Forest Management Related Studies of the Tropenbos-Cameroon Programme

Papers presented at a
joint WAU-Tropenbos workshop
held in Wageningen,
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Wageningen Agricultural University

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PREFACE

In its capacity of Dutch main implementing agency of the Tropenbos-Cameroon Programme (TCP), Wageningen Agricultural University felt the need to review the relevance of the Dutch contributions to the Programme for forest management planning on a sustainable basis. With this in mind, an internal workshop was organised on 1 October 1998. Those TCP researchers who were finalising their research in The Netherlands presented their work to members of the Board and Programme Advisory Committee of Tropenbos, to TCP researchers and supervisors and to scientists of other Tropenbos sites.

The workshop does not provide a complete overview of the TCP research, as financial means did not permit the university to invite the TCP researchers residing in Cameroon to participate in the workshop and to report on their research. In spite of this limitation, the organisers felt that the various presentations deserve a wider audience than the one present at the workshop, and decided to publish proceedings of the workshop in the present document.

Wageningen, February 1999

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CONTENTS:

FOREST MANAGEMENT PLANS; WHAT ARE THEY ABOUT?

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1 BACKGROUND

Tropenbos was asked to give a general introduction on Forest Management Plans (FMP). Since a long time we felt is was important to draft a Tropenbos paper on this subject, because of our involvement in discussions on sustainable forest management, criteria and indicators for sustainable forest management and our obligation to produce an FMP for the Tropenbos-Cameroon Programme (TCP) and the Campo Ma'an project. It becomes more and more clear that confusion exists about the concept and contents of FMP and Tropenbos could fulfil a role in the clarification of the concepts and work out a methodology for the preparation of an integrated FMP, enriched by practical experience, as gained in the TCP.

The invitation to give this presentation motivated us to put this slumbering idea into practice and actively start with the subject. But this also means that, contrary to the other presentations of today, we are in the starting phase. This presentation reflects the results of a first literature search, discussions between Tropenbos staff, and common sense. Many ideas are derived from the lecture note of Filius (1998) of the Sub-Department of Forestry of the Wageningen Agricultural University (WAU).

This paper should be seen as a base for further discussion, and we hope and expect an input from persons having experience, both theoretically and practically, with this subject. Many of the participants of this seminar can be seen as resources person and this seminar provides the possibility to listen to the experiences gained within the TCP and match them with those of other participants.

The major part of this paper deals with the objectives, contents and components of an FMP. Then we will touch upon pitfalls that hamper the preparation and implementation of FMPs and finally we will elaborate upon the role of research in this process. We will not go into detail on sustainable forest management (SFM) and the related issue of criteria and indicators (C&I). However, many of the remarks given in this paper can be translated into essential criteria for SFM.

In the starting phase of this study, more questions come forward than answers can be given. Questions will be a recurring factor in this presentation. Take the title, 'Forest management plan', what does it tell?

- *'Forest'* is the object of study. At first sight, it seems simple, but Lund (1998) found a total of 61 different definitions in which forest is defined as an administrative unit, land cover or land use.
- *'Management'* can be associated with the manner of directing or using anything, in our case forests. It is oriented towards decision-making. But who will take what decision? And, what is a decision?

- *'Planning'* is a procedure that is expected to lead to a desired result. It is a preparation of future decisions. This implies that it is future-oriented and based on assumptions. But from which perspective is an FMP prepared?

The intriguing question is how to integrate these three aspects, forests, management and planning.

2. WHAT, WHY, WHO, WHERE, WHEN, HOW.

2.1 What is a forest management plan?

As mentioned before, the concept of what FMPs are differs among the people working with the concept.

A working definition used in this paper is:

> *A Forest Management Plan is the description of the decisions and activities to produce the anticipated objective(s) with regard to the use and conservation of forests in an area.*

Three main sets of forest management objectives can be distinguished:

Protection and conservation

To keep the forest as it is because of its intrinsic value. These values are, though difficult to quantify, essential to the functioning of a forest ecosystem or its environment, such as biological diversity, living space of indigenous people and wildlife, preservation of species or gene pool, soil fertility and erosion prevention, regulation of watershed and climate.

Production

To manage the forest as a source of raw material either in a sustainable or non sustainable way.

Conversion

To remove the trees and use the soil or land for other purposes.

(adapted from Poore and Sayer, 1991)

For planning purposes, these major objectives have to be elaborated into land utilization types.

An FMP can only be seen as an useful tool when forests play a significant role in the future of the management area. In this paper we will focus on production forest, although protection and conservation, production and conversion are often unified in the same area.

Poore and Sayer (1991) summarize some crucial points to be considered for each set of objectives:

- Are the proposed land uses in practical terms irreversible? Is one of the functions of the natural vegetation damaged? *(When affirmative, protection objectives are difficult if not impossible to match).*
- Does the proposed management option remove a significant part of a country's natural or cultural heritage? *(When affirmative, conservation objectives can't be reached)*
- Is the forest use sustainable, in such a way that the function for which it is maintained, can be sustained in the long term? *(When negative, sustainable production objectives can't be reached)*

- Will the potential future benefits of the forests, and future costs incurred for land restoration or social support to affected communities, be likely to exceed the benefits derived by forest conversion? *(When affirmative, conversion can not be considered a viable management objective)*

Figure 1 Relationship between strategic, tactical and operational planning (Bos, 1994)

Part of the confusion on FMPs is caused by the different levels of planning. In the lecture note of Filius, strategic, tactical and operational planning are distinguished (fig. 1).

Strategic planning is the highest level of abstraction. Decisions on the allocation of functions should be taken. Objectives of the main stakeholder(s) are the point of departure and only the direction of development and the way this will be implemented are described. This is the most important and difficult level of planning, because no higher level of planning exists on which we can rely. Other levels of planning are derived from this general level. Despite its high level of abstraction, efforts should be made to formulate the objectives and strategies in a clear way. Vagueness and over-generalization must be prevented.

Land use planning is the most important aspect of strategic planning. Societal needs, economic and political forces, current land use, land qualities and location of the land determine whether the land is allocated to forestry. Next, the different uses of the forest are to be attuned to the needs of the society. Here, the first question is, what *can* be done with the forest (options; land evaluation) and, furthermore, what *will* be done with the forest (choice; land use planning). Finally, it has to be worked out how the change from the current state of forest into the desired one can be achieved (method). The latter is a check whether the chosen objectives are feasible.

Tactical planning describes management activities and also deals with the implementation of these activities. It focuses on decisions regarding the scheduling of activities. The tactical plan is derived from the foregoing strategic plan.

Operational planning is focused on the execution of management activities. This plan has to be tuned to the tactical plan. Operational planning also includes budgeting.

In FMPs, the hierarchy within one level, but also between the three levels, should be clearly elaborated. The detail of elaboration depends on the final goal of the FMP. To make sure that the concept of Forest Management Plans is properly used and well implemented, answers must be given to the questions 'by whom and for whom the FMP will be prepared; which area is included; for how long is it valid?'. These will be addressed in the following part of this presentation.

As can be learnt from the above, the objective (or desirable condition) takes a crucial position in strategic planning and, hence, also in other levels of planning. For TCP, the management of the natural forest is directed at the sustainable production of timber and other products and services within limits that are ecologically sound, socially acceptable and economically viable.

2.2 Why should an FMP be prepared?

Planning is a tool to identify the optimum use of the land, in which demand and supply are adjusted to each other. It gives control over the development of an area and is a means to reach the objectives. Decisions that influence the future (in either a positive or a negative sense) are to be considered, alternatives to overcome current and future problems can be worked out and it gives the possibility to anticipate possible changes. The preparation of an FMP can also be an obligation, e.g. to become a concession or to be certified.

2.3 Who are involved in FMP?

This question can be broken down into several sub-questions. Who are the stakeholders, who owns; who uses?; for whom, with whom and by whom is the FMP being prepared; who is responsible for the implementation?

National and regional governments, concession holders and the local community all have their own interests. As explained in the foregoing, objectives are set in the strategic planning phase and these objectives play a crucial role in the planning process and the final result. But whose (stated or unstated) objectives are these? And, coming back to the 'future desired forest', whose desires are these? How can this be combined in one FMP?

Identification of the stakeholders is of importance but also the question 'who represents the stakeholder?'. How are the stakeholders organized to bring forward their interest? It is essential that the 'voice' of all stakeholders is included in the plan, which will improve the quality of the plan. Participation of all stakeholders from the onset is necessary to achieve commitment to the plan and increase the possibility that the proposed actions will be implemented. I would like to mention that consultation, which is often practised, is not the equivalent of active participation, or even collaborative decision-making. Negotiation will often be the most appropriate way of decision making.

Who gives commission to prepare the FMP and who will have the task to write it? If an FMP is prepared on behalf of one stakeholder, which is often the case, the final product will have a strong bias to the objective of this stakeholder.

As forest management, as intended by the TCP, should include 'social acceptance', much attention should be paid to this aspect. It plays a crucial role in strategic planning.

2.4 Where (space)

The exact location and size of the management area has to be determined, and the distribution of the various land uses within the area has to be described. The size should be large enough to meet the objectives. Consensus should be reached on the boundaries of the management area and between different zones within the area. When boundaries have been set by land allocation in the past, the current boundaries ought to be studied critically. If no boundaries have been set, these should be considered from the onset. Attention should especially be given to boundaries between different land uses as these are often causes of conflict.

As activities in one part of the area may influence other parts of the area, the management plan should focus on the area as a whole, and should also take into account the surrounding areas, as they may influence or be influenced by the management as well. There are several ways to distinguish a management area as a whole, e.g. administratively, ecologically, socially, economically or juridically. Often one looks to the management area in an administrative way, e.g. within administrative boundaries such as local or regional governing authorities. Within ecology, watersheds are often seen as an entity for management. Sociologically or anthropologically, an entity depends on the boundaries of local population groups, either indigenous or immigrants or a combination of the two. Economic entities could be defined along trade patterns and markets, but this will be complex when markets overlap each other and patterns become complicated. Special attention ought to be paid to all kind of entitlements (including those beyond legal jurisdiction) as often different stakeholders lay claim to the same resources.

It is of importance to give consideration to the influence of different scales. At national level (small scale), large areas will be set aside for forestry purposes. But at a larger scale, e.g. at concession level, this forest area falls apart into forest and non-forest land. A more detailed zoning plan should be elaborated.

2.5 When (time)

Preceding newly initiated changes in objectives, an FMP should be drafted. This can, partly or entirely, be well in advance of the real changes. The preparation can also be a prerequisite before e.g. a concession can be obtained. This implies that an FMP has to be prepared before the forest can be exploited.

By nature, changes in forests have a long-term effect and can only be measured after considerable time. A time span of 20-30 years is not exceptional within the forestry sector. Hence, strategic plans must be developed that comprise information of an indefinite character and decisions with 'calculable' consequences. These plans should not have a static character but should allow adaptation due to changing circumstances and new insights. Tactical planning is of a medium-term character, while operational planning deals with short-term planning.

2.6 How should an FMP be prepared?

In the preparation of an FMP, the points discussed so far should be taken into consideration, supported with viable information.
It has to be clear which information is essential. The kind and required detail of information depends on the management objective. Does it already exists, is it accurate and reliable or does it need to be gathered (how and when?). A minimum set of information is needed for each FMP.

Planning is a phased process that is liable to change during the preparation and implementation of an FMP. Continuous feed-back is an essential part of an FMP. The major trigger to the feed-back will be changed circumstances and new information. Hence, each FMP should include a proper monitoring and evaluation system. This is of utmost importance to control the implementation and anticipate changes. It can be used as a steering instrument.

In the discussion of (the assessment of) sustainable forest management and certification, criteria and indicators (C&I) play an important role. Criteria and indicators are a tool to promote sustainable forest management, a basis for monitoring and reporting or a reference for assessment of actual forest management (Lammerts van Bueren and Blom, 1997). The latest sets of C&I are important tools to assess SFM and are to be included in the elaboration of FMPs.

3 CONTENTS OF AN FMP

The objective and the steps to reach this objective are, together with a description of the area, the core of an FMP. The descriptive part contains bio-physical, social, economic, juridical and management data. Many different FMPs are written, each with a different contents. It is impossible, and possibly also undesirable, to draft a blue-print for the contents of an FMP.

An FMP:
- justifies the establishment of a management plan
- describes the management area;
- includes an inventory of the resource base, actors and their objectives;
- provides an evaluation of forest use options (objectives) and resource capacities;
- states objectives in order of priority;
- describes the forest management practices and activities that best meet the management objectives;
- includes a mechanism to respond to changing circumstances and insights.
  (Adapted from Government of the State of Sabah, n.y.; Wiersum,1997; and FAO, 1993).

What can be attempted, and we intend to work this out, is drawing up a matrix that includes the different planning phases, the different subjects that are to be tackled and the major objectives.

A complete FMP should pay attention to all aspects put forward in figure 1, from the decision on the kind of land use to the decisions on the execution of management activities. The topics that are dealt with strongly depend on the objective of the plan.

4 MAJOR PITFALLS

A large part of the plans are not used or used incorrectly and lack therefore the impact that was intended. In order to enlarge the impact of forest management plans it is important to consider the pitfalls of FMP preparation and implementation.

Contents
First of all, a sound FMP should be simple, compact, flexible (to adapt to changing circumstances or insights) and realistic (objectives, time, costs etc).

Commitment
As mentioned before, commitment of and agreement between the different groups of stakeholders is of utmost importance. Commitment can only be obtained if the stakeholders participate from the onset, and clearly see the benefits. Also, the final product should be a product of negotiation and be visible to a wide public.
Confidence
Hidden objectives and a lack of transparency hamper the confidence in the plan. Confidence will also be lost when it proves that the assumptions that underlie the plan are incorrect and the plan has to be adjusted continuously, making the profits lower than expected.

5 ROLE OF RESEARCH AND RESEARCHERS

A good FMP needs to be based on sufficient, reliable information. The better the information is, the better decisions can be taken. However, data collection should be limited to information that has a clear relationship with the objective. Research must provide the information on which decisions are to be based.

Distinction can be made between concrete data, relations between data and modelling (where data and relations are put together). Research provides basic data, but may also give insight on alternatives. Of course, research plays an important role in the monitoring and evaluation process.
Major impact of research will be on strategic or tactical planning. It may assist in limiting the number of alternatives.

Involvement of researchers in the development of an FMP has several advantages:

1. They are able to produce sound, scientific information on which decisions can be built;
2. They are able to develop methods, models and scenarios which allow to think ahead a few steps;
3. They are able to review the current FMPs in a critical way and come up with new (creative) approaches;
4. They are able to prepare an objective basis for an FMP with an unbiased view.

In the next presentations, the contribution of each project to an FMP will be elaborated. I expect that the scheme presented will enable us to categorize these contributions and gives insight into possible gaps.

I hope that the contributions of each project to the development of an FMP will be made as explicit as possible and that comparative and contradictory results between the projects will come forward. It should also be clear how reliable the results are, for what period they are valid, which assumptions underlie the results presented and how sensitive the final outcome is to changes of these assumptions. Also, attention should be paid on how and when the results or the decisions based on the results are to be monitored and evaluated.

In this context, FMP was used as an acronym for 'Forest Management Plans', but it could also be read as 'Forest meets perspectives', in which the desires of each stakeholder will be taken into account.

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LANDSCAPE SURVEY, LAND EVALUATION AND LAND USE PLANNING IN SOUTHWEST CAMEROON

(land use planning as a prerequisite for forest management planning)

P.W.F.M. Hommel and A.J. van Kekem

INTRODUCTION

Land use planning is needed when land is becoming scarce, the demands for land are greater than the available sources, and conflicts may arise between different land use groups. In Southwest Cameroon, as in many other tropical forest areas, land is becoming exceedingly scarce and the various types of land use seem hard to reconcile.

The aim of *land evaluation* is to provide a scientific basis for land use planning. In 1976, the FAO designed a practical methodology. Basically, land evaluation should provide an answer to three questions:

(1) Which types of land use are relevant in a given area, or in the FAO terminology: which *land utilization types* (LUTs) can be discerned?
(2) What is needed to fulfil the demands of these LUTs, or in FAO language: what are their *requirements*?
(3) Where can these requirements be fulfilled?

To answer the third question, land characteristics are to be described, mapped, and interpreted in terms of *suitability* for a specific LUT. Such land characteristics are called *qualities* or (if they are negative) *limitations*. A landscape survey, resulting in a map, provides the starting-point for this procedure.

LANDSCAPE SURVEY

The aim of the landscape survey in the TCP area (1700 km^2) was to produce a map at reconnaissance scale (at a scale of 1 : 100 000) (van Gemerden and Hazeu, 1999). This map was to meet two important demands. First, it should be integrated and multi-functional, since in the TCP area we are dealing with a wide spectrum of very different, but interrelated LUTs. Secondly, it should be possible to interpret the mapping units in terms of the requirements of the various LUTs.

The survey implied three main activities:

(1) interpretation of aerial photographs, resulting in a preliminary map, and a (stratified) sample strategy;
(2) field work, implying the description of sample sites, and resulting in preliminary typologies for the major aspects: landform, soil, and vegetation;
(3) integration of these aspects, resulting in final typologies for the three aspects mentioned, and in one map with one legend;

It should be stressed that in this procedure, the vegetation aspect has a very prominent and specific place, since it provides both a method and an objective. Differences in vegetation reflect ecologically relevant differences in the abiotic environment. However, we are also interested in the vegetation for its own sake, for instance as a source of timber or as an environment of rare plant species. For both aspects (method and objective), it is essential to study the floristic composition of the vegetation, i.e. the specific combination of plant species. Therefore, we have opted for the so-called `phyto-sociological' approach. On many locations, the species combinations was recorded. Using similarities and differences between all these so-called `relevés', seven main vegetation types were defined, including primary submontane forest (I), three types of primary and old secondary forest (IIa, IIb and IIc), swamp forest (III), young secondary forest (IV), and secondary shrubland on recently abandoned fields (V).

Thus, vegetation types are based on floristic composition. Likewise, landforms are defined by relief characteristics and altitude, and the soil typology is based on depth, drainage and texture. Combination of patterns of vegetation types (7), soil types (4), and landforms (7) resulted in an integrated landscape ecological map of which the legend reflects the ecological interpretation of the mapping units discerned. The legend is hierarchically composed. On the highest level altitude determines the patterns of soils and vegetation. Next, a subdivision in landforms is used, and finally the degree of disturbance by human activities is indicated (which is related to vegetation only, and does not determine the soil type).

In small study areas, the typologies for both soil and vegetation were refined. This is for instance of significance for understanding the process of recovery after logging, and for pinpointing the species involved. For the land evaluation procedure, however, the main typologies mentioned above are the starting point.

LAND EVALUATION

The challenge of land evaluation is to determine the suitability of each mapping unit for sustained use of the land. The procedure consists of five major steps:

(1) definition of land utilization types (LUTs);
(2) definition the requirements for each LUT;
(3) description of the mapping units in terms of qualities and limitations;
(4) matching of requirements with qualities and limitations;
(5) suitability classification of the mapping units.

In the TCP area five different LUTs are of importance: (1) nature conservation, (2) collecting of Non Timber Forest Products (by both villagers and forest dwellers), (3) production of timber, (4) shifting cultivation, and (5) plantation agriculture. The sequence of these LUTs does not only reflect the increasing impact on the natural environment, but also the relative ease with which the land evaluation procedure can be applied. Since land evaluation was originally designed for purely agricultural purposes, both shifting cultivation and plantation agriculture provide the least methodological problems. For instance, to map land which is physically suitable for oil-palm plantations, one `simply' has to mark mapping units with slopes of less than 8%, and freely drained, deep soils.

For a full account of all LUT's with their requirements and suitability classifications, we can refer to the report on land evaluation in the TCP area (Hazeu and van Gemerden, in prep.). Here, we shall focus on one LUT only: nature conservation, which is far beyond the original scope of land evaluation, and therefore from a methodological point of view the most challenging.

Nature conservation as a `land utilization type' is a strange thing, most notably when the protection of wild flora is concerned. In fact, *suitability* for nature conservation means priority of an area to be set aside as a conservation area, in other words: conservation value. *Requirements* can consequently be interpreted as criteria to assess this conservation value. As for the botanical part of this value, three criteria were formulated: (1) species diversity, (2) occurrence of rare species, and (3) indication for the integrity (or disturbance) of the vegetation.

Species diversity can be assessed using the contribution of each vegetation type to the total species diversity of the area. These `objective' figures should consequently be translated into a more subjective rating of the conservation value as far as species diversity is concerned. It was found that the primary and old secondary forests at altitudes between 350 and 700 m. a.s.l. have the highest species numbers. Species diversity of the submontane forests (above 700 m. a.s.l.) proves to be significantly lower. Swamp forests and recently deserted agricultural fields are also relatively poor in species.

As for the occurrence of rare species, rarity was interpreted in a phytogeographical sense. Therefore, the distribution area of all species (except the ones that do not occur more than occasionally in any vegetation type) was determined on a global scale. Species with a very small distribution area are considered to be the rarest. Consequently for each vegetation type, the phytogeographical spectrum was drafted (table 1). As was to be expected, rare species prove to be most abundant in the primary and old secondary forests (including swamp forests). Species with a very large distribution area (global to pantropic) are most prominent on the recently abandoned fields.

As for the indication of species for integrity (or disturbance) a similar approach was used. All species, occurring more than occasionally, were classified according to their ecology. Based on literature data a distinction was made between species of: primary forests, forests (in general), secondary forests, secondary vegetation (in general), and secondary shrubland. Again, spectra were drafted and the conservation value was assessed.

Table 1: Occurrence of rare species, based on the distribution area of species (%).

vegetation type: distribution area:	I	IIa	IIb	IIc	III	IV	V
World / Pantropic	3	1	2	3	3	1	12
Tropical Africa	6	7	9	12	9	16	19
West & Central Africa	39	43	42	40	46	50	55
Central Africa	19	14	17	15	15	12	3
Cameroon and `neighbours'	32	34	28	28	27	19	10
Cameroon only	1	2	2	2	1	2	2
conservation value[1)]	1	1	1	1	1	3	4

1) 1-4 in decreasing order of value.

Finally, the botanical conservation values for all three criteria were combined into one value for each vegetation type (table 2). from which a value for each land mapping unit (which is in most cases a complex of vegetation types) can be derived.

Table 2. Conservation value of the vegetation types

vegetation type: conservation value based on:	I	IIa	IIb	IIc	III	IV	V
species diversity	3	1	1	2	3	2	4
occurrence rare species	1	1	1	1	1	3	4
indication for disturbance	1	1	1	2	2	3	4
total bot. conserv. value[1)]	2	1	1	2	2	3	4

1) 1-4 in decreasing order of value.

LAND USE PLANNING

The whole set of suitability maps for each and every land utilization type (or even parts of LUTs like botanical conservation value or oil palm plantation), together with all tables and explanatory notes, is the final product of the land evaluation procedure. It is also the starting point of land use planning, which is (unlike landscape survey and land evaluation) primarily a task and responsibility of politicians, ideally with full involvement of all stakeholders.

Still, scientists involved in land evaluation can assist in the process of land use planning in several ways. For instance, it is very useful to indicate which LUTs can (partly) be combined and which are mutually exclusive. Secondly, scenario's may be compiled in order to optimize the allocation of LUTs and to pinpoint frictions. Finally, in order to reduce frictions, variants of LUTs may be proposed with varying requirements and thus varying land claims.

Once choices have been made on the spatial distribution of land use types, one can proceed with planning for the management of the land, including forest management. The results of the studies supporting the land evaluation can thus be used again in order to ascertain a sustained use of the land.

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SUSTAINABLE EXPLOITATION AND MANAGEMENT OF FOREST RESOURCES: DIVERGING PERCEPTIONS ON THE FOREST

Jolanda van den Berg[1]

ABSTRACT

This paper examines the basic contents of the 1994 Cameroon Forest Law and of Bulu Forest Tenure to clarify the ways in which management and exploitation rights on forest resources are conceptualised. The basic perceptions on forest management maintained by the current law and its social implications are first provided. This analysis is followed by a description of Bulu forest tenure. Next, three aspects in which the 1994 Forest Law and Bulu Forest Tenure differ from each other and contradict each other are briefly alluded (the distinction between forest and agricultural land; the organisation of property; relation between forest use and property rights). The paper concludes with some implications for future forest management scenarios.

INTRODUCTION

International interest in tropical forests and biodiversity was responsible for stimulating the Cameroonian Government to declare an increasing concern for forest conservation on several occasions during the past decade. In 1989, the Tropical Forest Action Plan (TFAP) formulated in association with FAO was adopted and in 1993 the first national forest policy document was formulated. The concern for the national forest heritage reached its peak in 1994 when the National Assembly adopted a new forest code. Legal reform of the forest sector was proposed as part of the World Bank's structural adjustment programme.

The 1994 forest law reflects the international call for forest stewardship. Its principle aim, as laid down in the first section of the law, is to ensure sustainable conservation and use of forest resources and various ecosystems. The recent forest law indicates, as will be shown in the first section of this paper, a bias in favour of state ownership of forest resources and centralised management. The legal structure of nationalising natural resources is not new to Cameroon (See e.g. Fisiy, 1992, Madec, 1997, Rietsch, 1992). Already during the German colonial period, the state administration had legally declared that all unoccupied land, except the land occupied by local communities, would be incorporated into the German Empire. The French and English colonial officials continued this land management policy. But while economic interests played a central role in colonial policy which in effect aimed to ensure constant extraction of raw materials, the state today legitimises its claims on forest resources by referring to the international issue of "forest stewardship". The arguments voiced during discussions on the 1994 forest law include the argument that the state wishes to regulate forest management in order to ensure national economic development, redistribution of forest benefits and conservation of forest resources and ecosystems. The question is, however, whether the state

[1] Paper presented at the FORAFRI conference Libreville, Gabon 12-17 October 1998

has sufficient political will and appropriate human and material capacity to truly realise its intentions.

The issues of forest stewardship and sustainable exploitation and management of forest resources have to be seen within the wider legal and administrative context. Management and exploitation of forest resources in Cameroon are subject to complex bodies of legal regulation of which rules derived from the State Law only form a part. The local populations also claim regulative authority over forest land and other valuable forest resources and maintain regulations on their allocation and the distribution of forest products. This plurality of different bodies of legal rules was the object of inquiry in a study of a Bulu village in the Tropenbos Cameroon Programme research area in southern Cameroon, conducted from 1994 to 1995[2].

This paper examines the basic contents of the 1994 Forest Law and of Bulu Forest Tenure to clarify the ways in which management and exploitation rights on forest resources are conceptualised[3]. The purpose of this paper is to show that these distinct rule systems differ from each other, and contradict each other in a number of aspects. It can be expected that any attempt to implement the recent Forest Law will be significantly affected by the existing conditions of *legal pluralism*[4]. The argument will be put forward that any new intervention in the current management and exploitation regime, therefore, have to take these conditions into account.

THE 1994 FOREST LAW

The basic function of the 1994 Forest Law is to divide the national forest area into a series of permanent forest and non-permanent forest estates (sections 21 & 22). Figure 1 shows the different types of forests conceived by this law. It is by understanding its property regime and conservation strategy that one can grasp the basic perceptions on forest management of the law, and its social implications.

PROPERTY RIGHTS UNDER THE RECENT FOREST LAW

The recent forest law perceives the state as the sole guardian of all the forests within the national territory (section 11). The rationale for such a claim is stipulated in the national forestry document upon which the current law was shaped: "Forest management involves long-term investments. To be successful, related action needs constant support from the public in order to escape from the constraints of daily life" (MINEF/Direction des Forêts, 1992). Consequently, according to the policy-makers, the state is the sole representative of the interests of the general public and, therefore, stands beyond all conflicting interests regarding forest resources.

[2] I am thankful to Mr. Caesar Bidja Mbetti and Mr. Samuel Efoua who were my research assistants throughout the period of fieldwork.

[3] The Bulu are one of the many Bantu-speaking groups that inhabit the coastal rainforests of southern Cameroon. The Bulu, together with the Beti (Ewondo) and the Fang, are in the literature referred to as the '*Pahouin group*' or '*Sanaga-Ntem group*' (Alexandre, 1965, Vansina, 1990).

…[4] See for the theoretical background of the concept *legal pluralism* e.g. von Benda-Beckmann (1989); von Benda-Beckmann, F. and K. (1991); Griffiths (1986); Moore (1973; 1978).

Figure 1 The 1994 Forest Law: Forest Classification

<table>
<tr><th colspan="6">National Forest Area</th></tr>
<tr><td colspan="3">Permanent Forests</td><td colspan="3">Non-Permanent Forests</td></tr>
<tr><td colspan="2">State Forests</td><td>Council Forests</td><td>Communal Forests</td><td>Community Forests</td><td>Private Forests</td></tr>
<tr><td>Protected Areas for Wildlife</td><td>Forest Reserves</td><td></td><td></td><td></td><td></td></tr>
</table>

The law provides for the creation of a permanent forest estate which entails land that is used solely for forestry and/or as wildlife habitat (section 20-2) and must cover at least 30% of the national territory (section 22). The permanent forest estate consists of two types of forest: state forests and council forests. To make the state's guardianship more effective, the law goes one step further by claiming legal ownership of state forests (section 25-2), while council forests belong to the state indirectly.

While the different forest categories which fall under the broad category of state forest are purely indicative in nature, thus rendering the precise legal definition of state forests unclear, the law provides that the procedure for classification be laid down by decree. This way, the law-makers create the executive power and the legal space to broaden the concept of state lands to include areas that do not fall under the current law, whenever the government deems it necessary.

The most possible interest, which the local population is allowed to have in the permanent forest estate, is a customary right, which means "the right of the local population to harvest forest products for their personal use, with the exception of protected species" (section 8). This right is more or less guaranteed by section 26 that stipulates that the instrument classifying a state forest should take into account the social customary rights. Such rights are subject to restrictions if they are incompatible with the purpose for which the forest was designed and can be temporarily or definitely suspended for reasons of greater public interest.

The remaining part of the national forests falls under the category of non-permanent forests, which may be used for other purposes than forestry (section 22-3). The law distinguishes three types of non-permanent forests: communal forests, private forests, and community forests.

The 1994 law only gives a residual or negative definition of communal forests: forests that do not fall under state, council and private forest (section 35). The same section stipulates that orchards, agricultural fallow land, wood land adjoining an agricultural farm and pastoral and agro-forestry facilities are not included in communal forests. After reconstitution of forest cover, however, former fallow land and agricultural or pastoral land without any legal land title once again becomes communal land and is managed as such. Thus, the vast majority of forest-dependent people without any stately recognized document of land entitlement find their resources absorbed by this all embracing concept of communal lands, which in this situation, again implies that their rights may be curtailed or withdrawn for the purpose of conservation or protection.

The law provides very limited legal space for private appropriation of forest resources. Holders of a legal land title over natural forest land are indeed the owners of that land. However, the forest law does not recognize their ownership of the products from the forest which belongs to the state (section 39-4). Private ownership of planted forests through legal land title is recognized by the law, but the exploitation of these forests is subject to the authorisation and restrictions of the forestry service. It is this provision that raised much suspicion among the members of Parliament in the debates on the draft version of the 1994 forest law and which furnished their fear that all forest resources had been nationalised (Nguiffo Tene, 1994).

During government level political discourse it was emphasised that the main premise of the recent forest law was to involve forest communities in forest management. The law does stipulate that parts of the communal forests may be brought under the management of the local population through the creation of community forests. This involves handing over the management of forests with a maximum area of 5000 ha. for a period of two years. This arrangement can be renewed at the end of the two year period. According to the current land laws, however, ownership of the forest stays with the state, since these laws stipulate that land without a legal title are part of national lands which belong to the state (section 15). Only the forest products resulting from the management of the forest belong to the community concerned. Meanwhile, the law gives strong powers to the state forestry service to control community forest groups since forest management and exploitation requires formal authorisation. In addition, the state has the right to suspend community forest management and consequently retains the sovereign right to repossess community forest if the terms and conditions of the handover are not met. The law, on the other hand, provides little protection for local communities in case of bad governance since it remains unclear about the legal conditions of suspension and does not make any provisions for public appeal. It remains to be seen how the law-makers envision co-operation from forest communities under these particular legal conditions.

To conclude this section, it must be stated that the guardianship the state claims over forest resources is not just benign forest protection, it is ownership with powers to exclude other existing forest users. In view of the state's intention to increase the forests' contribution to the GDP and to become the largest African timber exporting country by the year 2000, its legal ownership claim involves the risk that forest resources will be withdrawn from forest dependent people, and that the forest will be exploited in a way that undermines their interests.

FOREST CONSERVATION UNDER THE 1994 LAW

The 1994 forest law was designed to match the political intention to encourage reasonable exploitation and conservation of the national forest area. In order to achieve this objective, the law-makers opted for a policy of centralised control of forest resources, relying on state agencies for administration. The legal regulations on access to forest resources and the exploitation of these resources reflect the omnipresence of the state. The forest law organises the intervention of the state in almost all categories of forest and all stages of forest management regardless of their purpose, e.g. conservation, subsistence or industrial use.

The legal preference for centralised control is remarkable with regard to production forests since the government, under strong international pressure, proposed in its draft legislation that concession holders take part in the design and implementation of management plans, as well as in the supervision of their own concessions. The rationale behind this was that concession holders, unlike the state forestry service, have the technical, human and material capacity to plan and supervise activities in the field. This proposal was rejected by the National Assembly which perceived it as a confirmation of their fear that the government was selling out the forest to meet its international financial obligations. In the same line of reasoning, the initial legal propositions to extend concession areas to at least 500,000 hectares to be granted for a minimum of 25 years, in order to induce concession holders to use their concessions sustainably, were amended. The National Assembly reduced the concession limits to 200,000 hectares for a period of 15 years (section 49 & 46-2).

The law perceives forest conservation merely as a technical exercise in which the exclusion of forest users and the strict regulation of forest exploitation are the main components. The needs, motivations and options of forest dependent people are only taken into consideration to a very small extent. Forest communities are given vague and limited rights to their forest resources, while having to face many restrictions, as the examples below demonstrate. Although law-makers recognise the importance of hunting for forest communities and allow this activity in almost all forests, local commonly used hunting techniques such as trap-hunting with steel wire cables and hunting with guns, are forbidden (section 80). With regard to agriculture, which represents the main source of income for forest communities, the law-makers are less responsive to local needs. The lighting of bush fires is forbidden in all forests without prior authorisation from the forest service on the national forest estate (section 14) and in the permanent forests it is forbidden to clear forest for agricultural purposes (section 16 & 28).

The above provisions significantly affect the ways in which the vast majority of local people exploit forest resources to sustain their livelihoods. Local forest communities are certainly justified in their worries over state involvement in forest management. As they rightly suspect, it can be argued that local modes of subsistence are criminalized by this law.

BULU FOREST TENURE

State forest legislation and Bulu forest tenure do not operate in isolation, nor are they ordered in a hierarchical way. In processes of social interaction rules derived from the state laws are used next to customary forest regulation. Actual forest exploitation and management are, therefore, conditioned by normative 'mixtures'.

In this section, however, Bulu forest tenure will be examined distinct from the state laws in order to demonstrate the different aspects in which these sets of legal regulation differ from each other and even are in conflict with each other. Three basic dimensions characterise Bulu forest tenure:

1. *Rights on Forest Resources are vested at different levels of Bulu organisation*

In Bulu conception land property and property of other valuable forest resources is a bundle of rights which are held by different people and vested at different levels of social organisation. In practical and analytical terms three categories of rights must be considered separately.

The Right to Exclude.
In principle the first to clear a part of the forest, or to plant trees or otherwise make labour investments to manage resources for productive purposes ("labour creating rights") legitimise the right to exclude others. But in reality this right can be vested in both the individual and larger social entities. Three different levels of social organisation are relevant: the village, the sub-clan and the patrilineage[5].

The village is an administrative entity and forms a special category distinct from Bulu segments of social organisation. Villages are divided into hamlets which are held by particular sub-clans (*mvôk)*, grouping all the members of a particular kin group together with those people attached to it through marriage or clientship. Within each sub-clan there are one or more residential compounds belonging to a patrilineage (*nda bôt*) accommodating those relatives and clients who share the accommodation and patronage of a single head of the family (*mbi ntum*). In south Cameroon a patrilineage usually consists of descendants from an ancestor one or two generations away from the present oldest man.

The Right to Access.
For Bulu access to forest resources is conditioned by gender, kinship and cordial relations. Male kin enjoy rights of access to forest resources belonging to both the patrilineages of their father and mother. In principle women's access to land is conditioned by male relatives. Unmarried women farm on their father's land and after their marriage on land of their husband. Under specific conditions, however, women can obtain direct access rights to land. When a man dies, his widow inherits the rights to the her husband's land when she continues to live with his family. Women's access rights to other forest resources such as NTFP tree species or fishing water are shaped in the same way as for men. Strangers, as they do not belong to the kin-group nor to the village, have no direct access rights and have to mediate access through the right holders.

The Right to Dispose.
Two types of rights are relevant: the right to lend land to someone else and the right to sell trees. Lending period is restricted to one cropping cycle. While the sell of land is (still) uncommon among the Bulu, the recent sell of trees to logging companies is a novelty.

2. The distinction between land tenure and tenure of other forest resources

Bulu land tenure is different with tenure of other forest resources. For example, trees can be "owned" directly, distinct from rights to land and certain uses of NTFP, e.g. traditional medicines, palm leaves and fire wood are permitted to all regardless of who owns the land on which the tree is growing. Although land tenure and tenure of other resources are distinct, each can affect each other. For example, clearing forest for agricultural purposes can establish de facto rights on fishing water and NTFP tree species. On the other hand, rights in fishing water and trees does not affect rights on land.

[5] See van den Berg (1996) for a discussion on Bulu social organization in terms of the significance of industrial timber exploitation for community formation, local leadership and land management.

3. *Property rights are conditioned by forest land types*

Figure 2 shows a Bulu land classification. The land categories have normative significance since they affect who may exercise what type of basic property rights over what forest resources (i.e. land, wildlife, fish, NTFP plant species), as well as the segment of social organisation in which these rights are established.

Figure 2 Bulu Typology of Land Categories

<table>
<tr><td colspan="4" align="center">Si
(Land)</td></tr>
<tr><td colspan="2" align="center">Si Mëfup
(Agricultural Land)</td><td colspan="2" align="center">Afan
(Forest)</td></tr>
<tr><td align="center">Afup
(Fields and Plantations)</td><td align="center">Ekotôk
(Fallow land)</td><td align="center">Mfôn Afan
(Old Secondary Forest)</td><td align="center">Fut Afan
(High or Virgin Forest)</td></tr>
</table>

Bulu distinguish two broad categories of land: agricultural land or *si mëfup* and forest or *afan*. The category agricultural land includes food crop fields, cacao plantations and fallow lands. The category forest includes high forest or *fut afan* and old secondary forest or *mfôn afan*. The latter category includes very old fallow land and takes an intermediate position between agricultural land and forest. Together these land categories constitute what Bulu call *si* which is a polysemic term for land and sub-soil, but can also refer to territories that belong to particular social entities, such as the (sub)clan and administrative units such as the village and nation. From a village level perspective the term *si* includes the village, and all the agricultural land and portions of forest land that belongs to the village's clans.

The land categories presented are of economic importance for the Bulu.

1. *Afup*, the field or plantation.

This term is assigned to any type of land actually under cultivation. It combines groundnut fields on young fallow with *ésep* fields exclusively created on forest clearings (both high forest and very old fallow land) and cultivated with *ngon* (*Cucumeropsis manni*), a climbing vine which is associated with tuber crops and maize. With the addition *kaka* or cacao the term *afup* also refers to cacao plantations. While food and income are the major goals of the creation of agricultural fields, Bulu maintain their fields and plantations to multiple-use environments which helps to fulfil subsistence and cash needs. Bulu preserve and manage wild trees, such as Moabi and Adjap for valuable non-timber forest products, and intercrop cacao with fruit trees and Kola. Men set traps on fields and plantations for crop protection and bush meat procurement.

2. *Ekotôk*, fallow land.

Bulu distinguish several types of fallow lands using criteria such as the age of forest regrowth and tree species, including young fallow land or *nyenga ékotôk* (< 6 years), medium aged fallow lands or *ékotôk* (about 10 years) and old fallow lands or *ngômbo ékotôk* (15-30 years). A young fallow still has productive value, though farmers do no longer cultivate the plot, since it contains remnants of food crops, such as cassava and plantains which are used for consumption and to supply cuttings for the next season field. When a field is no longer used as 'store room' for crops and the farmer 'rest the field', the Bulu refer to it with the term *ékotôk*. Old fallow land or *ngômbo ékotôk* is characterized by high trees and resembles according to farmers to high forest or *fut afan*. To bring this type of forest land into cultivation, Bulu use the same techniques as for the high forest. Although not exploited agriculturally during the fallow period, an *ékotôk* type of terrain is by no means economically unimportant. It is exploited by hunters and trappers of the various mammals and birds, and by gatherers, both women and men, who collect and harvest the various NTFP (van Dijk 1994, 1997). This type of environment is temporary in the sense that it alternates with *afup*, the field type.

3. *Mfôn Afan*, old secondary forest.

Bulu classify as *mfon afan* all agricultural land in fallow for about 30 years and longer. Though it is conceptually distinguished from the unexploited virgin forest, the addition *afan* suggests that the forest predominates human activity, and the vegetation can no longer be distinguished from that in the high forest (cf. Dounias 1993). Bulu use *mfôn afan* as hunting, trapping and gathering grounds.

4. *Fut Afan*, high or virgin forest.

The distinction between this type of forest land and *mfôn afan* is that in local people's recollection the virgin forest is never exploited for agricultural purposes. The Bulu conception of the village (*nlam*) includes portions of virgin forest, which they believe forms an integral part of village life. *Fut Afan* is a source traditional medicines and of protein food and monetary income for groups and lone trap and gun hunters. The virgin forest also provides seclusion for sorcerers whose magic activities demand secrecy.

The dimensions of Bulu forest tenure presented above provide a picture of a rather complex organisation of property rights in terms of construction and differentiation of 'bundles of rights'. Forest resources and space, as has shown, are subject to multiple, overlapping rights, which are vested in different segments of social organisation[6].

DIVERGING PERCEPTIONS OF THE FOREST

In the conception of property rights and objects with regard to the forest, the 1994 Forest Law and Bulu forest tenure differ from each other and contradict each other in three aspects.

1. The distinction between forest and agricultural land

In order to protect the forest from agricultural encroachment the 1994 Forest Law makes a sharp distinction between forest areas and agricultural lands, i.e. land under cultivation and/or land with visible signs of human presence, such as planted fruit trees. While the underlying

6 See van den Berg (in prep.) for a comprehensive analysis of Bulu organisation of property rights in terms of different levels of organisation that are entitled to different basic property rights to different land categories and resources.

assumption that agricultural activities destroy forest is controversial since actual land-use provides a picture of woody multiple-use environments, the property implications of this distinction are even more problematic. Bulu regard specific parts of forest (*mfôn afan*) as agricultural land which is object to property relationships, and claim property rights in those parts of the virgin forest (*fut afan*) were they plan to extent their fields and plantations. The narrow definition of agricultural land enclosed in the recent forest law creates the legal space to contradict these customary property claims on forest, indeed even conserves the "myth of a vacant forest".

2. The organisation of property rights

In contrast with property concepts underlying the 1994 Forest Law, in Bulu property conceptions land and other forest resources are never controlled, nor used exclusively by an individual or by one group of people. In such a context individual property of land, for instance, concerns the relative degree of exclusion of land type areas from the control of larger social entities.

3. Relation between forest use and property rights

Basic to the Bulu conceptualisation of forest tenure is, as has shown, the principle of "labour creating rights". This principle legitimates, both in case of permanent and impermanent use, property rights on very different elements of the forest environment, from animal tracks to specific NTFP. The recent forest law perceives the relation between forest use and property rights in terms of *mis en valeur*. The latter notion is restricted to land only and refers to individual land ownership established by clearing the forest and permanent use of the land. Property rights thus are structured by fundamentally different legal principles.

While the 1994 Forest Law gives priority to forestry aspects of sustainable forest management, it has very limited concern for the local legal context within which the rules are to be implemented. This context, as has shown, is full of customary rights and property objects that pertain to forest management and exploitation. Creation of different types of forest as provided by the recent law thus imposes its own set on the already existing ones. As a consequence, the 1994 Forest Law maintains or even creates conflict between different sources of forest regulation. It can be expected that these conditions oppose any attempt to implement the recent forest law

IMPLICATIONS FOR FUTURE FOREST MANAGEMENT SCENARIOS

In any forest management scenario conditions of legal pluralism, as discussed above, must be examined to avoid three problems. These problems are particularly a matter of concern when any type of co-management of forest resources with local stakeholders is planned.

1. The destruction of customary rights

Destruction of customary rights may result from forest management interventions as a consequence of a number of factors:

a) Planned interventions may contradict existing customary property rights. This circumstance may be a great potential for social conflicts, which in turn may hamper efficient implementation.

b) When the value of forest resources is increased by external actors, such as forest officers, there is a tendency for increasing tenure problems. The effect of compensation of individuals for logging commercial tree species by private companies in the south of Cameroon was that individuals increasingly claimed private ownership on trees in a common property context. As a consequence conflicts between different right holders arose. Similar effects are to be expected with individual compensation for the loss or restriction of different rights on forest resources in the context of a management plan.

2. The demarcation of community territories can be a problem

The ability to exclude others from the use of forest resources is essential if forest communities are to benefit of their investments in forest management. In the case of Cameroon, Bulu village communities have a strong legal right to prevent neighbouring villagers to clear forest on their territories. In contrast the right to exclude others from other forest uses, such as gathering NTFP products and gun hunting, is less obvious. Boundaries between village territories appear, therefore, to be fluid and subject to negotiation and conflict. The effect of these ambiguous rights is that implementation of management plans may be in considerable difficulty because local stakeholders are less motivated to cooperate and adhere to its regulations.

Participatory mapping of forest areas zoned for various uses is a valuable tool to show the multiple, overlapping rights on forest space and resource elements (Tropenbos-Cameroon Programme, 1997).

3. The definition of local stakeholders can be a problem

An inclusive definition of local stakeholders' groups is essential for feasible forest management plans. Stakeholders' groups should include those people with property rights in a given forest area. In the South of Cameroon user groups are not geographically defined. While kingroups control specific territories and all residents of a certain village are granted access rights, individual villagers have access rights to forest resources in other areas depending on gender, kinship and cordial relations. A management plan which does not take this into account may become a failure because of disregard of new forest regulations by those who are excluded from the definition of local stakeholders' groups.

CONCLUSION

The village study presented in this paper demonstrates that forest management and exploitation in the south of Cameroon is subject to largely contradictory bodies of legal regulation. In the Cameroon 1994 Forest Law this issue of legal pluralism is ill defined. While the law-makers have allocated vague and uncertain rights to forest communities, the legal conception of community forests in practice involves an incomplete and ephemeral handover of forest management. Forest communities are left with different, and even more restricted rights than the rights the same people have under their own customary law. These legal circumstances are a serious source of economic insecurity for forest communities, indeed even pertain to a basic human right, which in turn may negatively affect their motivations and options with regard to contributing to the sustainable use of their forest resources.

It has been argued above that any new intervention in the current management and exploitation regime should take the conditions of legal pluralism into account. Consequently, the forest management issue of recognition of customary rights should be considered, while keeping in mind that ecological conditions for sustainability should not be sacrificed in favour of social conditions.

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FOREST DWELLERS AND FOREST MANAGEMENT PLANNING BRIDGING THE COGNITIVE GAPS

Karen Biesbrouck

ABSTRACT

This paper discusses some of the major issues for future sustainable forest management emanating from research among Bagyeli pygmies. This is done with particular reference to ideas about co-management. Bagyeli mobility, combined with current local arrangements for the management of forest resources, makes for a community that is not geographically demarcated. Differences in interests in forest resources, and in power positions, make "the local populations" a heterogeneous group. For these reasons, it is argued, Bagyeli require special attention over other actors in the process of decision-making on future forest management. Towards the end of the paper, a sketch is given of Bagyeli perceptions of current logging activities.

The paper sets out by sketching the author's view on the function of social science research within the Tropenbos Cameroon Programme in terms of bridging the cognitive gaps, gaps between disciplines as well as those between scientific debates and local peoples' experiences.

1 FUNCTION OF SOCIAL SCIENCE RESEARCH WITHIN THE TROPENBOS CAMEROON PROGRAMME

During the preparations of this workshop, we, researchers of the Tropenbos Cameroon Programme (TCP), were asked not only to present the results of our research, but also to pay attention to the relation between our respective work and the other components of the programme. This, of course, is a good point in a multidisciplinary programme. And I gathered I'd better start straightaway by clarifying my views on the functions of social scientific research within the programme. This because the function as I perceive it is the rationale behind the selection of issues to be dealt with later on in this paper.

When receiving the neat schedule on the relationships between strategic, tactical and operational planning, such as applied by Vellema and Maas as well as by Wessel and Jonkers (both this volume), I was unfamiliar with its terminology and had difficulties "locating" my research. I became curious to know the meanings attached to the notions of "strategic" "tactical" and "operational" planning, let alone the significance of the difference. Apparently, this schedule did not connect with my view on the programme. Of course, I do sympathize with their effort of putting the different projects into perspective. But the fact that we seem to be telling entirely different stories about the same "thing", our programme, is probably the best way of illustrating the cognitive gap that can exist between disciplines.

I am an anthropologist, and as such I seek to understand the current behaviour of my human research subjects, pygmies in this case. I am aware of the fact that the different aspects of a particular society are strongly interconnected, and therefor have to be comprehended in their context. Furthermore, I consider the current situation to be the temporary outcome of historical processes.

The aim of this Tropenbos Programme is to contribute to the development of methods and strategies for future sustainable forest management. In Cameroon, pygmies are part of that future. If only because they economically and culturally depend on it. So I assume it would be practical if we social scientists, on the basis of our research, could somehow "predict" actual future human behaviour. If colleagues of other disciplines ask for information, their questions all go into this direction. And preferably, my answers should be quantified in order to allow them to put these into models.

Here is where I arrive at one of the limits to what anthropologists can offer. In our discipline, predicting behaviour is something we generally feel uncomfortable about, because our subjects' future behaviour is not a mathematical outcome of past processes. The "problem", of course, with people is that they learn from previous experiences, even from other people's experiences, they respond to changing circumstances and subsequently adapt their behaviour. Even their perceptions do change over time. For those who have an eye for this, this really is a fascinating subject to work with. However, this "problem" makes predicting actual future behaviour of Bagyeli pygmies too precarious a task.

Apart from this, there is a limitation that we as social scientists within the programme have set for ourselves. We will not act as the mouthpiece of local populations, despite the fact that we sometimes felt to be put into such a position. If it comes to planning and decision-making about the future of the forest, we will not speak on their behalf.
Local stakeholders will have to speak for themselves.

Now then, what is it that we can and what do we do as social scientists within the TCP?
Prior to discussing my own research, I would like to make two points. On the "outskirts" of our social scientific research, we put efforts into creating an environment within the programme that is favourable for far-reaching forms of local people's involvement in the formulation and implementation of future forest policy. This space necessary for local populations to express themselves is something which had to be established. If I am not mistaken, we have made quite some progress with our colleagues[7]. To give but one example: when reading Wessel and Jonkers' paper I was glad to discover the remark that "thought has to be given to ways in which the various stakeholders are brought into the planning process". Of course, the Tropenbos programme does not operate in a vacuum, if only because of the importance of management regulations formulated at the national level. These are dealt with elsewhere in this volume (van den Berg). Creating further room for co-management within the Cameroonian legal context, however, is a challenge at another scale, that other organizations are willing to tackle.

[7] As a matter of fact, my forestry colleagues, Parren and van Leersum, know that the joint article we are currently writing, on social conditions for sustainable timber harvesting, goes beyond face value and is -also- an attempt to communicate at this more hypothetical level (hypothetical as opposed to the "real" negotiations between actual stakeholders in the forest, that will have to take place in the near future). At last, we are sounding out each other: What are the things that matter for this "other" discipline, how do these relate to views from social sciences, how far can we get in combining these in theory?

In addition to this, by supervising student research, I experiment with techniques to optimize the use to be made of communicative capacities of the Bagyeli pygmies as a stakeholder. In our area, and for various reasons, this stakeholder is likely to have a particularly weak power position in future negotiations concerning the management of forest space. Special attention will have to be paid to this group. The student research intends to assess the suitability of several (participatory) techniques for enabling pygmies to formulate their ideas about future forest management and future timber exploitation.

Having elucidated this, let me get at the core, at the function of my research. As a social scientist I can generate insight into processes of social change. As a part of preparing this communication process, yet at another level, I consider it my task to study Bagyeli mobility and the process of sedentarization (which are two sides of the same coin), as well as Bagyeli management of forest resources, and the interconnections between the two. I consider these in the context of Bagyeli social organisation, their economic activities, and their -changing- relations to Bantu villagers and external agencies (= NGOs, the Government of Cameroon, and logging companies). This is the work for my thesis.

Such texts are interesting and intelligible for fellow social scientists, and this type of knowledge is absolutely necessary prior to formulating ideas of future forest management. However, it would be completely naive to assume that people from other disciplines will comprehend this in the way it is intended. I would probably use terminology unknown to them, and the information would be far too detailed and extensive for the kind of use that they will make of it. So a selection has to be made. In order to do so, I connected my understandings with debates on sustainable forest management, as these structure the ideas of the representatives of the other disciplines within the programme. I also connected them with existing ideas about co-management of forest resources. This process of connecting is what Paul Richards, in a slightly different context, eloquently described as anthropologists "bridging the cognitive gap" between local people in Sierra Leone and conservationists (Richards 1992: 153).

The outcome of this reflection process are some strategic issues that will have to be dealt with in the planning of more concrete future forest management. The disclosure of some basic assumptions underlying such debates is a contribution in itself to the development of methods and strategies for sustainable forest management, and co-management in particular. In addition to this, social scientific research can provide starting points to build upon for future sustainable forest management. For example in the sense of assessing the suitability of several local institutions as instruments for more sustainable forms of forest management. But also by revealing the principles that govern the local ("traditional") management of forest resources. If indeed these principles do resonate in future arrangements defining the access to forest resources, this will definitely enhance the likelihood of local stakeholders' compliance with such new regulations. These are the kind of findings I will turn to within shortly.

2 WHY IS CO-MANAGEMENT A PRECONDITION FOR SUSTAINABILITY?

Before going on with my argument, I would like to pay some attention to the idea of "co-management". This notion is also known under a whole variety of other terms (collaborative-, joint-, or participatory management, to mention but the more common ones). Borrini-

Feyerabend, gives a sufficiently broad definition, based on her work for the IUCN[8]: "Collaborative management", as she calls it

"is a partnership by which two or more stakeholders collectively negotiate, agree upon and implement a share of functions, benefits and responsibilities associated with the management of a particular territory or set of natural resources".
This is in striking contrast with the top-down approach currently still perceived in Cameroon, with its few restricted participatory elements such as the "community forests" provided for in the 1994 forest law. Please note that whenever I write about "co-management", what I have in mind is the involvement of affected local populations in the management of the entire area and its resources, including agricultural land, fallows, secondary and "high" or primary forests. And this includes their involvement in the decision-making process preceding the categorization of forests as, e.g., production forests and protection forests.

For some readers, the connection between "sustainable forest management" and "co-management", may not be obvious. When looking into the matter, one discovers that the social dimension of sustainable forest management presupposes particular forms of co-management. CIFOR and ITTO principles and indicators provide evident examples "Local stakeholders should have a voice in defining forest management" is a CIFOR principle (in: Lammerts van Bueren and Blom, 1997). The ITTO has an indicator referring to "the degree of public participation in forest management, such as in planning, decision making, data collection, monitoring and assessment." (ITTO, 1998).

Why would one want to involve local populations into sustainable forest management? There is a large number of arguments put forward in advancing this point. I will sum up four of the most important ones.

1 Exploitation by local populations influences the availability of forest resources, and it will continue to do so in the future. In order to enhance local compliance with new regulations, (and reduce such "illegal" activities as "encroachment", "poaching"), such new arrangements need to be well-known, -accepted and -respected. Co-management is considered to be a way of achieving this.
2 Exploitation of forest resources is crucial for the economic and cultural survival of local populations. Future arrangements regarding the exploitation of natural resources directly affect their well-being, much like current arrangements do (e.g., logging). This is why nowadays it is widely considered to be indispensable that they take part in the decision-making process leading to such arrangements, and that they share in the economic benefits of the exploitation of their forests by outsiders.
3 In spheres geared to development assistance, participation is even considered to be an aim in itself: it would stimulate accountability. International donor agencies consider it to be part of processes of decentralization of power, a means to reduce the (costs of) state bureaucracy.
4 Actual managers. To a large extent, local populations actually manage the forest resources on a day-to-day basis. Their physical proximity to the forest contributes to this. Building on such local structures for management is considered to make for more enduring effects, especially as bureaucracies are often too weak to effectively implement their national forest policy.

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8 "Co-management of protected areas: tailoring the approach to the context", September 25 1998, at the IAC executive Seminars on Co-management of Forest Resources. Wageningen. See also Borrini-Feyerabend 1996.

The social dimension of sustainable forest management, however, should not be narrowed to co-management only. An important social condition for sustainable forest management is the recognition and respect of customary principles of forest tenure and management. These principles structure local notions of justice with respect to forest exploitation, as well as they structure current and future behaviour vis-à-vis the forest. The recognition and respect of such principles, guarantees the maintenance of local people's social and economic well-being over time.

The social component of the concept of sustainability entails empowerment in the sense of getting a voice in the management and exploitation of the forest on which they depend. This implies including the possibility for Bagyeli to prevent or restrict particular types of exploitation, e.g., logging, or to formulate conditions as to species to be spared, damage to be avoided, and compensation measures to be taken.

Following this introduction of my views on the function of social science research in the TCP, and on co-management and its relation to sustainable forest management, I will now turn to my own research.

3 THE RESEARCH ON BAGYELI PYGMIES

Bagyeli pygmies strongly depend on uncultivated -"wild"- forest resources, as hunting and gathering are generally their main economic activities. Bush meat and the seeds of the *Strophanthus gratus* liana are some of the major sources of income. Bagyeli live in small groups scattered over the forest, usually their camps are located at some distance from the roads. Numerically they are a minority if compared to Bantu villagers -farmers- in the rain-forest of southern Cameroon.

Two main themes figure in this PhD research. Bagyeli mobility is studied in its several forms, the changes that took place over time, and the factors influencing such processes of change. To this end, histories were reconstructed of the mobility of particular families. Furthermore, and in connection to this, Bagyeli management of forest resources and its dynamics are subject of study. For this purpose, issues are examined such as the mechanisms governing the distribution of the various collective and individual rights to natural resources, the management of conflicts on forest resources, and factors influencing local management. These main themes must be understood in their context, which brings me to the supporting research topics: Bagyeli social organisation, the composition of packets of economic activities, the changing relations to Bantu villagers, and the influence of external agencies (such as NGOs, logging companies and the Cameroonian authorities).

I collected data over 18 months in a period of three years, using a combination of several research methods. Semi-structured interviews and participant observation, the standard anthropological research methods, provided me with a large body of qualitative data. For particular issues, specific additional methods were used, such as archival research and the use of questionnaires.

Two Bagyeli camps were selected for long-term, in-depth research: Mangamé and Minlolemio. Both were situated in the vicinity of the road connecting Kribi to Lolodorf. For comparative purposes, briefer research visits were made to some six other locations[9]. Furthermore, two students gathered additional data in Ngalé and Maboulo respectively. In this way, an estimated ten percent of the entire Bagyeli population of southern Cameroon (part of which is living outside the TCP area) was covered.

4 MAIN ISSUES ARISING FOR FUTURE SUSTAINABLE FOREST MANAGEMENT

I will now present a selection of the contributions that my research can make to discussions on sustainable forest management in general, and to those on co-management in particular. The first two issues disclose some of the basic assumptions underlying these debates. The third one provides insight in the way Bagyeli perceive current commercial logging activities and the environmental effects.

4.1 Mobility: Bagyeli "Community" not geographically demarcated

In debates on co-management, it is a common assumption that each particular part of the forest is related to a geographically defined group of users. A "community" is often equated with a "village". However, this assumption does not hold true for the Bagyeli in the TCP research area. This is due to the fact that the rights to control, exploit and allocate forest resources are distributed by two separate social entities. Every Bagyeli is labelled both as belonging to a base-camp (geographical position), and as a member of a kin-group, namely of a section ("houses") of father's and mother's patri-clans. These entities overlap each other only partly. As Bagyeli derive their collective rights to forest resources from kinship ties, and kinship networks stretch over large distances, each section of forest can be used by a group of people which is more encompassing than the current residents of the camp in the immediate vicinity. As a consequence of their spatial mobility, Bagyeli do in fact make use of their rights in forests other than the one in which they live. The intensity of such exploitation varies from a temporary collection of a specific resource to a more general and lengthy exploitation of forest resources during a longer stay with kin.

To elucidate this point, I will give an example of one Bagyeli couple: Tchagadic and his wife Silpen, who live in a camp called Minlolemio. Through their parents, their own marriage and those of Tchagadic's sisters, they have the right not only to exploit natural resources in the forest in the immediate vicinity of Minlolemio, but also with their kin and in-laws in places such as Ngalé, Bitoumbi, Lobé, Maschooh-Maschooh and Yanebouti. Some of these forests are near this couple's place of residence, others are as far as forty or fifty kilometres away. Note that Tchagadic's sister's children and in-laws have similar rights in the Ndtoua area. There is a large network of mutual rights, and mobility makes Bagyeli actually effectuate those claims.

With this example I hope to have made clear that groups of Bagyeli rightholders to natural resources are not geographically defined. If future arrangements for more sustainable forest management are based a choice for zoning, these would risk to be made with the current inhabitants only. This results from notions on exploitation of resources developed in western,

[9] These locations are Binzambo, Nyamenkoum, Kaba-Mbango, Maschooh-Maschooh, Yanebouti and Bitoumbi.

sedentary societies, taking geographical entities as a criterion rather than kinship. However, if applied rigidly to the southern Cameroonian context, such an approach leaves out related rightholders living elsewhere, who will certainly come and manifest their rights some time in the future. This is likely to create controllability problems. Therefore, when developing such arrangements for areas inhabited by mobile peoples, provisions will have to be made for the rights and the responsibility for the behaviour of these "distant" individual stakeholders.

4.2 Heterogeneity of "the local populations"

Bagyeli share their kinship system and clans with villagers, as well as they share (classifications of) forest space and some of the norms with respect to access to forest resources. From a management point of view, one could therefore be tempted to consider these groups as a homogeneous unit.

However, there are some crucial differences between Bagyeli and Bantu farmers that matter for future sustainable forest management. Bagyeli have different interests in forest resources than do villagers, and their power positions in dealings with outsiders differ too. In the first place, Bagyeli are more affected by future new rules regulating the access to these forest resources than farming populations, because Bagyeli economic dependence on wild resources in the forest is stronger. Hunting and gathering wild forest products is a major economic activity for most Bagyeli; professional traditional healers completely depend on forest ingredients for their treatments. Nearly all Bagyeli live inside the forest area (as opposed to the road-side). In the second place, as a consequence of their relative mobility, Bagyeli effectuate their rights in large forest areas much more frequently than farming villagers do. These areas include those forests at a distance from their place of residence, forests inhabited by their kin. The importance of this point was demonstrated in the preceding paragraph. Furthermore, Bagyeli power position in dealings with other groups and institutions (villagers, Cameroonian government, logging companies etc.) is weaker. Among other things, this arrear if compared to farmers, is due to Bagyeli's limited knowledge of administrative procedures, limited eloquence in French, limited negotiating capacities, and the cultural norm of avoidance of conflicts and violent controversies with outsiders.

This is well reflected in logging companies "negotiating" with villagers prior to starting the activities, in the absence of Bagyeli. Villagers cannot be expected to defend Bagyeli interests vis-à-vis outside agencies. Consequently, it is necessary to pay special attention to Bagyeli in the process of future decision-making on the forest, and in the distribution of benefits. Bagyeli, and their organizations such as CODEBABIK, should explicitly be enabled to take part in such discussions.

Limitations of space do not allow me to provide additional material on the assumptions behind the debates on the social component of sustainable forest management. Yet I do want to take this opportunity to enrich the foresters' debate on logging damage (see van Leersum, this volume) on the basis of my material on Bagyeli perceptions of current logging activities.

4.3 Bagyeli perceptions of current logging activities

Years after the logging activities have stopped, their negative consequences for the availability of certain forest products are still being felt by Bagyeli. These are not at all counterbalanced by the positive effects of the temporary presence of the labourers.

Bagyeli tend to think of logging in terms of wasting or spoiling the forest. These views are "gendered", that is, men and women each have their own type of stories. Male hunters complain about the larger game being chased away by the noise of the heavy machinery used during the logging. In their experience, these animals return to the area only years after the logging has stopped[10]. The changed light conditions make for an increased density of understorey, which hampers the pursuit of game. Furthermore, these men are affected by the destruction of part of the Strophanthus gratus liana population, their main cash "crop", torn down with the felling. Professional traditional healers, in their turn, particularly regret the destruction of medicinal trees. Bagyeli women, on the other hand, see themselves confronted with damage done to trees from which they used to gather the fruits and kernels. Frequently, the demolition of these medicinal and food trees is an accidental side-effect of the logging operations, as there is only a partial overlap between locally highly valued species and the commercially interesting ones. Contrary to that against agricultural crops, this damage done to the fauna or to uncultivated-but-valuable plants in the forest is not compensated by the logging company.

Nevertheless there is some ambiguity in their views. Some of these Bagyeli profit from the logging activities. A few exceptional young Bagyeli men manage to obtain a temporary job in the logging industry. Some Bagyeli informants are able to use to their advantage the ecological changes provoked by the felling of trees. At one location, the pygmies consider the opening up of forest space an advantage for starting a new agricultural field. At several other locations, the increased density of the soil vegetation is known to serve as hiding places for smaller game. The technique of net-hunting is practised here in particular to make optimal use of this concentration of animals.

This last paragraph provides a view on the logging damage which is complementary to that from a forestry expert's perspective (van Leersum, this volume). Forestry research focuses particularly on the destruction of vegetation in the logged areas (special attention for loss of timber), soil compaction and the excessive construction of infrastructure. Such a frame of reference is inherent to the forestry discipline. However, it is essential to keep in mind that this is but one of several possible ways of seeing commercial logging and the damage related to it. Describing and discussing, e.g., Bagyeli experiences with commercial logging is one of the necessary preconditions to bridging such cognitive gaps.

[10] When logging activities had ended in the forest south of Bidjouka, ten years passed before Bagyeli hunters saw signs of the return of gorillas.

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LOGGING RESEARCH FOR THE DESIGN OF A FOREST MANAGEMENT PLAN IN SOUTH CAMEROON.

Gart van Leersum

ABSTRACT

The F1 project "Logging, Damage and Efficiency" is one of several other forestry research projects within the Tropenbos Cameroon Programme. The objective of the study is to design a rational timber harvesting system, with emphasis on restriction of damage, improvement of efficiency of operations and a sound interaction with the local population in the area. The design should take into account the latest developments in global logging research, as far as local conditions permit.

The study was carried out in several working coupes of one of the best organised logging companies in the country. It started with an inventory of current logging practices and linked these practices to the damage levels and patterns in the area. Potential adaptations to the current logging method were then identified and tested in the forest. At the moment the test results are being analysed and the proposed harvesting system is being described.

The study has gained better insight into the extent and the nature of conventional logging damage as well as the current utilisation rates of felled timber.

The technical aspects of the rational harvesting system to be proposed will greatly resemble the current 'best practice' in the area. The results of the research show that substantial damage reduction can not be expected, due to the study area's specific forest composition, the large timber dimensions and the relatively poor cartography service available to the forestry sector.

The most significant difference between current best practice and the model logging system lies in the insertion of a pre-felling planning phase in order to give room to silvicultural considerations and the inclusion of local people's interests. For a shift to "precision forestry", with the objective of maximum damage reduction, far better topographic information of the area is needed and maybe a move will have to be made to advanced teledetection methods. Apart from the possible legal obstacles, possibilities for the local population to guide and co-supervise logging in the area are present. The presence of the logging company in a certain (coupe) area will have to be continuous in order to establish relationships of mutual understanding and benefit between these two stakeholders.

INTRODUCTION.

With the ever-evolving insights in the complexity of the management of Cameroon's tropical forests, the management plans are becoming increasingly complex. From a relatively simple, that is purely timber production focused management plan, the concept now seems to develop into a rather detailed scenario including the rights and obligations of all parties concerned during the preparation and execution of the plan (ONADEF, 1991; ONADEF, 1997). Much emphasis is nowadays placed on local people's participation. Whether this aspect is sufficiently elaborated remains at the appreciation of the social scientists within the Tropenbos Cameroon Programme and will be dealt with during this seminar.

As much as there is a need for codes of practice vis-à-vis the local population, a further specification of how a logging company executes or should execute the logging activities has to be part and parcel of a forest management plan. Surprisingly, governmental concepts of how concessionaires should execute their logging activities have seen very little reform over the last decade. Prescriptions for logging road and landing construction are sometimes mentioned, but clear regulations concerning felling and extraction of the trees - normally the two most damaging operations - still do not exist. The 'Guidelines for logging enterprises' of 1988 in Cameroon (MINAGRI, 1988) do not pose restrictions on the logging exercise. It does not mention, for instance, any guidelines for skidding operations. Felling should be carried out causing the least possible damage, without further specification. Only inventory has recently been subject of a guideline (ONADEF, 1992).

A logical set of harvesting and management guidelines should be developed for Cameroon to enable proper monitoring during and verification after the lease period of the concession. It should be made possible to hold a concessionaire accountable for the damage created in the forest. Ideally, the concessionaire should also be obliged to switch to production technologies, which further reduce damage inflicted to the residual stand. To that end, FAO has recently developed some very generic codes of practice for logging with damage reduction and improvement of utilisation rates as primary objectives (FAO, 1996). Furthermore, CIFOR, amongst other organisations, is trying to integrate these codes into local sets of criteria and indicators for sustainable forest management (Prabhu *et al*, in press). Putting these codes, criteria and indicators into practice for the case of Cameroon is now much needed.

The Tropenbos Cameroon Programme can contribute to a further specification of the codes of practice and criteria and indicators for logging and silvicultural operations in the rain forest of Cameroon. The F1 research project, entitled "Logging, Damage and Efficiency' was formulated with the objective of designing a rational timber harvesting system, with emphasis on restriction of damage, improvement of efficiency of operations and sound interaction with the local population. The outcome can well serve as a guideline for the design of codes of practice for the logging industry in Cameroon.

The F1 project started in March 1994 and will finish by the beginning of 1999. Various sub-studies are still being executed and data is still being processed. This presentation gives an overview of some of the most important results and of how they put the quest for reduced impact logging in its perspective.

CONCEPTUAL FRAMEWORK.

Publications on reduced impact logging for sustainable forest management have been on the increase since the start of the Tropenbos Cameroon Programme. Many researchers - Crome *et al* (1992) in Australia, Blate (1997) and Johns *et al* (1996) in Brazil, Webb (1997) in Costa Rica, van der Hout (1996) in Guyana, Bertault and Sist (1995) in Kalimantan, Pinard and Putz (1996) and Cedergren *et al* (1994) in Sabah - have taken up the topic and all describe its advantages. In addition, international organisations such as FAO, IUFRO and CIFOR have held consultative meetings on the issue of reduced impact logging (FAO, 1996). So far, very few results on reduced impact logging have been recorded for the African tropical moist forest.

Table 1 gives a summary of the common denominator for the harvesting and post harvesting operations amongst the above and various other publications (e.g. de Vletter, 1993; van der Hout, pers. com.) as well as the author's opinions at the onset of the project. Together they make up the outline of what could be called the logical framework of a model harvesting system for sustainable timber logging. It is within this framework that the logging research in the study area has taken place.

Table 1: Characteristic elements of a model timber harvesting system for tropical moist forests.

Harvesting phase:	Features/issues/purpose
Inventory:	
scale of maps	1: 5000, balance between information density and size
full topography	location of dissections in terrain, obstacles to skidding
inventory unit size	20-50 ha, prospector density and communication
marking/mapping of timber trees	including their natural lean
climber cutting	well in advance, at individual tree level
girdling of timber trees	reduction of crown biomass
marking/mapping of potential crop trees	to spare them - gives an indication of tree population
marking/mapping of NTFP trees and sites	to spare them - with local people's participation
report	relay information to planning department
Pre felling logging activities:	
planning	
*assignment of buffer zones	forest protection within the working coupe
*tree selection	
**assignment of seed trees	1 per 10 ha per species (>60 cm)?
**assignment of harvestable trees	60% of harvestable stock? trees to be spared for local people
**felling pattern	scattered or clumps?
*felling direction	avoiding NTFPs, pct, adverse angle with trail, single or multiple tree felling gaps
*skid trail alignment	design system of unambiguous, shortest tracks
*report	relay planning outcome to local people /prescriptions to field crews
marking of skid trails	extra orientation for felling direction of trees
report	feed back alignment results to planning
Felling:	
tree selection	only felling of trees indicated by planning
felling direction	check whether planned direction is realistic
directional felling	avoid damage to pct and NTFPs, avoid unfavourable angles
bucking	} avoid skidding problems
cross cutting	} according to log size preferences outside forest
report	relay information to skidding crews, feed-back planning dept.

Skidding:	
marking of skid trails	present unambiguous trail to operator
construction of skid trails	computer aided, computer controlled?
construction of creek crossings	hollow trees as culverts, feller present
stump operations/winching of logs to trail	reduction tertiary trails/stump site damage, communication
skidding to landing	remain on trail, terrain conditions
report	relay information to transport crew, feed-back planning dept
Road and landing construction:	
clearing width	depending on orientation towards sun
wildlife corridor	connected crowns of bordering trees
durability	shape, compactness, top layer material
Post harvest operations:	
felling gaps	sanitary operations on trees, diseases, growth stimulus
skid trails	ploughing, blocking, removal of culverts
main roads	to remain open for local population
feeder roads	blocked to prevent re-logging and hunting
bridges	blocked to prevent re-logging and hunting
landings	ploughing, 60 cm depth

From the above table can be perceived that the experimental logging concept more than ever implies planning of activities at tree level. The decisions concerning the felling of a tree are no longer based on harvestable diameters and physical state of the tree at the discretion of the feller. They should now be based on the tree's position vis-à-vis the surrounding trees, its place in the species population, its role in the ecosystem and its importance to the local population. In addition, the new concept foresees more feed back of information from the harvesting exercise to the silviculturalists and more relay of tree bound information between the harvesting phases themselves. The F1 study looks into the technical feasibility of the above mentioned components and the necessity of their introduction in Cameroon.

METHODOLOGY

Research site.

The concession where the study was carried out is situated in the evergreen moist tropical forest zone. Emergent trees in the area reach heights of up to 50-60 meters and their trunk diameters may measure up to 2.5 meters. A recent survey showed a basal area value of 31 m²/ha, which is well above the pan-tropical average. The number of species found amongst trees of >10 cm dbh ranges from 70 to 86 per hectare (Foahom and Jonkers, 1992). According to the vegetation map of Letouzey (1985), the forest belongs to the mid-altitude evergreen forest dominated by *Ceasalpinaceae*. This family is indeed well presented, but the most important species is Azobé (*Lophira alata*), characteristic for the low altitude evergreen forest. The logging company is particularly interested in this species for marine constructions and railway sleepers.

Figure 1. Location of the study area

A substantial part of the forests has in the past been subject to slash and burn agriculture. Young secondary forests and lands currently used for agriculture are restricted to the vicinity of roads and cover 16% of the area. Old secondary forests cover about 33% and 'primary' and selectively logged stands occupy the remaining half of the total area. The presence of Azobé indicates that most 'primary' forests are in fact very old secondary stands (Letouzey, 1985).

The study area is sparsely populated (five inhabitants/km²). Most people live along the roads, which form the boundary of the concession area, and along the major truck roads inside. The local population consists mainly of Bantu's who practise shifting cultivation for subsistence and produce cacao for cash on smallholdings. Gathering and hunting used to be the mainstay of the pygmy minority and still is important, although these people are gradually becoming sedentary farmers (Foahom and Jonkers, 1992).

The climate is hot and humid, with average temperatures of approximately 25 °C and a mean annual precipitation of 2000 - 2500 mm. Two rainy seasons and two dry seasons can be distinguished. The periods December-February and July -August are comparatively dry with a mean monthly precipitation of 80 mm or less. The wettest months are April, May, September and October, with an average monthly rainfall of 200-400 mm. These figures justify the classification as a tropical rainy monsoon climate (Am) sensu Köppen (Foahom and Jonkers, 1992).

The landscape is variable. The terrain is undulating to hilly, with locally some very steep slopes (80%), especially in the eastern part. Altitudes are mostly low, ranging from 100 m in the western part to 1000 m in the east. Weathering of pre-Cambrian parent material has lead to predominantly poor, acid and ferrallitic sandy clay soils in the area (Foahom and Jonkers, 1992).

According to the land classification map made by the Programme (Hazeu, pers. com.), three landscape types can be distinguished in the research area. Figure 1 shows the coupes 1222 and 1223 in the Programme's study area, where this specific study was conducted. These coupes are located in the intermediate landscape region with altitudes of 350 -500 m. a.s.l. and locally very steep slopes. During the field work, the terrain turned out to be heavily dissected.

Description of current logging practices.

Trying out the blueprint of the model logging method in Cameroon primarily involves comparison with the current logging practices in the country. To that end, the research has started with a description of the logging operations of one of the best-organised logging companies in Cameroon in the South Province. The reason for choosing the best possible organisation ('close to best practice' cf. de Koning *et al.*, 1995) is manifold:

* The model harvesting system strongly hints in the direction of more (tree level) planning and communication. The company already incorporates a high degree of planning in the logging activities. Testing the validity of the model's last details to be added can thus best take place with the 'next best', practical alternative in this respect. For illustration: comparing the latest model vacuum cleaner with a broom is not very challenging.
* Field-tests and comparisons are, due to their expensive nature, invariably very small-scale activities. When choosing the sites for comparison, one risks selecting the most ideal places, without knowing how representative these are for normal, conventional logging. Without careful study of production figures obtained over longer periods, one may overlook the overriding conditions during logging. The company, because of its planned way of work, possesses a great amount of cost and production figures, which help to put the comparison of an experimental set-up with a current practice in a more realistic perspective.

* The company, by practising some form of planning and reporting, has already validated these aspects of logging for Cameroon. If the Government of Cameroon should decide to adopt the majority of the recommendations of this study and enforce them in the logging sector as a whole, a close example of how they can be put to practice in a profitable fashion will already be at hand.

The description comprises a time and method study of the phases: inventory, felling, skidding, landing operations, truck road and landing construction and transport. Financial, administrative and general managerial aspects were included as much as possible, with the objective to better understand the rationale behind what can be perceived in the forest and what is proposed in the conceptual framework of table 1. This description should already give an indication of the most damaging operations and provide the scope for possible adjustments for the reduction of damage.

Damage study.

A systematic damage study was carried out in twelve 25 hectare plots in working coupe 1222 (2500 ha, Fig 1). The study assesses the amount of logging disturbance in a specific working coupe and tries to specifically correlate damage patterns with harvest levels and terrain conditions. For this study, damage has been defined in terms of the disturbance of the soil and vegetation projected at ground level, demarcated by the last injured seedling and tree branch or the last inundated sapling (in case of water logging at creek crossings). Soil compaction may be minimal (in the case of felling) or severe (skidding, landings, roads) in the measured area. The unit of measure is m^2 disturbed area per m^2 plot surface (25 ha) and can consequently be expressed in percentages. The expression in surface and the actual mapping of the surfaces was opted for in view of the communication with disciplines like ecology and social science within this multidisciplinary research programme.

In addition to this systematic damage survey, a smaller, less representative damage sample (4 x 25 ha) was taken in the working coupe of a local, least organised logging enterprise at Bivouba in the South Province. The primary objective here was to assess the re-utilisation of old truck and skid roads in a previously logged over concession. This study also provided insight into damage levels and patterns, which can be correlated to production method and technology level.

Field experiments.

In a third phase, potential adaptations to the operations with the aim of damage reduction were identified and tested. Finally, a small-scale field comparison (120 ha) was made between conventional and experimental logging. Now the test results are being analysed and the proposed harvesting system is being described.

SYNTHESIS OF THE PRELIMINARY RESULTS.

1. Description of logging operations.

Forest harvest inventory is carried out by the concessionaire at 100% level and the result is plotted on 1: 5.000 maps. The inventory is carried out per working coupe of 2500 hectare. Within the coupe a 1000 x 1000 meter block is enumerated by a crew of 4-5 persons, working a 100 meters apart. Only the trees with a diameter well above the cutting limit of only the species that the concessionaire may be interested in are enumerated. The topographical foundation for the inventory map is obtained through enlargement of the Government's 1: 200.000 maps and field data. The resulting maps are used mainly for harvest and marketing

planning, for truck road alignment and for felling. To a far lesser extent, these maps are also used for skidding.
Felling is carried out in two or three men's team of which one handles a Stihl chainsaw with only some very basic features. The felling technique is rudimentary. Harvestable trees are always emergent, with diameters at breast height of 116 cm and a bole volume of 13 m^3 on average. Few commercially important species have buttresses. The trees are felled in the direction of their natural lean. The direction is rarely but successfully altered in case of possible damage to agricultural fields. Trees are subsequently bucked and crosscut without any information on the log lengths desired further down the production chain. The felling productivity in the study area was monitored for 6 months and calculated at three trees per effective working day per feller.
Skidding is carried out with D7 dozers and Cat 528 skidders. The D7 constructs the trail to the stump site and prepares the log(s) for transport to the landing by the Cat 528. Trail construction is mostly going from gap to gap in the forest, rarely guided by an inventory map, which to that effect is too rough anyway. Tree skidding is executed one tree or one log of a tree at a time. Prolonged activities under terrain inclinations of more than 20% are avoided. The large tree dimensions and the adverse terrain conditions in basins and on hills lead to a skidding productivity of five logs per skidder per day (over a period of 6 months). At the landing site, logs are further cross-cut to improve their appearance before transport and sale.
Truck roads are aligned on the basis of the 1: 5000 inventory map and extensive reconnaissance in the forest. Roads are cleared with a D8 dozer at a rate of approximately 100 meters a day, highly depending on the terrain conditions. Felling of large trees and additional clearing of vegetation alongside the road for more rapid drying of the road surface is carried out by fellers. Road grading is partly carried out by D7 dozers and partly by graders. Compaction with vibrating smooth rollers is not practised.
Log transport is carried out with a fleet of 12-16 dolly trucks with a loading capacity of 25-35 tonnes.
Logging administration and reporting comprises recording of the daily production per crew. The administration format may differ substantially between crews and is primarily geared towards recording the amount of logs produced per day. The system serves for the payment of bonuses and the monitoring of stocks in the forest and on the landing. Due to a lack of corresponding tree and log numbers on the various forms, these reports can at present not be used as a monitoring tool for the utilisation rate of felled timber.

2. Damage.
The disturbance level in the study area due to logging under conventional conditions ('close to best practice') has been estimated at 5%. This means that 5% of the area designated for logging has incurred disturbance, either in the form of compaction of the soil by the logging machines or removal of forest vegetation and damage to standing trees through falling trees. The subdivision of this damage level can be found in table 2 below.

Table 2: Average level of disturbance of the forest due to logging activities. Measured in 12 plots of 25 hectares within a working coupe of 2500 ha. Difference in total is due to rounding off.

Logging activity	Damage level (% area disturbed)
Felling	1.4 %
Skidding	1.1 %
Road and landing construction	2.7 %
Total	5.1 %

This total of 5.1% is well below what was expected and is primarily related to the low harvest level in the coupe. The calculated average yield in this study amounts to 0.3 trees per hectare, which differs greatly from the 0.7 tree/ha expected from the inventory results. This difference could have four causes:

* The area presented problems of accessibility. In addition, some patches in the forest were very poorly stocked with harvestable trees and consequently not entered by the concessionaire.
* The distance of the southern coupe boundary to the village of Ebom is only 2-3 km and so the forest contains large patches under agriculture, which were skipped by the concessionaire.
* During the study, the concessionaire maintained a temporary shortened list of species to be cut for reasons of marketing.
* The concessionaire is only interested in trees from the larger diameter classes. Some inventoried trees do not reach the desired dimensions.

The composition of the total damage level needs clarification. Half of the damage comes from truck road and landing construction. Normally, this category would not be greater than 10% of the total damage. In the study area, however, the following exceptional situations occur:

* Road density is very high in the parts where logging takes place. Roads are not very far apart from each other, each following one the many ridges in the heavily dissected terrain. In this way, skidding on the swampy downhill slopes and basins is kept to a minimum.
* Road width is great. The study was carried out in a 'vente de coupe', which is a working coupe allotted to the concessionaire only shortly before logging. The roads through this coupe are constructed only very briefly before actual logging takes place. Only little time is available for the roads to dry up and the concessionaire therefore exposes the road to the sunlight as much as possible by opening the trace excessively broadly (fig 2).
* The log landings in the area are extremely oversized (fig 2), possibly for the same reason as above. In addition, unnecessary landings can be perceived; landings with no connecting skid trails. This coincides with the instruction to construct landings every 500 meters, which is observed too rigidly by the forest crew.

Based on the damage maps, the amount of avoidable road construction has been estimated roughly at 30%.

The overall disturbance level in coupe 1222 may be low, but there is great local fluctuation. According to the measurements in the sampling plots, the damage can vary locally from 0% to 25% of the area. The corresponding harvest levels can locally go up from 0 to 1.8 tree per hectare. Figure 2 shows the damage patterns in four sample plots.

From these damage maps, in combination with a method study carried out in the area, the logging damage (skidding damage more specifically) can be described and correlated to various variables.

Hilly terrain does not necessarily lead to increased skidding damage levels as one would expect (van Leersum, unpublished data). Facing hilly conditions, the forest crew may decide not to enter the area or, if they do, the machine operators tend to be extremely careful in their movements in order not to get stuck and incur production losses. On the other hand, flat terrain, especially in the poorly drained basins, may lead to high degrees of avoidable skidding damage. The relative ease of movement on flat terrain makes the creation of extra skid trails the easiest solution to bypass deteriorating terrain conditions. This practice is firmly rooted in the operator's belief that the forest will be able to unconditionally cope with the damage incurred (van Leersum, unpublished data).

Figure 2: Logging damage patterns in four sample plots in working coupe 1222. Landings, truck roads and skid trails in black, felling gaps are dotted. Source: de Hart and Kampen (1995) and Ndjofang (1996).

Harvesting more trees leads to more disturbance of the forest. Even in the plots with the highest harvest levels, the felling and skidding damage still increase proportionally with the number of trees felled. The distances between the trees to be felled in the current logging density range (up to 1.8 trees/ha in our study) is still too large for the tree crowns to overlap substantially in a multiple tree gap. The multiple tree gap is more of a conglomerate of neighbouring tree gaps than an area where felled tree crowns meet and overlap. The increment in total felling damage or felling gap area per tree consequently does not decrease with an increase in the number of trees per hectare harvested (van Leersum, unpublished data).

The distance between two consecutive trees to be logged is on average 92 meters and is so large that careful planning of the trees' direction of fall to facilitate subsequent skidding is not necessary. There is always enough room to approach the tree under the best possible angle. However, the skidding maps show that at higher harvest intensities (and thus under shorter tree distances, around 50-60 meters), the frequency of trees extracted under adverse angles increases and that the skidding pattern turns messy. The necessity to plan and communicate more carefully during skid trail construction does become apparent then (van Leersum, unpublished data).

Dozers entering the gap area is a frequent phenomenon as this always happens. On average an area of 50 m2 round the stump is compacted by the dozer. The total amount of avoidable damage incurred this way, amounts to 10% of the total skidding damage. This practice roots firmly in the tendency amongst dozer operators to leave the log at the stump site under the best possible conditions for further transport by the skidder. Best possible conditions here means the stump area clear of undergrowth and felling debris. Moreover, the log is pushed through its cross cutting kerf to make sure that the log is loose from the rest of the felled tree. The log should also be partly lifted from the ground so as to facilitate the attachment of the winch cable and ease the pulling by the skidding crew. This log lifting with a dozer blade causes considerable extra damage in an already sensitive microenvironment (van Leersum, unpublished data).

The amount of avoidable skidding damage has been assessed at roughly 20% of the total skidding damage (van Leersum, unpublished data). Avoidable damage comprises the obvious parallel trails, shortcuts and trails not leading to any harvestable tree within the context of conventional logging. The combination of damage maps and method studies revealed that the most important factors for the creation of avoidable damage are:

* Rain and unstable, saturated ground conditions. This is probably the single most important factor. Logging in the area is practically a year round activity with only a break in October/November. During the week, skidding is only stopped when the daily output starts to equal zero. In other words, skidding continues under even the most humid conditions. It is then not very surprising that a skid trail rapidly deteriorates immediately after the first passage of a dozer or skidder.
* Deviation from the planned skid trail tracé. This follows from the above. It is noteworthy here that some degree of good quality on-the-spot-skid trail planning already exists in the area, but that this planning can not outweigh the consequences of entering the forest under moist conditions.
* Lack of control of machine movements in the forest. The machine operator is his own boss; he can set his own standards of work as long as he produces the logs on the landing, there is nobody around to check on him. This used to be different several decades ago (Mâry, pers. com.), but nowadays the supervisors of the logging operations largely remain on the landing and only inspect the logs that effectively reach the roadside.

* Lack of environmental sensitivity amongst the operators and supervisors. Again, this follows from the precedent point. Having been asked specifically about their opinion on the necessity of damage reduction, most operators replied that the forest will regenerate anyway.
* Large volumes per tree. The diameters are such that even with the shortest log length of 6 meters for sawn wood, the corresponding weight of the resulting volume becomes hardly manageable for the current generation logging machines. The skidding damage around the stumps, due to the skidding machine manoeuvring and manipulating badly crosscut logs or logs stuck in the mud, constitutes 10% of the total skidding damage.
* The skidding machines are not up to their task under these circumstances. Bulldozers are not even designed for forest operations other than road and landing construction. Adaptations are thinkable to make this machine a more adequate forestry machine, but they have not met with manufacturers' attention or interest so far. The skidders are indeed typical forestry equipment, but for the African timber dimensions, the largest machine, a Cat 528, is even too small and lacks sufficient traction. Larger equipment, how contradictory this may seem, would surely perform better under the given situations and thus create less damage. Unfortunately, the project could not experiment with adjustments to machinery at a practical scale.

3. Efficiency

Increasing efficiency of operations (i.e. increasing timber recovery rates from felled trees) leads to less forest area affected and less damage created by a logging company per period. Koops (1996) did a post-harvest study on timber losses from felling to saw milling in the study area. His results are summarised in figure 3.

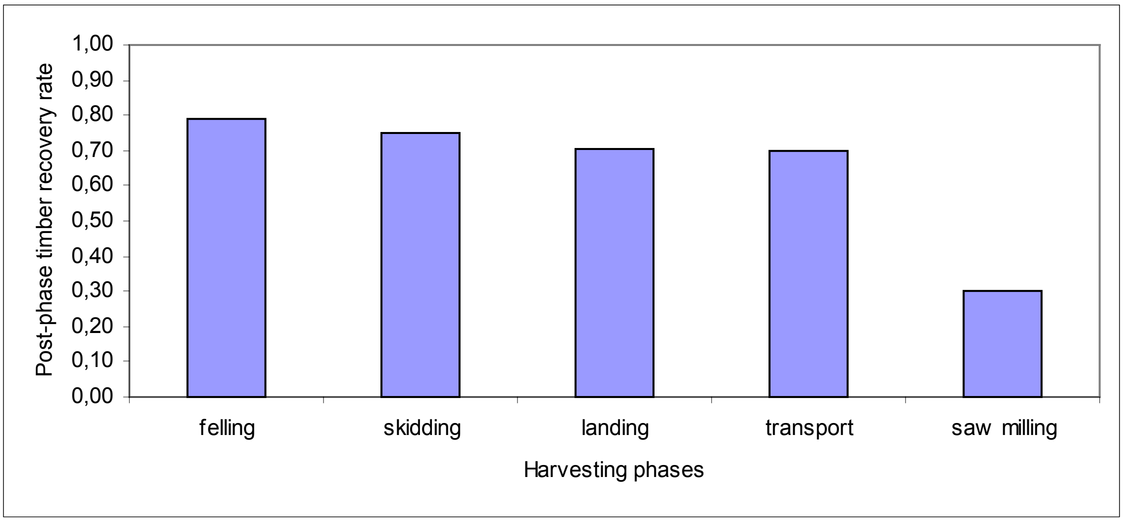

Figure 3: Efficiency of various sawn wood harvesting and processing phases. Values (%) indicate the average cumulated relative decrease in timber volume per felled tree after each phase. Source: Koops (1996).

It was felt that this study did not need to be preceded by a complete inventory of the standing stock in order to measure the efficiency of the inventory and the retrieval of enumerated trees in the felling phase. Other research had already shown that 15% more trees are felled than inventoried, thus demonstrating the relative inaccuracy of current inventory techniques, which eventually pass unsanctioned (Leersum, unpublished data).

Figure 3 shows that the amount of timber eventually delivered at the sawmill amounts to 70% of what had been felled initially in the forest. Most of the 30% timber loss occurs during felling. The 21% loss in this phase consist of abandon of the conical butt end of the log (15%). This part of the bole will be rejected by the sawmill and/or may have split during felling. Rot and badly shaped trees and logs take up 6%. Suspended trees, trees broken after fall or lost in a valley bottom generally amount to less than 1% (van Leersum, unpublished data). Only a rough, very conservative estimate was made of the amount of timber lost because of bad bucking of the tree, i.e. cutting off the crown part at too low an altitude. The calculated 7-10% was confirmed by the concessionaire (Hollander, pers. com.). During skidding, 5% of the logs does not reach the landing. Logs abandoned on the skid trails account for this considerable amount. The reason for abandon here may lay in interruptions during skidding due to difficult terrain conditions causing machine problems. Logs are then left alongside the trails and the machines are towed to the landing. From the logs actually arriving at the landing, another 6% loss has to be extracted, due to crosscutting of muddy or infected cross sections at both log ends. This is done to give the log a better appearance after skidding as clients may arrive to hand pick the logs they desire. This selection is based on the exterior in general, but more specifically on the growth ring pattern. Being overlooked for transport is another reason for loss of timber at the landing site. Waiting periods for logs to be transported of well over 3 months have been recorded (van Leersum, unpublished data). A survey of harvestable trees omitted for further logging during road and landing construction as well as estimates of losses during truck transport report totals below 1% (van Leersum, unpublished data).

When looking beyond logging in the timber production chain, the largest single most timber loss (43%) can be recorded in the sawmill. This is mostly due to internal deficiencies of the wood, the round log shapes and to a far lesser extent to the inappropriate log length assortment entering the mill. Log perishing on stock in the sawmill's log yard does not represent considerable losses (Hollander, pers. com.) The recovery rate in the sawmill of an export company in a duty free zone seems low because it is defined as only the fraction of exportable timber per volume of incoming logs. Second grade timber, still usable for local use in neighbouring villages is considered a loss and is disposed of at virtually no cost to middlemen. When comparing the volume of sawn export timber with the volume of the tree felled, one arrives at the remarkably low timber recovery rate of 30%.

From the above, it follows that the main causes for timber loss during logging are:

* Quality demands on the harvested produce imposed by the sawmill and the export branch within the company. This may be by far the single most important issue.
* Natural factors like tree rot.
* Reporting and administration. At the end of the logging exercise it remains unclear which part of the felled tree has been removed from the forest and which parts are still there to be extracted. Lack of relay of information and feedback between harvesting phases makes it difficult to quantitatively monitor each logging phase.
* Monitoring and supervision. This concerns a qualitative check by forestry professionals on the work done in the forest. It is to check the abuse of machines, to detect necessities for proper training amongst the operators, as well as to assess the waste and damage created in the forest.
* Remuneration and incentives for the forest labourers. The actual system is based on the shape and volume of the timber at the landing site. It is not based on relatively easily obtainable indicators such as: the timber volume per tree harvested or per quantity of fuel used. This allows for deterioration of felling and skidding techniques.

Field experiments

Within the conceptual framework presented in table 1, some field experiments were carried out to assess the technical feasibility of some, for Cameroon crucial components. Below is a first brief overview of what has been tried out on an experimental scale.

<u>Felling</u>

Directional felling proved to be technically feasible in the study area. Only the rare occasion of a tree with no clear natural lean presents a problem to make the tree fall (into a particular direction). Assessing the natural lean is hampered by the fact that the tree to be felled is emergent and the crown layer closes around its stem at already low altitudes. Visual assessment of the presence of trees to be protected near the tree to be felled poses problems. The visibility in the thick understorey is limited to 30 meters on average and this is exactly where the bulk of the felled tree's crown penetrates the crown layer. Only far more detailed inventory maps would undo this obstacle. However, the damage to potential crop trees is low under conventional felling (Parren, pers. com.). Preliminary results of a field comparison indicate that directional felling does not alter this low level. The explanation may lie in the forest composition itself; in whichever direction one may wish to fell a tree, there is always a small, potential crop tree around to be hit. Climber cutting neither appears to have great damage reduction impact (see Parren and Bongers, 1999). By far the greatest improvements in felling efficiency can be expected from refresher courses in controlled felling and better cross cutting instructions.

<u>Skidding</u>

Skidding does not offer great scope for improvement along the lines which have been developed outside the African continent. Reduction of tertiary skid trails through winching and previous alignment of skid trails on the basis of more detailed harvest inventory are the major promising techniques in this respect. Both have been tried in the study area. Winching over long distances resulted impossible because of the log weights and volumes, obstruction by the bucked, conical butt end and the hilly and slippery terrain. Most attempts ended in the skidder or dozer being pulled to the stump instead of the other way round. Alignment of skid trails based on more detailed inventory maps was executed as well. The outcome of this experiment was that not so much the design of the skid trail grid matters, but rather the terrain conditions. Especially on the wet slopes and the basins, the terrain seriously deteriorates after the first passage. In order to reduce the skidding damage around the stump, various prototypes of a skidding stick were tested with the objective to facilitate the attachment of the logs to the cable of the skidder/dozer. In the relatively few cases where the stick seemed necessary, it did not yield success. Radio contact between someone at the stump site and the dozer operator for better guidance of the latter in his approach of the logs, was also tried, but to no avail.
Supervision of skidding operations has proved to have immediate positive effects on damage reduction. Restrictions related to the precipitation in the area may also have immediate positive effects for damage reduction, but possibly the opposite for the company’s earning capacity. Possibly, as this is still subject of further research. Ground skidding in the study area is difficult. Even the newest skidders and dozers can just cope with the hilly and wet terrain. Improvements in the sphere of improved dozer/skidder traction, possibly implying larger machines, seem to contribute substantially to damage reduction in the area. Harvest scheduling on a yearly basis has still to be looked into.

<u>Harvest inventory</u>

Given the current level of topographic precision, more detailed inventory work in the field does not lead to a better planning tool for logging. The irregularly dissected terrain with great local variations in elevation, still make it impossible to draw a skid trail system without the necessity to double check in the forest before marking the trails in the forest. Even then, the frequency of utilisation of the trails forces the machines to deviate from the intended pattern. Increasing the precision of work and map scale has been experimented with, but to no avail. The blown up topographic map, on which the inventory results are plotted, is too inaccurate for 'precision forestry' purposes. Obtaining topographic information through more costly aerial photographs or radar images of the working coupe may lead to far better results in this respect. This topic, however, could not be included in the research.

Field reporting

Some drafts of improved daily report systems for field crews have been designed and tested. The final draft has not been tested so far.

DISCUSSION

With the current low harvesting levels in the tropical lowland forest of south Cameroon, damage levels remain equally low. At a level of less than 0.5 trees per hectare, the proportion of the area under disturbance approximates 5%. Whether this level - or twice this level - is well or little above the ecologically, sociologically or silviculturally permissible, is yet unclear.

Logging damage has been measured in the concession of a relatively well organised enterprise, which already operates with a relatively high degree of planning and control. The comparison of this logging practice with the full range of Reduced Impact Logging aspects will therefore not show dramatic differences. No doubt a comparison with the practices of a less organised enterprise may put RIL in a more favourable position.

The amount of obviously avoidable damage under best practice conditions has been estimated at approximately 20% for skidding and 30% for truck road construction. Total logging damage could thus be reduced to 4% at the maximum. And they should of course, as anything avoidable when it comes to forest disturbance should be avoided. The price of this damage reduction has not been subject of this debate. The concepts and activities to achieve this reduction are not new in Cameroon. Better communication, reporting and supervision during the various logging phases will already on behalf of the concessionaire, diminish most of the avoidable damage and improve the utilisation rate of felled timber. Other factors, in government sphere (forest zoning, taxation, etc) and outside the scope of daily forest operations, seem to have an even greater impact on the possibilities of taking logging to the required level for sustainable forest management.

With these low disturbance levels, it seems difficult to encounter the sense of more planning during the logging exercise. Even at higher than the actual harvesting levels - as in various sample plots of the damage study -, the necessity to improve planning does not seem evident. Planning is, however, not only meant for damage reduction, but also for the accommodation of forest management (= silvicultural) aspects and for the inclusion of local people's interest in the forest.

The forest management aspects are not part of this study. They are subject of the F2 project: "Growth, regeneration and mortality in managed natural forests". This project has recently completed a large scale forest inventory, which will enable the computer simulation of various planning scenarios during logging. The outcomes of this simulation will put the inclusion of a planning moment in the model harvesting system in its proper perspective.

Furthermore, the significance of the F3 project: “Lesser known species” can also be demonstrated. Also the results from the ecology projects in the Programme and the F4 study: “Forest dynamics in disturbed evergreen forests”, like for instance the preferred gap size and -distribution, still need to be incorporated in the logging scenarios.

As for planning for the sound interaction between logging and the local population, the project has so far gained some insights to be shared within the Tropenbos Cameroon Programme. The time is ripe, as so far, specific draft scenarios have still to crystallise from the interdisciplinary discussions. Nevertheless, some contribution to the discussion can already be made concerning the logging activity.
The 'model' harvesting system foresees various moments in its execution, when people can play an active role in safeguarding their interest. The guiding principle here is: if the local people are concerned with their forest, let them be there when a decision is being and damage is about to be made. Turning to table 1, we can distinguish the following moments:

- Inventory: A forest inventory with participation from the local people ('participatory forest inventory', cf. Ambrose, pers. com.) puts all tree individuals and forest sites of interest to the local population on the inventory map. This map then forms the basis for the silvicultural considerations in the company's planning department or directly for the negotiations between logging company and local people. Objective criteria to determine what people could reasonably claim still need to be developed. These criteria should be as objective as those to be in place for the logging company should.

- Pre-felling planning activities: The assignment of the eventual trees to be felled and the alignment of the skid trail system should include this 'negotiation' between local people's value and logging/silvicultural considerations. Objectivity may be accomplished through rules established by the Forest Administration. These rules should be clear for all. In case of disagreement between logger and people, the Forest Administration should decide.

- Felling, skidding, road and landing construction: in these harvesting phases when the actual disturbance of the forest is taking place, the local people should be present to record whether is adhered to the actual plans. Local people can record whether proper use is made of felled timber, whether logs mistakenly remain behind in the forest or any other abuse of the forest resource.

Training local people in the inevitable map reading and the principles of damage recording has proved to be technically feasible during the project. Strengthening of negotiation power was not a topic. In this respect, it is the author's conviction that the negotiation power of the local people increases when the relationship between the logging company and the local people is maintained at a high level in between two cutting cycles of approximately 30 years apart. The more needs to be done by the local population and logging company in conjunction during the remainder of the cutting cycle, the more committed these two will have be towards each other. The current short presence of the logging company in a certain (coupe) area hampers the establishment of this long lasting, more profound relationship between the two stakeholders.

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FOREST LIANAS AND PRE-FELLING CLIMBER CUTTING IN SOUTHERN CAMEROON: A SILVICULTURAL EVALUATION[11]

Marc Parren and Frans Bongers

ABSTRACT

In southern Cameroon an experiment was set up to test whether pre-felling climber cutting could reduce logging damage. The abundance of lianas in the forest and their resprouting capacity after cutting was assessed. Logging damage was considered as tree mortality and tree damage in the felling gaps and the sizes of the created gaps after felling.
Lianas were very abundant: on average nearly 5000 individuals of which over 100 large ones per ha. Only a limited number of lianas died after cutting. Resprouting capacity was high but variable among species. Felling gap sizes (average 550 m^2 per felled tree) and tree mortality (12 trees per felled tree) and damage (20 trees per felled tree) were not significantly affected by pre-felling climber cutting. A minority of the damage was severe. Smaller trees were most prune to destruction and serious damage.
The results show that pre-felling climber cutting has no significant effect on resulting gap sizes, tree mortality and damage levels. It can be concluded that overall climber cutting does not contribute to damage reductions at the felling sites.

RESUME

Dans la forêt du sud-Cameroun, une expérience a été réalisée pour savoir si le délianage avant abattage pouvait réduire les dégâts de l'exploitation. Ces dégâts ont été évalués à partir des niveaux de mortalité et de dégât aux arbres constatés dans les trouées d'abattage ainsi que par la taille de ces trouées. L'abondance des lianes dans cet écosystème et leur capacité de bourgeonnement après abattage ont également été estimées.
Les lianes sont très abondantes: en moyenne, cinq mille individus par hectare, dont plus de cent de taille importante. Seul un nombre limité de lianes meurent après l'abattage. La capacité de bourgeonnement est haute mais variable selon les espèces. La taille des trouées d'abattage (en moyenne 550m^2 / arbre abattu), la mortalité (12 arbres détruits / arbre abattu) et les dégâts (20 arbres endommagés / arbre abattu) ne sont pas modifiés de manière significative par le délianage. Dans notre cas, une faible proportion des dégâts sont sévères; les arbres de petit diamètre sont les plus touchés.
Ces résultats montrent que le délianage n'a pas d'effet significatif sur la taille des trouées d'abattage, les niveaux de mortalité et de dégât. L'opération de délianage ne contribue donc pas à la réduction des dégâts sur les espaces forestiers exploités

Keywords: Cameroon, lianas, climber cutting, silvicultural treatments, logging damage

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1. INTRODUCTION

In a forest lianas compete with trees and interfere with their growth. Many foresters regard them as a nuisance and the cutting of liana stems has thus been an important operation in forest management. In general, when a tree is felled in a forest this tree pulls down several trees and damages others. Partly this is the result of the direct effect of the falling tree: it falls on top of other individuals. Another part is believed to be related to the presence of large woody lianas. These lianas ascend to the forest canopy by a primary host and often explore available space and light resulting in growth from tree crown to tree crown (Putz and Chai 1987, Clark and Clark 1990, Balfour and Bond 1993, Pinard and Putz 1994). In their expansion they intertwine several tree crowns. Vidal *et al*. (1997) for example found that on average 3 crowns (range 1-12) were connected by a single liana individual. Large and thick lianas can 'tie' tree crowns together and form an important structural component of the forest canopy. Felling a tree laden by lianas thus may cause considerable additional damage to surrounding trees and create large gaps. Climber cutting prior to logging seems to be worthwhile as a silvicultural treatment to reduce logging damage. Studies in SE Asia (Fox 1968, Appanah and Putz 1984) and in the Amazon Basin (Vidal *et al*. 1997) have shown positive effects.

The basic idea behind pre-felling climber cutting is that the cutting reduces the binding forces of the lianas: lianas die and dry out and get rotten. Information on the actual effects is scarce however. To what extent do these lianas really die? Are the strength properties reduced adequately after drying, or rotting? Liana leaves contribute significantly to total leaf production (Hladik 1974, Putz 1983, Bullock 1990, Burghouts *et al.* 1994) and massively fall-off after climber cutting operations. Tests on strength of alive and dead lianas are to our knowledge not available in the literature.

Even after cutting liana stems the rooted parts often show a tremendous vigour. These alive stems will mostly resprout within three months after they have been cut. The same (but to a lesser extent) accounts for the liana debris that falls on the forest floor and can resprout (Appanah and Putz 1984). These resprouting lianas will look for support and reach out for their favoured environments such as forest edges (canopies) and gaps.

Damage at the felling site of a tree can be operationalised as the combined effects on the size of the felling gap, the number of trees that die, and the amount and quality of the damage to trees and the effect of skidding in felling gaps on soil compaction. This total damage is the combined result of e.g. the size and type of trees felled, climber abundance, initial stand density and harvesting method. The damage at the felling site should be separated from the damage along the skid trails and at the landings. In this study we analyse the damage related to tree felling alone, within the framework of a large study on the development of reduced impact logging systems in southern Cameroon.

In general, forest exploitation in West- and Central Africa can be characterised as being highly selective, in the sense that only the best stems of a very limited number of species, in demand on the world market, are felled. Densities of these species are typically low and as a result of this in most areas on average only one to two stems per hectare are removed (Debroux and Karsentry 1997). Average harvest level in Cameroon is about 5 m^3 per ha and indicates that logging is very selective (Gartlan 1992). The African forest is also known for its high liana abundance. In the past climber cutting was described over vast areas on the African continent but proper evaluation never took place (Parren and de Graaf 1995).

The aims of this study were to assess whether climber cutting would be effective to reduce felling damage. Specifically we asked the following questions: (1) how abundant are lianas in the forest studied, (2) to what extent climber cutting results in the death of the lianas and what is their resprouting capacity, (3) what is the effect of pre-felling climber cutting on the felling gap sizes, and on the number of dead or damaged trees?

2. STUDY SITE

This study was conducted in a logging concession 100 km east of Kribi, Cameroon (3°N, 10°E). The concession area covers over 2000 km². The study area was located in the north-eastern part near the village Ebom, in a part that never had been logged before. The mean annual rainfall is 2000 mm with two distinct wet seasons (March - May and August - November), associated with the movement of the intertropical convergence zone over the area (Waterloo *et al*. 1997). The study area is located on a Pre-Cambrian shield resulting in clayey soils and classified as a Xanthic or Plinthic Ferralsol. The topography ranges from undulating to rolling with isolated hills with elevations between 350 m and 600 m a.s.l (Waterloo *et al*. 1997). Research plots were located in more or less flat terrain. The forests of the area are evergreen and can be characterised as late secondary forests of the Biafrian type (*sensu* Letouzey 1968) with a more or less closed canopy layer between 25-40 m with emergent trees surpassing 60 m in height towering above. Climbers are abundant in the canopy and in gaps where light conditions are favourable to their growth. The omnipresence of *Pycnanthus angolensis* (Welw.) Warb. and *Lophira alata* Banks ex Gaertn.f. indicates that the forest is quite degraded (see also Letouzey 1968 p. 153).

3. METHODS

In the area in total 33 1-ha research plots were established. In 5 control plots no logging and no silvicultural treatments were applied. The remaining 28 plots were all logged and in 16 of them pre-exploitation climber cutting was applied (May 1995). Felling was carried out nine months later (February 1996). Climber cutting for each plot was applied in the 1-ha research plot and in a surrounding buffer zone. Harvest levels were set at one tree per ha over 60 cm diameter at reference height (drh) resembling normal exploitation practise in the region. The baseline of the 1-ha plots was placed perpendicular to the natural inclination of the tree to be felled some 20 m from the stem foot to make sure that the entire tree would fall within the plot.

3.1 Liana abundance and resprouting

Liana stems over 2 cm in diameter at breast height were counted in all 33 1-ha plots (using 10 x 10 m subplots). All lianas cutting through the imaginary surface at breast height were counted and their dbh measured. Lianas smaller than 2 cm in diameter at breast height were only counted per subplot. During field inventory lianas over 2 cm were identified at their local Bulu name and at a later stage herbarium vouchers of each Bulu name were collected and identified in the field (G. Caballé, Montpellier, France), and at Herbarium Vadense in Wageningen, The Netherlands. In 8 1-ha plots a selection of 184 liana individuals were cut and tagged for subsequent monitoring. Resprouting capacity and mortality were assessed regularly for a period of 22 months after climber cutting. Resprouting capacity was expressed as the total number of spots where new sprouts developed on the main stem. This does not concern the actual number of sprouts, as at every spot several sprouts can develop.

At the beginning of the rainy season, we laid down 1-m long climber cuttings on the forest floor to find out their resprouting capacity. We concentrated the experiment on two dominant groups of lianas distinguished by the local Bulu as (a) *Avom* consisting of the genera *Landolphia* and *Dictyophleba* of the Apocynaceae and (b) *Atuk* comprising the genera *Neuropeltis* and *Calycobolus* of the Convolvulaceae and *Icacina* of the Icacinaceae. Of each group we collected 1-m cuttings in four diameter classes < 3 cm, 3-6 cm, 6-9 cm and > 9 cm with 20 cuttings per class. These were divided and placed on the forest floor in two different environments, in a felling gap and in closed canopy forest, and monitored for resprouting during a period of three months.

3.2 Felling gap sizes and residual stand damage

We expect climber cutting to result in considerably smaller gaps as a result of removing the binding effects, and lower tree mortality and tree damage levels compared to those without such treatment. To properly interpret damage levels, pre-logging data should be compared with post-logging data because trees crushed by the crown are not found (personal observation, Mensah 1966). To examine this we selected a total of 161 harvestable trees over 60 cm drh in the 1-ha plots and their buffer zones. Of these 81 trees had climber cutting applied in their plots and 80 trees were located in untreated plots. Of all these plots gap size was determined using the gap definition of Runkle (1981, 1982). Runkle considers trees as part of the surrounding forest canopy when they have a diameter of over 25 cm (and in general reached a height of over 20 m). Runkle's gap size was calculated using the gap centre as a starting point. Direction and distance from the gap centre to the bases of all surrounding canopy trees was measured. The gap size was calculated as the surface of the area enclosed by the bases of the surrounding canopy trees. Runkle's definition is a useful method for measuring gap size at forest floor level (van de Meer *et al.* 1994).

In 28 felling gaps tree mortality as well as bark and crown damage to trees over 10 cm drh were assessed. The damage assessment classification was similar to the one applied in Suriname under the CELOS harvesting system (Jonkers 1983). Stem damage was classified as no stem damage, severe bark damage when at least one third of the circumference of the stem (or over 20 cm) or over a length of at least 2 m was damaged. When less then this amount it was classified as having only minor bark damage. Severe stem damage included stems that had split, unstable trees resting on others and stems that were visibly hollow or severely decayed. Crown damage was classified as no crown damage at all, minor crown damage when less than half of the crown was broken off and severe crown damage when more than half of the crown was broken off. Finally a category where the whole crown was broken off.

4. RESULTS

4.1 Liana abundance and resprouting capacity

Lianas are very abundant in the area. On average there were 408 lianas > 2 cm dbh (SD = 200, n = 33) and 4370 smaller ones per ha (SD = 2264, n = 33). The abundance varied considerably, however, between 187 and 1092 for the large lianas and between 1890 and 10451 for the small ones, roughly a factor 5 between the lowest and the highest density. Really large lianas that could influence damage levels were quite common as well as on average 113 lianas > 5 cm dbh (SD = 58, n = 33) and 10 lianas > 10 cm dbh (SD = 6, n = 33) were present.

During May 1995 we labelled 184 liana individuals > 1 cm dbh that had been cut that same month. In total 53 morphospecies were distinguished (33 genera and 19 families). Liana mortality increased over time from 34% after 6 months, to half the population after logging, and 70% after almost 2 years (see Table 1). We noticed a slow die-off in most species: first the sprouts closest to the cutting surface died and later those closer to the stem foot. At the end of the monitoring period fungal attack was clearly causing wood rot of the entire stem. The total number of locations along the liana stem with sprouts declined also over time (Table 1). The decline was less than expected based on the number of surviving lianas because these were the more vigorous ones, having many sprouting spots.

Table 1. Liana performance after climber cutting: mortality, survivorship and resprouting capacity of 184 individuals > 1 cm dbh.

	0 months	6 months	11 months	15 months	22 months
Dead	0	63 (34%)	92 (50%)	108 (59%)	128 (70%)
Alive	184	121	92	76	56
Total sprouting spots	n.a.	427	403	313	208

Some liana genera were more flexible and resistant with respect to cutting, while others were very vulnerable (Table 2). Genera belonging to the families Connaraceae, Dilleniaceae, Euphorbiaceae and Papilionoideae had survival rates of at least 50%. Genera in the Annonaceae, Apocynaceae, Celastraceae and Icacinaceae had extremely low survival rates.

In both the felling gap and the closed canopy forest the 1-m cuttings did neither show any rooting nor sprouting after three months. This was contrary to our expectations. In the gap the cuttings had completely dried and in the closed canopy forest the cuttings were to a large extent already decomposed.

Table 2. Vulnerability of ten liana genera after climber cutting

Resistant genera		# lianas monitored	# lianas alive and with sprouts after 22 months
Agelaea	CONNERACEAE	13	9
Rourea	CONNERACEAE	4	3
Tetracera	DILLENACEAE	9	5
Maniophytum	EUPHORBIACEAE	8	5
Iodes	ICACINACEAE	9	5
Vulnerable genera			
Artabotrys	ANNONACEAE	6	2
Landolphia	APOCYNACEAE	15	0
Strophanthus	APOCYNACEAE	3	0
Icacina	ICACINACEAE	25	1
Strychnos	LOGANIACEAE	3	0

4.2 Felling gap sizes and residual stand damage

Although all felled trees were large canopy trees with a diameter of more than 60 cm at reference height the resulting felling gaps were very variable in size, ranging from 103 m^2 to 1385 m^2 (Figure 1). The majority of the gap sizes were between 300 and 900 m^2 (mean 565 m^2), irrespective of whether climber cutting had taken place before felling. The logging gaps without climber cutting were more variable and extreme in size. Sizes of felling gaps with (mean 550 m^2, N = 81) previous climber cutting were not significantly smaller than felling gaps without (mean 575 m^2, N = 80) climber cutting. Also the size distributions of the gap sizes were not significantly different. This was contrary to our expectation.

Tree size, tree height, and crown size and form are expected to influence the resulting gap sizes, as well as densities of nearby trees, and numbers and strength of lianas binding the trees together. As our 161 trees consisted of 25 species, and species are expected to be different with respect to their size and form, this was expected to have a large influence on the felling gap sizes. To reduce this variability we selected all 48 Azobé (*Lophira alata*) felling gaps. Surprisingly the results were the same: no difference between gap sizes that result of logging with (n = 27) or without (n = 21) previous climber cutting (Parren and Bongers unpublished data).

Figure 1. Frequency distribution of felling gap sizes (Runkle's method) that result from felling with (+) and without previous climber cutting (-).

At a tree felling operation on average 12 other trees died, but variation again was large (Parren and Bongers unpublished data). The averages were not different between trees felled with (mean = 12.3, SD = 6.9) and without (mean = 12.5, SD = 6) previous climber cutting. The majority of the dead trees were small and medium sized trees (Figure 2), and climber cutting had no significant effect on the size distribution (Parren and Bongers unpublished data). Between 16 and 20% of all affected trees belonged to the diameter class that includes potential crop trees (30-60 cm drh) for both mortality as well as residual damage in treated and untreated plots. Damaged harvestable trees (> 60 cm drh) made up 9% of all affected trees treated or not, mortality of trees that attained felling sizes was as low as 2% for treated and 7% for untreated plots. Apart from the dead trees on average 20 trees were damaged per felled tree. In total 33 trees were affected for each felled tree (Parren and Bongers unpublished data).

Figure 2. Diameter distribution of stand damage after felling of trees with (black) and without climber cutting (blank). Seventeen felled trees with climber cutting resulted in mortality of 194 trees and residual stand damage of 414 trees, 11 felled trees without treatment resulted in mortality of 130 trees and residual stand damage of 225 trees over 10 cm drh.

In the field 10 different types of damage were distinguished. For analysis some of the damage classes were grouped into one composite class. In general the damage caused at the felling operation was not too bad. Minor stem and crown damage was most common and made up 80% of all damaged trees in untreated plots (class 1). Severe stem damage (class 2) and serious crown damage (class 3) were proportionally represented at the felling sites for both treatments. The most striking aspect was that trees with previous climber cutting showed a three times as high chance of having their crowns torn off (class 4) with 30% of the effectives showing such fracture (Figure 3). This was completely contrary to our expectations as for the effect of climber cutting. The smaller sized trees (class 10-30 cm drh) were most prone to serious damage: roughly two-third of the total number of damaged trees were in this size class. The mean diameter for all damaged trees was 27.3 cm (N = 625 trees) for treated plots and 29.3 cm (N = 366 trees) for untreated plots.

Figure 3. Type of damage for trees in an operation with (N = 379) and without (N = 226) previous climber cutting. Damage classes are minor crown and stem damage (1), severe stem damage (2), serious crown damage and hardly any stem damage (3), no crown anymore (4).

5 DISCUSSION

Abundance of big lianas

In the forests studied lianas are very abundant, compared to many other forest sites (Gentry 1991, Hegarty and Caballé 1991). Especially the number of small lianas is high, but with respect to climber cutting and its effects the number of very large lianas is of prime importance. These forests harbour many large liana stems of over 5 cm dbh (113 liana stems ha^{-1}) but this is not exceptional compared to other continents. Appanah and Putz (1984) in Pahang, Malaysia (13 ha inventoried) found equal numbers of liana stems over 5 cm dbh in their forest. In Para State, Brazil Vidal *et al*. (1997) estimated that some 100 large lianas per ha (only 0.42 ha inventoried) were present in mature forest. In a forest at Ituri, D.R. of Congo, Makana *et al*. (1998) found some 67 large lianas per ha (3 ha inventoried), but in a monodominant forest type only 24 large lianas per ha (3 ha inventoried) were found. That classifies these African forests even as poor concerning large lianas. Unfortunately no comparable density data were found for really large lianas of over 10 cm dbh. Still these large lianas may be the main cause for tearing off entire tree crowns of surrounding trees. Unfortunately too little is known so far of their densities in the forests and their effects at the felling sites.

Sprouting of lianas
The goal of climber cutting is to remove or diminish the strength of the liana, leading to a smaller binding force between trees and tree crowns. We used mortality of lianas after cutting as an indication of weakening. For a large group of lianas, mortality was very low, and thus the effect is not very obvious, at least not during the period of observation (22 months). Of course we cannot prove a positive relation between mortality and a decline of strength of the lianas. For that we need to have knowledge on strength properties of alive and dead lianas.

The fact that cutting had severe effect to some species while others were very resistant can partly explain the results that we found for the 1-m cuttings. Because the Bulu names do not correspond with one species or genus the expectations were equivocal. *Avom* can be both *Dictyophleba* (high survival) and *Landolphia* (low survival). The same accounts for *Atuk*, which can be both *Neuropeltis* and *Calycobolus* (high survival) and *Icacina* (extremely low survival). The choice of the species thus was not the right one. We suggest studying a large number of botanical well-defined ones in this respect. The study performed by Appanah and Putz (1984) is a nice example in this respect (32 species), but was performed without taking into account the diameters of the cuttings or the environment (gap or understorey).

Climber cutting effects on gap sizes, tree death and damage
This study shows that climber cutting had no effect on the sizes of the felling gaps, contrary to our expectations. Of course a lot of other factors influence gap size and with a small number of gaps we would not have expected a difference. We studied 161 trees however, a very large number, and expected that the large number would have filtered out the variation due to other non-controlled factors. That this was not the case is a strong indicator of the probably very weak role that lianas play in this respect. An important drawback of this study, however, may be the fact that we did not count the actual number and sizes of lianas on trees to-be-felled and the liana links to surrounding trees in the upper canopy. Several of the trees might not have lianas on them at all, thus blurring the difference between the groups. Vidal *et al*. (1997) did select individual trees based on the difference in liana load and found that felling trees with many liana connections resulted in twice as large canopy gaps as those of liana-free felled trees.

Our results show that in general climber cutting has only a very small effect on the number of trees that die and that are damaged during the felling operation. This, of course, excludes trees that were affected by skidding operations. This is a very surprising result as we expected that the number of affected trees would be much lower when climbers were cut some time before the felling of the tree. Even more striking was the three times as high chance of having a complete crown torn off after climber cutting, completely opposite to our expectation.

In general crown damage is much more abundant than stem damage. Damage assessments in Sabah, Malaysia (Nicholson 1958), Pahang, Malaysia (Appanah and Putz 1984) and Ghana (Mensah 1966), following Nicholson's (1958) damage classification, all showed that there was more crown damage than bark damage and that the damage was predominantly of trees in smaller diameter classes. A similar pattern was found in Para, Brazil (Uhl and Guimarães Vieira 1989). These results are consistent with ours.

General damage levels in our study are in concurrence with studies in Ghana (Mensah 1966) and Gabon (White 1994), but in contrast to studies in Malaysia (Nicholson 1958, Appanah and Putz 1984) and Brazil (Uhl and Guimarães Vieira 1989) where they found much higher levels. This is probably related to the difference in extraction intensity of 1-2 trees ha^{-1} in Africa versus 8-11 trees ha^{-1} in S.E. Asia and Latin-America.

Is climber cutting cost effective?
The application of a systematic and large-scale climber cutting operation will strongly depend on the cost and effectiveness of this treatment. Climber cutting was executed by villagers who are used to cut trees and lianas and were given instructions to cut all lianas over 1 cm dbh at breast height. An area of in total 90 ha was covered and the time required was recorded. The cost of cutting was expressed as the number of man-days spent per ha. The average time required cutting all lianas over 1 cm dbh at breast height in a 9-ha plot with a team of 13 labourers was approximately 1 day (with 5 hours efficient working per day). On average this is 0.7 man-days of work per ha. At a daily wage of CFA 1000 (US$ 1 = CFA 600) this would equal approximately US$ 1 per ha. This amount excludes the costs of transport and other additional costs, which probably are considerably higher. Compared to other costs in the whole logging operation this is very low and should not be a reason for not applying climber cutting.

Although the costs of climber cutting is very low (1US$ per ha compared to 16 US$ in Brazil, Vidal *et al.* 1997) we believe that it is not worthwhile to do a general climber cutting the way it was done in this study. We believe that climber cutting, if at all applied, should be much more selective, namely on a tree-by-tree basis. We suggest that during the enumeration the liana situation of every potentially-to-be-felled tree should be verified. Only in the cases that really large lianas are present on the tree these should be cut. Ideally we should know what big woody lianas have the greatest strength properties, both alive and dead, to enable to be more selective with climber cutting. This would require some additional research. Depending on the total planning climber cutting could be combined with the enumeration at least one year before the felling operations begin.

6. CONCLUSIONS

1. Lianas are very abundant in the forests studied.
2. Post cutting mortality and resprouting capacity is highly variable among species/genera and thus the effects are species dependent.
3. Pre-felling climber cutting has only a very weak effect on the sizes of felling gaps, on the number of dead trees and on the damage to remaining trees.
4. The effectiveness of a generally applied pre-felling climber cutting in the studied forests is very doubtful.
5. We suggest that climber cutting will be applied on a tree-by-tree basis only, and after a judgement of the liana load.

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SYNTHESIS AND SIGNIFICANCE OF THE RESULTS OF THE RESEARCH IN MANAGEMENT AND ECONOMICS FOR THE DESIGN OF A FOREST MANAGEMENT PLAN

By Richard Eba'a Atyi and A. M. Filius

ABSTRACT

The discipline of "Management and Economics" within the Tropenbos Cameroon Programme consists of two research projects. The first one is titled " A model for sustainable forest management in South Cameroon" (code: Econ1) and the second one "Environmental impact assessment of forest management in South Cameroon". These two projects are in general synthetic in their designs and intend to integrate ecological, economic and social concerns in the quest of sustainable forest management. Of the two projects, only Econ1 has been mostly implemented, Econ2 is still in its preparation phase.

To achieve sustainable forest management when timber production is involved, there is a need to define an optimal steady state structure and the management guidelines associated with it. The most important of these guidelines are the length of the cutting cycle and the allowable cut at each cycle. A steady state is defined at a stand level by a structure and composition that allows a sustained yield of forest products at each cutting cycle that can be perpetuated indefinitely. Each forest stand can have many steady states and only one should be selected according to its ability to meet the defined forest management objectives. Project Econ1 tries to generate alternative steady states and provide a methodology (through a model) for selecting the desired one according to the objectives of forest management. The model considers three types of objectives: timber production, nature conservation and production of other forest products for the local population. But, Econ1 also tries derives conversion strategies from the current forest state to the desired future steady state and analyzes the trade off between different forest management objectives.

To be able to generate these steady states and select the desired one, three main components are needed in the model: first a growth and yield module for the prediction of alternative stand structures; second and economic module to depict the socio-economic context of forest management and; third a methodology to combine both modules. At this stage of the research the growth and yield and economic modules have been developed and a methodology which uses mathematical programming has been designed. Analyses are still being conducted to provide final outcomes, which will be available in less than a year.

The Econ1 project has worked in collaboration with others projects of the TCP, particularly the F1 project for the characteristics of the logging practices, F2 for the characterization of forest stands and S1bis for forest utilization by local population. It should provide information for Econ2

INTRODUCTION

The discipline of "Management and Economics" within the Tropenbos Cameroon Programme consists of two research projects which titles are:

- A model for sustainable forest management in South Cameroon" (code: Econ1)
- Environmental impact assessment of forest management in South Cameroon (code: Econ2)

The two research projects are in general synthetic in their designs because the research in management and economics in the TCP have two underlying hypotheses, which are:

a) The goal of sustainability in forest management can be attained only if ecological, economic and social concerns are taken into account within any management strategy developed and implemented.
b) There are ways to reconcile forest conservation (maintenance of forest cover and an acceptable level of biological diversity) with some levels of both industrial timber harvesting and forest utilisation by the local population

Of the two projects only Econ1 has mostly been implemented, Econ2 is in its designing phase but will soon be implemented in the field. Therefore, this paper relates more with the progress of Econ1.

The Econ1 research project started in 1994 and is expected to be completed in 1999.

INTENDED CONTRIBUTION TO MANAGEMENT PLANNING AND ITS SIGNIFICANCE

In general the concept of planning can be defined as a process of preparing a set of decisions for action in the future, directed at achieving well defined goals by the best means at disposal (Dror, 1972). This suggests that decision making has a central role in management planning like in any other type of planning. In forestry, perhaps because of the time spans separating management actions and reaction from the resource, management planning has always played a key role. As proposed by Filius (1998), forest management can be seen as " the art and science of preparation and implementation of decisions with regards to the use and conservation of forests to meet the objectives of an organization". The organization hereby concerned is the Cameroonian society with is different stakeholders. Forest management specialists try to design a course of actions to be taken by forest managers during a certain time interval hoping that these actions will lead to achieving the identified and defined objectives. Using the best available knowledge, forest management planning not only designs a course of action to be implemented in the forest but also predict future reaction from the resource and its users. To that end, alternative forest management options are developed and one is selected for implementation based on the predicted ability to meet management objectives.

Traditionally forest management planning has concentrated on timber production as its most important objective, and despite what may be thought now, sustainability of production has always been its main concern (Wiersum, 1995). This has changed not so much about the ideal of sustainability but rather about the ranges of aspects to be included in the search for sustainability. Sustainability has moved from sustained production of a single product, to sustainable development, which is more comprehensive. Other objectives such as the production of other forest products or nature conservation have gained importance. However, sustainable timber production still remains an important concern for forest management in general and within the TCP in particular.

Classical forest management planning for sustainable timber production uses the renewable attribute of the forest resource and tries to obtain a sustained yield of timber. Sustained yield of timber in this context means a quantity of wood harvested after one cutting cycle, which is equal to the forest net growth and can be continued in perpetuity. Such a sustained yield is produced from a theoretical fully regulated forest, which in uneven age management system (which is the case of natural tropical forests) is characterized by its structure defined as number of trees per species and per size class to be left after each harvest. Such a structure is often referred to as a steady state structure. To obtain a sustained yield, the forest should be managed according to certain rules. Two of the most important of these relate to the periodicity of harvests (cutting cycle) and the amount of timber to be taken at each harvest entry (Davis and Johnson, 1987). The cutting cycle can be defined as the time interval (number of years) which separates two successive harvests on the same unit area of forest land. The level of harvest can be defined either as the volume of timber or the number of trees to be cut at each harvest. Although there are many more important decisions to be made in forest management planning with sustainable timber production as an objective, decisions on the cutting cycle and the level of harvest are critical. Inadequate choice of cutting cycle and level or harvest can lead either to exhausting the resource (cutting cycle too short or harvest to heavy) or under supply of needed timber products to the society (cutting cycle too long or harvest to light). Decisions on these element have been mostly based on biological (mainly stand dynamics) and some times economic factors.

However, in most cases the forest is not fully regulated and the desire of sustainable forest management is to convert the non-regulated forest to a regulated one. The time interval between the first management operations in the non-regulated forest and moment at which a fully regulated forest structure is reached can be called the conversion period. The conversion period poses a number of questions which forest management planning should confront. Two of these questions are: how long should or will be the conversion period given the defined management objectives? What are the harvesting rules to adopt during the conversion period? The answers to these questions will be referred to as conversion strategy.

The Econ1 research intends to contribute to the objective of achieving sustainable timber production at the TCP site by providing insight into the characteristics of the desired steady state and related management guidelines. But, it also investigates the characteristics of the conversion strategy since the forest is not fully regulated. More precisely, the intended contribution of our research to forest management planning relates to an analysis of the following points:

The target steady state structure, in terms of number of trees to be left at each harvest and their distribution in diameter classes.

1. The appropriate cutting cycle to be adopted for timber production.
2. The amount of wood to be harvested at each cycle. This point relates to point 1 and in the light of results of investigations on uneven age forest management systems gather elsewhere, the amount of timber to be harvested for a sustained yield should be expressed as the number of trees to be harvested per species above a certain diameter limit.
3. The expected length of the conversion period and expected levels of harvest during that period.

4. Multiple use of the forest through an analysis of the trade-off between alternative land use types and especially between timber production, nature conservation and forest utilization by the local population
5. A methodology (and eventually a technological) to generate consequences of chosen management options.

In contrast with traditional approaches of developing of guidelines for decisions on the above elements, our research intends to base the determination of rules for these management elements simultaneously on stand dynamics considerations as well as on economic, nature conservation and social objectives.

RESULTS ACHIEVED

The above-mentioned items are the end results, to arrive at these many intermediary steps are necessary. The three main steps required are; a growth and yield module, an economic module and a methodology to combine the two modules for the development and assessment of management options.

A growth and yield module

It is necessary to develop some procedures which will help in the prediction of future stand characteristics if a given management course of action is applied to the stand, these procedures constitute the growth and yield model. The development of a reliable growth and yield model is conditioned by the existence of estimates of growth rates of all tree species that make up the stand. Such growth rates are estimated through long run experiments using permanent sample plots. Once these growth rate estimates are obtained, they are processed and used to develop predictive tools for stand growth. The predictive tools may be in the form of yield tables, regression equations, transition probabilities or some combination of these. In tropical forestry, the development of growth and yield models is difficult both because of the lack of data from well designed networks of permanent sample plots and the complexity of the tropical forest ecosystem characterized by a great number of tree species. In Africa, some countries have been recording observations from the permanent sample plots for more than 5 years, unfortunately Cameroon is not one of these, so estimates of growth rates to be used for growth and yield modelling should be extrapolated from experiments conducted in other countries. Grouping species of similar characteristics in a few categories may scale down the difficulties resulting from the complexity of the ecosystem. All the procedures, which allow the prediction of future forest stand characteristics, constitute the growth and yield module.

At this phase of the research, the growth and yield module is about developed. Tree species have been grouped in four categories using Cluster Analysis on the basis of their growth habits and commercial value (see table 1). The data used came from Liberia because the network of Permanent Sample Plots of the TCP is just being established, and its takes many years to obtain reliable estimates once the network is established. The four groups can briefly be described as follows:

- A group of fast growing, large size and high commercial value species,
- A group of fast growing, medium size and medium commercial values species,
- A group of slow growing, small size and low commercial value species and,
- A group of slow growing, large size and very high commercial value species.

For each of these groups, transition probabilities have been estimated taking into account mortality. The method that gave the best results was logistic regression analysis. The probabilities developed (see table 2) are mainly the up-growth probabilities (called b) and the stability probabilities (called a). An up-growth probability is a probability that a tree of a given species group inventoried in a certain diameter class will remain alive and grow out of its diameter class after a certain number of years. A stability probability on the other hand is the probability that a tree of a given species group will stay alive and stay in the same diameter class after a certain number of years. These probabilities, when applied to stand level inventory results of a forest, allow the prediction of future stand composition and structure. In addition to these probabilities, recruitment to the smallest diameter class has also been estimated.

An economic module

In addition to modelling growth and yield, information about the economic, social and administrative environment within which timber production is conducted should be gathered. These will make it possible to value forest resources and develop criteria by which forest management decision-makers will assess options. Processing of this information is done within an economic module. Parameters of the economic module have also been developed. Specifically, stumpage prices have been estimated on the basis of average FOB prices of logs, handling and miscellaneous costs, transport costs and logging costs (table 3). Stumpage prices have been estimated by species group and diameter class. They allow the estimation of revenues on the basis of current price levels.

A methodology for developing assessing management options

Both the economic and growth and yield modules are used to generate options and define the characteristics of the desired steady state. However, the two modules should first be combined to formulate a management problem in quantitative terms. A methodology has been designed to combine growth and yield and economic modules, generate alternative management options and, assess them. The methodology uses mathematical programming techniques such as Linear Programming and Simulations to derive alternative steady state structures, and assess them to chose the best under a set of defined objectives. It should also help in the analysis of trade off between options through sensitivity analysis.

Once the characteristics of the desired steady state and the associated harvesting rules are known, simulations can be done to obtain a description of the conversion period. The description focuses mostly on the length of the conversion period and expected harvest and revenues during that period.

In addition, inventory results have been processed to obtain the current structure and composition of a stand typical of the TCP research site (table 4). The current structure and composition of typical stands are very useful for the characterisation of the conversion period. Also, the use of plant products by the local population has been summarised (table 5) as well as the current management options of the forestry administration in Cameroon. These will allow the assessment consequences of alternative management options.

These results show that most of parameters needed are now in hand and analysis through model running (Linear Programming and Simulations) is being conducted.

RELATIONSHIP WITH THE OTHER COMPONENTS OF THE PROGRAMME

The results already achieved have been so far with the collaboration of other components of the TCP. The logging costs needed for the derivation of stumpage prices were estimated with the cross-checking allowed by the collaboration of the logging damage and efficiency study (F1). The inventory data analysed and summarised here were collected in the plots designed for experiments for the silvicultural study (F2), while the summary of the utilisation of tree species by the local population is extracted from the study of Non Timber Forest Products (NTFP, by S1bis).

It is anticipated that the results of this study which concern management options at stand level, will be used by the study on Environmental Impact Assessment (Econ2) which will develop management alternative for the forest level. They should also be of key importance in the design of the forest management plan especially concerning the area devoted to timber production.

OUTLOOK

The TCP research site covers a total land area of about 200,000 ha. This area encompasses many land utilisation types (LUT) one of which is timber production. Timber production was already identified as one of the potential LUTs by the zoning plan developed by the Government of Cameroon, which is a major stakeholder in forest management. Therefore, although the area devoted to timber production appears not very large; the guidelines for its management should be developed based on the best available scientific tools. The Econ1 research tries to contribute to that end. However, more important for the Programme may be the contribution to the overall goal of improving forest management in Cameroon as well as in other tropical countries. This study intends to contribute to such a broader objective by developing a methodology, which allows the assessment of alternative forest management options. It also intends to contribute to the development of norms for the framework of criteria and indicators of sustainable forest management in Cameroon. The research is now at its final stage and should be completed in less than a year.

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Table 1: Tree species groups

Group	Species	Average Diameter (cm)	Average diameter increment (cm/ 5 years)	Average DME (cm)	Average price (FCFA/m^3)
I	Acajou Ayous Bibolo Tima	56.3	3.3	80	127,880
II	Adjouaba Afane Andock Babang Essia Kiasose Kumbi Nom atui Ngobisolbo Nsangomo Odjobi Tola	20.4	1.1	50	49,660
III	Aiele Azobé Bilinga Bongo Bongo H Dabema	55.1	2.46	56.3	74,130

Group	Species	Average Diameter	Average diameter increment	Average DME	Average price (FCFA/m^3)
III	Ezang Faro Frake Fromager Ilomba Kibekoko Kotibe Koto Landa Mubala Mutondo Oboto Parkia Rikio Sougue Tali				
IV	Assamela Ebene Kossipo Sapelli Sipo	21.1	0.9	88	202,440

Note: The minimum diameter limit allowed for harvesting

Table 2: Transition probabilities used in TROPIFOMS

	Group1		Group II		Group III		Group IV	
Dclass	a	b	a	b	A	b	a	b
1	0.717	0.273	0.915	0.075	0.890	0.100	0.899	0.035
2	0.704	0.286	0.923	0.067	0.717	0.273	0.899	0.091
3	0.590	0.400	0.936	0.054	0.712	0.278	0.740	0.25
4	0.490	0.500	0.934	0.056	0.68	0.310	0.561	0.429
5	0.419	0.571	0.672	0.318	0.538	0.452	0.546	0.444
6	0.390	0.600	0.704	0.286	0.584	0.406	0.390	0.600
7	0.240	0.750	0.704	0.286	0.686	0.304	0.285	0.715
8	0.704	0.286	0.923	0.067	0.773	0.217	0.285	0.715
9	0.823	0.167	0.989	0.001	0.927	0.063	0.285	0.715
10	1	0	1	0	1	0	1	0

Note:
a is the probability for a tree of a given diameter class to stay in the same diameter class after one growth period of five years
b is the probability for a given tree to grow up to the next diameter class after one growth period of five years

Table 3: Stumpage prices per species group and diameter class (FCFA/stem)

Diameter class (cm)	Group I	Group II	Group III	Group IV
10 - 20	86.18	8.74	28.84	173.76
20 - 30	271.57	27.86	88.53	552.34
30 - 40	578.40	59.79	185.35	1183.15
40 - 50	1017.36	105.77	321.87	2089.99
50 - 60	1596.99	166.80	500.11	3291.94
60 - 70	2324.46	243.72	721.74	4805.15
70 - 80	3206.04	337.27	988.23	6643.69
80 - 90	4247.28	448.09	1300.86	8820.14
90 - 100	5453.20	576.79	1660.76	11345.85
>100	20882.80	7302.61	10507.19	32127.23

Table 4. Summary of forest inventory results in the Tropenbos Cameroon research site

Diameter class		Group I		Group II		Group III		Group IV	
No	center	Trees/ha	Vol(m3/ha)	Trees/ha	Vol(m3/ha)	Trees/ha	Vol(m3/ha)	Trees/ha	Vol(m3/ha)
1	0.15	3.1	0.3	171.1	9.1	107.8	14.5	6.7	0.9
2	0.25	1.2	0.3	51.4	10.8	36.3	15.0	1.4	0.6
3	0.35	0.3	0.2	24.4	12.7	13	11.3	0.3	0.3
4	0.45	0.1	0.1	9.6	9.9	7.2	10.8	0.2	0.3
5	0.55	0.2	0.4	4.2	7.4	5.6	13.1	0.3	0.7
6	0.65	0.1	0.3	2.9	8.0	3.7	12.5	0.2	0.7
7	0.75	0.1	0.4	2.4	9.8	2	9.2	0	0.0
8	0.85	0.1	0.6	0.8	4.6	1.1	6.7	0.1	0.7
9	0.95	0	0.0	0.6	4.6	1.1	8.5	0	0.0
10	1.25	0	0.0	2.6	42.1	4.4	62.4	0.1	1.6
Total		5.2	2.7	270	119.0	182.2	164.0	9.3	5.8

Note: Vol. Stands for volume

Table 5: Important tree species for the local population and the logging company at the TCP research site

Pilot name	Group	Pilot name	Group
Angongui	3	Acajou	1
Moabi	4	Azobé	3
Aiele	3	Bibolo	1
Movingui	3	Iroko	4
Sapelli	4	Bahia	3
Eyong	3	Bilinga	3
Tali	3	Dabema	3
Bongo	3	Padouk	3
Bubinga	4	Niove	3
		Frake	3

Source: adapted from van Dijk (1995)

RESEARCH CONTRIBUTIONS TOWARDS FOREST MANAGEMENT PLANNING: MISSING LINKS AND OUTLOOK

M. Wessel and W.B.J. Jonkers

1. THE RESEARCH PROJECTS IN A PLANNING PERSPECTIVE

Before one can discuss missing links the various pieces of the jig saw puzzle which depicts a forest management plan have to be put together. For this purpose the diagram of Figure 1 is used, which gives a hierarchy and categories of planning. Most of the contributions discussed to-day belong to the left column of the diagram which deals with strategic planning: preparing of decisions for future action on a rather high level of abstraction.

The top box (1) refers to land evaluation and land use planning as carried out in project LU 1. This project gives the land suitability for forestry, smallholder- and plantation agriculture.

The second box deals with the land use objectives of the land allocated to forestry. It concerns objectives or rather fulfilment of functions such as sustained timber production, nature conservation and production of non-timber forest products, or a combination of these functions. Planning results usually in a proposal for allocation of zones for different land use objectives.

As the planning in box 1 and 2 directly affects government policy and the rights and livelihood of the local population, especially here contributions of project S 1 as presented today by van den Berg and Biesbrouck are essential.

The third box deals with the management options, to-day especially with those which relate to planning with the objective of sustainable timber production. The most important management aspects are the length of the cutting cycle and the level of harvest. In this process not only the course of action to be implemented but also the reaction of the research base (tree growth and yield after logging) are considered. Eba'a has presented his approach which includes the development of a growth and yield model and of an economic model. Basic data for these modules are provided by project F 2 (and Ecol 2) and F 1 (and F 3) respectively. To the same block 3 belongs project Econ2: Environmental impact assessment of forest management in Cameroon.
It will evaluate the various management options and proposed zoning of land use objectives in terms of their effects on the economic and financial results, the physical environment and social conditions (Filius, 1996). In fact Econ1 and Econ2 deal to a certain extent with the two sides of the same coin.

Econ1 deals also with the management actions needed to arrive from the present forest condition to that of a steady state, a regulated forest in which the wood harvested in one cycle equals the net growth in the same cycle period. This is the contents of box 4. Here again the contributions of F 2 and Ecol 2 fit in.

Shifting from strategic to tactical planning, the next bold lined box (4) concerns planning of management activities. These require especially the inputs of the logging research in F 1 (including the sub-topic of pre-felling climber cutting) as presented by van Leersum and Parren and of the post-logging silvicultural studies which are part of project F 2.

Contributions of the planning activity in box 4 are also expected from Ecol 1 and Ecol 3 which deal with criteria and indicators for sustainable forest management. Planning of a monitoring systems for the effects of logging (and collection of NTFPs) have to be considered as an integral part of forest management planning. As the logging activities themselves will directly affect the daily life of the local population and especially that of the forest dwellers, project S1 (and S1 bis) should also contribute to the planning in box 4.

Reviewing the various contributions to forest management planning one can conclude that the boxes 1-4 of Figure 1 are at least partially filled. Almost all important ingredients of forest management planning have been or are being researched. A complicating factor is that so far the order in which the research activities are carried out, is not the result of deliberate planning but of availability of funds for specific projects.

2. OUTLOOK

Looking ahead attention has to be given to the fact that the planning figure gives in bold two-way arrows which link the various planning processes. At present many of these arrows are not more than dotted lines. Especially, thought has to be given to ways in which the various stake holders are brought into the planning process. As a start customary land rights of local communities could be mapped and combined with the land evaluation data. The outcome of this exercise could be a differentiated zoning of land utilization types which takes into account the major claims of the local populations.

For sustained timber production are especially important the results of the harvesting research and of the growth and yield studies in logged forests. Data from these activities, separately and integrated in the models of Econ1, are key ingredients
for a forest management plan. For this reason priority should be given to analysis of the data and reporting of the results.

Points of general importance include the lack of growth and yield data of forest species in Cameroon. Permanent sample plots have only recently been installed. Although they can not be used in the present studies, they are of vital importance for future forest management plans and care should be taken that they are being preserved and monitored after the TCP programme has ended.
By its very nature TCP directs its attention mainly to the left and to a certain extent to the middle part of Figure 1. Operational plans are usually prepared by the concession holder and need the approval of a government agency prior to implementation. This stresses the importance of links between the left and middle positioned activities in Figure 1 with those on the right.

Figure 1: Relationships between strategic, tactical and operational planning and the position of the various projects within this framework. The projects are briefly described in Appendix 1. (Source: Bos, 1994)

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APPENDIX 1

I.	**ONGOING/STARTING PROJECTS**
Ia.	**Ongoing projects**
Lu2	Shifting cultivation in evergreen forest: farming systems and soil degradation
Ecol1	Structure and species composition (biodiversity) of evergreen moist forest in southern Cameroon
Ecol2	Functional aspects of the evergreen forest in southern Cameroon
Econ1	A management tool for efficient and sustainable timber production in south Cameroon
Econ2	Environmental impact assessment of forest management in south Cameroon
S1	People's perspectives on forest exploitation- villagers, pygmies and changing relations to the forest
S1bis	The economic and ecological assessment of non-timber forest products in the Bipindi-Akom II region
F1	Logging, ecology and efficiency
F2	Growth, regeneration and mortality in managed natural forest
F3	Commercial potential of lesser-known species (expected to be completed in 1997)
F4	Forest dynamics in distributed evergreen forest, with special reference to actual and potential tree species
F5	Plant-insect relations, with special reference to pests of commercial tree species
F6	Mycorrhiza associations in tropical evergreen forest
Ib	**Starting projects**
Ecol3	Plant-animal relationships: effects of disturbance on the regeneration of commercial tree species

GENERAL DISCUSSION

The general discussion at the end of the workshop started with the question what a Forest Management Plan (FMP) does entail. It was made clear that scientists present scenarios after which policy-makers should start the negotiating process. Therefore the role of Tropenbos-Cameroon Programme (TCP) with the establishment of a FMP will be limited to providing a scientific basis for the decisions to be taken. Only a limited amount of options have been discussed during the workshop. The lack of attention to tourism values was pointed out.

The decisions are to be taken by the stakeholders, but the problem is how to mobilise these stakeholders and have them participate in the negotiating process and the zoning of the area. In a project adjacent to the TCP area a lot of experience has been gained with participatory mapping. It is important to understand people interests, needs desires and expectations, During negotiating realistic ideas are needed so that actors involved consider the plan as acceptable after modification.

During the discussion two different viewpoints were stated. On one hand there was the solution of zonation. Options for the management area may differ in time and space. So different management uses can take place in different zones or times. Biodiversity conservation might be a good option for some areas, but for others it is not. In an extensive area various options might exist and might even appear combined. The drawn boundaries should be treated in a flexible manner.

On the other hand researcher discuss that zonation hampers the access of local people to the resources and violate their rights, and will therefore not be accepted by the local people. In this way zoning will hamper the implementation of the FMP. In a project adjacent to the TCP area a lot of experience has been gained with participatory mapping in which the interests and boundaries of the local people are visualised. Currently zoning is seen in the context of excluding other uses, but it is advocated that land-use types should be refined, so land uses can be combined. In Cameroon the law does not see a Land Utilization Type (LUT) as an exclusive unit.

The contradiction between these tow extreme cases exists for a long time, and has been extensively discussed in the Dutch context as well. Perhaps something can be learned from the experiences in the Netherlands. It is advised to incorporate planners in the TCP.

Finally an overview of the TCP in historic perspective is given.
At the start it was felt that the logging practices which were already being executed, could be more efficient and sustainable. At that time sustainable logging implied only a sustained yield. Nowadays sustainable forest management is about maintaining the capacity of the forest to fulfil all functions (production, habitat of people, flora and fauna, cultural values). Three main issues can be distinguished:

1. Solutions should be found for the question which stakeholders are accepted in the process of decision making by the other stakeholders.
2. Then you can come to some sort of designation of the current and future forest uses. In this perspective zoning is not a distinction of functions per definition, but can be about compatibility and combining of functions. To what extent are logging activities compatible with the livelihood of the pygmies was an important question raised in the begin of the programme.

3. Once a function is agreed upon, the question raises how it should be managed. What are important parameters? Tropenbos can provide an example of a plan and provide insight into the different management alternatives.

The contract with ITTO contains the obligation to prepare a Forest Management Plan. However this is stated in French. The French word *plan d'aménagement* is considered as a zoning plan (which is a feasible option for the TCP), while *plan de gestion* is more seen as a management plan. First a zoning plan should be established after which a management for each zone can be agreed upon.

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