improved waste reclamation, etc.);
- While it is not essential to achieve full regeneration rates, it is important to remain within a bracket of 50% to 75% for the group of species managed in virgin forest;
- On the other hand, it is important to tend toward full regeneration of the group of managed species in previously harvested forest areas in order to guarantee a sustainable yield;
- Regeneration indexes vary greatly from one area to another, making it necessary to adjust the approach to come into line with the actual state of the land and the collected data;
- Despite the greater subjectivity of the approach in comparison with these indexes, an understanding of the structures, dynamics and ecology of each individual species is nonetheless an equally vital part of the decision-making process, if not more so;
- In all cases, the forest manager must make their decisions jointly with all the stakeholders, while accepting a certain level of subjectivity.

Regeneration parameters

Regeneration parameters

Six different parameters are used when calculating the regeneration index:

- Three parameters specific to forest dynamics:

*(1) The **distribution of the numbers of standing trees** as per diameter classes. This distribution is given by the results of management inventories and depends on the species' own individual dynamic: fruiting of individual trees as from a certain age, seed germination rate, immature tree survival rate, growth pattern, etc.*

*(2) **Tree growth**, expressed in annual diameter increases.*

*(3) **Natural mortality**, which expresses, as a percentage, the number of stems that disappear each year;*

- Three parameters relating to forestry legislation or logging operations:

*(4) **MCD** or minimum cutting diameters, which vary depending on the species;*

*(5) **Rotation**, which corresponds to the time the forest is allowed to "rest" between logging operations;*

*(6) **Logging damage**, which expresses, as a percentage, the number of stems destroyed by the logging operation;*

These six parameters impact directly on the forest regeneration calculation developed by the API Dimako project. A great deal of uncertainty still remains concerning the many variables linked to forest dynamics such as mortality, fruiting diameter, species increment, etc.).

Acting on the last three parameters allows us to improve regeneration rates.

Currently, working plans officers have to use all the calculated indexes and ratios not as a rigid and definitive picture of forest dynamics, but rather as a decision-making support tool that helps them seek a satisfactory balance between the needs of logging operators, and their economic requirements and concerns over the sustainability and long-term survival of the forest.

Calculating allowable cuts

The rotation period and the DMA will be used to calculate the logging concession's overall allowable cut, i.e. the quantity of harvestable timber per hectare during a given logging operation.

The allowable cut has to be calculated globally for the whole concession and for every species to be managed, as well as for each harvesting unit or block, in order to optimise the planning of cutting cycles and smooth out the figures for annual production capacity. Regeneration rates of the species to be managed (target species), DMA and rotation periods all interrelate to determine the allowable cut. **According to the company's needs, and in order to optimise the permit's profit-generating capacity, the maximum annual cutting volume thus defined for the species to be managed may be supplemented by the harvesting of secondary marketable species.**

The above-mentioned calculations can also be used to estimate numbers of standing trees and volumes for the second cutting cycle. All these adjustment calculations are highly complex, requiring the management team to use a database connected to a GIS, using special statistics software. At the same time, the management team can use the GIS to perform another important management decision, that of planning the UFA's main road network.
The allowable cut can also be used to define and limit the logging operator's potential industrialisation capacity. In other words, there will be no question of extracting, and a fortiori of processing, any more timber than the forest is capable of producing on a sustainable basis.

Factoring forest dynamics into the calculation of the allowable cut?

Allowable cut can be calculated either statically, by considering the standing volume without factoring in forest dynamics, or dynamically, by factoring in data on forest growth and mortality. This second approach is the one generally adopted, by making the following assumption:

- A non-harvested forest is more or less in equilibrium, with natural mortality rates counteracting any increase in the volume of standing trees;
- A recently harvested forest regains volume after each cutting cycle.

Moreover, national forest management directives in the Republic of Congo state the following concerning the establishment of the allowable forest cut: "The calculation of the allowable forest cut shall factor in the natural dynamics (growth, mortality, etc.) of the inventoried stands."

Increment must be calculated per Management Unit, taking account of the scheduled logging date, and applied to previously logged Management Units only.

The stand growth calculation factors in the same parameters as those used to calculate regeneration indexes:

- Stand growth (i.e. ingrowth of diameter classes reaching the DMA);

Mortality rate

- Diametric species structure.

Under the precautionary principle, and due to the uncertainties on calculation parameters, it may be necessary to set an upper limit on the calculated growth.

Dividing the forest area into compartments

The last step in the management proposal process is to decide how to subdivide the production series into blocks or Management (or Harvesting) Units, sometimes referred to as Forest Management Units (UFG, as in Gabon), or Forest Production Units (UFP, as in Congo). Hereafter, we will refer to them as Management Units.

Management by capacity or management by volume?

There are two options for subdividing the production series into annual allowable cuts:

- **Divide the total harvestable surface area by the rotation period; otherwise referred to as management by capacity or by surface area**. This gives annual compartments of an equal size, but with highly variable harvestable volumes due to the diversity of forest composition. This option facilitates the forest administration's control over the management process, but, from the forestry operator's point of view, has the considerable drawback of not guaranteeing control over the annual harvestable volume, meaning it is impossible to ensure a secure timber supply from one year to the next. **This capacity-based management method is no longer used in Central Africa.**

- The other option is to divide the total marketable volume by the rotation period, and then to define compartments with the same volume, otherwise referred to as **fixed-volume forest management. In this case, annual allowable cuts are of varying size but with equal volume. This type of management ensures that logging operators have access to a relatively constant harvestable volume which guarantees a far more regular supply of timber**. It also means though, that compartments have to be redefined with each new management cycle.

The management inventory is a **statistics tool** whose parameters have been calculated to achieve the **necessary accuracy for blocks representing 1/5th to 1/8th of the concession's total surface area** (the range of Management Unit surface areas in relation to the rotation period). The management inventory cannot be used to divide the concession into units of smaller surface areas as it would no longer guarantee the accuracy required to estimate the volumes of annual compartments.

Consequently, the option selected for the management of tropical production forests in Central Africa is an **intermediate solution that combines both the volume and capacity management approaches**:

First the harvestable area is divided into **large blocks or harvesting units**, which are sub-multiples of the rotation period, each of which corresponds to a **volume that more or less equates to 5 years of annual allowable cut (for five-year units), and therefore have differing surface areas**. A computer will be used to calculate the surface area of these blocks, progressively adding in data on compartments where inventory tallies have been performed until the desired volume is reached (accepting that this volume may vary to a certain degree, generally by about ± 5%). Care will be taken to situate these blocks within easily recognised boundaries (roads, hydrographic network). **Each of these blocks will then be further subdivided into annual allowable cuts.** This subdivision is made at the level of either the management plan or the annual operations plan (see chapters II.4.4).

Not only does this make logging operations easier to control in terms of the annual cut, but in addition the logging operator is guaranteed access to a regular supply of timber from the block.

Incidentally, as the law generally allows the opening of several annual cuts at the same time (2 to 3 depending on national legislation), each of which remains available for logging for a period of 2 to 3 years, the operator benefits from the guaranteed and flexible timber supply that is required to respond to market fluctuations and opportunities.

The order of logging operations to be carried out at each unit should be set out in the management document. (see the procedures manual for the 'Forêt et Terroirs' project (Borie JM. & Pasquier, 2001) relating to the subdivision of a forest management unit into blocks of equal volume.

The management document

The following table proposes a standard template for a Forest Management Plan together with a brief description of the content of each section of the plan. Naturally, this template can be adapted to fit special cases and can also be supplemented to be brought in line with actual forest situations and national legislations; its overall structure, however, will stay the same for any production forest within Central Africa.
Most States in the region have developed standard forest management plan templates, which forestry operators are required to follow (see example in Annex 2). All these templates are compatible with that given in the table below. While the information it contains is a necessary component of the drafting of any Forest Management Plan it may not, however, meet the requirements of the countries' laws.
Some general steps of lesser importance are not described in detail so as to avoid unnecessarily increasing the length of the document. It may be useful to take a look at current management plans to find out the exact content.

It should nevertheless be noted that the management process reduces the forest's "marketable value" over successive cutting cycles as the value of large-diameter boles (between 120 and 200 cm) is significantly greater than the value of the timber produced during later cutting cycles (where diameters are generally between 80 and 120 cm). This difference in value, referred to as the "initial cut benefit" is used to offset initial investments for setting up timber processing plants, such as major infrastructures. The decrease in the value of smaller diameter trees in later cutting cycles could also be offset by increasing industrial yields (by processing logs at the plant that all have similar diameters) and by cutting operating costs.

- CHAPTERS OF THE MANAGEMENT PLAN	- COMMENTS	- REFERENCES
- GENERAL INTRODUCTION		
- INSTITUTIONAL FRAMEWORK	- International treaties ratified by the State, and other international commitments - Description of the national forestry policy - Description of current legislation	- International treaties - Government regulations - Forest code
- THE FOREST AREA TO BE MANAGED	- Geographic situation of the forest area within the country - Surface area and geographic boundaries - Administrative and legal context	- Geographic database - Legal texts
- DESCRIPTION OF THE COMPANY	- Structure, organisation chart, business areas, history - Workforce number - Features of the sustainable management project	- Logging operator statistics
- THE NATURAL ENVIRONMENT		
- **RELIEF AND HYDROGRAPHY**	- Main characteristics - Potential impacts on logging operations (rivers to be forded, areas with steep slopes, etc.)	- Maps that are already available or that need to be produced (use of satellite imaging technology)
- **CLIMATE**	- Rainfall and temperature measurements for different forest areas - Diagrams	- National and/or regional Weather Bureau - Measurements taken at living camps
- **GEOLOGY AND PEDOLOGY**	- Geological and pedological maps - Potential impacts on logging operations	- National or international research agencies - Field observations
- **VEGETATION**	- Brief description of existing forest types - Lists of the main species and their relative abundance: wood, low shrubs, vines, etc. - Ecological benefits	- National or international research agencies - Information gathered during inventory cruises
- WILDLIFE	- Main species found within the area - Threat status, CITES classification; Information on poaching networks	- Management inventory - Field observations - Available studies - Contacts with NGOs

CHAPTERS OF THE MANAGEMENT PLAN	COMMENTS	REFERENCES
SOCIO-ECONOMIC CONTEXT		
HUMAN POPULATIONS	- Established population centres: number of villages, location, maps - Regional economy: business sectors, productions, etc. - Administrative structure and regional organisation - Ethnic and demographic aspects*:* description of the different ethnic groups, migratory flows and land occupation history, population growth - Living conditions and access to social services in villages: literacy rates, schools, health centres - Living conditions specific to disadvantaged populations: women, pygmy communities, children with no schooling - Economic types and activities in rural areas; in relation with the forest (NTFP, etc.), farming, local customs, information on income, etc. - Regional areas supporting activities such as farming, harvesting, hunting, etc. - Relations between local populations and the logging operator: claims, requests, conflicts - Living conditions at the operator's living camps: social structures (schools, hospitals, etc.), worker housing, etc.)	- Socio-economic studies - Information supplied by NGOs and local authorities - Official census data - Statistics from the various forest administrations
REGIONAL INFRASTRUCTURES	- Infrastructures for schools, health clinics: quantity and level of operation - Access routes - Cartographic data: roads, navigable waterways, air transport	- Socio-economic studies - Available maps, local data
INDUSTRIAL ACTIVITIES	- Concerning the logging operator: working conditions, occupational health and safety, further training, labour regulations - Other industrial activities inside the forest region	-

- CHAPTERS OF THE MANAGEMENT PLAN	- COMMENTS	- REFERENCES
	- **ANALYSIS OF FOREST RESOURCES**	
- **PREVIOUS FOREST MANAGEMENT INITIATIVES**	- Description of the area's history (population flows, classification or declassification of some areas) and previous logging operations (location of logging areas and opening of rows, harvested volumes) - Mapping of previously harvested areas - Management enforcement actions	- National government - Logging operators
- FOREST MAPPING AND STRATIFICATION	- Recap of the procedure for determining forest stratification and the construction of a cartographic database - Maps illustrating the various forest strata - Summary table of land use - Definition of inaccessible and non-harvestable surface areas (i.e. flooded areas, etc.)	- Use of the GIS - Use of satellite images and/or aerial photos
- MANAGEMENT INVENTORY PROCEDURE.	- Description of the procedures for the Preliminary Inventory and the Forest Resource Inventory - Procedure for the wildlife and plant life inventories	- Management inventory and other studies
- **PROCEDURES FOR ANALYSING INVENTORY DATA**	- Presentation of the Minimum Cutting Diameters for each species - Definition of species or groups of species to be managed; to be performed jointly with the logging operator - Presentation of the results of additional research: volume tables, verification studies, species increment, mortality, fruiting diameters	- Results of other studies
- PRESENTATION OF THE RESULTS OF THE MANAGEMENT INVENTORY	- Analysis in view of the exploitation of timber: presentation of results tables: - Stratification of each forest type - Diametric distribution of every species - Tables showing total and per hectare figures for the gross and harvestable numbers of standing trees and volumes, for each species, group of species and diameter class - Results of other surveys: wildlife distribution map, etc.	- Inventory report - Results of other studies
- ENVIRONMENTAL IMPACT STUDY	- Analysis of impacts linked to logging operations	- Mapping - Management inventory - Socio-economic studies - Specific studies

CHAPTERS OF THE MANAGEMENT PLAN	COMMENTS	REFERENCES
MANAGEMENT DECISIONS		
CONCESSION BOUNDARIES	Validation or modification of the concession's initial boundaries	
OBJECTIVES, STRATEGIC DIRECTIONS, CONSTRAINTS	Definition of forest management objectives: timber production objectives, social objectives, environmental objectives, research-development objectives	
DEMARCATING MANAGEMENT SERIES	Definition and demarcation of the different management series, i.e. production, protection, agricultural or rural depending on the main objectives.	All map data together with the results of inventories and social and environmental studies
MANAGEMENT OF THE PRODUCTION SERIES	Calculation of regeneration indexes for each main species or group of species Definition of Minimum Forest Management Cutting Diameters (DMA) Definition of the rotation period Estimate of the number of standing trees during the 2nd cutting cycle Calculation of allowable cuts for each managed species Division of the forest area into compartments (multi-annual blocks)	Tasked to the working plan officer
MANAGEMENT MEASURES FOR THE PRODUCTION SERIES	Later management documents: planning and content Reduced-impact logging rules Tracing of the main road network Silvicultural treatments and research (monitoring of forest dynamics, assisted regeneration tests, etc.) Use rights to the production series - regulations governing farming establishments	Environmental impact study Mapping
MANAGEMENT OF THE CONSERVATION, PROTECTION AND RESEARCH SERIES	Regulations governing activities and establishments of the different series (logging, construction of roads, harvesting, fishing, hunting, etc.) Planning of technical studies and research Partnerships set up or under study	Contacts with specialist NGOs
MANAGEMENT OF THE AGRICULTURAL SERIES	Definition of management rules jointly with local populations Relations with local NGOs Logging operator's participation in rural development initiatives Involvement in community life: schools, health clinics, etc.	Socio-economic studies Joint action by the logging operator and the local communities
INDUSTRIAL DIRECTIONS	Presentation of the existing industrial tool (current productions, sawn wood production capacity, rotary veneering, etc.)	Results of the management

- CHAPTERS OF THE MANAGEMENT PLAN	- COMMENTS	- REFERENCES
	- Planned development of the tool in the short to medium-term, in relation with the available resource	inventory - Information on the industrial tool
- **MANAGEMENT OF HUNTING AND WILDLIFE**	- Management rules governing wildlife and the fight against poaching - Regulation set up by the logging operator - Zoning of the concession for hunting activities - Support measures: monitoring of wildlife populations and data collection, support of the development of alternative methods for producing and supplying proteins, etc. - Partnerships set up	- Biodiversity studies - Management inventory
- **ACTIONS OF THE SOCIO-ECONOMIC SECTION**	- Procedures for ongoing dialogue between the logging operator, local communities and forest administration authorities - Social measures specific to the living camps - Measures targeting the sustainable development of resources by local populations - Contributions to the development of the local fabric: support with setting up official channels, support for specific projects, etc.	- Socio-economic studies
- **ACTIONS LINKED TO WORKING CONDITIONS**	- Measures relating to occupational health and safety - Definition of work procedures - Procedures for dialogue between the company and its staff - Development of a training programme for company staff covering every activity area: logging, timber processing	- According to the company's needs -

- CHAPTERS OF THE MANAGEMENT PLAN	- COMMENTS	- REFERENCES
- **ASSESSMENT, MONITORING AND CHECKING OF THE MANAGEMENT PROCESS**		
- **IMPLEMENTATION OF THE MANAGEMENT PLAN**	- Organisation set up within the company (organisation chart, definition of responsibilities, staff, equipment) - Role of Forest Administration Authorities - Partnerships set up or under study	- Government regulations - Information supplied by the logging operator
- MONITORING AND EVALUATION OF THE MANAGEMENT PLAN	- Regularly, throughout the cutting cycle - In-house (by the logging operator itself) and external (by forest administration or other certification bodies) measures for checking proper execution of the Management Plan	- Forest Administration missions - Development of a certification system
- **REVIEW OF THE MANAGEMENT PLAN**	- Schedule a review half-way through the cutting cycle at the latest; the best time is just after completing operations on one or two of the multi-annual blocks.	- Performed by the logging operator
- **ECONOMIC AND FINANCIAL ASSESSMENT**	- Cost of preparing the Management Plan based on the main items: inventories, additional research, drafting of the plan - Cost of implementing the Management Plan (over the first few years) - Fees and taxes: drafting of a forecast	- Information supplied by the industrial operator - National tax framework
- **BIBLIOGRAPHY**		
- **ANNEXES**		
-	- Government regulations - Forest illustration maps: topography, geology, forest stratification, climate, social aspects - Species distribution maps - Descriptive sheets for each species - Numbers of standing trees and volume tables - Etc.	-

I.9 IMPLEMENTING THE MANAGEMENT PLAN

The management document is the final synthesis of all the work carried out on the relevant studies. It defines both the objectives of the concession holder, and the activities to be performed during the following 20 or 30-year period, thus requiring the logging operator to commit to a long-term undertaking. However, the Management Plan also, and above all, provides the foundation of a genuine sustainable forest management approach that must be both enforceable, and enforced, by all the parties involved. The plan's execution requires a fundamental reshaping of forest workers' day-to-day occupation, partly through a change in working methods, but also through the reorganisation of logging activities and the related monitoring and checking activities, and through each staff member's ownership of their personal responsibility to enforce the set measures.

Among the operations covered by the overall management plan for the managed concession, and therefore including implementation of the forest management plan, we will deal only with those requiring specific field work:

- Setting permit boundaries;
- Measures relating to the logging operation and the reduction of its impact on the ecosystem, in particular by using the planning and monitoring tool provided by the operational inventory;
- Management and planning documents for the short and medium terms;
- Measures targeting industrialisation and improved valorisation of the resource;
- Social measures;
- Environmental measures;
- Applied research programme.

I.9.1 Setting permit boundaries

The definitive boundaries of the forest area to be managed are defined in the Management Plan and, in some countries, validated by a classification order. Boundaries must be clearly marked out by law, to make it easier for the relevant authorities to check that the logging operator is not straying outside the perimeter for which it was granted logging rights. It is also often in the concession holder's interest, as this gives it a basis on which to oppose any illegal logging activities on its territory. Furthermore, this gives the operator a clear set of reference points over its forest area.

Depending on the country, the marking out of the permit's artificial boundaries may include:

- Accurate signposting of the key points: depending on the legislation, the owner of the forest, i.e. the State (Cameroon) or the concession holder (Gabon) is responsible for installing this signposting;
- Marking out boundaries, considered by some actors as being the first step in the management process. This is always the responsibility of the concession holder. This marking may involve opening up and maintaining a forest track, marking trees with paint, setting up signboards, etc.

The boundaries of the different management series, the management blocks and of the annual allowable cuts may also be marked out.

Signboards at the entry to an AAC in Congo and a CFAD in Gabon
© Nicolas BAYOL and Benoît DEMARQUEZ

I.9.2 Operational Inventory

Our aim is not to make a detailed description of technical inventory procedures, but rather to provide a recap of the operational inventory's main features and challenges.

The operational inventory is the keystone start point when putting a logging operation under a sustainable management plan. As such, it is an essential tool for planning and monitoring forest logging activities, and therefore for implementing the "forest production" series of the forest management plan. It is also the first step in enforcing reduced impact logging rules.

Sighting with a TOPOCHAIX compass to open up a forest path - © Nicolas BAYOL

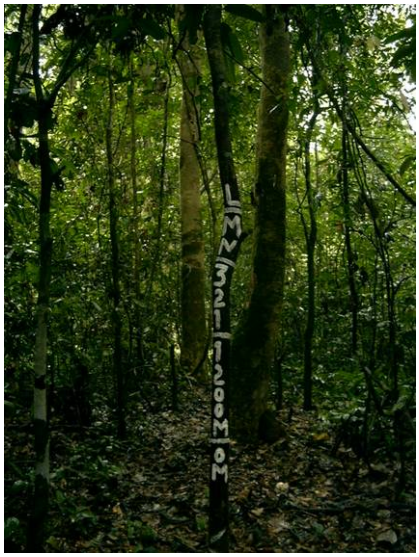
This inventory is required by all the new forest management laws. Apart from the management plan itself, this is surely one of the best decisions that can be made in terms of protecting the forest, and which also enables forestry operators to optimise operational costs. Formerly carried out in a systematic manner, it has been abandoned little by little, noticeably with the intensification of forest exploitation.

The operational inventory has to meet all the following requirements:

- Provide the means for identifying, tallying, mapping, marking out and numbering all the harvestable trees, or those that are likely to be harvested. The area will be mapped out with a relative accuracy of 50 metres at the most;
- Provide reliable data on the current status of harvestable volumes per species and per quality, accurately locate them and thus harvest them in full. This can result in a fairly significant increase of the volume harvested per hectare, and therefore in a corresponding decrease of the surface area covered;

- Complete and define the topographic map, detailing all the components of the hydrographic network and mapping out the logging operation's potential constraints;
- Be carried out for an Annual Allowable Cut (AAC) at least 3 months before the start of logging operations there (which means the inventory needs to be carried out about a year in advance);
- Provide for demarcating zones outside the logging area, or for which special measures have to be implemented;
- Provide for optimising the roll-out of logging operations in the field, in particular the building of infrastructures such as roads, skid tracks, drainage culverts, bridges, and so on, in order to limit the impact on the forest ecosystem (on future stems in particular) and to ensure the cutters have no difficulty in finding the stems to be felled (and therefore completely do away with "counter-prospection" or "stem search" operations that are still far too frequent);
- Act as the start point of the log traceability process, and of the monitoring of logging operations from the standing tree right up to the marketed log.

The operational inventory can therefore be defined as **all the operations involved in tallying, identifying, marking and locating harvestable trees, in mapping out the Annual Allowable Cuts scheduled to be logged, and in planning harvesting operations.**



Operational inventory forest path © Benoît DEMARQUEZ

The main features of this operational inventory are given below:

- It is started over a year before the start of logging operations, thus providing an overview of production potential in the medium term;
- It involves a "full" inventory, i.e. it covers all the stems within a given area (in contrast to the management inventory, which is a statistical inventory);
- At the very least, it takes account of all the stems for managed species with a diameter greater than the MCD (or the DMA following approval of the Management Plan);
- It is paired with a very detailed mapping, at a scale of between 1:2000 and 1:10000, of trees, topographic features and logging constraints.

The operational inventory includes:

- A field survey phase, referred to as the cruise or tally phase, during which the trees are counted, inventoried, marked and mapped, as are all the topographic features. An operational inventory map is the outcome of this phase;
- A tracking phase (also referred to as the "tracing out of paths", "sorting" or " clearing" phase), during which the manager plans and prepares the roll-out of logging operations.
- The tracking phase has been use for a long time, having been developed in order to implement reduced impact logging methods.

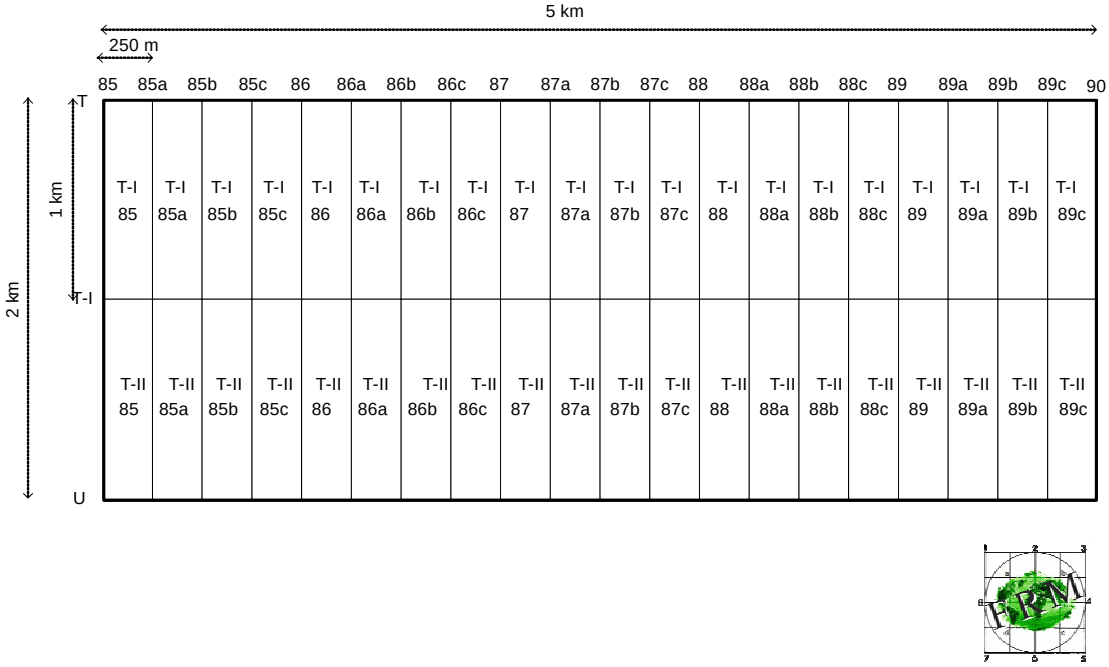
The operational inventory map provides a basis for planning the activities performed during the tracking phase, the three main objectives of which are given below:

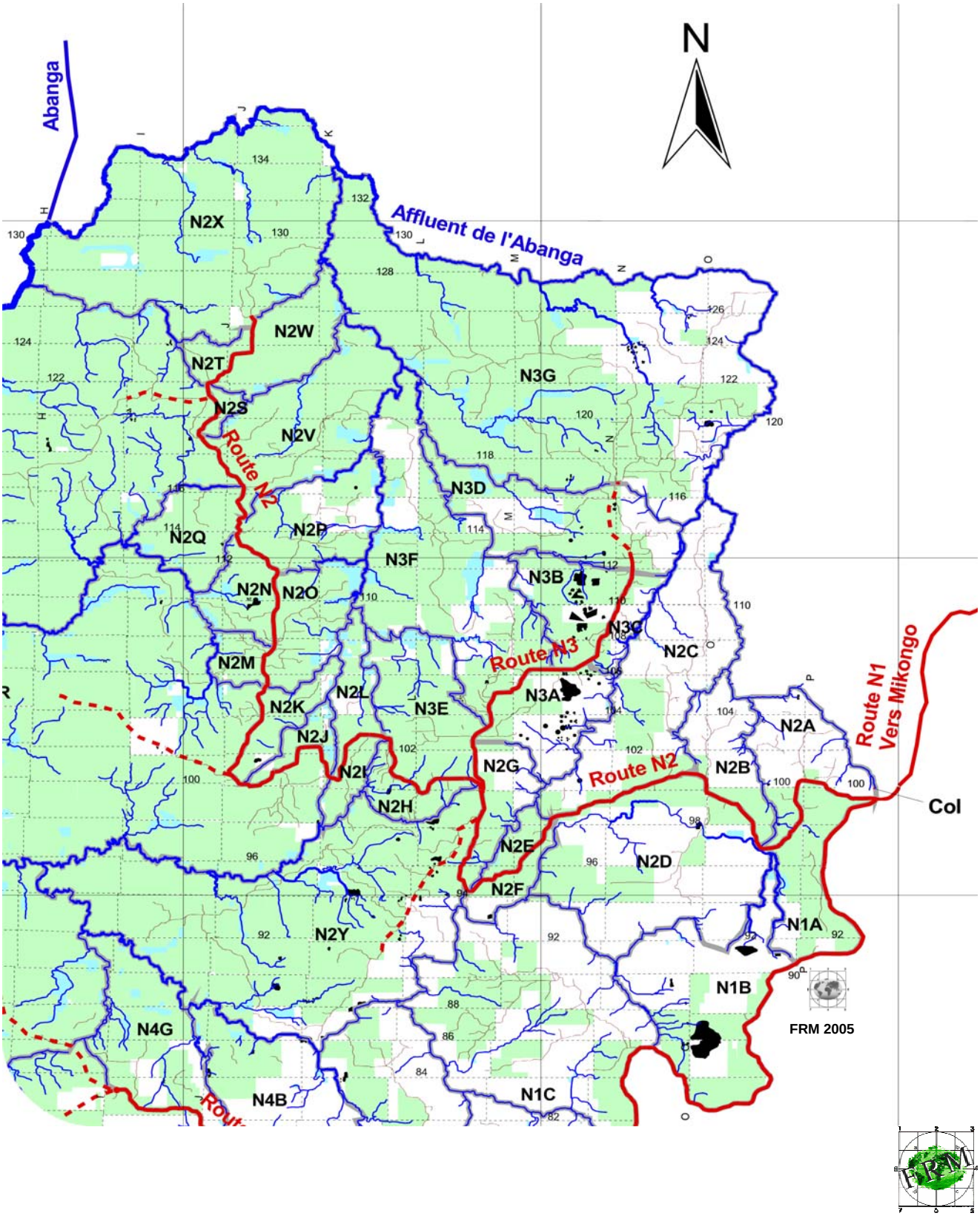
- Mark out timber extraction networks in the field so as to limit the impact on the forest ecosystem;
- Make a final decision on which trees are to be harvested, and identify them individually (by numbering them);
- Identify and mark trees that are to be protected during logging operations (future trees, seed-bearers, and sensitive species).

This tracing out of forest paths is used to produce a forecast logging operations map, summary reports on the available resource and a list of the trees to be harvested for each compartment. These documents will then be used to monitor and check logging activities.

Machete cuts indicating the recorded quality for an Ilomba stem
© Nicolas BAYOL

Example of an operational inventory device (DRC - proposed operational guide)





Example of a plot within an Annual Allowable Cut (extract)

I.9.3 Reduced Impact Logging

As in the previous chapter, the aim here is not to provide a detailed description of the techniques used in Reduced Impact Logging (RIL), which have already been discussed in several specific works (cf. bibliography, notably the Regional code for reduced Impact logging techniques, FAO 2003) but rather to present a general outline.

Logging activities inevitably impact on the physical and natural surrounding environment, as well as on human communities. While these impacts are generally negative, it is an often overlooked fact that some logging impacts can generate positive effects, such as encouraging the regeneration of a particular species or increasing the available food sources for some animal species (e.g. elephants, gorillas, etc.). The positive impacts in social terms can be considerable (i.e. funding of national and local development via the tax system, increased job opportunities, connecting villages to the outside world, creation of community infrastructures, etc.).

Impact on the forest stand © Nicolas BAYOL

Impact on soils, via erosion
© Nicolas BAYOL

The concept of reduced impact logging is now widely incorporated into the laws of the various timber producing countries and is supposedly required of every logging operator. In practice however, these measures are enforced to widely varying degrees. Moreover, there may be some cases where companies wishing to obtain a certificate of proper forest management may be motivated to go even beyond these legal requirements.

To successfully carry out a reduced impact logging programme, it is essential to begin by carrying out an environmental impact study to evaluate all potential impacts. Based on the results of this study, an impact analysis chart will then be drawn up for each type of activity or impact factor (installation of camp sites, opening of roads, felling of trees, and so on) and for each impact area (soil, water, forest stand, etc.). Each potential impact is given a rating, for example by evaluating its frequency, duration and seriousness. Next, measures are sought to prevent the occurrence of the impact or reduce its effects. While the Environmental Impact Study is not necessarily required in the management approach, it is nevertheless an essential component of the certification process, and is required by the latest environmental legislation.

Several different types of measure are then applied to the reduced impact logging approach:

- Enforcement of the measures set out in the Forest Forest management plan such as compliance with multi-annual harvesting blocks, annual allowable cuts, list of protected species, and with Minimum Cutting Diameters;

Impact on soils, via erosion
© Nicolas BAYOL

- Planning of logging activities and harvests as set out in the management documents, Management Plans and Annual Operations Plans (AOP), in order to ensure compliance with the requirement for sustainable logging of the forest resource, and to avoid endangering the future resource;
- Monitoring of field operations, based on the AOPs, forecast logging maps, and the list of trees to be harvested on each plot;
- Product traceability, in order to maximise the valorisation of the harvest and thereby reduce the impact generated by removing a m^3 of timber;
- Compliance with rules on sensitive areas (wetlands, slope areas, areas of cultural or religious importance, holy sites, and keystone animal or plant ecosystems) identified by the Forest management plan or during operational inventories;

- Protection of specific trees: future stems, seed-bearers, protected species, trees with cultural or religious significance for local communities and which have been listed during discussions with villagers, trees that are important for wildlife;

Specific measures concerning each separate stage in the logging process

Below is a list of just some of the measures featured in the RIL approach (see also II.4.7):

Stage of the logging operation	Reduced impact logging measures
Roads, quarries, log yards	Effective planning (Management Plans and AOPs) based on the topography (relief and hydrography), the resource, the options for reducing the villages' isolation, and sensitive environments (nearby national park), etc. Reduction in the width of the roads and the size of yards and quarries Measures to improve drainage Rules governing access (checks, closure of secondary roads) and use
Fording of streams and rivers	Measures aiming to preserve the moisture balance
Felling	Application of techniques that ensure the safety of the logging teams; best possible control over the direction in which a tree falls; best possible valorisation of felled trees
Forwarding	Effective planning (forecast harvesting maps) in order to limit the length of forest tracks, avoid having to pass over steep slopes or cross waterways, and avoid stems or stands marked for protection Limitation of soil erosion (i.e. by limiting the removal of topsoil), restrictions on working on wet soils Limitation of damage caused to trees marked for protection
Polluting and at-risk activities: Mechanical maintenance **Timber treatment**	Personal protective equipment, information on safety rules and risks Choice of suitable products, equipment and materials Recovery and treatment of contaminants

Safety rules shall be defined and personal protective equipment provided for each logging activity and each job.

All the measures set out in the forest management plan should be listed in the operational procedures for each operation; these procedures should be circulated to all relevant staff.

At the very least, the forest management plan should outline the major directions of the reduced impact logging programme, describe the principal measures that have been set together with the programme for training staff in the new techniques, and specify the procedure for checking compliance with these measures. Logging operators should avoid the error of fixing an over-ambitious programme of measures that will prove difficult to enforce on a wide scale and in the long term, and should ensure that every possible effort will be made to enforce a range of fixed, achievable and efficient measures.

Controlled, reduced impact logging
© Nicolas BAYOL

RIL measures cannot be set up unless it is possible to evaluate their proper enforcement and all the related effects. This evaluation may be carried out using post-harvesting diagnostics (field checks and surveys), internal or external evaluations and audits (as part of the certification process for example, or conducted by the Forest Administration).

This regular evaluation of the impacts and outcomes of the measures makes it possible to:

- Define which actions need to be performed first in order to minimise these impacts;
- Define ways of improving RIL measures;
- Initiate corrective measures should a major impact (pollution) be identified, or in the event of deviation from the logging operator's specified standard.

Equipment and safety signalling on industrial sites © Catherine VIVIEN et Benoît DEMARQUEZ

Diagnostics, checks and audits can also be used to identify needs in training and staff and to detect weaknesses, along with the corresponding need to clarify the adopted approach, etc.

De-silting and hydrocarbon separation tank
© Bernard CASSAGNE

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I.9.4 Management Documents

The standard approach to the management of closed moist forests consists of a three-tiered system based on management planning deadlines.

As opposed to other continents with closed moist forests, the 'long-term' management planning level, i.e. the forest management plan, is far more advanced in Central Africa. However, the other two levels are given just as much attention as it is these levels that will express the operational aspect of the strategic decisions set out in the Forest management plan.

The Management Plan concerns the enforcement phase of the Forest management plan and thus covers the medium-term, i.e. the multi-annual blocks.

An example of the Management Plan template is given in Annex. It is important to stress that, in contrast to the Forest management plan, the content of which is well defined and relatively similar from one region to another, it is difficult to propose a standard template for the Management Plan, which is supposed to relate as closely as possible to the actual situation, and which therefore has to be tailored to each new situation. Furthermore, national legislations often differ widely in terms of their enforcement of management measures in the field despite all the efforts to standardise the procedure.

The Management Plan is not based on specific new studies, rather it reproduces the decisions set out in the Forest management plan and then tailors them to the area of a multi-annual block. Two key items provided by the Management Plan are:

- Planning of the principal road infrastructures
- Demarcation of Annual Allowable Cuts (AAC) (except in Congo, see below).

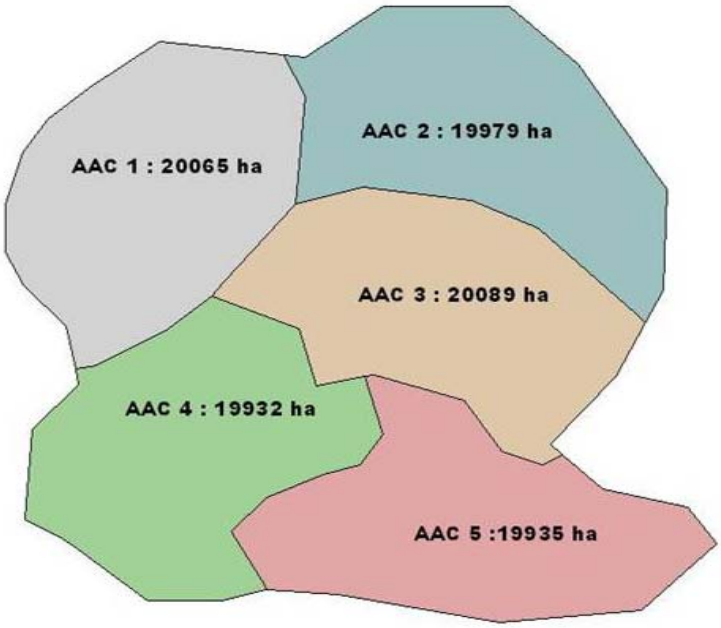
It is impossible to apply the 'equal volume' principle used for demarcating five-year blocks to the demarcation of AAC as the results of the management inventory cannot provide a sufficiently accurate estimate of the available resource when applied to such small surface areas. AAC are generally defined by capacity, i.e. they have an equivalent surface area within a given multi-annual block. In this case, to mitigate any risk of changes in the available volume from one year to the next, operators are given the option of bringing forward or extending the opening of an AAC. Each AAC can thus remain open for a 3-year period, and 3 AAC can be opened at the same time.

In Congo, National Forest D Directives have chosen another option: the demarcation of Annual Allowable Cuts is based on capacity and evaluated by the operational inventory. Each AAC is demarcated so as to

contain the maximum possible gross volume of stems with a diameter exceeding the DMA for the Species Group being managed; this option is provided for each multi-annual block under the Forest management plan.

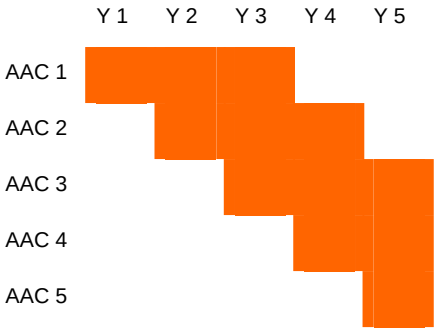
However, given the risk of demarcating too large an area for an AAC following errors in the inventories, a capacity limit has also been set. Under no circumstances may the surface area of an AAC exceed by more than 20% the indicative annual surface area, which is equal to the surface area of the multi-annual block divided by the number of years it is open for logging; this decision will stand even if the gross volume of managed species within the AAC thus defined is below the figure of its annual production.

The multi-annual block covers 100,000 ha



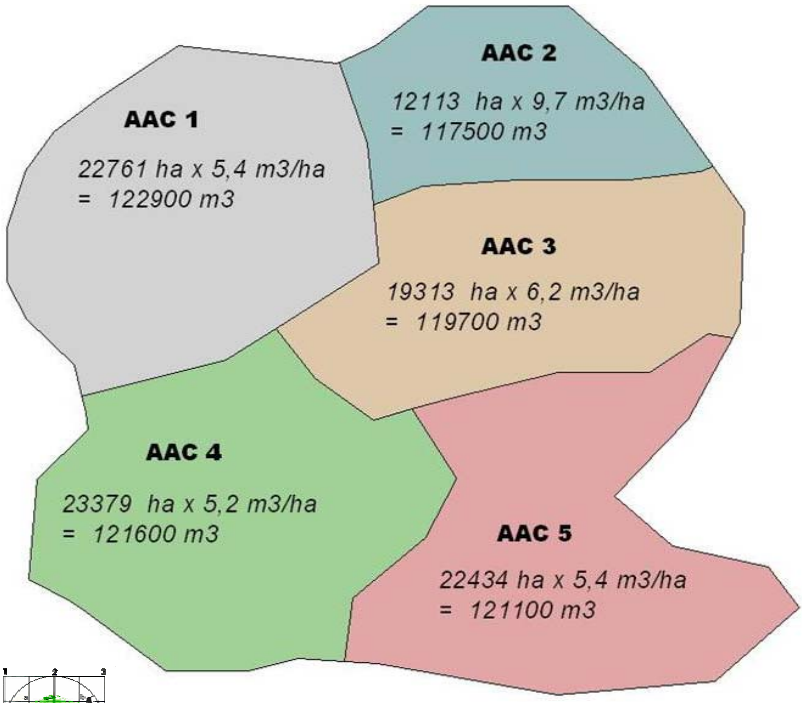
Each demarcated AAC measures 20,000 ha +/- 5% (tolerance threshold).

AAC opening schedule:



Open AAC

Demarcation of AACs by capacity, as in Gabon



The multi-annual block covers 100,000 ha and contains 602,800 m^3 (based on the management inventory)

AAC are demarcated year-on-year based on the results of the operational inventory (AAC1 year 1, AAC 2 year 2, etc.). Each AAC contains 602,800 m^3 / 5, i.e. 120,560 m^3 ± 5%.

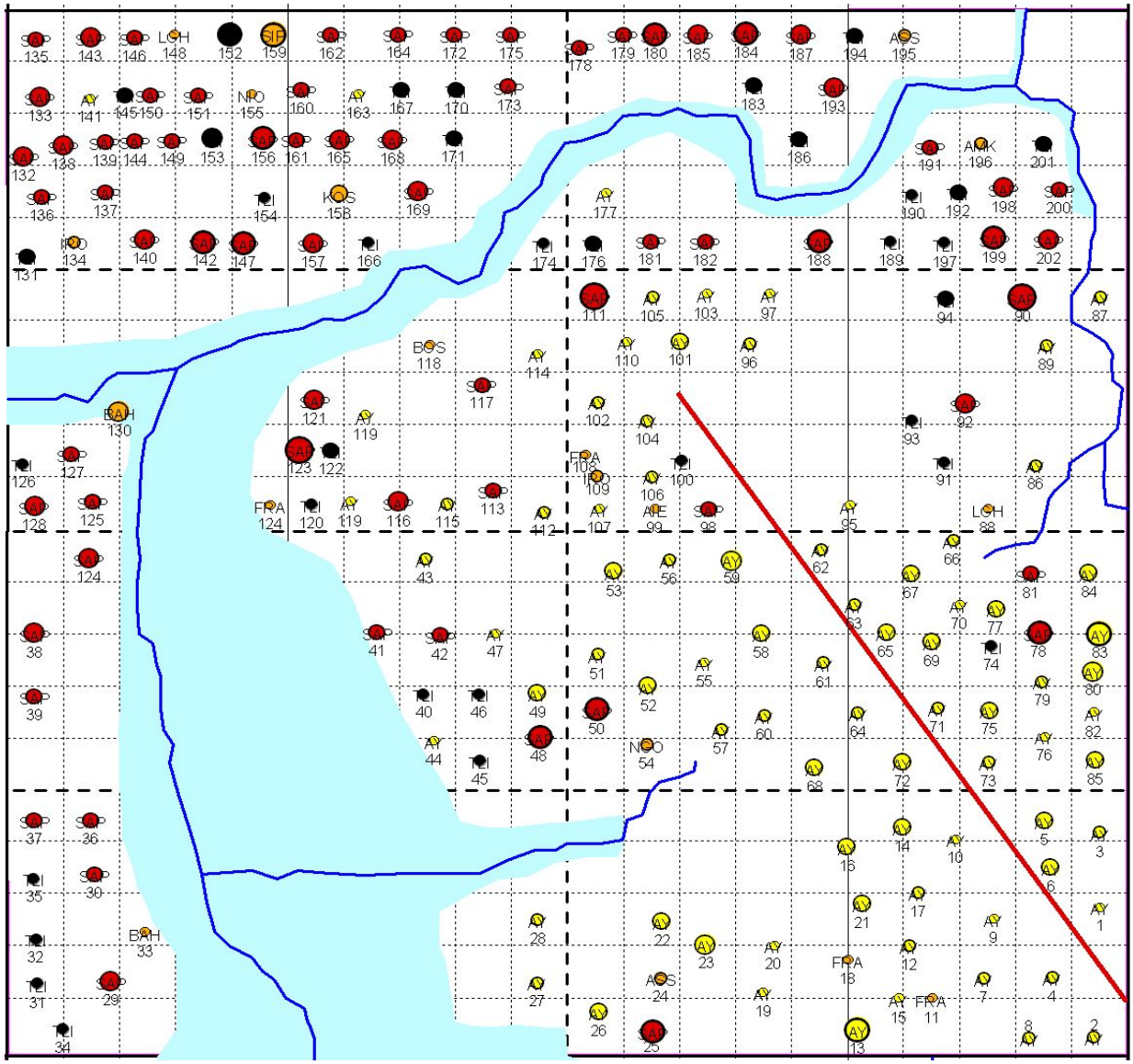
AAC measure 100,000 ha / 5 + 20% at the most, i.e. 24,000 ha.

Demarcation of AACs by volume, based on the results of the operational inventory (as in Congo)

Based on the results of the operational inventory, the **Annual Operations Plan** provides a short-term schedule for Annual Allowable Cuts (AAC).

The AOP includes the following in particular:

- Accurate operational inventory results, in terms of numbers of standing trees, standing volumes and harvestable volumes;
- Distribution maps for the resource, the logging parcel, and the whole road infrastructure;
- Details on the management and logging rules governing the AAC.



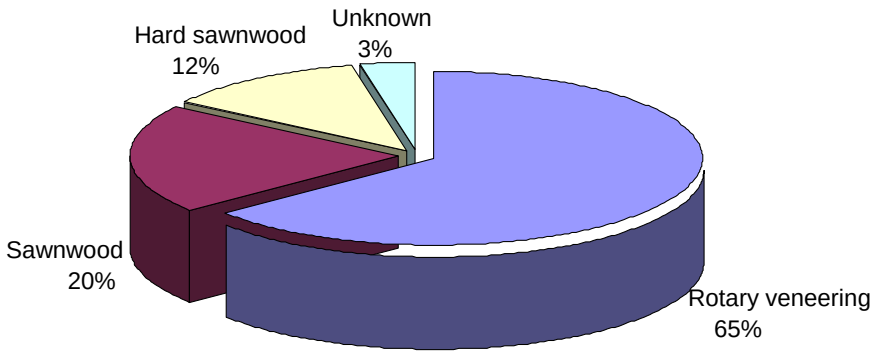
Example of an operational inventory map, concerning an operational inventory block (in Cameroon)

I.9.5 Industrialisation and enhanced valorisation of the resource

For a number of reasons, enhanced valorisation of the resource is one of the cornerstones of the sustainable management of closed moist tropical forests in the Congo Basin. The first harvesting cycle concentrates on both trees of the best species and quality. During following rotations, the resource in this range of species will have been reduced making it essential to compensate for this reduction by removing new species and by enhancing the valorisation of lesser quality resources. In environmental terms, the act of maximising the valorisation of an available resource can lessen the surface impact (disrupted surface areas) in relation to the quantity of the valorised resource. This is an aspect that is too often ignored by reduced impact logging measures: a keystone measure of the Reduced Impact Logging (RIL) approach is the maximised valorisation of the harvested potential. In economic terms, stronger industrialisation enables operators to cut transport costs; this is essential, in particular for remote and isolated forest areas, such as is the case in the DRC. A reasonable increase in the volumes harvested per hectare cuts operating costs. In social terms, timber processing companies drive the local job market.

Efforts to enhance resource valorisation take several forms, such as sales campaigns that target the marketing of new species or new products (as was the case for Okoume sawnwood a few years ago), development of an increasingly advanced local industrialisation, and also the energy conversion of unsold timber (via cogeneration or carbonisation). Operators are progressing strongly in all three of these directions, a trend that is set to continue over the next few years. Recent knowledge of the resource gleaned from management inventories can be used to focus marketing initiatives on new species, and also to improve industrial forest management planning.

Steam engine installed to generate electricity © IFO



Pie chart representing resource distribution in terms of each possible use on a given concession

Finally, industrialisation, the development of new species and forest development are all complementary tools used to achieve the same goal, i.e. the development of a sustainable forest economy in harmony with its surrounding environment.

I.9.6 Social Measures and consultative structure

Social Measures

All forest management plans should include a chapter on social measures, listing the measures that have been set and providing a rough schedule of their implementation. This generally involves a detailed medium-term schedule and long-term goals based on the socio-economic diagnostic performed when preparing the Forest management plan

The social measures listed in the Forest management plan are described in detail in the document 'Study of a Practical Forest management plan for Natural Tropical Production Forests in Africa' - Volume 2 – Social Aspects'.

Note that these measures are based around the three objectives listed below. Each objective includes a general outline of the measures to be set.

- Objective 1 :

Ensure suitable living conditions at logging worksites and industrial plants for staff employees and their legal dependants.

Measures relating to objective 1

Measures involving the logging operator's direct and full commitment, regarding the following points:

Healthcare: measures concerning the provision of medical care and basic healthcare services by a professional team, at suitable, properly equipped premises;

Basic education: measures concerning the schooling of eligible children at living camps, with classes to be delivered by qualified teachers at suitable premises;

Access to drinking water: measures concerning the supply of drinking water to living camps and of a suitable distribution network;

Food safety: measures concerning the supply of food products to living camps, providing a healthy, balanced and suitable diet. This supply is not to compete with the food requirements of local communities; supply of food products via sustainable forest management (farming, hunting, fishing);

Habitat and hygiene: measures concerning the quality of the habitat, hygiene, preventive health services and safety at living camps;

Further training: measures concerning the training and valorisation of employee career paths;

Occupational safety: safety measures concerning the employees' job (instructions, training, equipment, preventive means, intervention means);

Socio-cultural development: measures concerning socio-cultural development and access to information for eligible parties (such as sports equipment, etc.).

- Objective 2 :

Ensure the harmonious coexistence of the different functions and uses of the area, and of the forest resources, to guarantee local populations maintain their legal use rights;

Measures relating to objective 2

These measures require a collaborative relationship between the various entities using the managed area, i.e. the concession holder–forest manager, local communities, administrations, local or international NGOs, development projects, etc.

These measures concern:

- Limitation of negative logging impacts on the living conditions of local communities, i.e. protection of at-risk resources (areas or trees with a cultural or religious value, holy sites, trees that produce NTFP); decrease in the disruption caused by opening up forest roads, etc.
- Efforts to encourage local populations to adopt sustainable management practices towards natural resources, such as in the fight against organised poaching activities or frontier advance. This requires

the active participation of the various stakeholders including the State and local communities, agricultural services, regional development offices, NGOs and development projects, etc.

Objective 3 :

Contribute to local development by funding social infrastructures and equipment for the benefit of local communities, in particular through the concession holder's execution of a set of specifications and/or via that part of the forest tax system intended to support State-run local development initiatives.

Measures relating to objective 3

The measures relating to this objective are not part of the "normal" role played by a private operator, and are the responsibility of the State, to which each company pays taxes. Accordingly, it is important to remember that this corporate contribution is first and foremost conditional on the tax component paid to the State.

Village school built by SIFORCO, in DRC

© *Nicolas BAYOL*

On the grounds of efficiency and practicality, and depending on national legislative frameworks, States may request logging operators to sign contracts whereby they agree to act as a State-appointed contractor (in the form of either a subcontracting agreement or a tax allowance). This corporate social contribution to local development is vital in terms of enhancing the corporate image and responding to certain requirements of proper forest management certification. Moreover, it also offers companies, which are often the sole actor driving local development, a way of improving their integration into the socio-economic environment and maintaining harmonious 'neighbourhood relationships'.

Cabins built at the Ngombé living camp © Antoine COUTURIER

Agricultural development project in the area of the Babylone living camp – Rougier Gabon in Gabon © Bernard CASSAGNE

Regarding the responsibility of the various actors towards the local development of concession holders' operating areas, we can refer to the Study of a Practical Forest management plan for Natural Tropical Production Forests in Africa: as applied to the case of Central Africa - Volume 2 'Social Aspects', published by ATIBT.

Consultative structure

To ensure all the stakeholders participate in implementing the social aspects of the Forest management plan, this plan should propose a consultative arrangement that targets both the concession holder's eligible parties, and also the gradual extension of the social aspects to cover the local population as a whole during the enforcement period of the Forest management plan.

C Boma hospital - FORABOLA © *Richard GARRIGUE*

This is a multi-tiered consultative process which operates:

- At the level of the forest administration, to ensure monitoring, control and possible review of the Forest management plan and other related management documents;
- At the level of the logging operator, with representatives of the staff and their legal dependants;
- At the level of the concession, with regional administrations, local representatives of forest administrations and other administrations involved in implementing the Forest management plan, plus representatives of local communities, development projects, environmental NGOs, etc.
- Locally, at the level of each village, in order to discuss management procedures for logging areas that overlap village lands (logging operations, wildlife management, installation of living camps, compensation procedures in the event of damage, identification of at-risk resources, etc.) and, where necessary, the procedures for implementing the company's contribution (cf. objective 3 above).

I.9.7 Environmental measures

Preliminary inventory: impact study

An assessment of the possible environmental impacts of logging activities may be performed prior to setting up the relevant reduced impact logging measures. Furthermore, environmental impact studies are increasingly regulated by legal requirements under reviews of environmental codes and instruments in the various Central African countries.

The environmental impact study should be tailored to fit the scale and intensity of forest management operations, and also shall be properly incorporated into the company's management system.

The environmental impact study should provide for:

- Evaluating positive and negative environmental effects related to activities that include logging, timber processing and forwarding of logs and processed products;
- Proposing mitigating measures for negative effects, and possibly measures for valorising positive effects.

Wildlife management:

We are not going to detail here the measures governing wildlife management, which is dealt with in Volume III of the ATIBT manuals. In this section we are simply going to outline the main principles to be taken into account when implementing a forest management plan.

Traditional hunting with nets © *Benoît DEMARQUEZ*

The hunting and wildlife management programme is based on national legislative frameworks governing hunting activities, forest management standards and corporate specifications, as well as on international market requirements (international conventions, forest certifications, etc.).

The hunting management programme should be defined according to the following three lines of action:

- Gather sufficient knowledge of the natural and human environment, then, use this knowledge to schedule interventions as part of the forest management plan;
- Implement a production activity that complies with legal and contractual requirements, and with the voluntary commitments relating to certification;
- Set up a system that continuously monitors the impacts of all the operator's activities on local wildlife.

Information on wildlife and hunting activities is gathered at a number of different levels during the preliminary phase of the forest management plan:

- Management inventory (wildlife surveys, indications of anthropogenic activity, etc.);

- Socio-economic studies (hunting practices, hunting territories, consumer surveys, etc.);
- Any specific wildlife studies.

The information collected thus can be used to develop a wildlife management programme whose main lines are set out in the forest management plan, and which may also be specified in an internal company document. The management plan and the annual operations plans may provide a more detailed overview of the activities to be deployed at the level of the forest management unit.

The following is a list of just some of the principal measures that may be recommended, depending on the case:

- **Regarding company staff and their day-to-day activities:**
  - Inventory and regularisation of hunting and firearm permits;
  - Ban on hunting during working hours and with company vehicles;
  - Organisation of planned hunts, based on a previously defined hunting plan (favourable hunting areas, etc.);
  - Creation of a hunting committee;
  - Monitoring of the movements of company vehicles;
  - Monitoring of roads providing access to the concession (barriers, guards, etc.);
  - Awareness raising and information on the rights and duties regarding hunting activities;
  - Regular supply of good-quality animal protein to company stores;
  - Etc.
- **Regarding local populations:**
  - Awareness raising and information;
  - Monitoring of roads providing access to the concession;
  - Getting local populations to participate in deploying organised hunting plans within their own hunting areas;
  - Support of job and income creation initiatives designed to replace hunting income;
  - Etc.

However, while logging operators may be able to provide technical support to wildlife management programmes, it is nonetheless essential that the State remains responsible for enforcing compliance with this management (via wildlife guards). The State is the sole authority with the power to book offenders and confiscate firearms where necessary. This therefore means setting up a major consultative initiative with the Administration to guarantee the efficiency and reliability of hunting controls. This involvement of NGOs and associations is another vital component of this initiative, as is the search for operating funds.

Environmental measures within protection and conservation series

Protection and/or conservation series can be defined within the concession to be managed.

According to National Forest Management Directives in the Republic of Congo, the conservation series is designed to "guarantee the long-term survival of forest species, as well as maintain, restore and enhance every element of forest biodiversity", while the protection series is designed to "protect fragile soils, water sources, swamps, mangroves and wetlands, together with any other natural resources and the related cultural resources."

Forest clearing meriting specific protection

© Benoît DEMARQUEZ

It is forbidden to conduct logging activities in a conservation series.

Each of these series may recommend strict protective measures such as:

- Involvement of all the stakeholders in planning forest track networks (construct tracks as far as possible from the series, avoid crossing protected areas, etc.) and logging activities in the immediate vicinity of these series;
- Setting up of a rigorous hunting control system (with, for example, a ban on organised hunts within and around protected or conservation areas);
- Setting up of a buffer zone governed by a set of specific management rules;
- Etc.

Where protection or conservation series are outlined by artificial boundaries, these boundaries should be established prior to the passage of cruise and logging teams in the nearby area.

Environmental measures within the production series

The production series shall be governed by a set of strict environmental measures. The major part of the logging operator's activities will be conducted within this series, with a correspondingly high potential for impacting on the environment.

These measures are generally grouped under the title 'Reduced Impact Logging' (RIL), and are currently deemed a key tool in ensuring the sustainable management of tropical forests.

The reduced impact logging programme shall propose specific measures for each step of the logging process. These measures shall be rigorously applied and regularly assessed in order to limit the impacts identified during the environmental impact study.

In this section we outline logging measures and rules governing the removal of timber (construction of roads, felling and forwarding of timber). Wildlife measures were mentioned earlier and are dealt with in detail in Volume III of the ATIBT manuals. Anti-pollution measures are discussed below.

The following is a list of RIL measures, which have been extensively developed in the Regional Reduced Impact Logging Code (FAO, 2003) that benefited from ATIBT's technical support, and which may be considered for implementation:

Limitation on land clearing

One of the main objectives of RIL measures is to limit the temporary or final clearing of forest land generated by both the construction of timber storage and forwarding infrastructures (roads, timber yards), and by planting crops on slash and burn land within the forest area. Standards governing the construction of infrastructures shall be defined and complied with. Control measures shall be applied to the extension of farming land (cf. Volume II – ATIBT, social aspects).

Limitation on timber removal

The damage suffered by forest stands is directly linked to felling rates and the techniques employed. Logging rates primarily depend on the amount of available timber and valorisation of the forests involved. Under extensive logging conditions, the selective removal of one or two trees per hectare has no significant impact on forest structure. However, following the implementation of management measures, it is essential to increase the number of trees felled per hectare, in particular, by valorising promotional species to optimise harvest profitability within annual allowable cuts. Nevertheless, the number of felled trees shall not exceed a certain threshold, above which the damage caused to the forest would become too great, with serious impacts on the structure and functioning of the forest ecosystem. When not specified by national legislation, maximum harvesting standards, which govern the % of canopy to be preserved, shall be gradually defined by the forest manager. Checks may be based on the number of stems, volumes, or even on the distance between two harvested trees. The adopted measures should be easy to check by company staff and by the Administration, and easy to apply in the field. Current knowledge on the dynamics of forests in Central Africa is not, however, sufficient to be able to draw a conclusion on this threshold. Some species, such as Okoume, require a wide opening in the forest canopy in order to regenerate successfully. Given the reigning uncertainty on this issue, it would appear necessary to apply the precautionary principle.

Marking a future tree © Olivier BONNEAU

Respect of the resource

* Limitation of damage to forest stands

Generally speaking, operators should take every possible precaution to avoid damaging residual forest stands that contain certain trees that represent the standing capital for future rotations. Special attention should be paid to future trees (the small stems of marketable species), to very large trees (referred to as "monument" trees), rare species, species of keystone importance for wildlife, and possibly to some trees that are kept as seed-bearers.

**Limitation of timber losses*

Special attention should be paid to limiting timber losses in the forest at the time of felling, forwarding and chain sawing (poor cutting, damage to the bole, etc.). Logging staff may be given training in how best to use logging tools and valorise the resource.

Protection of environments, sensitive areas and waterways

Streams and rivers, forest clearings, hilly areas, or any other area deemed sensitive following the management study, and not included in the protection or conservation series, shall be subject to protective measures, such as application of the precautionary principle, setting up of buffer zones, erosion control, harvesting limits, etc.

Every effort shall be made to ensure stream and river flows are not obstructed (rivers must not be blocked during earthworks, vegetation must not be left lying around when building bridges, etc.).

Forest clearing in closed moist forest

© Jean-François GILLET

Planning and building roads

Efforts shall be made to limit as far as possible the direct (loss of forest area due to land clearing, fragmentation effect on wildlife, etc.) and indirect (providing poachers and nomadic farmers with access to new areas, etc.) negative impacts of road infrastructures on the forest ecosystem.

> The road network shall be planned so as to optimise the service, minimise the length of the roads and, as far as possible, by-pass environments of recognised ecological or biological sensitivity.

- Roads opened during the first harvesting cycle will be reused, unless otherwise specified for economic or ecological reasons.
- Stakeholders (local communities, conservation NGOs, local administration, etc.) will be consulted when planning the main logging area roads.

> Road infrastructures (main and secondary roads, quarries) will be kept as small as possible, while still taking account of transportation requirements (safety regulations, sunlight and maintenance of proper driving conditions during the rainy season, etc.).

> When fording rivers, the construction of embankments and bridges shall ensure there is sufficient water flow to avoid the river silting up and forming stagnant ponds.

Anti-pollution measures

Measures aimed at limiting pollution-related environmental impacts shall be enforced over the whole of the managed area. These measures concern:

- Timber treatment products: this will involve checking which type of product is used and limiting sources of ground spillage or dumping; Batteries: used batteries can be taken to waste treatment centres or collected by the suppliers. If there is no waste reclamation structure, the batteries can be dealt with internally;
- Management of petroleum hydrocarbons:
    - Used hydrocarbons: these shall be collected, stored and then taken to the appropriate waste treatment centres. Operators may also sign agreements with suppliers regarding their collection;

- Install engine washing areas (numerous oil leaks);
- Secure the storage of contaminants;
- Storage of waste, which shall be:
- Secured
- Tracked (landfill site traceability)
- Sorted: separate household waste from industrial waste

Secured storage of lubricant barrels – CEB site

© Benoît DEMARQUEZ

Silvicultural measures

Few silvicultural measures are currently practiced within forest concessions in Central Africa. **Logging is the first, and often the only, silvicultural action**. Logging opens up both ground and canopy areas, thereby creating favourable conditions for rapid growth of young residual stems. Logging is conducted solely by the forestry operator.

Kangou Waterfalls © Benoît DEMARQUEZ

The main silvicultural management measures concern:

- A survey of the minimum cutting diameters of some species with diametric structures that are not propitious to the regeneration of their population;
- Timber removal limits (harvested volumes) per parcel.
- Marking and protection of future species, seed-bearing trees and other trees that warrant protection.

Other treatments that may be considered are:

- Pre-felling climber cutting: it has been suggested that cutting lianas on harvestable trees and those in the neighbouring vicinity prior to cutting facilitates directional felling, thereby minimising logging damage to the residual stand. Nothing has so far been proved in Africa and, moreover, systematic pre-felling climber cutting should be strenuously avoided due to its role in the loss of biodiversity and the disruption of local use. Externally funded research may be carried out to verify the merits of this costly operation.

- Support of natural regeneration or artificial enhancement.

- Thinning: the purpose of this operation is to encourage growth, i.e. accelerate the regeneration of

future stems of marketable species by removing competing neighbouring trees of no value from the dominant storey. This normally involves devitalisation of the standing tree (partial removal of the sapwood at the base of the tree; the use of chemicals is not allowed for this type of operation).

This one-step silvicultural treatment is a simple, easy to carry out operation but one that remains fairly expensive. Furthermore, its economic benefits are neither proven, nor suitable for general use in every forest. In addition, if this treatment is poorly designed it could lead to biodiversity losses. In any event, thinning should only be recommended for stands with a large number of future stems and should be carried out selectively.

Measuring the diameter of a buttressed tree © Jean-François GILLET

In some forest areas with large numbers of young stems of a pilot species, such as Okoume, silvicultural experiments could be performed on the operation and enhancement of forest stands. The same could eventually apply to work dedicated to the enhancement of logged areas. The silviculture of these young, future forest stands, which sometimes cover several tens of thousands of hectares, could involve a fairly significant increase in the volumes harvested per hectare during future cutting cycles.

However, logging operators rarely have the necessary technical skills for making decisions on the potential benefits of performing a given treatment within its concession; neither do they have the skills required to successfully perform this work. At best, they might be able to participate, by joining forces with a research centre or with the Silvicultural Department of the Direction Nationale des Eaux et Forêts (National Directorate of Water and Forests). Moreover, we think it logical for the State to take responsibility for silvicultural work dedicated to the enhancement of natural forest stands following the logging phase, bearing in mind that it can delegate this responsibility to a specialised service provider.

Research programme

A forest dynamics research programme may be carried out under the forest management plan. The concession holder may form a partnership with an experienced research organisation and seek funding for deployment of the programme. The logging operator may participate in this programme, for instance, by providing the necessary logistics set-up.

The research programme should be part of a national, or even regional programme and should be conducted along with other research.

Above all, it is important to consider what, exactly, the expected needs for improving forest management are, rather than plunging headfirst into vast programmes that are not always suited to the needs of sustainable management or that are not under the control of logging operators.

The results of this research will, in particular, be used to implement silvicultural actions designed to encourage the regeneration of some species. This programme will mainly cover the study of forest dynamics, and monitoring of the impact of logging operations on the residual stand.

The following sections may also be addressed:

- **Population dynamics**

A long-term system for studying and monitoring the phenology, growth and mortality of marketable species could be set up. Observations and measurements would be taken for a period of at least five years.

- **Study of species regeneration**

A forest regeneration study (all species included) could be conducted in the heart of the forest (logged and non-logged areas) on felling holes and skid trails.

- **Enhancement of regeneration capabilities**

A silvicultural research programme could be set up to design a practical regeneration method.

Applied forest research - example of the Gembloux Faculty of Agricultural Sciences

The Gembloux Faculty of Agricultural Sciences and the Belgian ASBL Nature Plus have been working together for several years now on studies and actions targeting forestry companies, with the following dual aim: (1) Define the ecology of harvested forest species, (2) Test and apply practical silvicultural techniques that fall within the scope of the forestry companies' economic and technical capabilities.

This is a multi-tiered approach: (1) Analysis of management inventory results and identification of species demonstrating regeneration difficulties, (2) According to the level of knowledge on these species, setting up of systems designed to monitor species dynamics (growth, mortality, phenology); (3) Design and application of supported regeneration techniques.

Moabi stem planted in a logging windthrow area after 18 months
© JL DOUCET

In terms of regeneration, a method of enhancing logging windthrow is currently being tested at several logging companies in Cameroon, Gabon and the Congo Republic. This currently concerns the following species: tola, black anzem, afrormosia, azobe, mansonia, makore, bubinga, iroko, moabi, ozigo, padouk, sapelli and tali. Long-term study devices, tracked by doctoral students, have been installed to monitor the behaviour of these species. The first results have been particularly encouraging. As an example, after a monitoring period of two years, moabi stems reached an average height of 207 cm for an average diameter of 1.3 cm. In Cameroon, the average cost of the operation has been estimated at 1.5 EUR per enhanced windthrow.

I.10 SOME OF THE CHALLENGES OF FOREST MANAGEMENT

PLANNING

I.10.1 Training

As things stand at present, setting up a sustainable forest management approach in Central Africa means, for most logging operators, **the recruitment of university educated supervisory staff with specialist training in forest management, together with the related field experience**, in addition to operational staff, in particular for forest cruises. During the plan's 1 to 3-year preliminary period, this group of employees, which is intended to form the company's **Management Unit**, shall generally receive either part-time or full-time **technical support** from a **design office specialising in tropical forest management.**

Beyond its conceptual support, the design office will also be responsible for training Unit staff, and for transferring its knowledge in forest management and management, logging practices, GIS and IT management.

Graduation ceremony following a felling course – CEB site © JM PASQUIER.

These courses, while essential, will nonetheless require further input. The company will have to develop its own training policy, which should be drawn up following an analysis of the company's needs. Training courses can be run internally, or **provided** by external, public or private organisations with solid practical experience of forest management and logging practices in closed tropical forests.

Among other things, these courses will target managerial and supervisory staff as regards management methods and reduced impact logging; and supervisory and operational staff as regards techniques for cruises, reduced impact felling, processing and forwarding. Courses shall focus on environmental protection and occupational health and safety. These courses should be delivered by specialist providers and be run mainly at the company's premises.

These courses may be partly funded by external organisations, especially during the preliminary phase.

Lastly, logging companies shall contribute to the field training of State employees in sustainable management and logging practices by hosting and instructing trainees at worksites, and by providing access to premises and infrastructures.

ATIBT courses for forest management officers

Conscious of the complexity of the forest management plan officer's job and of the lack of qualified personnel, the ATIBT Commission Forêt, which embraces the main forestry consulting firms in Africa, has responded by setting up a forest management plan officer course.

Theory modules

These courses provide an overview of the tools used in sustainable forest management, and enable trainees to organise and supervise the fieldwork required when preparing a forest management plan for forest concessions.

These courses target operational field staff with basic knowledge of forestry activities working in the private sector, NGOs, Administrations, project teams, etc.

These are short-term (2 weeks) vocational courses, during which experts with extensive field experience of forest management and development deliver theory classes, tutorials and practical work on the following topics:

- General outline and history of the sustainable management concept
- Dendrometry and topography
- Forest mapping
- Operational inventory
- Forest development inventory
- Botany / biodiversity
- Reduced impact logging
- Wildlife - hunting
- Social aspects
- Drafting the forest management plan

Trainees will receive a lesson folder that they can refer to when they get back to their company.

ATIBT courses for working plan officers are legitimised by an exam, on successful completion of which trainees will receive an 'ATIBT Working Plan Officer' certificate.

Fieldwork modules

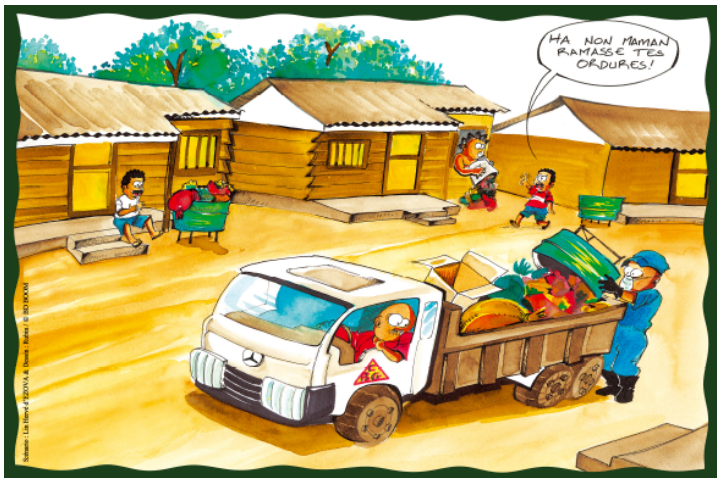
A diverse and numerous public

ATIBT working plan officer course held in Cap Esterias, Gabon, 2006
© B. DEMARQUEZ/ ATIBT

I.10.2 Awareness raising actions

It is important that logging operators establish a policy of raising staff awareness of issues relating to sustainable forest management and occupational safety. Generally speaking, at each stage of the logging process, staff must think about safety (wearing of protective equipment and handling of suitable machinery) and respect of the environment, i.e.:

- Limitation of timber waste;
- Respect of the future resource (protection of listed timber);
- Respect of waterways, protection of fragile



Environmental respect awareness raising poster © Société CBG / TEREA / BD Boom

environments;

- ➲ Waste collection (oils, gas-oil, miscellaneous waste, etc.);
- ➲ Regulation of hunting activities and fight against poaching;
- ➲ Etc.

This awareness raising policy can be based around the following lines of action:

- **Publication of awareness raising documents** (brochures and posters) introducing the sustainable forest management concept and the company.
- **Publication of technical data sheets** describing the working methods for the different jobs;
- **Organisation of regular information and awareness raising meetings** on occupational safety and the environment;
- **Raising company workers' awareness at the time of their recruitment,** firstly at a meeting with a manager, followed by having them sign a certificate of commitment towards environmental respect;
- **Themed videos** shown at the workers club;
- **Etc.**

I.11 MONITORING, INSPECTION AND COSTS INVOLVED IN FOREST MANAGEMENT PLANNING

I.11.1 A skilled and permanent forest management planning team

Logging operators shall ensure that their workforce includes a permanent team with forest management planning skills and experience. This team will contribute to implementing management planning measures, and will also perform monitoring and inspection activities.

The company shall have its own permanent mapping department. It shall also have an efficient IT set-up, a Geographic Information System (GIS), together with the necessary human resources to ensure regular updating and publication of the themed maps required for forest management, in particular prospection and harvesting maps.

Where applicable, a social unit comprising specialist officers (leader, investigator, and interpreter) shall be formed so as to:

- Improve knowledge of the actors, their activities and their needs;
- Inform, raise the awareness of and hold talks with local communities about management planning measures and their implementation;
- Integrate communities and make sure they are involved in local development.

In particular, this team is responsible for monitoring the proper implementation of the forest management plan and the related management documents, i.e.

- Compliance with annual allowable cuts;
- Compliance with minimum cutting diameters;
- Implementation of reduced impact logging measures;
- Compliance with social and environmental programmes;
- Etc.

I.11.2 Monitoring and assessment actions

As a rule, any action implemented under a forest management system must be subject to regular monitoring and assessment in order to measure and assess the effects of the measures taken, and to ensure the continuous improvement of environmental performance.

Assessment methods include:

- **Internal assessments:** specialised teams of company officers perform internal assessments on a regular, on-going basis, which underpin the inspections carried out on each activity sector (worksite inspections, workshop cleanliness inspections, etc.);
- **Internal audits**: these are performed on an ad-hoc basis, and cover the whole forest management system; they are carried out by a company manager designated by General Management, possibly accompanied by specialist consultants;
- **External audits**: these are required by certification procedures, and involve inspections subcontracted to the relevant organisations.

These regular assessments provide for:

- Checking the effective implementation of the work programme;
- Checking the relevance of the measures taken and their effectiveness;
- Initiating corrective measures should a major impact (pollution) be identified or in the event of deviation from the logging operator's specified standard.

Requirements governing monitoring and assessment activities under the various certification systems

Regional ITTO/ ATO principles, criteria and indicators:

Principle 1, Criterion 1.6, Indicator I1.6.1:

"There is a continuous monitoring and assessment procedure concerning implementation of the forest development process."

SI I1.6.1.1 While maintaining information confidentiality, forest management plan officers shall nevertheless be able to provide a summary of monitoring results on the following:

a. Yields of all the products removed from the forest
b. Growth and regeneration rates, together with figures on the forest's current status;
c. Composition of and observed changes in fauna and flora;
d. Social and environmental impacts generated by timber removal and other operations;
e. Impacts in terms of the costs, productivity and efficiency of actions performed as part of

the implementation of forest management plan directives

Principle 8 of the FSC guideline states:

"Monitoring and assessment: Monitoring shall be conducted - appropriate to the scale and intensity of forest management - to assess the condition of the forest, yields of forest products, chain of custody, management activities and their social and environmental impacts."

Criterion 8.2 is almost identical to SI 1.6.1.1 of the ATO/ITTO PCI.

ISO 14001 Ed. 2004:

4.5.1 – Monitoring and assessment:

The organisation shall draw up, implement and update one or more procedures for regularly monitoring and assessing the main features of its operations that may have a significant environmental impact. These procedures shall include all the documents needed to monitor performance, perform the applicable operational inspections and check conformity with the organisation's objectives and environmental targets.

The organisation shall make sure that all calibrated or verified monitoring and measuring equipment is used and maintained, and shall keep the relevant records.

I.11.3 Economic forest management plan assessment

The preparation of a forest management plan involves major investment on the part of logging operators, who sometimes find it difficult to accept the amount given the lengthy return-on-investment period: **the forest management process represents an investment that is non-productive in the short-term.** Unfortunately, there is little data currently available on long-term economic benefits, which can nonetheless be extremely positive provided that the company fully integrates the sustainable management approach into its day-to-day activities.

Forest management unit © ATIBT

- **Costs relating to the elaboration of a forest management plan**

The costs distribution between the various steps in the preparation of a forest management plan varies considerably depending on sources. It is closely dependent on the way the management plan programme is organised (especially as regards the amount of subcontracted work), on the available data (whether or not there is any cartographic data, previous studies, etc.), on other actors working in the area (presence of NGOs, miscellaneous partners, etc.), and on the environment (i.e. whether there are any national parks nearby). The costs distribution also varies greatly depending on the analysis carried out, i.e. whether or not the supervisory aspect is factored into the cost of the inventory, whether or not administrative costs are accounted for, whether supervisory work is taken into account for internal studies, etc. This makes it very difficult to estimate the cost of each separate preliminary step of a forest management plan. Conversely, the overall cost is now well known and can be broken down as follows:

Costs relating to the elaboration of a forest management plan

- Forest management unit: equipment, supervisory staff (forest management plan officer, design office, etc.) and operational staff (technicians, mapping department, secretariat, etc.), operation (vehicles, stationery, etc.)
- Acquisition of cartographic data, satellite images, setting up of a GIS
- Studies (wildlife, socio-economic, biodiversity, etc.) and training courses (RIL, forest management training, etc.)
- Forest management plan inventory

2 000 à 3 500 Fcfa / ha – 3,0 à 5,3 € / ha

The forest management plan will be the sole instrument capable of providing a detailed breakdown of the expenses involved in implementing the sustainable management programme. The measures recommended in the forest management document shall be costed wherever possible.

Ideally, these costs shall be reduced to the hectare and the marketable cubic metre, thus providing the company with a better overall view of the expenses directly linked to the sustainable management process.

Long-term benefits of the forest management planning approach

Management planning undeniably represents a very heavy investment for logging operators, particular as this involves an investment that is generally qualified as non-productive, in contrast to the purchase of logging equipment for example.

However, it is important to keep in mind the numerous advantages offered by the forest management planning approach:

The management planning approach primarily allows companies to focus their work on planned and optimised operations:

- Planning and optimisation of the road network;
- Operational inventories used to establish a rational logging programme, optimisation of skid tracks, organisation of worksites, etc.
- Reduced impact logging measures that enable operators to cut certain costs (increasing yields through improved felling techniques, optimisation of chain sawing operations, etc.);
- Investments in an industrial tool suited to the resource.

Valorisation of secondary species:

- The forest management plan inventory provides knowledge of the resource over the whole concession, thus enabling the promotion of new species, with the guarantee of a sustainable supply;
- Operational inventories are used to prepare the markets one to three years in advance.

- **Curbing of social unrest:**
    - The social part of the forest management plan facilitates discussions with local communities, and often provides for resolving, or even anticipating social unrest;
    - From the local populations' point of view, implementation of a social programme often encourages them to vocalise their needs. Further investigation is required to determine whether increased interaction with local communities actually limits outbreaks of social unrest, and at what price for the logging operator;
- **Improvement of staff working conditions:**
    - Reduction in the number of occupational accidents;
    - Stabilisation of the workforce (better housing conditions, access to healthcare, etc.);
    - Further training, more qualified staff (as employees tend to remain with the company and are better trained);
- **Added-value for the logging operator:**
    - Adopting a forest management plan approach enables long-term allocation of concessions, thereby ensuring a secure real estate holding;
    - Clearly defined and officially validated forest management plan series; clearly identified timber production zones;
    - Knowledge of the resource allows logging operators to more accurately cost the company's heritage (sustainable resource);
    - Better access to 'sensitive' markets, and European markets in particular (associated with increasingly strict requirements to prove legality), and the preservation of some markets during crisis periods, provided that the company offers proof via external audits (certification, certificate of legality);
    - Tax benefits in certain cases.
- **Enhancement of company image:**
    - Corporate relations with the Administration, NGOs, local communities;
    - Employees' image of their own company;
- **Certification, which may be obtained following implementation of the forest management plan.**
    - Access to certain markets;
    - Valorisation of secondary species;
    - Cost improvements (even if this is still too restricted)

The logging operator's partners (Administration, NGOs, etc.) shall also play a role in encouraging companies that decide to adopt a sustainable management approach.

It is occasionally deplorable to see some companies that demonstrate a firm commitment to sustainable management being subjected to criticism from NGOs, while other companies that have not even begun to move in this direction remain in the background, and all too often manage to avoid these attacks.

It is also important that, when carrying out their inspections, the Administrations take account of the considerable efforts made by some companies to bring themselves into line with a sustainable management approach.

Only the general recognition of all the actors will motivate logging operators to continue their long-term mission of sustainable forest management.

I.12 INTEGRATING SMFE INTO THE FOREST MANAGEMENT PLAN PROCESS

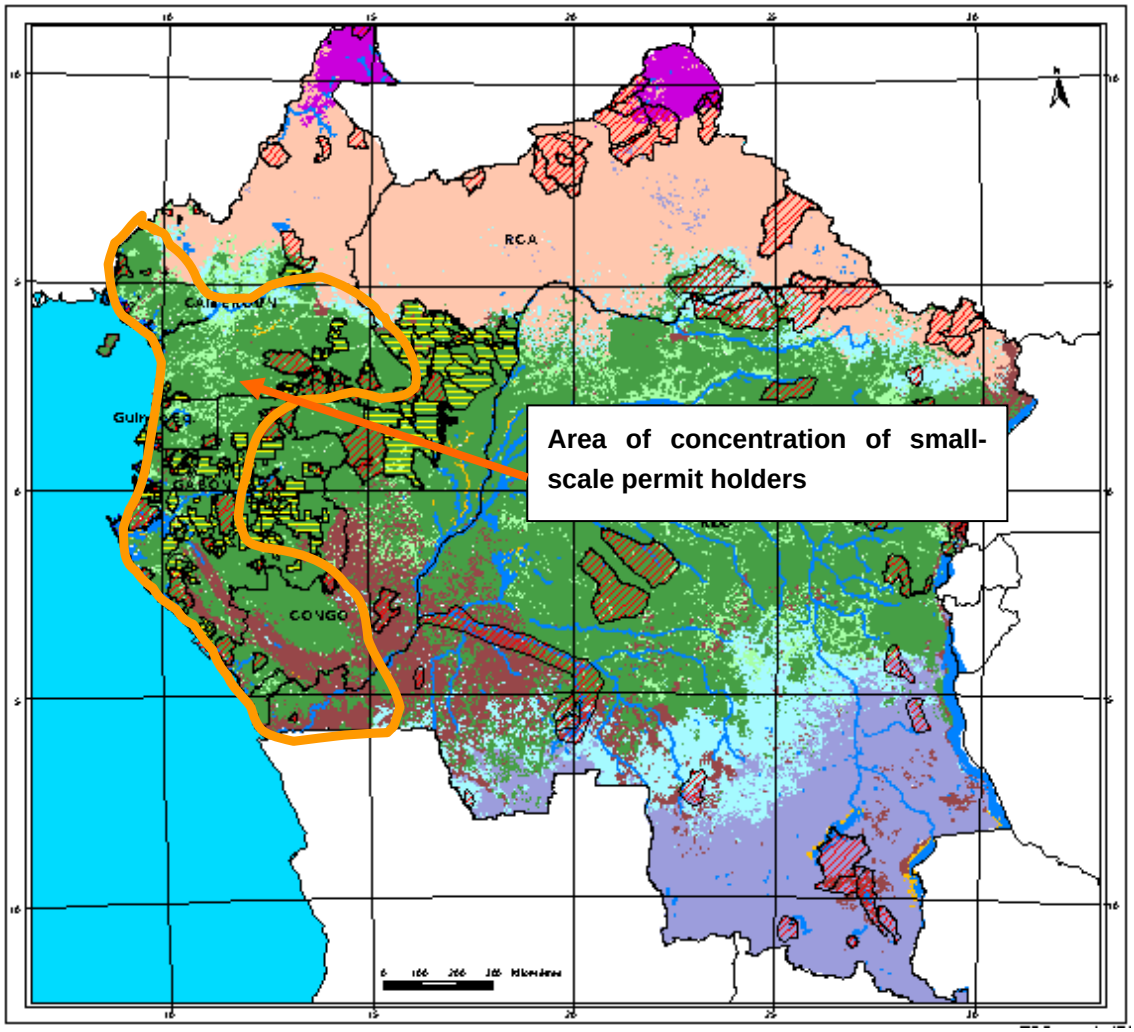
At large-scale concessions exploited by major foreign industrial groups, the forest management plan process is now well underway, concerning at least the preliminary phase of study and analysis of all the factors impacting on sustainable management, in addition to the consultative phase in which stakeholders seek practical management solutions. Naturally, there now remains the issue of successfully enforcing all the decisions taken, but, the level of motivation demonstrated in the preliminary stages allows us to be optimistic on this last point.

There are still some large-scale concessions of this type that need to be brought into the process, and some entrepreneurs who are still showing resistance to the idea. There again, there is a clear set of obstacles to be overcome (cf. conclusion). The technical solutions for valorising these concessions are now fully controlled, meaning there should not now be any major impediment in extending the scope of the sustainable management process. Accordingly, we can be highly optimistic about the chances of the Northern Congo forest area, the western forest area in CAR, a significant part of the 'Congolese Basin' forest (upstream watershed of the Congo River) in DRC, a large part of the forest area in Cameroon and the central forest area in Gabon eventually joining the sustainable management movement.

Conversely, some forest areas, in particular those in Southern Congo, part of Gabon and in the Bas-Congo province in DRC face certain difficulties in introducing a similar approach. This is due to the areas' fundamental dissimilarities regarding forest management constraints, such as, in particular, the smaller size of the concessions for which radical new sustainable management solutions have to be found, and also the informal nature of business dealings in this sector, meaning that it is difficult to obtain information where smaller sized operators are concerned. Below we give a detailed analysis of the case of Gabon. While the statuses of small-scale permit holders in Southern Congo (useful surface area is generally around 72,000 ha, against 180,000 in the northern part of the country), in Bas-Congo in DRC and in Cameroon, do have some similarities, they are nevertheless quite different to the situation in Gabon, and obviously, the approach to be developed will have to be tailored to fit the national context.

The sustainable management instruments used for these small-scale areas, valorised by small-scale, and often national enterprises, will in all likelihood involve a grouping of production means via partnerships between title holders, logging operators and industrials, based on management templates that could take

their lead from similar initiatives in other agricultural sectors around the world, with agricultural cooperatives.



Area of concentration of small-scale forest permit holders in the Congo Basin

Case of Gabon

Gabon has actively driven thinking on the issue of the sustainable management of small-scale forest permit holders; several studies have been conducted there since 2001, and a project has just been initiated to extend the sustainable forest management plan dynamic to cover small-scale forest permits logged by Small and Medium Forest Enterprises (SMFE), funded by the *Agence Française de Développement* and the *Fonds Français pour l'Environnement Mondial*.

In Gabon, in order to share out forest revenues, a large number of permits (generally small-scale, but not always) are allocated to national companies with no knowledge of or experience in logging activities. These companies then call on logging operators with whom they sign a leasing agreement. This means that, where these permits are concerned, the resource is not therefore directly attributed to the company responsible for logging operators.

'Small-scale permits' of less than 50,000 ha, account for between 3.5 and 4 million hectares in Gabon, with most of these permits covering an area of around 15,000 ha.

The successful management of such small areas would appear hard to achieve insofar as their annual production will never be enough to guarantee a profitable business activity. This will inevitably mean operators having to group their operations in order to reach minimum surface areas of around 30,000 ha

(this figure may vary according to the available resource and the operators). While the Forest Code has already made provisions for these groups, their operational mechanisms still need to be defined.

Furthermore, despite being grouped together, these limited surface areas would still require the adjustment of technical programmes; effectively, it would not be possible to reproduce all the solutions adopted for the management of large-scale concessions. Certain management plan parameters will always remain elusive (timber removal may not exceed the annual forest production), while it may be possible to adapt certain others, i.e. given the extremely small areas involved, cutting cycles may have to be organised differently. Besides this, the social and environmental aspects of the management plan process will probably have to be cut back to a level that is acceptable to SMFE with limited financial resources.

Two types of logging operator are currently active in the Gabonese timber sector: large companies, with foreign capital input, have their own permits. In the past, these companies also based a part of their operations on small-scale permits allocated to national operators. These days however, in order to improve their control over the forest management plan process, there is a growing trend for these large companies to focus on the quasi-exclusive operation of forest areas under their sole ownership.

Fifty-six SMFE were listed in 2001, responsible for around a third to a half of national production. These companies are often poorly informed about the new Forest Code and on recent developments in the forestry sector, which explains why, before 2005, they had taken no action to make their businesses conform with the requirements of the new Forest Code, dated December 2001, which made provision for doing away with former forest permits, and consequently integrating companies into the management process, by December 2005 at the latest.

Furthermore, these companies have poor control over their supply chain due partly to the limited area over which they have sole ownership, and also to the fact that part of their business operations has traditionally been based on working small-scale third-party permits, and another part on household permits (a practice set to be phased out by 2006). These companies therefore suffer from a significantly restricted view of the issue.

Given all the identified constraints, the project's stated five-year goal is to set up forest management plans governing 2.25 million hectares of 'small-scale permits'. The following is a list of the action directions of main concerns identified to date:

- Make sure that small-scale permit holders understand the implications of the new forest code, and also the challenges and end results of putting the resource under sustainable management planning;
- Create geo-referenced databases on the resource, actors, tracking of awareness-raising initiatives, and monitoring of the forest management process;
- Provide support to groups of small-scale permit holders in order to form CFADs (forest concession under sustainable management);
- Set up technical management routes tailored to small-scale permit holders and provide PMEF with technical support in elaborating forest management plans, and then in establishing the sustainable forest management process;
- Build up the services delivered by the *Directorate General of Water and Forests* (National Directorate of Water and Forests).

Case of Congo

A similar challenge characterises the distribution of UFAs and general involvement in the forest management approach in the Republic of Congo. This country possesses two major forest areas that cover 60% of its land, i.e. some twenty million hectares (representing a tenth of the closed tropical forest in Central Africa). Over half of these forests are exploitable, and demonstrate a strong timber species potential.

In Southern Congo, the mountainous Mayombe region and the extensive Chaillu forest together make up one set of forests covering an area of 4 million hectares, and which is characterised by the abundance of two 'flagship' species - Okoume and Limba. These are highly sought after for their technological qualities and have been exploited for over fifty years already.

The large expanses of savannah in Central Congo form a clear barrier between these forests and the country's northern forest coverage. The northern forest comprises a vast expanse of over fifteen million hectares of equatorial forest, over half of which is (nine million hectares) consists of unbroken forest on firm ground dominated by species with a high commercial value such as Sapelli, Sipo, Wenge, Padouk, etc.

There is a striking contrast between these two regions: to the north there is dense forested cover, still nearly intact, with a low population density and the presence of large-scale industrial and logging companies, while the forests to the south are occasionally over-exploited or degraded, worked by numerous logging companies of variable size and are far more densely populated. The forestry sector is equally contrasted, with the South having taken the full brunt of the Congo wars, while the vast forests of the North have remained relatively unscathed.

A few companies in Northern Congo were thus able to rapidly launch the forest management plan process as from 2000. These initiatives were very rapidly taken on in this same area with the result that at present nearly every company in Northern Congo has committed to the process. Before long, we should see the whole of this forest area under sustainable management.

The dynamic established so successfully in Northern Congo has so far mostly failed to take root in the other forest areas in the north-western, central or southern part of the country. Just one company has recently launched operations involving the forest management planning approach. None of the other logging operators, small or large, have even started similar initiatives despite operating in an area that has experienced intense logging activities over several decades already.

There is a project, funded by the *Agence Française de Développement*, which aims to develop the forest management plan process over the whole of Congo region, integrating national enterprises and smaller-scale UFAs. There again, appropriate standards, initiatives focusing on training and awareness-raising, together with financial support and motivations will have to be developed in order to encourage every actor in the Congolese forestry sector to exploit the forest under sustainable forest management plans.

PART III THE PROCESS OF DISTRIBUTING TECHNICAL AND FINANCIAL RESPONSIBILITIES BETWEEN THE PARTNERS

I.13 THE PARTNERS IN THE FOREST MANAGEMENT PLANNING PROCESS

It is now generally agreed that the key to successfully implementing a sustainable management approach in Central Africa lies in achieving a consensus between the chief partners in the region. Who are these partners?

National forestry strategies and policies may differ significantly from one country of the sub-region to another as regards the respective responsibilities (social, technical and financial) and delegations between the forest owner (generally the State) and the forest manager (concession holder).

Up to about five years ago, it seemed appropriate to devolve the role of forest manager to the owner of the forest, as is the case in Europe. Indeed, the elaboration and drafting of Forest Management Plans is usually the domain of the forest owner, i.e. the **State** as regards Central Africa, but, in contrast, the Congo Basin countries decided to delegate all or part of this responsibility to the **concession holder**, who therefore becomes the forest manager.

Logging operators are often the only companies established in the field, and the only ones able to mobilise the resources needed to perform the preliminary steps of the forest management plan, and the most qualified to define the technical and economic strategies required to exploit forest resources.

I.13.1 Forest Administrations and States

While private operators in Central Africa, in the form of concession holders, have become the key forces driving the management of the world's second largest tropical forest area, they do not act alone and are not equipped to handle every aspect of the process.

The Forest Administration maintains control over all forest activities and specifies the rules to be followed by all the actors involved; NGOs and researchers are able to take advantage of project dynamics in order to defend their interests, while efforts are made to involve local communities in the process.

As such, the Forest Administration:

- ✓ Defines national labour standards and/or validates the technical protocols proposed by concession holders for preliminary forest management plan technical studies;
- ✓ Checks and validates fieldwork by conducting its own inspections, separately from those of the concession holder;
- ✓ Examines and validates management documents;
- ✓ Checks the proper application of management documents

I.13.2 Forest concession holders

Forest concession holders are now the driving force behind the sustainable forest management plan process.

This involves:

- Complying with the legal and fiscal frameworks governing the sustainable management of national forests;
- Carrying out technical studies to prepare the way for drafting forest management plans;
- Participating in discussions on management decisions, often held at their request, and at which they are the leading source of proposals;
- Implementing all the measures set out in the Forest Management Plan under their responsibility, such as the preparation of management documents and management measures for the various series, in addition to setting up environmental and social measures.

We should nevertheless bear in mind the limits of the responsibility of private operators; while it is perfectly logical to ask them to participate in all matters relating to their own business activity, they cannot be expected to replace the State either in matters pertaining to regional development, the building of infrastructures, provision of educational facilities, healthcare, local development, or the safety of persons and property, or in supplying other actors with comprehensive knowledge of the physical and natural environment they have been granted to exploit.

I.13.3 Design Offices specialising in forest management planning

In most cases, neither the logging operator, nor the Forest Administration has all the necessary human and material resources to be able to successfully conduct a sustainable forest management process. This step takes considerable time and effort to implement, and both main partners require support from external organisations. Most of the areas under forest management planning to date were developed with support from advisory design offices specialising in forest management planning.

In addition to preparing the forest management plan, design offices also advise operators on reduced impact logging techniques, forest management affairs, social and environmental matters, legality or forest management certification, and on the setting up of sustainable management systems.

I.13.4 Non-Governmental Organisations

The number and diversity of established NGOs explain the multitude of roles they play in the management of timber producing forests. Accordingly, international NGOs have played, and continue to play an important role in lobbying States, corporations, the public and funding agencies.

In the field, NGOs specialising in forestry matters provide their technical expertise on environmental or social issues in order to support the preparation or implementation of forest management plans.

In particular, partnerships have already been organised to fight against poaching and work on wildlife management, or to provide support when drafting forest management plans, or on environmental or research topics.

I.13.5 Rural populations

A successful sustainable management approach must be grounded in extensive discussions with local communities that lead to increasingly close consultation and collaboration between these communities and the parties responsible for forest management planning. This consultative process takes the form of socio-economic surveys, with the end-result that local populations are taking an increasingly active role through NGOs. Nevertheless, it is still difficult to ensure the effective representation of every population in the forest management plan process, especially where minorities, semi-nomadic native or nomadic populations and women are concerned.

It is important that Forest Management Plans provide for setting up permanent consultation mechanisms with local populations, at varying scales (i.e. the concession, and more locally in each village territory). The best solutions for such a consultative process still have to be found.

I.13.6 Projects

While these external organisations are usually mandated by industrials to produce their forest management plan, they may also be directly mandated by the Forest Administration to work on a national forest management plan project that covers all the concessions in a given country, as is the case with the PARPAF (Support Project for Elaborating Forest Management plan Plans) in CRA.

I.13.7 Funding agencies and international organisations

Logging operators do not always have the financial means to take on the heavy financial investment required to prepare their forest management plans. Some funding agencies provide substantial and valuable support towards the forest management plan process, or advise governments on how best to define forest policies.

International organisations also encourage communication on methods and experience (ATO, ITTO, ATIBT, etc.).

I.13.8 Local administrations

The management of certain production forests may be entrusted to local communes. Currently, very few communal forests exist, and those that do are found exclusively in Cameroon, but we can nevertheless

cite the example of the Dimako communal forest management plan project. This forest model could in future be extended to cover other countries (perhaps soon in CAR).

Furthermore, it is vital that these administrations be included in discussions concerning the management planning of forest areas located on their territory; such a consultative process is already active in Congo.

I.13.9 Research centres

National or international research centres (cf. example of Gembloux University, page x) can work closely with logging operators in order to set up and monitor research programmes.

I.14 IMPLEMENTING A FOREST MANAGEMENT PLAN

I.14.1 The different steps in the process

When allocating a forest title, both parties, i.e. the State and the concession holder, which are also the main partners in the forest management plan process, sign a contract setting out their respective obligations.

These contracts (or agreements), in force in just about every Congo Basin country, now include obligations relating to the management of forest concessions (temporary agreements) and compliance with forest management plans (final agreements).

It is important that both parties comply with their obligations if this partnership is to function effectively. For example the concession holder/forest manager must comply with a forest management plan schedule that specifies technical study advancement deadlines as well as deadlines for submitting technical reports and management documents.

Each technical task required by the forest management plan process is conducted according to specifications (or a protocol). Depending on the country, these specifications are defined either by the Administration, or prepared by the forest management plan officer and then validated by the Administration.

I.14.2 A new organisational structure to be set up

For both the forest owner and the concession holder, the forest management plan process should act as a decision-making and management tool materialised by practical and realistic action programmes on social, technical and financial aspects. This process should be both relevant and functional if it is to lead to action programmes and an easily applicable funding plan.

Forest management plan and other management documents should be used as reference documents, guides and implementation tools by the forest owner and manager (State and concession holder in most cases), throughout the duration of logging operations on the concession.

The forest manager, through their management, supervisory and operational staff, should demonstrate full involvement in every aspect of the preparation and enforcement of the forest management plan process, that it should gradually make its own.

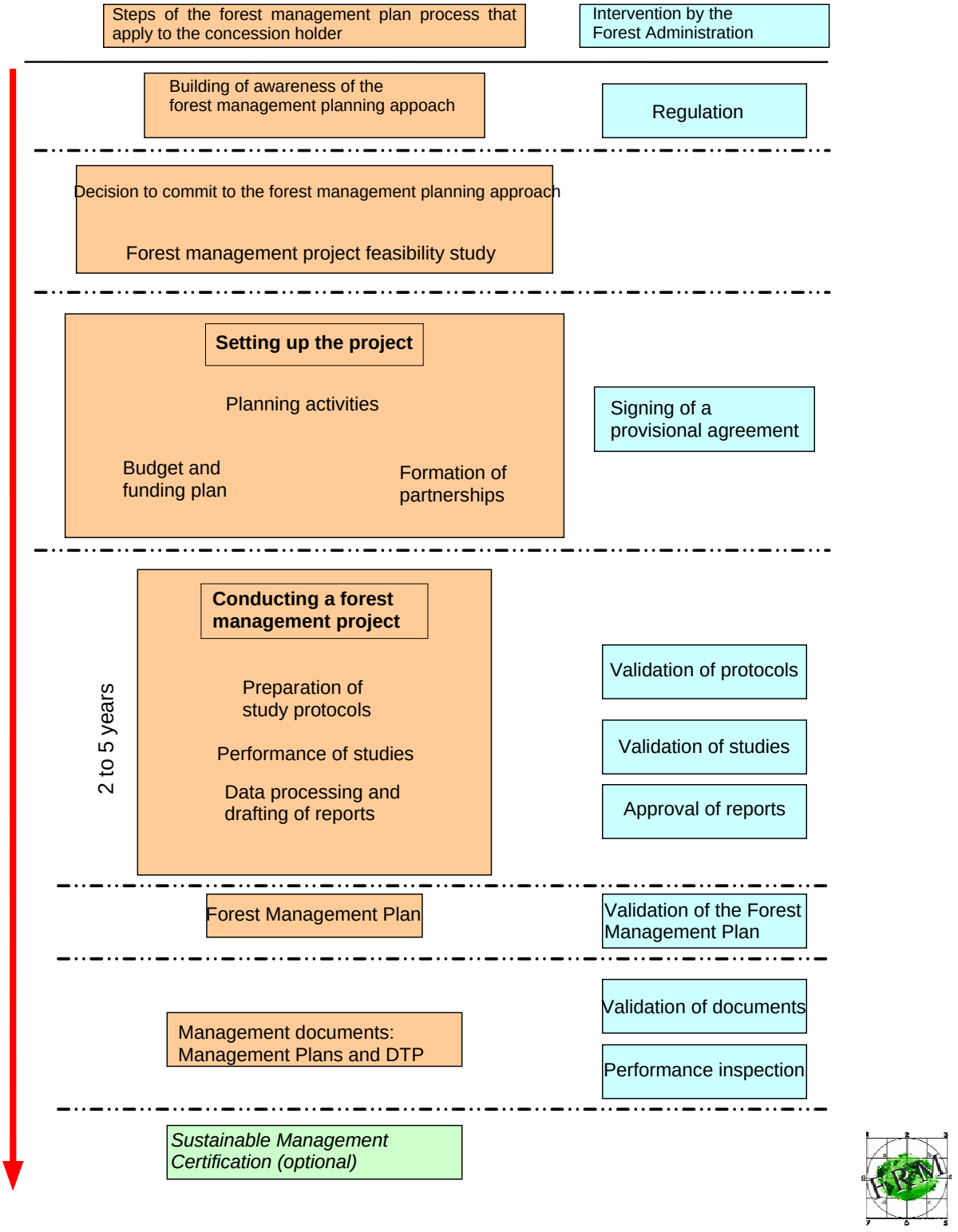
If the forest management plan is treated as just another report or document among a pile of others, drafted as part of an external expertise and left to collect dust on an office shelf, it will be of no use whatsoever. In this case, the plan would represent no more than a large financial outlay for no visible result and of absolutely no corporate value.

We have also remarked that most plans based on bilateral or international funding and elaborated by external organisations fail at the time of implementation. The decisions they contain, non-negotiated and not incorporated by the partners, end up being contested resulting in the plan being left dead in the water.

The best solution would be for the operator to create its own Forest Management planning Department at the start of the plan preparation phase. This department would then conduct or participate in all the work, depending on whether or not the plan is to be entrusted in all or in part to a specialist design office.

Trainees being formed in mapping techniques at the SFID Forest Management planning Unit in Mbang – Cameroon
© Jean-François CHEVALIER

CFT Forest Management planning Unit in Kisangani - DRC © Jérôme CHABBERT



The Forest Management Plan Implementation Process as applied to a Forest Concession

I.14.3 Table of the distribution of technical and financial responsibilities between partners

Table of the distribution of financial responsibilities between partners

Topic	Action Programme	Technical Responsibility						Funding			
		Owner (State)	Company* 1	Company* 2	Company* 3	Research - Development	Populations	Company* 1	Company* 2	Company* 3	State Funding agencies NGOs
Knowledge of the forest and its environment	Preparing the forest management plan										
	Analysis of the physical environment										
Mapping, photo-interpretation and stratification of the forest area	History of activities carried out on the forest area to be developed										
	Definition of mapping procedures Acquisition of existing documents (maps, aerial photographs, satellite images)										
	Establishment of basic cartography (topography, hydrography, roads)										
	Acquisition of new photographic or satellite data										
	Constitution of a georeferenced database on the concession (using GIS)										
	Stratification of ground occupation over the forest area										
Forest development inventory	Production of maps included in the Forest Management Plan										
	Preparation of procedures and specifications										
	Preparation of sampling plans										
	Performance of preliminary management plan inventories Performance of the management plan inventory: inventory of the timber resource										
	Data entry and processing Performance of the inventory, data entry and processing: wildlife inventory, NTFR and regeneration surveys										
Analysis of the socio-economic environment	Drafting of a management plan inventory report										
	Preparation of the socio-economic diagnostic protocol										
	Performance of field surveys Data analysis - thinking on the social strategies of the Forest Management Plan										
Supporting studies	Drafting of the socio-economic diagnostic report										
	Preparation of the protocols Performance of dendrometric survey reports (volume tables										
	verification study)										
	Field surveys for Dendrometric studies Preparation of volume tables tailored to the concession or to a coherent										
	set of concessions Determination of sampling and marketing rates										
	Setting up of a streamlined mechanism for monitoring changes in harvested stands: network of permanent sampling parcels										
	Performance of occasional studies on the regeneration and phenology of the main commercial species, on annual growth (growth ring studies), harvesting and marketing sectors for non-timber forest products.										
Management and conservation of biodiversity											
	Study of the environmental impact of logging activities										
	Assessment report on the concession's biodiversity status Preparation of a programme of management and conservation measures										

Drafting the forest management plan	Allocation of land: setting of the concession's definitive boundaries, demarcation of series and definition of the objectives for each series											
	Modelling of stand dynamics (regeneration)											
	Setting of management plan parameters for the timber production series											
	Planning of harvest, logging parcels and harvest forecasts											
	Management measures for the production series, RIL measures in particular											
	Environmental measures, in particular for wildlife management											
	Management measures for the other series											
	Strategies for industrialisation and improved valorisation of the resource											
	Preparation of the social programme for workers and their families											
	Preparation of the social programme for local populations											
	Measures for monitoring and evaluating the forest management plan											
Implementing the Forest Management Plan												
Timber production section	Physical demarcation of the permit and forest parcels											
	Operational inventory											
	Short and medium term management documents											
	Industrialisation measures											
Social section	Social measures for workers and their families											
	Social measures for local populations (development)											
	Setting up of a consultative framework											
	Setting up of the management of agricultural series											
Environment section	RIL measures											
	Management and conservation measures on the protection and conservation series											
	Implementation of the wildlife management programme - part concerning local populations											
	Implementation of the wildlife management programme - part concerning eligible parties											
Research & Development section	System for monitoring forest stand dynamics											
	Silvicultural studies and improvements of RIL techniques											
	Phenology studies											
	Best characterisation of conservation and protection series											
	Measures governing the monitoring and evaluation of the wildlife management programme, in particular the monitoring of large mammal populations											

Integration of skills and know-how concerning sustainable forest management											
Training	Training of staff who will conduct the management plan inventory - timber resource inventory										
	Training of staff who will conduct the management plan inventory - wildlife inventory, NTFP surveys, regeneration surveys										
	Training of staff who will conduct supporting studies (varies depending on the study involved (see above)										
	Training of staff who will conduct the social section										
	Training in GIS and mapping techniques										
	Training of the staff responsible for the wildlife management programme										
	Training of supervisory staff in forest management planning and sustainable forest management										
	Transfer of know-how to the Forest Administration										
	Training in RIL techniques										
Corporate organisation, planning and management	Setting up of a Management planning Unit										
	Development and installation of sustainable forest management support software (GIS, database)										
	Definition of corporate organisation for the preparation and implementation of the forest management plan process										
	Internal monitoring and evaluation of the application of the development plan										
	Monitoring and evaluation by the Administration of the application of the Forest management plan										
	Measures targeting enhanced valorisation of the resource										
	Setting up of a traceability system										
	Deliverance of the sustainable management certificate(s) (optional)										

Key	
Technical responsibility, in the company column, meaning of the figures	
1	Full company responsibility
2	Partial company responsibility
3	No company responsibility
Funding, in the company column, meaning of the figures	
1	The company funds the whole cost, by self-financing or by taking out a loan
2	The company funds the whole cost, additional funding (donation or subsidy) to be found
3	Funding external to the company, which may possibly contribute on a case-by-case basis by providing its logistics or infrastructures, the company invoices its intervention
Funding, in the "State, Funding Agencies, NGO column", meaning of the colours	
	in the form of a donation
	in the form of a loan

Conclusion

The reader of this study, the first version of which was ordered by the **Fondation Européenne pour la Préservation des Ressources de la Forêt Africaine, and funded by the MAE and the FFEM,** will have noticed its aim to provide **an ambitious approach to the issue of sustainable forest management, while also remaining sufficiently practical and realistic to ensure it is both operational and applicable within the African context.**

There is nothing especially innovative in this report, which was mainly produced based on the contributions and writings of all those who, over the last 20 years or so, have actively driven thinking on the techniques and conditions necessary to the design and implementation of the forest management planning and sustainable management approaches.

This study is none other than a **working document, a technical tool** that allows economic operators to better perceive and understand the process, the challenges and the constraints of the sustainable management process that they are now ready and willing to promote.

The content of this report forms one component of the three-part work, "Forest Production", "Social Aspects" and "Wildlife Aspects", which together make up the main sections of the sustainable forest management plan process in Tropical Africa.

The **forest management plan** is a **mandatory step, a legal requirement** of all countries in the Congo Basin. It is the cornerstone of the sustainable management approach.

It enables companies to work towards the certification of their production. **The preparation of a forest management plan, however, is just one of the necessary steps of the certification process, and is not sufficient in itself. Above all, it has to be deployed in the field and its requirements and directives have to be enforced.**

This commitment to sustainable management can be monitored and evaluated using sustainable management Principles, Criteria and Indicators. These are used to evaluate a company's level of sustainable management in relation to one or several certification guidelines of its own choice. It is therefore entirely up to the company to decide whether or not it wishes to commit to certification, in other words, certification is in no way a legal requirement.

While there can be sustainable forest management planning without certification, there can never be certification without sustainable forest management.

The decision of industrials to commit to sustainable management is not entirely selfless. The process involves major and numerous benefits and constraints, the main ones being:

- **Guarantee of the company's long-term total or partial supply** via large concessions allocated over long time periods, generally renewable once or several times;
- **Enhanced medium to long-term vision and management** of the company's commercial future, thus making it easier to build the investment strategy;
- **Planning of harvesting operations** based on forest management planning and operational inventories;
- **Planning of the industrial tool** and enhanced valorisation of the forest resource, in particular where secondary species are concerned;
- **Boosting of company productivity** by optimising management and harvesting techniques, which impact positively on cost prices and **improve forest valorisation**;
- **Improved protection of the forest in the most general sense**, i.e. concerning its social, wildlife and plant diversity;
- **Improvement of living and working conditions for company staff**, resulting in a more stable workforce which can then be trained in sustainable management techniques;
- **Better social environment and improved relations** with local populations living in or around the developed concession.

The Forest Management Plan provides logging operators with a highly effective tool for managing their forest area and resources, a tool on which it can base its efforts for many years, guiding its decisions in terms of investments, development and the search for new markets.

All these benefits require a correspondingly high input from the company, which also faces several constraints:

- Firstly, the company as a whole has to **adapt itself technically, socially and financially** to the new methods and patterns of behaviour that are a direct result of the forest management plan;
- The company has to **agree to the large initial investment** involved in preparing the forest management plan;
- The **ban on reharvesting** before the end of the rotation period in annual allowable cuts that have already been harvested forces companies to improve the optimisation of timber removal in line with market demand for the 2 to 3 years the parcels are open, with the risk of not being able to harvest the total marketable volume;
- Compliance with MCDs is not a new restriction as this has been covered by all forestry legislation for many years now, and is effectively enforced. Conversely, while MCDs have been determined in order to respect the regeneration of some species, the **determination of Minimum Forest Development Diameters**, which occasionally exceed MCDs, may penalise operators by reducing the harvestable volume of these same species;
- **Tying production levels to the forest area's annual allowable cut** will restrict the operator's usual freedom of movement to respond to greater market demand;
- The zoning of conservation series coupled with new operational constraints in steeply sloping zones and zones near rivers or streams can reduce surface area, and thus harvestable volumes. Setting aside seed-bearers or resource trees has the same effect.

We are now in 2007, and the ambitious goal set by the International Tropical Timber Organisation - to be producing timber taken solely from sustainably managed forests by 2000 - is still in its early stages, at least as far as Central Africa is concerned. The last five years, however, have nevertheless seen a major evolution in the approach to forest management. When revising this management planning manual towards the end of 2006, nearly 30 million hectares of dense forest were under forest management plan, over 20% of which (7.4 million hectares) boasted a forest management plan approved by the Administration. This proves that the process is well under way. This means there will be a total of some 50 million hectares of forest under forest management planning within the next few years, within a forest area estimated to cover 150 million hectares in the Congo Basin.

It has to be admitted that to date, the major forest operators, mostly funded by foreign capital, are the only actors to have initiated the process. There are a number of initiatives underway, which benefit from the financial backing of the AFD (Agence Française de Développement) and the FFEM (Fonds Français pour l'Environnement Mondial), and are aimed at bringing SMFEs into the forest management plan process. The next few years will therefore be crucial as the forest management planning approach cannot be extended unless the appropriate financial and technical solutions are found, in order to ensure all the actors in the timber sector are brought into the process.

To sum up, the forest development process can only succeed if logging operators make a firm commitment to design and implement development plans, and above all, **to use these plans as a strategic tool** for developing their future success as an industrial and a forestry operator.

The forest management plan will actively drive the sustainable management process and be a source of hope providing that States demonstrate a firm commitment to:

- Making the sustainable management of their forest heritage a national priority;
- Setting up an adapted tax mechanism that takes account of management planning costs for companies that have decided to sign up to the environmental respect process, thereby encouraging all the other companies in the sector to join them;
- Penalising all those who fail to comply with national legislation or regulations governing sustainable management of the forest resource by withdrawing allocation rights and placing a ban on timber removal.

Central African States have sent a strong signal of their commitment to achieving the sustainable management of their ecosystems in the form of the recent changes to forest codes and taxation in several Congo Basin countries, together with the gradual establishment of harmonised legislation and policy decisions concerning sustainable forest management as part of the COMIFAC convergence plan.

Industrials will only genuinely commit to sustainable forest management provided that:

- They have complete confidence in the relevant countries' political, economic and technical (national infrastructures)

Monitoring the implementation of a forest management plan
© Benoît DEMARQUEZ

background, and they are convinced that the States are politically and financially committed to the sustainable management approach;

- At the same time, all the funding agencies, bilateral and international organisations, development banks, and international NGOs also demonstrate their firm commitment alongside the States and logging operators, providing them with vital technical support and funding.

Forest certification remains one of the keystone reasons for companies to agree to commit to a costly and lengthy process. For major companies working to an approved forest management plan, certification should be a priority over the next few years, whatever system(s) the companies have chosen to adopt. The development of the PAFC national certification system (including PAFC-Gabon which is the first section of the development of this system in other ATO countries), proves that there is both a demand for certified products, and a firm commitment on the part of some companies to have their timber production certified.

However, certification will only spread if all the actors in the timber sector opt into the sustainable management process: this does not concern just logging operators. Industrials, traders, industrials working in the primary or secondary timber processing sector, etc. and also end consumers must show a willingness to promote this process, and sometimes to pay the price of a responsible and sustainable management approach.

From logging operators to forest managers, a deep-rooted change is transforming the forestry profession in the Congo Basin

As has been explained in this document, becoming a forest manager and management plan officer involves a significant transformation of the logging operator's profession. It is no longer just a question of harvesting, marketing and/or processing logs. The social and environmental aspects become one of the forest manager's activities in their own right. All decisions must be taken jointly by the different partners, planned and well thought-out in terms of the possible social or environmental impacts that they might generate.

Being a forestry operator and management plan officer also requires companies to have qualified staff to manage the social programme, monitor forest management plan activities, the reduced impact logging programme, environmental impacts, and so on. The commitment towards certification is set to become even more stringent with analysis reports, impact measures and monitoring, etc. The preparation of a forest management plan is just one of the steps in the process, which may require back-up from an external organisation. Skilled staff, the cornerstone of any successful management plan process, are unfortunately not always available, especially given that this is a recent profession which still has to get established "in the bush".

Training is a vital step in the successful implementation and proper application of forest management plans; ATIBT has responded to this challenge by organising a set of forest management planning courses. This initiative will be repeated and extended to cover all disciplines and levels of qualification, to ensure that every logging operator is able to find the qualified human resources vital to the successful outcome of its sustainable management programme.

The other challenges are of a financial nature; preparing a forest management plan involves a major financial investment coupled with a costly implementation phase. This is a permanent expense that companies have to factor in to their accounts. A sustainably managed company is more expensive to run than its more informal counterparts, even if there are long-term gains to be had from the initial investment, if only because it ensures the company's long-term survival. Unfortunately, at the time of drafting this document, it is still more advantageous to sell uncertified logs from non-managed forests,

rather than products processed in the producing countries, and stamped with a logo proving its sustainable management status. It is time for this situation to change.

It is absolutely essential that all partners in the sustainable forest management process, including both NGOs and funding agencies, recognise the considerable efforts and progress made. The Administrations should do everything in their power to ensure that all the relevant actors effectively apply the new sustainable management policies.

Lastly, recognition by international markets would facilitate the promotion of products from a legally harvested resource. Certification must also open up new market possibilities, and generate added value on the products sold, in order to persuade companies to invest in a sustainable management approach.

Above all, the key to successful sustainable forest management planning hinges on the willingness of corporate executives to commit to the process: in future, all corporate policies need to be built around the concept of sustainable management. This is a pivotal condition for the success of the sustainable management approach.

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Annexes and tables

Annex 1 : Définitions

Series:

A group of areas belonging to a forest concession assigned to the same purpose and subject to the same processing procedures.

Example: timber producing series, protection series, conservation series, agricultural series, research series, etc.

MCD:

Minimum Cutting Diameter: minimum diameter, taken at a height of 1.30 metres or above the buttresses if these rise to above 1.30 metres, used as a basis for felling authorisations; the Forest Administration sets the MCDs for each species.

MCD or DME/AME:

Minimum Cutting Diameter for a tree set by the Forest Management Plan. These are determined in order to guarantee the sustainability of the forest resource based on a fixed rotation period.

Rotation:

Period set by the Forest Management Plan to allow forestry operators to exploit the whole timber production series, so as to guarantee the long-term survival of the forest and its diverse functions.

Annual allowable cut:

Maximum quantity of timber that can be regularly removed from a stand without reducing the environment's productive capacity. This also means the average quantity of harvestable timber per hectare.

Regeneration index:

Indicator evaluating the potential harvestable resource (in number of stems or in volume) for a 2nd rotation period (cutting cycle) against the actual resource harvested during the 1st rotation period.

Multi-annual logging blocks:

Logging parcels defined by the Forest Management Plan so as to ensure an equivalent annual production. Depending on the country, they are variously referred to as "Forest Production Units" or "Forest Management Units" or as "Five-year blocks".

Annex 2 : Forest Management Plan Template

(as per forest management directives in the Republic of Congo)

•Introduction:

- International, sub-regional, national and local context
- Stated objective of the forest management plan
- Partners of the forest management plan
- Organisation of the forest management plan

Title 1: General overview:

1.1. Institutional framework

1.2. Legal framework

1.3. Presentation of the company

Title 2: Presentation of the UFA and its environment:

2.1. History

2.2. Location, surface area and description of geographic boundaries

2.3. Administrative and legal status

2.4. Ecological factors

- Climate
- Geology and Pedology
- Topography
- Hydrography
- Vegetation (forest and non-forest formations)
- Wildlife

2.5. Human populations

- Demographic features
- Description of the population
- Mobility and migration
- Land ownership status
- Customary features or social structure
- Development organisations and Common Initiative Groups (CIG)

2.6. Communication networks and infrastructures

- Airline services
- Road network
- River and rail networks
- Educational, healthcare and misc. infrastructures

2.7. Economic activities

- Population activities:

  * Forest-related activities
  * Farming
  * Fishing

* Hunting

* Livestock breeding

* Handicrafts

* Gathering or use of non-timber forest products (NTFP)

* Minor retail (forest products)

- Corporate activities:

* Logging and forest industry

* Mining

* Agro-industry

* Industrial fishing

* Tourism and ecotourism

* Trade and other industries

Title 3: Analysis of studies and work performed

3.1. Stratification and mapping

3.2. Multi-resource inventories

3.3. Socio-economic and anthropological studies

3.4. Environmental impact studies

3.5. Forest management decisions on the various series

Title 4: Forest management measures

4.1. Choice of objectives

4.2. Breakdown into management series

4.3. Enforcement period of the forest management plan

4.4. Forest management decisions on the various series

Title 5: The forest management plan measures governing the management series

5.1. Production series

5.2. Conservation series

5.3. Protection series

5.4. Community and agro-forestry series

5.5. Research series

5.6. Other series

Title 6: Wildlife management

6.1. Objectives

6.2. Review of hunting legislation and regulations

6.3. Management programme

Title 7: Social aspects

7.1. Organisational and institutional framework

7.2. Local community use of forest resources

7.3. Type of conflicts that can arise in response to the management of natural resources

7.4. Participatory management plan

7.5. Healthcare and education

7.6. Jobs and training

7.7. Food safety

7.8. Improvement of living conditions

Title 8: Implementation, monitoring and evaluation of the forest management plan

8.1. Functional organisation

8.2. Enforcement of the forest management process

8.3. Control of the enforcement of management measures

8.4. Audits

8.5. Forest management plan review.

Title 9: Economic and financial assessment

9.1. Cost of elaborating the forest management plan

9.2. Cost of implementing the forest management plan

9.3. State revenues.

CONCLUSION

Annex 3 : Management Plan Template

INTRODUCTION

Chapter I - General framework

Presentation of the company

Presentation of the concession

Presentation of the Forest Management Unit

Chapter II - Review of forest management objectives

II.1 - Sustainable timber production objectives

II.2 - Industrial objectives

II.3 - Socio-economic objectives

II.4 - Environmental objectives

II.5 - Research & Management objectives

Chapter III - Description and location of the Forest Management Unit

III.1 - Forest stands and stratification within the Forest Management Unit

III.2 - Summary of results of the forest management inventory conducted within the Forest Management Unit

III.3 - Forest management series within the Forest Management Unit

Chapter IV - Implementing the forest management process within the Forest Management Unit

IV.1 - Forest management parameters

IV.2 - Average marketable annual allowable cut for the Forest Management Unit

IV.3 - Establishing forest management parcels

IV.4 - Management rules

IV.4.1 - Demarcating the Forest Management Unit

IV.4.2 - Operational inventory

IV.4.3 - Rules governing logging operations

IV.4.6 - Staff management programme

IV.4.7 - Social programme

IV.4.8 - Training & awareness-raising programme

IV.4.9 - Wildlife management programme

IV.4.10 - Environmental programme

IV.4.11 - Research & Management programme

IV.5 - Measures governing the monitoring and evaluation of the forest management process

IV.6 - Forecast activity time chart

NOTES

Practical forest development plan for natural tropical African production forests

Volume one : Forest production

Study coordinated by the ATIBT commission I-Forest and the former commission chairman Mr Jean Estève

This technical publication financed by the European Foundation for the Preservation of the African Forest and the French Ministry of Foreign Affairs, is a realistic and applicable common denominator, both technically and financially, for the whole of the different forest zones, regions and the large variety of enterprises in the Congo Basin.

Its objective is to examine the diverse phases and actions that are indispensable for the preparation of a practical forest development plan, a fundamental instrument for implementing in place sustainable management practices within the tropical forests.

Recall that the development of a production forest has as its main vocation the balanced, and durable harvesting of forest products from a programmed and planned exploitation, located on a permanent forest massif, that at the same time assures the maintenance of the patrimony and the social and environmental functions of the forest.

The forest development plan is also the result of a process of dialogue and arbitrage amongst different partners, between which the obtaining of a consensus is necessary. Finally, the forest development plan is also a reference and management tool that fixes a medium term programme of action for social, technical and financial plans.

This publication falls into three large chapters that examine successively :

- a reminder of the different approaches and concepts of sustainable management and forest development;
- the definition of the content of a forest development plan : analysis of the forest massif and its environment, knowledge of the resource (cartography and forest development plan inventory), application, monitoring and control;
- the repartition of the technical and financial responsibilities between the different partners (concessionaire, State, populations, donors…).
- the study concludes by a presentation of a framework for both a forest development and management plan.

This study is to be followed by a second publication that will address the specific social and wildlife requirements that need to be taken into consideration when drafting a forest development plan.

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