

Hierarchical
Framework for
the Formulation
of Sustainable
Forest
Management
Standards

TROPENBOS

Principles

Criteria

Indicators

HIERARCHICAL FRAMEWORK
FOR THE FORMULATION OF
SUSTAINABLE FOREST MANAGEMENT
STANDARDS

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PREFACE

This is a timely, useful and thought provoking contribution to the international discussion on the development of principles, criteria and indicators for sustainable forest management (C&I). The purpose of this paper is to highlight and discuss the underlying concepts for the formulation of C&I and to explore their inter-relationships in an effort to achieve greater clarity and consistency in their use. The paper is timely because, as the authors point out, our own research on criteria and indicators at CIFOR has revealed a lack of consistency in the use of terms and concepts, based possibly on an incomplete understanding of their meanings. Underscoring its timeliness, the recently concluded Intergovernmental Seminar on Criteria and Indicators for Sustainable Forest Management (ISCI) held at Helsinki identified the need for common understanding of the terms, concepts and processes related to the development and application of C&I.

The authors provide a brief but comprehensive overview of the status of current developments in the field of C&I. They examine the most important concepts and terms currently in use in C&I development and application and go on to offer a design of a consistent framework for the formulation of C&I. They do so in a manner that aims to promote user-friendliness. In this regard I particularly commend the liberal use of examples to illustrate the meaning of the concepts and terms, as experience shows it is seldom sufficient to simply provide definitions, however precise these may be. This constructive approach should provoke and facilitate the process of improving our understanding of some of the concepts at the heart of sustainable forest management.

The paper reflects long national and international experience with the development of C&I, for instance through the Scientific Support Group of the CIFOR C&I research project. I strongly recommend it to readers interested in the further development of C&I, whether at the FMU, national, regional or international levels.

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SUMMARY

1. The purpose of this publication is to give guidance for the formulation of principles, criteria and indicators (P, C & I) for sustainable forest management (SFM). The presented hierarchical framework may serve as a manual to develop consistent standards for boreal, temperate and tropical forests. A standard is a set of principles, criteria and indicators, (P, C & I) or at least a combination of these hierarchical levels that serves as a tool to promote SFM, as a basis for monitoring and reporting, or as a reference for assessment of actual forest management.
2. The future of the world's forests is a major public concern. At the international level the concern has been translated into a need for monitoring and reporting on the state of the forests. The UNCED conference 1992 in Rio de Janeiro has activated this process. In market segments pressure is building up to identify products coming from sustainable or at least well managed forests, which has stimulated the development of assessment procedures of the quality of forest management.
3. The need for better control of the world's forests has raised renewed interest in ways to make the concept of SFM operational. Notwithstanding historical achievements of elaboration of the concept of SFM, more recently international and national fora and individual organizations have worked out various standards for sustainable management, for different purposes and spatial scales (international, national and forest management unit).
4. Standards developed for monitoring and reporting at regional and national level may not be fully compatible with standards used for assessment of the quality of the forest management at the level of the forest management unit. Nevertheless, there seems to be a tendency towards adopting similar definitions for SFM and similar principles for all spatial levels, although specific spatial levels may require additional principles particularly relevant to that level. Differentiation and specific adoption to conditions and adjustment to changes are necessary at the level of indicators and verifiers, and to a lesser extent at the level of criteria.
5. The existing standards contain a wide range of interpretations of terms. Within individual standards one may find inconsistency in use of terms, allocation of parameters (P, C & I) at a wrong hierarchical level, and inadequate formulation of parameters. These irregularities are partly caused by insufficient elucidation and understanding of the meaning of a standard. Definitions of P, C & I are lacking or are formulated in too general a way. They often provide insufficient information to fully understand their meaning in the context of SFM and they tend not to give enough guidance for a proper formulation of these parameters. These deficiencies make it difficult to compose different standards. As a consequence the requirements of SFM as imposed by one standard are difficult to compare with the requirements of another standard. Inconsistency and a lack of coherence may result in insufficient coverage of the various aspects of sustainable management, possible overlap and redundancy of parameters and inadequate transparency. As a result a sense of confusion can be observed in the practical application of P, C & I and in the international debate on this issue.

6. The Tropenbos framework presented in this report has been designed in an attempt to help to solve the problems which are encountered with the formulation, use and comparability of present standards. The proposed hierarchical framework has been developed on the basis of several starting points and considerations. The proposed hierarchical framework takes into account the following current typology for parameters:
 - a) Input: an object, capacity, or intention, put in, or taken in, or operated on by any human driven process (e.g. management plan)
 - b) Process: the management process or a component of the management process, or other human action, describing human activities and not the result of the activity (planning process, field operations)
 - c) Outcome (performance/output): the actual or desired result of a management process which describes the state or capacity of the ecosystem, the state of a physical component or the state of the related social system or its components.

The proposed hierarchical framework has been developed on the basis of several starting points and considerations.

7. First, the notion of horizontal and vertical consistency of the framework is being introduced. A standard should cover all relevant aspects of SFM or well managed forests. A standard is horizontally consistent if parameters at one level do not have any explicit or implicit overlap or duplication, while at the same time all aspects are covered. Vertical consistency refers to the relation between parameters appearing at adjacent levels. A standard is vertically consistent if the parameters are placed on the right hierarchical level, expressed in correct terms, and linked to appropriate parameter(s) on the higher hierarchical level. The requirement to link an indicator to one specific criterion is particularly relevant for indicators formulated as outcome parameters and to a lesser extent for indicators formulated as process and input parameters.

The level of detail by which parameters, particularly principles and criteria, should be formulated is determined by the balance between a meaningful unambiguous set of parameters and a practical transparent standard which may conveniently be communicated to policy makers, managers and forest users.

8. Second, the function of each level in the hierarchical framework is made explicit and this function determines the way that the parameters are formulated. The characteristics for formulation of parameters at each hierarchical level are identified.
9. Third, choices are made with respect to input, process or outcome parameters for the formulation of criteria respectively indicators. At the level of criteria the implications of compliance with the principles should be described in terms of the desired state/dynamics of the forest ecosystem and the related social system. Thus criteria should be formulated as outcome parameters. In order to assess whether the criteria are met, appropriate indicators should be formulated in terms of outcome parameters. In practice one needs to complement the outcome indicators with process and input indicators. These types of indicators are particularly necessary in order to give an impression of the quality of policy and management.
10. These three considerations are elaborated for each level of parameters (P, C & I) in order to present guidelines for the formulation of P, C & I.
11. Fourth, both the function of each level and the characteristics of the requirements for the parameters are reflected in the definition of the parameters (principles, criteria, indicators, verifiers).

12. Actual monitoring, reporting or assessing depends on the availability and quality of unambiguous practical indicators. Quantitative indicators formulated in terms of outcome (state and dynamics of a forest ecosystem or the related social system) are meaningful if reference values are available. The complexity of the ecosystems and the relatively limited scientific knowledge make the practical availability of reliable norms (thresholds) scarce. This leads to two conclusions. The knowledge available now should be used as extensively as possible and thresholds and target values should be set conservatively. Norms should be developed and adjusted when new scientific information and experiences become available and changes, as a result of the dynamics of the forest ecosystem and related social system, have taken place. Moreover, a pure mathematical approach using quantitative indicators would yield too many criteria and indicators to be practical. Assessment of the quality of the forest ecosystem and the management would rely to a certain extent on best professional judgement.
13. In addition to outcome indicators, various standards need to be complemented with process and input indicators. These indicators refer to aspects of the management system (planning, field operations, etc.). The link between the criteria and process and input indicators is in most cases weaker and less direct than the link between criteria and outcome indicators. Special attention should be paid to demonstrate the indicative value of process and input indicators for the degree of compliance of the ecosystem or social system with the respective criteria and principles they refer to.
14. Standards to assess environmental management systems (EMS) (focusing on management procedures, organizations, etc.) should somehow be incorporated in outcome oriented standards, which are characterized by the formulation of principles in terms of aims and attitudes and the formulation of criteria in terms of outcome. Inclusion of an (part of an) EMS standard will take place at the level of indicators. Vice versa, EMS standards should be complemented by outcome criteria and indicators to serve as an adequate tool for the assessment of the quality of forest and forest management.
15. As the indicators are determinant for the conditions and requirements that should be fulfilled in practice by forest management (either at national or at forest management unit level), their choice is of crucial significance for the level of management quality that should be achieved. In practice, the assessment of the quality of forest management boils down to a check on compliance with indicators and norms, not with principles and criteria. However, without the formulation of principles and criteria and the understanding of the link between them and the indicators, this check is not meaningful.
16. Some aspects need further attention and thinking.
 - * The question of whether standards developed for different purposes, monitoring, reporting or assessing, require different hierarchical frameworks. This publication works on the hypothesis that this is not necessarily the case.
 - * The question of whether standards developed for different spatial scales, global, regional, national and FMU, require different hierarchical frameworks and different parameters. The position in this publication is that the same hierarchical framework can be used for the development of any standard for any spatial level. Further the definition of SFM and principles are alike for all spatial levels although particular principles may be relevant only for one spatial level. Differentiation is partly needed in the formulation of criteria and is certainly necessary at the level of indicators.
 - * The linkage between standards for the national level and the FMU. It is argued that they should be developed with mutual interaction and that assessment of SFM at the FMU level is not fully satisfactory without taking into account some crucial aspects at the national level. In this document it is recommended that close links are established between the development of standards for national and FMU level. A fully satisfactory assessment of forest management at the FMU level should take into account any crucial aspects at the national level.

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- * The appropriate level (P, C or I) in a standard for matters such as the presence and quality of the legal and institutional framework. The publication introduces arguments based on considerations of consistency to formulate these requirements as indicators. The importance of the issue is determined by its nature and not by its position.
- * The distinction between criteria (always formulated as outcome parameters) and indicators which are formulated as outcome parameters. This document states that the distinction should be sought in the hierarchy itself and in the difference of function between the two levels, as the formulation may be sometimes the same. Anything that is implied by a criterion and at the same time is to be used for assessment should appear as an indicator. Thus redundancy at the level of criteria is avoided and horizontal consistency is maintained.
- * The meaning of a vertical consistent framework with respect to the use of indicators which are formulated as process and input indicators. The document makes clear that systematic hierarchical thinking helps to allocate these types of parameters at the appropriate level and to formulate them in an effective way. Although some process and input indicators may be directly deducted from single criteria, for most process and input indicators this is not the case. In most cases they will implicitly refer to a substantial part of the whole spectrum of principles and criteria. These type of indicators are not the result of a straightforward top-down analysis of principles via criteria into indicators. They are however located at the right level and refer to the higher hierarchical level.
- * The relation between outcome oriented standards (principles are formulated as an aim or attitude in relation to the function of the forest ecosystem and to the interacting social system; criteria are formulated as outcome parameters) and standards for Environmental Management Systems (EMS). This publication mentions that a kind of EMS standard should be part of the set of indicators that is contained in the outcome oriented standard. Vice versa an EMS standard must be complemented by outcome parameters of an external outcome oriented standard.

1. INTRODUCTION

Concern for forest degradation

For years, the future of the world's forests has been a major concern among scientists, but has more recently become a matter of public concern (Evans, 1995). The most significant issues of concern often related to tropical forests have been: reduction of forest area and quality, environmental degradation of forest areas, loss of biodiversity, loss of cultural assets and knowledge, loss of livelihood, and climate change (Upton and Bass, 1995). The concern is not only confined to tropical forests, but has also extended to boreal and temperate forests (Baharuddin, 1995). More and more people realise there is a need for Sustainable Forest Management (SFM). At the international political level the public concern has been translated into a need for monitoring and reporting on the shifts in forest lands and the quality of the forests. In segments of the European and North American markets, pressure built up to identify products coming from sustainable or at least well managed forests. In this respect certification is regarded as a possible instrument. Not only timber and forests, but also products from other ecosystems are in the process of certification. A certificate in relation to forest management is a written quality statement attesting the origin of wood raw material and its status and/or qualifications following validation by an independent third party (Baharuddin and Simula, 1996). For monitoring and reporting at national level and assessment of the quality of the forest at management unit level, formats and references are essential tools

Standards/hierarchical framework

Lately, various hierarchical standards have been developed in a renewed attempt to capture the concept of SFM. A standard is defined here as a set of principles, criteria and indicators (P, C & I), or at least some combinations of these hierarchical levels, that serves as a tool to promote SFM, as a basis for monitoring and reporting or as a reference for assessment of actual forest management. Note that the term 'standard' is also used as a reference for one particular aspect of forest management, e.g. desirable species composition, tolerable erosion levels etc. In the glossary (page 42) of this document the term 'norm' refers to one particular aspect. An unambiguous and well explained hierarchical framework is a prerequisite for a coherent and consistent standard. Such a framework, consisting of different levels (P, C & I) for the formulation of parameters, should describe the function of each level, and the common requirements for the formulation of parameters appearing at a particular level.

Problem

Hierarchical frameworks for standards for SFM have not yet been well developed and explained. There also seems to be little, if any, indication that an elaborated concept of a hierarchical framework has formed a common basis for the standards so far developed. The result is a weak comparability between the standards. This means that requirements for SFM as imposed by one standard, are difficult to compare with those of another standard. The need to adopt a systematic approach that involves agreed definitions of key terms is recognized (Maini, 1993). The Intergovernmental Panel on Forests (IPF) expressed, at its second meeting, unanimous support for 'examining the possibilities for developing a global consensus on concepts, terms and definitions related to sustainable forest management'. The Intergovernmental Seminar on Criteria and Indicators for Sustainable Forest Management held in August 1996, in Helsinki, Finland, recommended to IPF that it should '... address the need for common understanding of the terms, concepts and processes related to their development and application, including definitions of essential terms'.

Besides the need to increase comparability, there is room for improvement of the consistency within individual standards (CIFOR, 1996). Deficiencies found are inconsistent use of terms, allocation of parameters at the wrong hierarchical level and inadequate formulation of parameters. Lack of a well elaborated and understood hierarchical framework is an important reason for this inconsistency. Definitions for P, C & I are lacking in existing standards or are often defined so generally that they do not provide enough guidance for the meaning and formulation of P, C & I. Inconsistency easily leads to

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confusion and misunderstanding of the proper use of criteria and indicators. Where consistency is lacking, the advantages of standards with coherent hierarchical levels of parameters (P, C & I) cannot be fully achieved.

Objective of this paper

This publication presents a suggestion for a consistent hierarchical framework which is meant to give guidance for the formulation and selection of relevant parameters (P, C & I) for SFM. The hierarchical framework could serve both the development of standards to be used for monitoring and reporting at the regional and national level, and the development of standards for the assessment of the quality of the forests and management at the management unit level. It is designed to be applicable to all forests, boreal, temperate and tropical. As a spin-off from its strong involvement in the international and national discussions and developments concerning SFM and forest assessment procedures, Tropenbos intends, through this document, to contribute to the development of globally comparable (not necessarily harmonised) and individually consistent standards.

It is hoped that other may wish to develop the ideas for a hierarchical framework for P, C & I set down by Tropenbos in this publication. The hierarchical framework can also serve as a manual for immediate use by those who wish to establish or improve a standard for sustainable or well managed forests. The framework can be used in the way it is presented in this document to help formulate P, C & I for use.

2. RECENT AND CURRENT DEVELOPMENTS

Nature of standards

Currently, there are numerous groups involved in the development of standards to conceptualize and evaluate SFM at the international, national or forest management unit (FMU) level. Sustainability indicators are also being developed for other sectors (e.g. Bakkes *et al*, 1989; World Bank, 1994; OECD, 1993). Methodologies and terminologies may differ relative to objectives, sectors and disciplines. On the one hand this may lead to misunderstanding and misinterpretation between the different parties involved. Confusion may especially arise when the same terms are used but with different interpretations. On the other hand, the processes all have certain facets in common and they can therefore support and complement each other. However, many of the processes which have led to standards for SFM have predominantly taken place within the forestry sector, and have been rather isolated from developments which tackle the problems of more general environmental assessment. As a consequence, the terminology as used in the context of forest assessment may differ from the terminology as used in similar processes developed in other sectors.

The concept of P, C & I, has been broadly adopted in the forest sector as the common approach to conceptualize and evaluate SFM. P, C & I may be formulated to serve at international, national and at the forest management unit level. Sets of P, C & I for use at the FMU level have been developed to assess the quality of management and the ecosystem. P, C & I have been developed for use at the international and national levels mainly to facilitate monitoring and reporting. Sets of P, C & I developed for different purposes and for application at different levels may not be fully compatible without adjustments (International Experts Working Group meeting - Bonn, 1996). The adjustments may be based on differences of relevance of certain issues, or on different degrees of detail by which parameters should be described. Present sets of P, C & I are to a large extent outcome-oriented (also referred to as performance-oriented) approaches, in a sense that the state and dynamics of the forest and the state and dynamics of the social system related to the forests are the central focus. More recently other sustainable forest/non-forest related assessment approaches have come more prominently into the debate, notably the assessment of environmental management systems, which focuses on the organisation of the management. This type of assessment is process oriented. There is a growing consensus that the two approaches complement the assessment of SFM.

The current activities geared to the development of standards may be distinguished by three types of processes that run simultaneously (*Ad hoc* Werkgroep Duurzaam Bosbeheer, 1996).

Political processes

Current forest and timber certification initiatives are developing against a rapidly changing background of international and national initiatives in forestry, biodiversity, conservation, environmental management systems and trade. In 1990 the International Tropical Timber Organization (ITTO) drew up guidelines for the sustainable management of natural tropical forests and for plantations. In 1992 ITTO published criteria and indicators for the measurement of sustainable tropical forest management at the national as well as at the management unit level. In 1992, tropical and temperate forests featured prominently on the agenda at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro. The outcome was a set of non-binding 'Forest Principles'. Three regional processes were started after UNCED; notably the Helsinki process, the Montreal process and the Tarapoto process. These were followed at a later stage by a UNEP/FAO initiative for Dry-Zone

Africa. In the Helsinki process, criteria and indicators at the national level were agreed upon for the European forests. Other countries in the boreal and temperate zones united in the Montreal process which resulted in the drafting of the Santiago Declaration. It includes recommendations on criteria and indicators at the national level for sustainable management for non-European temperate and boreal forests. Through the Tarapoto process the countries of the Amazon Cooperation Treaty (ACT) have developed a standard containing criteria and indicators for the global, national as well as the FMU Levels. The African Timber Organisation (ATO) has taken up a 'Green Label initiative'. Originally the idea behind the label was to offer the market a provenance certificate. ATO is now exploring possibilities of developing a standard for West and Central African countries using the results of the CIFOR (Center for International Forestry Research) tests (see *operational process*). The Intergovernmental Panel on Forests is paying due attention to the development of standards for SFM and to the harmonization of systematic approaches (IPF, 1996).

Several countries are in the process of developing their own national standards, either based on these international processes, on the ITTO standard, or on combinations of these and other standards.

Operational processes

Whereas national standards have been developed essentially as a basis for reporting and monitoring sustainability at the national level, the focus of assessing sustainability for certification programmes is at the forest management unit (FMU) level (Upton and Bass, 1995). *An FMU may be defined as a clearly demarcated area of land covered predominantly by forests, managed to a set of explicit objectives and according to a long-term management plan* (CIFOR, 1996).

The Forest Stewardship Council (FSC) is an international NGO that evaluates, accredits and monitors certification bodies which themselves assess the quality of forest management. The FSC itself does not certify forest management or products; its mandate is to accredit the certifiers. FSC is founded by a diverse group of representatives from environmental institutions, certain elements of the timber trade, the forestry professions, indigenous peoples' organisations, community forestry groups and forest products certification organisations from 25 countries. FSC has been strongly supported by NGOs and it is gradually gaining more credibility from trade and governments. The organisation is broadly recognized as being the most advanced yet in developing and applying an accreditation scheme. Part of the requirement for a certifier to be accredited is the application of an assessment standard which complies with the FSC standard of principles and criteria. Up to now, four certification organisations have been accredited, more are under consideration.

The International Organisation for Standardisation (ISO) is the worldwide federation of national standards bodies. The ISO 9000 series of standards provides establishing and auditing systems for the quality of management. After the Rio Earth Summit, in 1992, the ISO started to define Environmental Management standards. This series is still under development and the first standard, ISO 14001, on Environmental Management Systems, was expected to be published in late 1996. The standards will set procedures and requirements for management of planning, implementation and monitoring processes.

Several certification bodies, among which are those that are accredited by the FSC, operate their own standards. The requirements for their assessment procedures are partly based on various ISO standards.

Scientific processes

The Center for International Forestry Research (CIFOR), in collaboration with several governmental and non-governmental organizations of tropical and temperate countries, is undertaking a project to test criteria and indicators for SFM at the FMU level. The focus of this project is to identify minimum reliable sets of criteria and indicators that will be objective, cost effective and relevant to the assessment of SFM. Existing standards developed by a variety of organisations and institutions are used as a basis for the test. Several of these standards are actually used in practice by certifying organisations. The test has revealed that present standards often lack consistency, both among parameters appearing at the same level, and between parameters at adjacent levels (e.g. the relation between a principle and a criterion, or between a criterion and an indicator).

Several comparative studies of existing standards have been undertaken, including the Hahn-Schilling BFH, 1994 and the Secretary-General's report on 'Criteria and indicators for sustainable forest management' for the third session of the Ad-Hoc Intergovernmental Panel on Forests, September 1996. Common features and discrepancies in approaches and coverage as to geographical levels are revealed. Compilations of terms, concepts and definitions have been made by FAO (1995) and the secretariat of ISCI (1996). Where appropriate, results of these studies and compilations have been included in this document.

For a list of documents with standards for SFM, see References.

3. HIERARCHICAL FRAMEWORK

3.1 Function

The hierarchical concept by which P, C & I are grouped is recognised for its ability to function as a basis for monitoring and reporting on SFM and as a reference for the assessment of the quality of forest management. A hierarchical framework serves as a guidance for the formulation of sets of P, C & I -or at least some combinations of these hierarchical levels. A hierarchical framework describes different levels, in this document P, C & I, to facilitate the formulation of a consistent and coherent standard (see figure on page 15 and 32). The challenge for the creation of a standard of P, C & I for SFM is that it fully covers, as explicitly and operationally as possible, all aspects of SFM. It enables the reporting, monitoring and assessing of these aspects in a practical way. The hierarchical framework describes the function of each level as well as the characteristics needed to formulate P, C & I. The framework helps to breakdown, step by step (level by level), the goal (e.g. SFM, or well managed forest) into parameters that can be managed or assessed. The level of the principles breaks down the goal into more specific components. The level of criteria translates the principles into states, or dynamics of the ecosystem and the social system. The level of indicators adds measurable elements. Finally, verifiers (V) are needed to clarify the source of information for the value attached to an indicator.

The following definition for a hierarchical framework is suggested:

A hierarchical framework describes hierarchical levels (P, C & I) to facilitate the formulation of a set of parameters in a consistent and coherent way. It describes the function of each level as well as the common characteristics of the parameters appearing on a particular level.

The potential value of a hierarchical framework is that it among others.:

- * increases the chance of complete coverage of all the important aspects to be monitored or assessed;
- * avoids redundancy; it limits the set of P, C & I to a minimum without superfluous parameters;
- * results in a transparent relation between the parameter that is measured and the compliance with the principle it refers to.

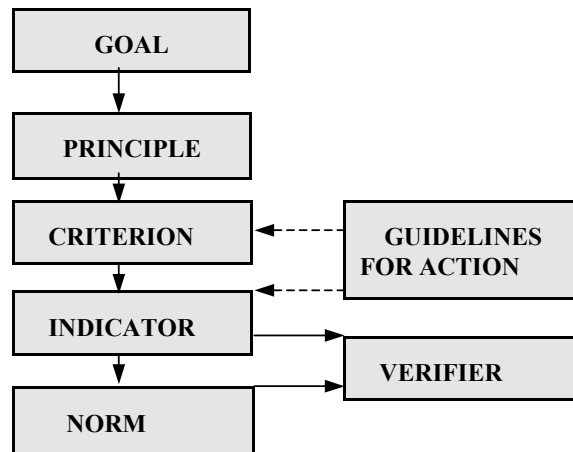
Guidelines for specific actions may be established to complement standards. This is appropriate in cases where the hierarchical framework is used to formulate standards to support and promote SFM and not specifically to assess the actual quality of the forests and the management.

The function of the guidelines is to translate criteria and indicators into practical guidance for actions to meet the requirements of criteria and indicators. Guidelines will often be formulated in terms of prescriptions showing how the requirements should be met.

From a systematic point of view, a more appropriate place for guidelines is outside the hierarchical framework but with a strong link to both criteria and indicators. As a next step concrete activities have to be planned to implement the guidelines. Activities should be formulated in management plans and annual work plans.

In conclusion, the hierarchical framework facilitates the development of consistent and coherent standards (sets of P, C & I). A standard describes **what** should be accomplished (P & C) and enables an assessment **if**, or to what extent, accomplishment is realised (I). Guidelines and derived activities indicate **how** one should comply with the P, C & I.

Summarizing figure indicating the hierarchical levels



3.2 Problem

As stated in the introduction, various standards are based on a wide range of interpretation of terms, making it difficult to compare one with another. As a consequence requirements for SFM imposed by one standard are difficult to compare with those of another standard. Therefore it is necessary to be as precise and concrete as possible. Standards developed often lack an explicitly elaborated hierarchical framework. The meaning of the standard itself is not sufficiently explained and understood. Definitions of P, C & I are lacking, or are defined in too general a way. They often provide insufficient information to enable their meaning to be fully understood in the context of SFM. They tend to give insufficient guidance for a proper formulation of P, C & I. As a consequence, this may diminish the chance to achieve sufficient consistency within the individual standards. Confusion is created as to the exact meaning of the different levels of parameters and as to the common denominators of the parameters that appear at the same level. The parameters may not be formulated in terms which are meaningful. Also in some cases the importance attached to a certain parameter may appear to determine the hierarchical position of that particular parameter, while the chosen position may be incorrect from a systematic point of view. These facts do not promote a common understanding among different involved parties. They also preclude to make operational the full potential advantages of a hierarchical framework.

3.3 Design, specific features

In this document an attempt is made to tackle the problems concerning the positioning and formulation of P, C & I. The hierarchical levels of P, C & I will be explained. Every individual hierarchical level will be discussed with respect to its function and the way the parameters on that level should be defined and applied.

Types of parameters

The parameters can be distinguished according to their type. Partly inspired by the descriptions by CIFOR (1996) the following working definitions are suggested:

- a) Input : an object, capacity, or intention, put in, or taken in, or operated on by any human driven process (e.g. management plan)
- b) Process : the management process or a component of the management process, or other human action, describing human activities and not the result of the activity (planning process, field operations)
- c) Outcome (performance/output) : the actual or desired result of a management process which describes the state or capacity of the ecosystem, the state of a physical component or the state of the related social system or its components.

In this study the term outcome will be used when referring to parameters as described under (c). It is essential that each parameter appearing at a certain level is expressed in conformity with the specific characteristics of that level. Other formulations should be avoided. In the following chapters, the possible preference for each of these parameters when formulating criteria and indicators will be discussed.

Horizontal and vertical consistency

The aim is to present a hierarchical framework that is consistent both horizontally and vertically. **Horizontal consistency** means that parameters appearing at the same level do not have any overlap. **Vertical consistency** refers to the relation between parameters appearing at adjacent levels. The set of parameters is vertically consistent, if the parameters are placed on the right hierarchical level, expressed in correct terms, and linked to appropriate parameter(s) on the higher hierarchical level.

In the next chapters it will be argued that principles should be formulated as a fundamental law or rule in terms of an objective or attitude, criteria should be formulated as outcome parameters and indicators will be formulated whether as outcome, process or input parameters. It will become evident that the requirement to link an indicator to one specific criterion is particularly relevant for indicators formulated as outcome parameters, and to a far lesser extent for indicators formulated as process and input parameters. Although a number of process and input indicators may also be deduced from single criteria, in most cases they will implicitly refer to a substantial part of the whole spectrum of principles and criteria. Examples are 'the application of scientifically based forest use planning' and 'presence of a management plan'. Thus for many indicators formulated as process or input parameters the requirement of vertical consistency relates more in particular to the appropriate place and the correct formulation of those indicators, and not so much to the linkage to a specific criterion.

Another important feature of a practical hierarchical framework is the guidance it gives for the degree of detail to which parameters at each level are to be formulated. A balance should be kept between a meaningful unambiguous formulation and a workable transparent standard. A standard should meet the requirements of practical use.

These specific features of the design of a hierarchical framework are elaborated in Chapter 4.

For a schematic presentation of a hierarchically consistent model and a hypothetical example of a hierarchically incorrect standard see Appendix I and II.

In Chapter 4 elaborated definitions are formulated for the groups of parameters used at each level (like principles, criteria etc.). Thus, guidance will be given for establishing a proper set with hierarchically correct classified and well formulated P, C, I & V. The framework as described here will especially refer to SFM or well managed forests, but it may also be useful in creating standards for other ecosystems.

4. HIERARCHICAL LEVELS FOR ASSESSMENT OF SUSTAINABLE FOREST MANAGEMENT

4.1 Sustainable Forest Management

Sustainability or the achievement of *Sustainable Forest Management* (SFM) can be regarded as the overall objective or as the goal in the P, C & I hierarchy. Some certification programmes emphasize quality - 'good' or 'improved'- forest management rather than sustainability itself. The concept of SFM is derived from the human goals. It is a cultural concept which is oriented towards cultural values and economic and social goals (Brünig, 1996).

The concept of SFM is not new. As far back as the 15th century the notion of managing sustainable forest existed in Europe (Wiersum, 1995). The concept of SFM and of well managed forests has been invented by mankind and is therefore bound to be adapted to the ideas and needs of society at any particular moment. The actual meaning at any one time is the result of discussion and compromise among interested parties.

Historically, the concept of SFM has evolved from sustainable timber production to the present meaning, expressing the sustainability of all functions of the forests. De Groot (1994) subdivided the functions of the forest into regulation, 'carrier' (by others referred to as habitat), production and information functions. The ability to fulfil the various functions is specific to each particular forest. The relevance to pursue specific functions or to take them into account in a management quality assessment is dependent on this ability and on the management objectives.

The forest functions as described by de Groot (1994) provide a good basis for formulating a definition of SFM and for identifying principles in the generally recognised three domains of sustainability, as described by Upton and Bass (1995) and others, namely:

Ecological or Environmental sustainability: This entails an ecosystem and adjacent ecosystems at the same or higher levels as the ecosystem in question to be able to maintain viability and functionality. The ecosystem should support healthy organisms, whilst maintaining its productivity, adaptability and capability for renewal. It requires that forest management respects, and builds on, natural processes;

Social sustainability: This reflects the relationship between cultural ethics, social norms and development; an activity is socially sustainable if it conforms with ethical values and social norms, or does not stretch them beyond a community's tolerance of change;

Economic sustainability: This requires that benefits to the group(s) in question exceed the costs incurred, and that some form of equivalent capital is handed down from one generation to the next.

There are many definitions of SFM. As examples two of them are presented here.

The definition by ITTO of SFM refers to tropical forests:

Sustainable Forest Management is the process of managing permanent forest land to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without undue reduction of its inherent values and future productivity and without undue undesirable effects on the physical and social environment.

Another comprehensive and useable definition of SFM was formulated by the Helsinki process which focuses on boreal and temperate forests :

Sustainable management means the stewardship and use of forests and forest lands in a way, and at a

rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global level, and that does not cause damage to other ecosystems.

Both definitions recognise scale and time as important dimensions of sustainability.

Spatial dimension

The concept of SFM needs to be formulated and elaborated for different scales (global, regional, national and forest management unit). It is obvious that at the international and the national level, the issues of concern are being discussed in a more generic way than in a smaller spatial scale such as the FMU. However, the substance of many issues may still be the same. The question is whether there is a need for a certain degree of differentiation of issues between the different spatial scales. If the answer is positive there is a necessity to develop specific sets of P, C & I for different levels of spatial scale. According to the growing international debate, there seems to be a general tendency towards adopting similar definitions for SFM and similar principles for all spatial levels, although certain principles can only refer to certain spatial scales instead of all scales. Differentiation may be needed in the formulation of criteria, and is certainly needed for indicators.

There is a strong relation between SFM at the national level and at the FMU level. SFM for the FMU is ultimately dependent on a national forest policy. The policy is reflected in laws and land use procedures. At the national level the forest base must be secured permanent forest estate, to sustain the forest at the level of the FMU. This is a condition for sustainable management of the FMU. Protected areas must be designated at the national level to prevent loss of biodiversity resulting from conversion or extraction. This requirement complements the criteria for SFM in an FMU. Other criteria at the national level such as recognition of customary rights should be implemented at the level of the FMU. National guidelines for SFM must be implemented at the FMU level. It is recommended that close links are established between the development of standards for national and FMU levels. There should be a two way interaction. A fully satisfactory assessment of forest management at the FMU level should take into account any crucial aspects at the national level.

Temporal dimension

The operational definition of sustainability implies a time scale: sustainability means that the forests should be able to fulfil their functions now and *in the future*. The existing standards refer to the time scale in vague terms like 'now', 'later' and 'next generations'. The sets of criteria and indicators must reflect the temporal dimension. This may be achieved by developing parameters which are a condition or indication for positive development of the forest ecosystem, for instance that the capacity of the forest to regenerate naturally is ensured. However a snapshot at one time may not always provide sufficient evidence of sustainability for all criteria and indicators. Particularly in the case of small estates, it is difficult to establish sustainability at a given point of time, or apply it as an operational concept over a long period of time (Baharuddin and Simula, 1996). Monitoring is essential for a proper assessment (see Chapter 5).

4.2 Principles

The meaning of principles in a standard is often not well explained while definitions tend to give insufficient guidance for a proper formulation of principles in the context of SFM. This is illustrated by the following examples:

Definition

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The definition for principles by the Concise Oxford Dictionary (1990) and also used by CIFOR (1996) is:
A fundamental truth or law as the basis of reasoning or action

The definition for principles by Maini (1993) is:
A fundamental law or rule as a guide to action, a rule of conduct, a fundamental motive or reason for action, especially one consciously recognized and followed

The definition for principles by the FSC (1996) is:
A principle is an essential rule or element, in the FSC's case, of forest management

In this section 4.2, the function of the level of principles in the hierarchical framework and the requirements for the formulation of principles are elucidated. The function and the characteristics for formulation are reflected in the following, more elaborated and focused, definition:

A principle is a fundamental law or rule, serving as a basis for reasoning and action. Principles have the character of an objective or attitude concerning the function of the forest ecosystem or concerning a relevant aspect of the social system that interacts with the ecosystem. Principles are explicit elements of a goal, e.g. sustainable forest management or well managed forests.

Function of principles in the hierarchical framework

The 'goal' of sustainable (or well managed) forests, is formulated as an ideal, which needs further elaboration to make it meaningful for forest policy, management and assessment. The goal, SFM, implies the sustainability of all the relevant forest functions and those aspects of the social system which are generally considered to be a prerequisite for a proper fulfilment of the forest functions. Some relevant issues of the social system interacting with the forest are equity, access, participation. The first hierarchical level will make the meaning of SFM explicit by splitting the goal into separate components, principles, which together fully cover the meaning of the goal. The principles should be a satisfactory result of consultation between all the parties involved or interested in the ecosystem and the social system interacting with it. Together with the goal, the principles define the scope of the standard.

Degree of freedom with selection and formulation

The concept of SFM has evolved. As stated in section 4.1, presently, the concept includes the social functions of the forest and the social system that interacts with the forests. Principles are a further interpretation of the concept of SFM. Accepted definitions of SFM and a list of principles are both results of a political process. Wisdom, interests of policy makers and stakeholders are important driving factors of that process, which involves consultation, negotiation and compromise. Among policy makers, stakeholders and other interested parties may be governments, communities living in or around forested areas, employees, investors and insurers, customers, environmental interest groups and the general public.

Box 1. Examples of correctly formulated principles

Selected and modified random examples of principles formulated in compliance with the requirements of the hierarchical framework

- * Long-term social and economic well-being of forest workers and local communities shall be maintained or enhanced.
- * Yields of forest products (timber and non-timber) shall be sustainable.
- * Legal and customary rights of indigenous peoples to own, use and manage their lands, territories and resources shall be recognized and respected.
- * Forest contribution to global carbon cycle shall be maintained.
- * Water resources shall be maintained and conserved.
- * Stakeholders, including forest actors, shall have a voice in forest management.

Box 2. Examples of horizontally overlapping principles

Randomly selected pairs of principles which have some overlap

Example A.

A1. Long-term multiple socio-economic benefits to meet the needs of society shall be maintained, or enhanced.

A2. The productive functions of the forest shall be maintained.

Example B.

B1. The rights and duties of all stakeholders should be clearly defined, perceived and accepted by all.

B2. Legal and customary rights of indigenous peoples to own, use and manage their lands, territories and resources shall be recognized and respected.

In a horizontally consistent standard, (for explanation see 3.3) inclusion of two principles that have close resemblance or overlap should be avoided. This means, in the examples given above, that only one of the two principles of a pair should be included. Thus in example A. a choice should be made between principle A1. or A2. The respective principles A2. and B2. focus on only one element which is implicitly included in the respective principles A1. and B1. Therefore, if principle A1. respectively B1. is deleted other principles should be added to cover the full meaning of the deleted principle, as a complement to principle A2 and B2. One may also choose to retain principle A1. respectively B1. and delete principle A2. respectively B2. In that case the further breakdown of the subjects covered in these principles, should be on the lower hierarchical level, the level of criteria. This bears the risk of losing full coverage of the meaning of the principles.

Principles which combine three or more narrowly focussed principles

1. The ecological functions of the forest shall be maintained
 - a. Protective functions of the forest shall be maintained and appropriately enhanced
 - b. Habitat functions of the forest shall be maintained and appropriately enhanced
 - c. Biological diversity shall be maintained, conserved and appropriately enhanced

In this example, it would mean that a choice should be made between principle 1. and the combination of the more narrowly focussed principles a., b. and c. The choice of principle 1. may risk losing full coverage of the meaning of principle 1. at the level of criteria.

Characteristics

A principle should be formulated and recognized as an implicit or explicit element in achieving the goal of SFM or well managed forest. A principle should refer to a function of the forest ecosystem or to a relevant aspect of the social system(s) that interact with the ecosystem. Like the goal, the principles should have the character of an objective or an attitude. Principles should be formulated in such a way that the objective or attitude in relation to the forest function and the social system becomes clear. Prerequisites or measures for the realisation of the goal should not be formulated as principles. These are elements which emerge when the principles are to be implemented. Parameters concerning legal and institutional requirements and conditions do not comply with the characteristics for principles as worked out in this hierarchical framework. Such parameters are a better match with criteria and indicators.

Principles can be described at different abstraction levels, meaning that principles differ in the extent to which they treat the issues concrete. A principle may refer to a combination of aspects, such as environmental functions, or may focus on just one aspect, such as CO₂ sequestration. The more explicit and specific the formulation of a principle becomes the less discussion on interpretation is needed. It becomes easier to imagine the impact of the principle and thus to formulate criteria, and actions can be better identified to implement that principle. (See box 2). However, too large a number of principles may cause a loss of overview. A practical balance should be maintained between, on the one hand, an unambiguous and specific formulation and, on the other, a practical and conveniently arranged package to communicate at policy and management levels.

In the hierarchical framework principles will be followed by criteria. To prevent duplication and confusion at both levels it should be avoided to include in one standard a particular principle as well as a set of principles which focus on one or more specific aspects of that one principle. This could result in duplication of parameters on the level of criteria. One should choose between the more integral principle and the complete set of the more narrowly focused principles. By doing so *horizontal* consistency at the level of principles is achieved. (See chapter 3.3. and box 2.)

The whole set of parameters should also be *vertical* consistent, meaning that parameters should be placed at the correct hierarchical level (see section 3.3). They should be formulated in compliance with the characteristics required for the parameters at that level. This means that at the level of principles only parameters appear which comply with the above mentioned characteristics. The importance attached to a certain parameter should not influence the hierarchical position of that parameter. For instance important issues of legislation will appear at the level of criteria and not at the level of principles, as has been explained above.

Ideally, principles should be applicable at different spatial scales, from global to local. Differentiation would then only appear at lower hierarchical levels. In practice, besides a common set of principles for all spatial scales, each scale may require some additional principles which are specifically relevant to that particular scale but which have no meaning for other scales.

Box 3. Examples of incorrectly formulated principles

Examples of principles selected from existing standards which do not comply with the presented hierarchical framework

Principles formulated as prescriptions of actions to be taken, instead of elaborations of the meaning of the goal (SFM) for society and the forests:

- * A management plan shall be written, implemented and kept up-to-date.
- * Monitoring shall be conducted to assess the condition of the forests.

Principles formulated as guidelines to be followed to meet a criterion:

- * Forest management minimizes negative impacts on the biodiversity.

Principles formulated as criteria:

- * Indigenous and traditional communities control forestry activities and their lands. (This is a *criterion* which may link to a principle like 'The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognized and respected'.)

Summary

The level of principles is often not consistently dealt with. In creating a hierarchically consistent set of principles, attention should be paid to conformity between the principles and the described characteristics. This means that all forest functions, and relevant aspects of the social system that interact with it, should be covered. Every principle should be described as an objective or attitude in relation to these functions and aspects. Measures and prerequisites for the realisation of the goal or attitude should not be formulated as principles, for instance issues concerning legislation and institutions. A consistent spatial scale should be used.

4.3 Criteria

As is the case with principles, the meaning of criteria in a standard is often not explained extensively. Definitions, when provided, tend to give insufficient guidance for a proper formulation of criteria in the context of SFM. This is illustrated with the following examples:

Definition

The definition by the Concise Oxford Dictionary (1990) is:

A principle or standard that a thing is judged by.

The definition by CIFOR (1996) is:

Criteria are the intermediate points to which the information provided by indicators can be integrated and where an interpretable assessment crystallises

The definition for a criterion as suggested by J.S. Maini (1993) is:

A distinguishing characteristic of a thing by which it can be judged

FSC defined criteria in the following way:

A means of judging whether or not a principle (of forest management) has been fulfilled

In this section, the function of the level of criteria in the hierarchical framework, and the requirements for the formulation of criteria are elucidated. The function and the characteristics for formulation are reflected in the following definition focused on SFM:

A criterion is a state or aspect of the dynamic process of the forest ecosystem, or a state of the interacting social system, which should be in place as a result of adherence to a principle. The way criteria are formulated should give rise to a verdict on the degree of compliance in an actual situation.

Function

Criteria are the parameters appearing at the first level below the level of principles. Principles are defined as fundamental laws or rules including an objective or an attitude. The function of the level of criteria is to show compliance with a principle in relation to the forest ecosystem, for the forest ecosystem or the related social system. Compliance with the principles is translated into descriptions of resulting specific and concrete states or dynamics of the forest ecosystem, or the resulting states of the interacting social system. These descriptions will show the practical results of compliance with each principle, and will also provide more concrete which are easier to assess, or at least easier to link indicators to, than the abstract non-measurable principles.

Degree of freedom in selection and formulation

Criteria are defined as the states of the ecosystem or the social system that result if the principles are adhered to. Criteria should not explicitly or implicitly add new requirements which do not arise as a logical consequence from the principles. If there is a need to do so, then those requirements (aims and practices to be complied with) should be formulated at the level of principles. Criteria should be the unambiguous logical consequence of one or more principles. Nonetheless, there is still some room for interpretation of the exact meaning of the principles. The formulation of criteria is to a certain extent also a process of compromises and negotiation, although with substantially less degree of freedom than the process of formulating principles. In fact, the desired quality of the ecosystem or social system is determined by the choice of criteria.

Box 4. Examples of correctly formulated criteria

Selected and modified random examples of criteria formulated in compliance with the requirements of the hierarchical framework

- * Soil quality is maintained.
- * Water quality is maintained.
- * Area of reserved forests is delineated and protected.
- * The capacity of the forest to regenerate naturally is ensured.
- * There is a continuous production of timber (products).
- * The health of forest actors is acceptable to all interested and involved parties.
- * The diversity of species of logged forest resembles the diversity of unlogged forests.
- * All stakeholders have acknowledged rights and means to participate in equitable forest management.
- * Forest workers have the right to organize and voluntarily negotiate with their employers.
- * The forest functions for the local community are identified and recognized.

Characteristics

There are a number of conditions for setting up a consistent and complete set of criteria for SFM. Compliance with each principle may be translated into one criterion or a group of criteria. Each principle should be fully covered by relevant criteria.

When referring to the types of parameters described in Chapter 3, *Input/Process/Outcome*, a choice has to be made how to formulate criteria. As the function of criteria is to show the implication of compliance with a principle for the forest eco-system or the related social systems, criteria should be formulated in terms of outcome. This means that a criterion describes which state is desired in the forest or social system. Formulations of criteria must not express that the desired state should be achieved nor how this state is to be achieved. Formulations in the form of prescriptions do not comply with the requirements for criteria in the hierarchical framework. Prescriptions should be reserved for the formulation of guidelines and actions.

The state of the forest ecosystem may be formulated in terms of capacity (e.g. maintenance of regeneration capacity, maintenance of soil productivity), or in terms of the actual appearance of the forest (e.g. manmade canopy gaps resemble natural gaps). For the development of a set of criteria it would be helpful to first formulate, where appropriate, which capacities should be maintained. The appearances of the forest ecosystem or its elements which are required for the maintenance of capacities should be formulated.

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Criteria in terms of the actual appearance of the forest ecosystem should be formulated as explicitly as possible, appropriate to the scale of application. Criteria should not be formulated in too great a detail. One loses the overview and the feeling of coherence. Moreover, greater numbers of criteria may unnecessarily invite more efforts to assess the quality of the forests.

The state of the forest ecosystem and the social system interacting with the forest is not confined to characteristics of the ecosystem itself or to the condition of communities and population segments interfering with the forests but relates also to their legal and institutional status. 'Forests are legally protected' describes the status of the forest (area) and is therefore a proper criterion. The parameter 'Rights for forest dwellers and forest workers are legally established' is conceived as reflecting the status of these population groups and thus should be recognized as a criterion. It should be remembered that the state of the legal or institutional framework itself is an indicator.

Two kinds of formulations are found in existing standards:

- * Criteria which do not indicate any value or aim. These criteria only raise the issue, e.g. 'forest resource base' or 'access to forest resource'. On the basis of such criteria there is no judgement or verdicts to be given. For instance, it is not clear what aspects of the forests resource base or access to forest resources is meant.
- * Criteria are formulated in a way that a verdict can be given as to whether or to what extent a principle is fulfilled.
According to the function of criteria in the hierarchical framework their formulation should enable a verdict to be given. This implies the use of a verb, or a noun derived from a verb in the formulation of a criterion. For instance 'permanent forest estate is established' or 'access to the forest resource is secured for local communities' or 'maintenance of regeneration capacity'.

Box 5. Examples of incorrectly formulated criteria

Examples of criteria selected from existing standards which do not comply with the presented hierarchical framework

Criteria are often formulated as process or input parameters instead of outcome parameters (result of the human driven process).

In many cases where criteria are formulated as issues, no verdict can be given, e.g.:

- * Socio-economic benefits.
- * Legal and institutional framework (process parameter).
- * Forest resource base.
- * Economic, social and environmental services performed by the forests.
- * Science and technology for the sustainable development of the forests (input parameter).
- * National forest protection policy (input parameter).

Parameters are also presented as criteria where the substance is more like a principle.

- * Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of society.
- * Maintenance and encouragement of productive functions of the forests (wood and non-wood).
- * Maintenance and appropriate enhancement of protective functions in forest management.

Criteria are also formulated as prescriptions.

- * Management planning and operations shall incorporate the results of evaluations of social impacts.

- * Forest management should minimize waste associated with harvesting.

- * Training and appropriate equipment must be provided to all operators (input parameter).

- * Trees to be retained for future extraction, or as seed sources, must be clearly marked to minimize damage during harvesting and extraction.

Summary

In practice a variety of formulations is used to describe criteria. Several of these formulations lack relevance to the function that criteria should fulfil in the hierarchical framework. The function of criteria is to make explicit what the practical implication of a principle is, by translating the principle into desired

states or dynamics of the ecosystem or the social system that interacts with it. The state includes the legal and institutional status of the forest and population groups. The formulation of a criterion must allow a verdict to be given on the degree of compliance with the criterion in an actual situation. This implies the description of a defined state. Formulations of criteria should not express that, or how, a desired state should be achieved and criteria should not be formulated as prescriptions. The criteria should match a principle and the combined set of criteria should cover the full scope of all the principles. Criteria should describe an objective using a verb, or a noun derived from a verb.

4.4 Indicators and norms

Standards do not always explain the meaning of indicators extensively. Definitions tend to give insufficient guidance for a proper formulation of indicators as parameters of a consistent standard for SFM or for well managed forests. This is illustrated with the following examples:

Definition

‘To indicate’ is defined in the Concise Oxford Dictionary (1990) as:

- a) Point out, make shown, show, or
- b) Be a sign or symptom of, express the presence of.

CIFOR used the definition originated from Landres (1992):

An indicator is any variable or component of the forest ecosystem or the relevant management systems used to infer attributes of the sustainability of the resource and its utilizations

The definition for an indicator as suggested by Maini (1993) is:

Any variable that can be measured in relation to a specific criterion (indicators are diagnostic and reveal the health of a particular forest ecosystem)

The FSC defined indicators in a way that does not explicitly refer to SFM:

An indicator is any variable which can be measured in relation to a specific criteria

In this section, the function of the level of indicators in the hierarchical framework, and the requirements for the formulation of indicators are elucidated. The function and the characteristics for formulation are reflected in the following more elaborate and focused definition:

An indicator is a quantitative or qualitative parameter which can be assessed in relation to a criterion. It describes in an objectively verifiable and unambiguous way features of the ecosystem or the related social system, or it describes elements of prevailing policy and management conditions and human driven processes indicative of the state of the eco- and social system

Function

The hierarchical level under the criteria is that of indicators. The function of indicators is to attach assessable parameters to criteria, which themselves are seldom possible to measure directly. The use of indicators reduces the number of measurements to describe the state of the ecosystem or social system (Verhallen, 1995). Indicators simplify the communication process by which the information on the results of measurements is provided to the parties involved. Indicators serve as the practical basis for monitoring and reporting tools for management decisions and for assessing to what extent principles are followed and their related criteria fulfilled. The set of indicators determines the conditions and requirements which should be fulfilled in practice by forest management at the national and FMU level. The assessment of the quality of forest management boils down to a check on compliance with indicators and norms, not with principles and criteria. However, without the formulation of principles and criteria and the understanding of the link between them and the indicator, this check is not meaningful.

Box 6. Examples of correctly formulated indicators

Selected and modified random examples of indicators formulated in accordance with the hierarchical framework

- * Balance between growth and removal of wood.
- * Changes in the number and percentage of threatened species.
- * Extension and proportion of forest lands and forests dedicated to sustainable production in the total permanent production area.
- * Yield regulation by area and/or volume.
- * Area and percentage of forest lands managed for environmental protection.
- * Area and percentage of forest land experiencing an accumulation of persistent toxic substances.
- * Infrastructure is laid out prior to harvesting.
- * Nature and quantity of benefits deriving from forest management.
- * Width of buffer zones around water streams.
- * Legal framework in place guaranteeing the stability of long-term investments in the forest sector.
- * Number of people employed.
- * Average wage rates.
- * Effective mechanisms for two-way communication between forest management and interested and involved parties.
- * Number of visitor days attributed to recreation and tourism, in relation to population and forest area.

Degree of freedom in selection and formulation

The indicator is an assessable parameter describing features of the ecosystem or social system (outcome parameters), or policy and management conditions and processes (input or process indicators). In a case where the indicator is described as an outcome parameter it must be linked in a scientifically sound way with the criterion. Those indicators should preferably be based on sound scientific research or long standing practical experience in forest management. According to OECD (1993), indicators are a compromise between scientific accuracy and the need for concise information. The choice of input and process indicators and the significance that is attached to their indicative value is again a matter of judgement and consequently of agreement between interested parties. As the indicators are determining for the conditions and requirements that should be fulfilled in practice by forest management (either at national or at forest management unit level), their choice is of crucial significance for the quality of management that should be achieved. The fact that process and input indicators are in many cases not directly derived from single criteria gives more room to interested parties to debate and compromise on their selection and formulation.

Characteristics

In making a consistent and comprehensive list of indicators a number of aspects must be taken into account. Again, a consistent formulation of the higher hierarchical levels is a prerequisite for defining relevant indicators.

Indicators can be categorised and distinguished according to their type, e.g:

- * **Input/Process/Outcome**
- * **Quantitative/Qualitative**

The features of these types and their role in the formulation of indicators are described below.

- * **Input/Process/Outcome** (as described in Chapter 3)

An indicator may be directly derived from criteria and thus appear as an 'outcome parameter' to be monitored. These indicators, directly connected to a criterion, must be formulated in such a way that the assessment results are unambiguous. This means that formulations which do not require an objective assessment should be avoided. Formulations in the form of open-ended prescriptions such as 'damage is minimized', are less useful and should be avoided as much as possible. For instance, instead of 'damage is minimized', measurable indicators for the actual degree of damage are required. The difference between an

indicator formulated as an outcome parameter and a criterion can not always be found in the way they are formulated. A criterion should always offer the ability to give a verdict. This is not always the case for an outcome indicator. An indicator formulated as an outcome parameter often describes an actual condition of an element of the forest ecosystem or the related social system, in quantitative or relative terms. In these cases a verdict can only be given to a outcome parameter when a norm is linked to it. The distinction between a criterion and an outcome indicator should be sought in the hierarchy itself and in the difference of function of both levels. Anything that is implied by a criterion and at the same time is to be used for assessment should appear as an indicator. Thus redundancy and duplication at the level of criteria is prevented.

Indicators may also refer to a human process or intervention which is to be executed, or to an input (e.g. the existence or characteristics of a management plan; a law). These types of indicators are respectively known as process and input indicators. They are in fact indirect indicators; they reflect elements of the management and policy system. They are often not directly deducted from single criteria, and refer implicitly to a substantial part of the whole spectrum of principles and criteria. A positive assessment of such an indicator does not ensure adherence to principles but makes it plausible.

Process and input indicators should preferably be formulated in a way that an unambiguous verdict can be given, for instance yes or no. 'The presence and quality of the legal framework' provides a status for the forest and for population groups and could serve as an indicator for criteria such as 'forests are adequately protected' or 'access to forest resources is secured', depending on what aspect of the legal framework is looked at.

* **Quantitative/Qualitative indicators**

- Quantitative indicator : is expressed and assessed in terms of amount, numbers, volumes, percentage, etc.
- Qualitative indicator : is expressed as situation, object, or process, and is to be assessed in terms of good/sufficient/unsatisfactory and yes/no.

Quantitative indicators are preferred to qualitative indicators, because the qualitative indicators are often more ambiguous. For some important criteria, no quantitative indicators exist and it is difficult or impossible to develop them. In addition, for several criteria for SFM it is not yet possible to use quantitative indicators because the limited scientific knowledge available does not allow the establishment of quantitative norms. Quantitative indicators are meaningless without a reference value. Moreover, a purely mathematical approach, using quantitative indicators, would yield too many criteria and indicators to be practical. Assessment of the quality of the forest ecosystem and the management relies to a certain extent on best professional judgement (DDB, 1994). Therefore both quantitative as well as qualitative indicators have to be used for the assessment of sustainability of forest management or, the general quality of forests and their management.

An indicator must be formulated unambiguously either qualitative or quantitative. It is confusing if indicators can be interpreted in more than one way. An example of an indicator of SFM which could be quantitative or qualitative, is 'climber cutting'. It may be expressed in terms of yes or no, in amounts, or acceptable or not acceptable.

Indicators should provide information without social bias; they should not be subject to different interpretations according to social groups. Furthermore, indicators should be selected on the basis of their cost-effectiveness and practicality (Palmer, 1996)

The set of indicators to be used is also highly dependent on the composition, expertise and capacity of the team working with it and will lead to selecting indicators in a pragmatic way (CIFOR, 1996).

Norms (threshold or target values)

The actual assessment of management performance should be based on a comparison between the actual value of the indicator and its reference value or norm. Where norms are established as the minimum (or maximum) allowable value of an indicator they are called minimum (or maximum) norms or **threshold values**. A reference value to strive for is called a **target value**. A norm can be expressed in quantitative terms but can also be expressed in qualitative terms. The quantitative norms are often easier to express and more suitable for making clear statements about the sustainability of forest management than qualitative norms.

For determining the norms, specific knowledge is needed about the particular area that is being assessed. This knowledge usually requires scientific, site specific research and experience. Once established, norms need to be continually monitored and adjusted as appropriate. Norms are the least developed elements in the existing standards.

The following definition is suggested:

A norm is the reference value of the indicator and is established for use as a rule or a basis for comparison. By comparing the norm with the actual measured value, the result demonstrates the degree of fulfilment of a criterion and of compliance with a principle

Indices

Individual indicators may be combined into aggregated indicators. Such aggregated indicators can be expressed as indices. They are values which represent a description of the overall status of an object or fact. The choice of an index depends on the purpose of the indicators. When information is needed on a small subject a detailed indicator is needed. When, on the other hand, an overview of a certain state in the forest has to be given, a highly aggregated index representing a set of indicators may be useful (SCOPE, 1994). Care has to be exercised, however, to avoid ambiguous aggregations.

Box 7. Examples of incorrectly formulated indicators

Examples of indicators selected from existing standards which do not comply with the presented hierarchical framework

For some indicators formulations are used that do not represent an objectively verifiable state.

- * Soil erosion is minimized
- * Canopy opening is minimized
- * Skidding damage to trees and soil minimized

Indicators are ambiguously formulated; it is not clear whether the indicator is qualitative or quantitative.

- * Climber cutting
- * Employment
- * Protected areas

Indicators may also exist from which the substance is more like an criterion or even a principle.

- * Ecological functions and values shall be maintained intact, enhanced or restored

Summary

Indicators are the parameters that can be assessed and measured in the forest, as well as from behind a desk. Indicators determine the conditions and requirements which should be fulfilled in practice by the management at the national and FMU level. There are two complementary categorisations relevant to the indicators; notably input/process/outcome and qualitative/quantitative. There is no generic rule for formulating indicators by category. It is, however, important that the differences between the various categories are understood, and that indicators are unambiguously formulated referring to only one of the options of a category. Indicators formulated as 'outcome parameters' should preferably be based on sound scientific research or long standing practical experience in forest management. These will be indicators which describe an actual condition of an element of the forest or the related social system, preferably in quantitative or relative terms. Process and input indicators should be formulated in a way that an

unambiguous verdict can be given, preferable yes or no. Indicators should be formulated so that they correspond to clear norms, from which the system can be evaluated. The determination of norms for indicators formulated as outcome parameters requires a great amount of scientific knowledge and practical experience of the respective forest area of similar forest areas. Consequently, they are often lacking or deficient in assessment systems. Generally a set of indicators will contain a combination of all types of indicators.

4.5 Verifiers

Function

A fourth hierarchical level, below the level of indicators, may be needed to describe the way the indicators are measured in the field. The parameters at this level are called the verifiers. They refer to the source of information for the indicator and relate to the measurable element of the indicator. The verification procedure clarifies the way the indicator is measured in the field and the way reference values are established. Choosing a reference value is always difficult when formulating target values or thresholds because it is often an arbitrary procedure. However, the existence of a well considered and thoroughly examined reference value is essential to support the role of the indicator.

Characteristics

In practice, verifiers may range from very precise, reliable and objective to vague, unreliable and subjective. The quality requirements of the verifier are dependent on the importance or impact of the value that is measured. In turn, this may be dependent on the scale at which it is exercised, for example the calculation of allowable cut over a large area. Other relevant factors are the plausibility of the verifier and cost-effectiveness. In actual assessment cases, there may be different quality requirements related to verifiers depending on the purpose of the exercise and the nature of the object.

Definition

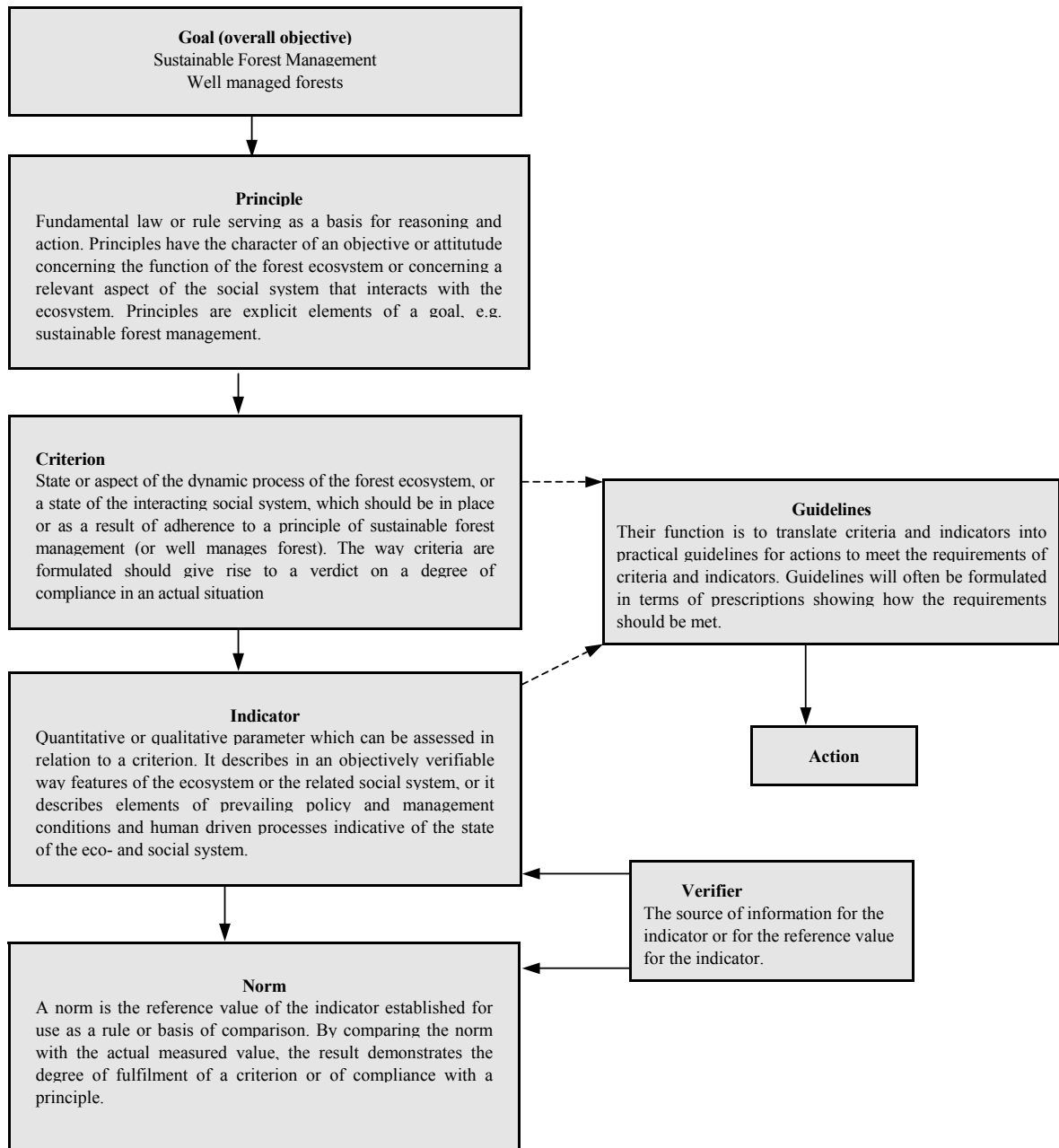
The definition as used by CIFOR is the following:

Data or information that enhances the specificity or the ease of assessment of an indicator.

The following definition is suggested in accordance to the function attached to a verifier in this document:

A verifier is the source of information for the indicator or for the reference value for the indicator

4.6 Summarizing figure and examples



Box 8. Examples of linkages between principles, criteria, indicators and verifiers

Elaboration of some principles with examples of criteria, indicators and verifiers in compliance with the requirements of the hierarchical framework. The criteria and indicators are just examples and do not necessarily reflect the full meaning of the related principle.

Principle 1

Long-term social and economic well-being of forest workers and local communities shall be maintained, or enhanced.

Criterion

1.1 Forest workers and local communities have their user rights well defined and secured.

Indicators

1.1.1 Tenure and user rights are clear to all stakeholders.

1.1.2 Area and percentage of forest land used for subsistence purposes.

Verifiers

* Interviews

* Written procedures

* Company annual reports

Principle 2

The productive functions of the forest shall be maintained.

Criterion

2.1 The productive capacity of the ecosystem is maintained.

Indicator

2.1.1 Operation of low impact felling and skidding techniques.

2.2.1 Silvicultural practices are adjusted to the specific ecology of the forest

Criterion

2.2 The productive capacity of the soil is maintained.

Indicator

2.2.1 Percentage of harvested area having significant soil compaction.

Criterion

2.3 The standing volumes after harvest and the diameter class variations are favourable to support future harvests.

Indicator

2.3.1 Actual harvest volumes compared with calculated allowable cut (net annual increment).

2.3.2 Abundance of regeneration after harvesting.

Principle 3

The protection function of the forest shall be maintained

Criterion

3.1 Slopes steeper than x% are continuously kept under forest cover.

Indicator

3.1.1 Occurrence of gaps or roads on slopes steeper than x%.

3.1.2 Presence of planning of harvesting activities on slopes steeper than x%.

3.1.3 Presence of planning of measures for the protection of forests on slopes steeper than x%.

Example Principle 4

The biodiversity of the forest shall be maintained, conserved and appropriately enhanced.

Criterion

4.1 The species composition of logged forests resembles original forest.

Indicator

4.1.1 Changes in the number of threatened species.

4.1.2 Changes in the number of forest dependent species.

4.1.3 Monitoring system to measure biodiversity is in place

Criterion

4.2 The structure of the logged forest resembles the original forest

Indicator

4.2.1 Gap size and frequency

4.2.2 Number of canopy layers

Verifiers

* Forest visit and observation by assessment team.

* Growth and yield tables, permanent sample plots.

* Annual harvesting reports.

* Management plan.

5. THE ENVIRONMENTAL MANAGEMENT SYSTEM

As explained earlier, it is possible to make a rough overall assessment of the sustainability of forest management by assessing processes and the outcome of these processes. The input and process indicators can be seen as substitutes for the outcome indicators. Currently, there appears to be a tendency in setting standards for the assessment of SFM to use process indicators. This is caused by the difficulties of choosing and measuring suitable outcome indicators. Moreover measuring process indicators is cost-efficient. A complete set of process indicators for a certain FMU will cover all the relevant elements of an Environmental Management System (EMS). EMS includes the organizational structure, responsibilities, practices, processes and resources for its implementation in the forest (Upton and Bass, 1995). It is the organizing framework designed to provide effective direction for an organisation's activities in the forest in relation to the environment. The basic concept of EMS is applicable to any FMU, regardless of size, type or level of sophistication.

EMS standards have recently been developed by a number of countries and organisations and the International Standardization Organisation (ISO) is developing an international EMS standard. The ISO standard is to be called ISO 14000 and will be analogous to ISO 9000 - an international standard for quality management systems. In ISO 14001 the EMS framework is divided into three categories:

1. Policy and planning
2. Implementation
3. Monitoring and improvement

Certification of a company to the ISO 14001 standard involves an external audit to make sure that all the components are in place and functioning.

Focusing exclusively on EMS would not involve any assessment against external performance standards (WWF, 1996). This means that there is no reference set by a third party for the quality of the forest ecosystem. The state of the ecosystem is not part of the assessment. It is presumed that if a proper EMS is put in place, the result will be improved products and a more sustainable system. The question in relation to forest management is to what degree EMS assessment can be indicative of the performance of the ecosystem or social system.

Two points should be stressed. The first point emphasizes the need for including outcome oriented parameters in the assessment procedure. Management procedures and activities are designed to achieve specific goals. Without clear perceptions of these goals in terms of performance of the forest ecosystem and the related social system, an adequate design for management procedures cannot be developed. On the other hand, if goals (outcome-based criteria) are clearly defined for the forest ecosystem and the related social system, and the management system is directed to achieve these goals, assessment of the management procedures and tools becomes relevant. A good illustration of the necessity to include outcome parameters in the assessment is the requirement for a management plan. Such a requirement makes no sense if it is not accompanied by more specific requirements as to the contents of the plan, which specify the outcomes with respect to the ecosystem and the related social system. One cannot avoid formulating outcome indicators in practice.

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The second point stresses the limitation of outcome oriented indicators and the necessity to include process and input oriented indicators. It is difficult to formulate meaningful outcome indicators in the absence of well established reference values (norms). Both process and outcome indicators are valid and necessary and both should be used. By using them both, the management procedures and methods to achieve sustainability can be revealed, as well as the effects of these methods.

In conclusion: any management or assessment system needs clear formulations in terms of outcome targets and clear concepts as to management procedures and tools. This means that standards oriented at the assessment of the outcome of processes and inputs should have included elements of EMS standards. These elements will be formulated at the level of indicators. Vice versa an EMS standard needs to be complemented by outcome parameters of an external outcome oriented standard to be meaningful as an assessment tool for SFM.

6. SPECIFIC ISSUES AND POINTS FOR FURTHER CONSIDERATION

6.1 Monitoring

In relation to the temporal dimension (Chapter 4.1) monitoring is considered to be essential. Monitoring means repetitive observations over time. Monitoring may focus on various aspects and may serve several purposes. In the context of this paper it is relevant to distinguish between monitoring the responses of the ecosystem or social systems to certain interventions/actions, and monitoring the continuation of the quality of the management process. Monitoring responses is a scientific activity which provides insight into the functioning of the system. The results may indicate a need for an adjustment of management. An operational system to monitor responses is a prerequisite for continuous improvement. In terms of the hierarchical framework described in this document the presence of a monitoring system could serve as an indicator for a well managed forest. On the other hand, monitoring the quality of management focuses more on the actual management procedures and operations and how they may need to be adjusted to achieve desired aims.

The assessment as applied in certification, provides information on the situation at a point of time and is thus a snapshot. Certificates are often granted conditionally. This means that within a certain time period specific aspects should be improved or changed. So, with monitoring it is possible to see whether such aspects are changing in the right direction.

6.2 Scoring and weighing

The question of scoring and weighing is beyond the scope of this document. Scoring is the evaluation of the actual value of a indicator. Weighing is the process of accomplishing an integral judgement on the quality of forests, their management and the related social system by calculating the scores of the individual indicators and their relative importance. Both scoring and weighing are highly subjective exercises. The greatest amount of transparency is required. Transparency does not take away subjectivity but it increases liability and enables the possibility of developing a single scoring and weighing procedure to be applied to the assessment of FMU's within one country. This is a complicated matter which needs to be solved and which also needs to be elaborated in a interactive way between practice and research.

6.3 Points for further consideration

Some aspects need further attention and thinking.

- * Whether standards developed for different purposes -monitoring, reporting or assessing- require different hierarchical frameworks. This publication works on the hypothesis that this is not necessarily the case.

The Tropenbos Foundation, 1996 - Hierarchical framework

- * Whether standards developed for different spatial scales -global, regional, national and FMU- require different hierarchical frameworks and different parameters. The position in this publication is that the same hierarchical framework can be used for the development of any standard for any spatial level. Further, the definition of SFM and principles are alike for all spatial levels although particular principles may be relevant only for one spatial level. Differentiation is partly needed in the formulation of criteria and is certainly necessary at the level of indicators.
- * Whether the linkage between standards for the national level and the FMU should be developed in mutual interaction and whether assessment of SFM at the FMU level is fully satisfactory without taking into account some crucial aspects at the national level. In this document it is recommended that close links are established between the development of standards for national and FMU levels. A fully satisfactory assessment of forest management at the FMU level should take into account any crucial aspects at the national level.
- * What should be the appropriate level (P, C or I) in a standard for matters such as 'the presence and quality of the legal and institutional framework'. This publication introduces arguments, based on considerations of consistency, that these requirements should be formulated as indicators. The importance of the issue should not determine its position but, rather, the nature of the issue.
- * What should be the distinction between criteria (always formulated as outcome parameters) and indicators formulated as outcome parameters. This document states that the distinction should be sought in the hierarchy itself and in the difference of function between the two levels, although the formulation may be sometimes the same. Anything that is implied by a criterion and at the same time is to be used for assessment should appear as an indicator. Thus redundancy at the level of criteria is avoided and horizontal consistency is maintained.
- * What is the meaning of a vertically consistent framework with respect to the use of indicators which are formulated as process and input indicators. The document makes clear that systematic hierarchical thinking helps to allocate these types of parameters at the appropriate level and to formulate them in an effective way. Although some process and input indicators may be directly deduced from single criteria, for most process and input indicators this is not the case. In most cases they will implicitly refer to a substantial part of the whole spectrum of principles and criteria. These types of indicators are not the result of a straightforward top-down analysis of principles via criteria into indicators. They are however located at the right level and refer to the higher hierarchical level.
- * What is the relation between outcome oriented standards (principles are formulated as an aim or attitude in relation to the function of the forest ecosystem and to the interacting social system; criteria are formulated as outcome parameters) and standards for Environmental Management Systems (EMS). This publication suggests that some kind of EMS standard should be part of the set of indicators that is contained in the outcome oriented standard. Vice versa an EMS standard must be complemented by outcome parameters of an external outcome oriented standard.

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GLOSSARY

The glossary features interpreted and elaborated meanings of terms in the context of sustainable forest management and a systematic approach to guide and assess the quality of management.

Certification

Certification is a process which results in a written quality statement (a certificate) attesting the origin of wood raw material and its status and/or qualifications following validation by an independent third party (Baharuddin and Simula, 1996).

Criterion

A criterion is a state or aspect of the dynamic process of the forest ecosystem, or a state of the interacting social system, which should be in place as a result of adherence to a principle of sustainable forest management (or well managed forest). The way criteria are formulated should give rise to a verdict on the degree of compliance in an actual situation (this document, page 24).

Forest Management Unit (FMU)

An FMU may be defined as a clearly demarcated area of land covered predominantly by forests, managed to a set of explicit objectives and according to a long-term management plan (CIFOR, page 12).

Guidelines

The function of guidelines is to translate criteria and indicators into practical guidance for actions to meet the requirements of criteria and indicators. Guidelines will often be formulated in terms of prescriptions showing how the requirements should be met (this document, page 14).

Hierarchical framework

A hierarchical framework describes hierarchical levels of parameters (P, C & I) to facilitate the formulation of a set of parameters in a consistent and coherent way. It describes the function of each level as well as the common characteristics of the parameters appearing on a particular level (this document, page 14).

Horizontal consistency

Horizontal consistency (of a hierarchical framework) means that parameters appearing at the same level do not have any overlap (this document, page 16).

Indicator

An indicator is a quantitative or qualitative parameter which can be assessed in relation to a criterion. It describes in an objectively verifiable and unambiguous way features of the ecosystem or the related social system, or it describes elements of prevailing policy and management conditions and human driven processes indicative for the state of the eco- and social system (this document, page 27).

Input parameter

An input parameter is an object, capacity, or intention, put in, or taken in, or operated on by any human driven process (this document, page 16).

Norm

A norm is the reference value of the indicator and is established for use as a rule or a basis for comparison. By comparing the norm with the actual measured value, the result demonstrates the degree of fulfilment of a criterion and of compliance with a principle (this document, page 30).

Outcome parameter

An outcome parameter is the actual or desired result of a management process which describes the state or capacity of the ecosystem, the state of a physical component or the state of the related social system or its components (this document, page 16).

(An outcome parameter may also be referred to as an output or performance parameter).

Principle

A principle is a fundamental law or rule, serving as a basis for reasoning and action. Principles have the character of an objective or attitude of society concerning the function of the forest ecosystem or concerning a relevant aspect of the social system that interacts with the ecosystem. Principles are explicit elements of a goal e.g., sustainable forest management or well managed forests (this document, page 20).

Process parameter

A process parameter is the management process or a component of the management process, or other human action, describing human activities and not the result of the activity (planning process, field operations) (this document, page 16).

Qualitative indicator

A qualitative indicator is expressed as situation, object, or process, and is to be assessed in terms of good/sufficient/unsatisfactory and yes/no (this document, page 29)

Quantitative indicator

A quantitative indicator is expressed and assessed in terms of amount, numbers, volumes, percentages, etc. (this document, page 29).

Standard

A standard is a set of P, C & I, or at least some combinations of these hierarchical levels, that serves as a tool to promote sustainable forest management, as a basis for monitoring and reporting or as a reference for assessment of actual forest management (this document, page 9).

(The term "standard" is also used as a reference for one particular aspect of forest management, e.g. desirable species composition, tolerable erosion levels etc. In this glossary the term "norm" is used for reference to one particular aspect).

Sustainable forest management

Sustainable forest management is the process of managing permanent forest land to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without undue reduction of its inherent values and future productivity and without undue undesirable effects on the physical and social environment (ITTO, page 18).

Sustainable forest management means the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global level, and that does not cause damage to other ecosystems (Helsinki process, page 19).

Verifier

A verifier is the source of information for the indicator or for the reference value for the indicator (this document, page 31).

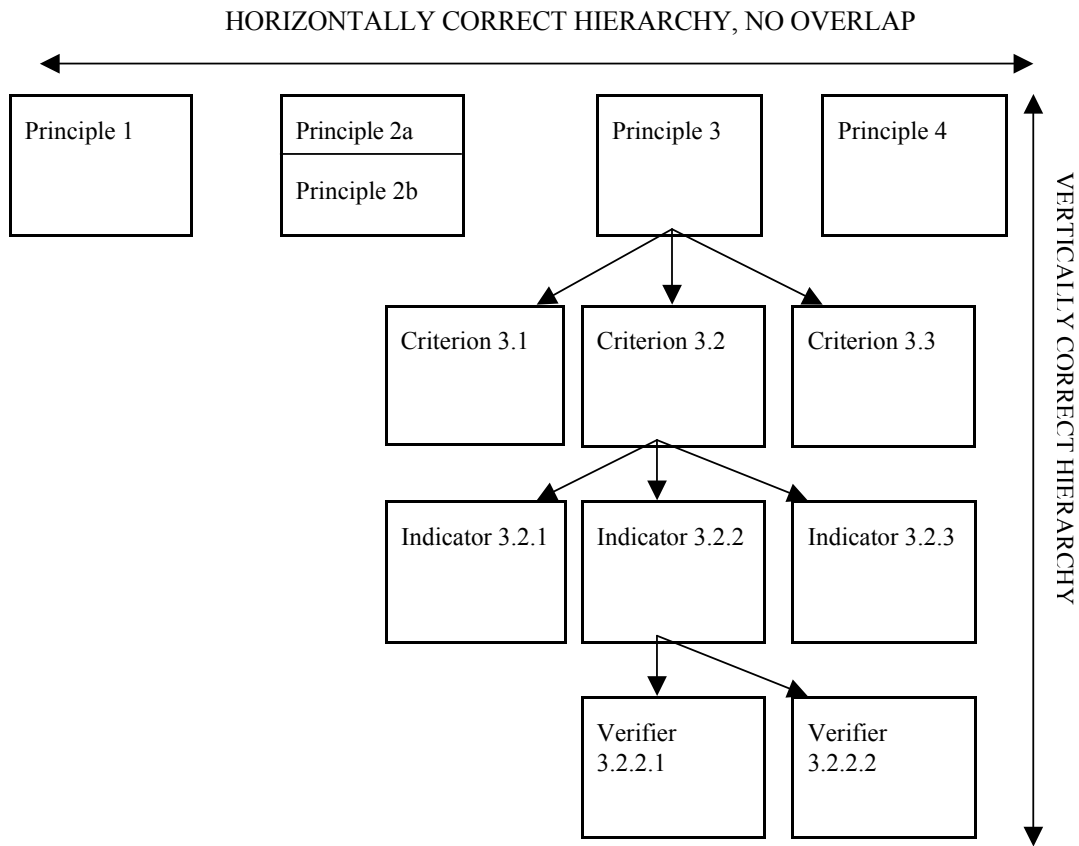
Vertical consistency (of a hierarchical framework)

Vertical consistency refers to the relation between parameters appearing at adjacent levels. The set of parameters is vertically consistent, if the parameters are placed on the right hierarchical level, expressed in correct terms and linked to appropriate parameter(s) on the higher hierarchical level (this document, page 16).

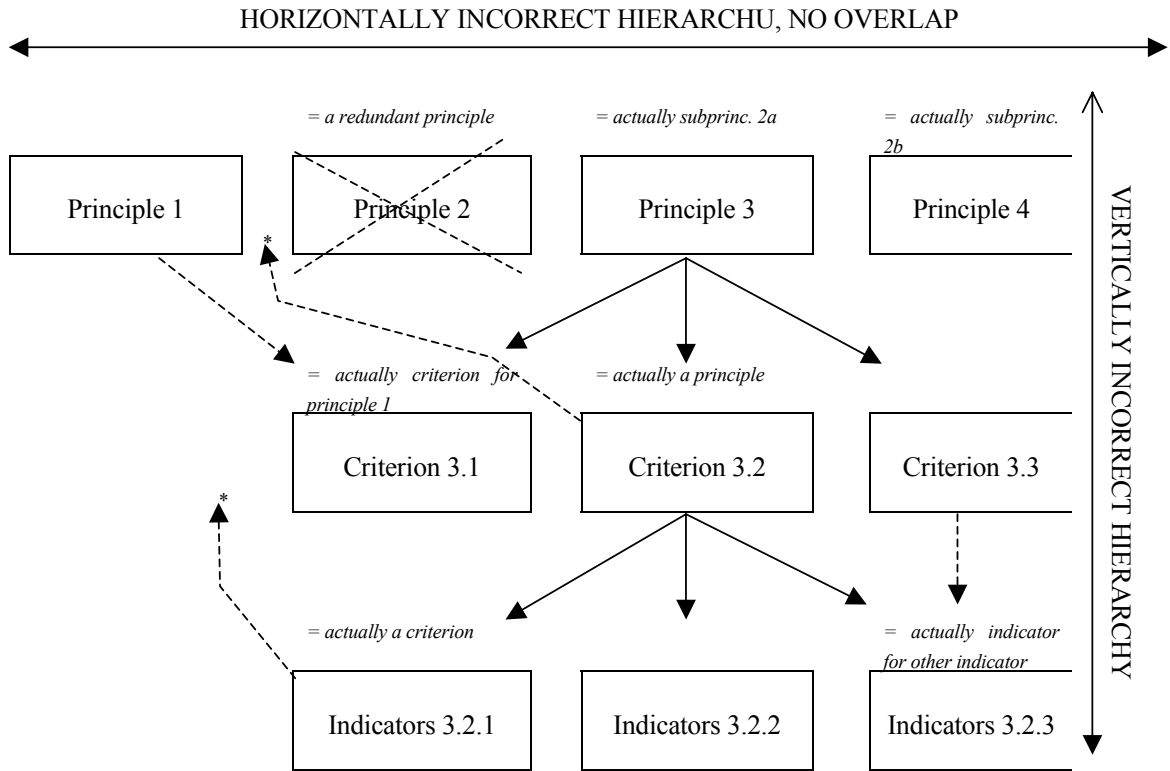
ACRONYMS

ACT	Amazon Cooperation Treaty
ATO	African Timber Organisation
CIFOR	Center for International Forestry Research
CSD	Commission on Sustainable Development
DDB	Deskundigengroep Duurzaam Bosbeheer
EMS	Environmental Management Systems
FAO	Food and Agricultural Organization
FMU	Forest Management Unit
FSC	Forest Stewardship Council
IPF	Intergovernmental Panel on Forests
ISO	International Organisation for Standardisation
NGO	Non-governmental organization
ITTO	International Tropical Timber Organization
IUCN	World Conservation Union
OECD	Organization for Economic Cooperation and Development
P, C & I	Principles, Criteria and Indicators
PFE	Permanent Forest Estate
SCOPE	Scientific Committee On Problems of the Environment
SFM	Sustainable Forest Management
UNCED	United Nations Conference on Environment and Sustainable Development
WWF	World Wide Fund for Nature

APPENDIX I Model of a hierarchically correct standard for the elaboration of the concept of 'sustainable forest management', or 'well-managed forests'



APPENDIX II Hypothetical example of a hierarchically incorrect standard



[italic] = how it should be

[roman] = as in hypothetical standard

APPENDIX 3 Illustration of the lack of a common concept (hierarchical framework) to develop standards, making comparison difficult

Three principles and two criteria are selected which serve as examples. Eight existing standards are examined on: 1) whether and how they deal with the subject as expressed by each principle or criterion and 2) on which hierarchical level the subject is dealt with. The parameter on the highest hierarchical level which deals with the particular subject is given in this table. If the subject is not explicitly dealt with in the existing standard, then the most related subject which approaches the original subject best, is being referred to. The relevant parameter of a certain standard does not necessarily need to be formulated in compliance with the presented hierarchical framework. In quite a few cases they are not. On the vertical axis, the organisations are grouped and the horizontal axis consists of the hierarchical levels of principles, criteria and indicators.

Principle 1.

Legal and customary rights of indigenous peoples to own, use and manage their lands, territories and resources shall be recognized and respected (FSC and this document, page 20)

Hierarchical level → Organization ↓	Principle	Criterion	Indicator
ITTO			Arrangements for forest management to take into traditional forest utilisation
ACT			Appropriate political and legal framework that stimulates sustainable development as a joint effort between the various levels of governmental and non-governmental groups
Helsinki		Maintenance of other socio-economic functions and conditions	
Montreal		Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies	
African Timber Organisation	The rights and duties of all stakeholders should be clearly defined, perceived and accepted by all		
DDB		Planning processes, directed at information, consultation and participation of local communities	
FSC	Indigenous peoples' rights: The legal and customary rights of indigenous peoples to own, use and manage their lands, territories and resources shall be recognized and respected		
SCS		Public use management (...facilitate and manage the use of the forest property by local people..)	
Smartwood Programme		Community relations: Local communities' traditional rights to own, manage or use forest resources have been formally recognized	
Soil Association	Land rights: Legal land rights of indigenous and traditional peoples are enforced. Customary use rights to the forest are maintained.		
CIFOR	Forest management maintains fair intergenerational access to resources and economic benefits		

Principle 2.

Biological diversity shall be maintained (this document, page 20)

Hierarchical level → Organization ↓	Principle	Criterion	Indicator
ITTO		The conservation of flora and fauna	
ACT		Conservation of forest cover and of biological diversity	
Helsinki		Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems	
Montreal		Conservation of biological diversity	
African Timber Organisation		Negative impacts of various interventions on biodiversity are minimised	
DDB		Protecting the size and quality of forest ecosystems Protecting or preserving threatened (tree) species	
FSC	Environmental impact: Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and by doing so, maintain the ecological functions and the integrity of the forest		
SCS		Ecosystem reserve management (Concern for biodiversity and the strategic retention of scarce ecotypes at risk on a local or regional level point to the wisdom of preserving representatives.....)	
Smartwood Programme		Biological conservation, among others: Biological conservation is explicitly considered in annual operating plans, and: Timber species on either local and/or international endangered or threatened species lists are not being harvested	
Soil Association	Environmental impact: forest management minimises negative impacts on the biodiversity, soils, water and landscapes of the forest and adjacent areas.		
CIFOR		Impacts to biodiversity of the forest ecosystem are minimised	

Principle 3.

Productive functions of the forests (wood and non-wood) shall be maintained and encouraged (this document, page 20)

Hierarchical level → Organization ↓	Principle	Criterion	Indicator
ITTO		The continuity of flow/ The continuity of timber production	
ACT		Sustainable forest production	
Helsinki		Maintenance and encouragement of productive functions of forests (wood and non-wood)	
Montreal		Maintenance of productive capacity of forest ecosystems	
African Timber Organisation	Sustainable timber production (in quantity and quality) is guaranteed (sub-principle) Sustainable production of non timber forest products is ensured (sub-principle)		
DDB		Guaranteeing basic abiotic and biotic conditions for the production capacity of forest areas Guaranteeing the continued timber production by means of regulation Guaranteeing the continued harvest of other forest products	
FSC	Benefits from the forest: Forest management operations shall encourage the efficient use of the forest's multiple products and services to ensure economic viability and a wide range of environmental and social benefits		
SCS		Stocking and growth control (This criterion is concerned with stand-level issues and the extent to which stand conditions are consistent with successful long-term harvest and forest structure regulation...)	
Smartwood Programme		Sustained yield management, among others: Actions to ensure quantity and quality of future crop, through either natural or planted regeneration, are being implemented	
Soil Association	Sustained yield: Yields of forest products and services are sustainable on the long term Economic potential: Forest management encourages an optimal and efficient use of all forest products and services, in order to ensure a wide range of environmental, social and economic benefits		
CIFOR	Yields and quality of forest goods and services sustainable		

Criterion 1.

The soil quality is maintained (this document, page 24)

Hierarchical level → Organization ↓	Principle	Criterion	Indicator
ITTO			Extent of soil disturbance
ACT		Conservation and integrated management of water and soil resources	
Helsinki		Maintenance and appropriate enhancement of protective functions in forest management (in particular soil and water)	
Montreal		Conservation and maintenance of soil and water resources	
African Timber Organisation		The function of water filtration (protection of water and soils) of the forest is maintained	
DDB			Production capacity of soil
FSC	Environmental impact: Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and by so doing, maintain the ecological functions and the integrity of the forest		
SCS			Extent of soil damage during harvesting operations- e.g. compaction, rutting, erosion, mass soil movements on steep sites
Smartwood Programme		No timber harvesting is taking place in highly erodible areas or within pre-designated buffer zones for rivers and streams, with a minimum protection (or buffer) zone equal to...	
Soil Association	Environmental impact: forest management minimises negative impacts on the biodiversity, soils, water and landscape of the forest and adjacent areas	(Felling, extraction and collection of logs must minimise damage to biodiversity, soils, water, landscape and sites of cultural heritage)	
CIFOR			Soil erosion is minimised

Criterion 2.

Area of reserved forests is delineated and protected (this document, page 24)

Hierarchical level → Organization ↓	Principle	Criterion	Indicator
ITTO			Areas of protection forests and production forests within the PFE
ACT		Conservation of forest cover and biological diversity	
Helsinki			Changes in the area of strictly protected forest reserves
Montreal		Legal, institutional and economic framework for forest conservation and sustainable management	
African Timber Organisation		Areas devoted to forestry activities or permanent forest estate are clearly delimited and their boundaries have been well established	
DDB		National forest protection policy	
FSC		Representative samples of existing ecosystems within the landscape shall be protected in their natural state and recorded on maps, appropriate to the scale and intensity of operations and the uniqueness of the affected resources	
SCS		Ecosystem reserve policies: concerns for biodiversity and the strategic retention of scarce ecotypes at risk on a local or regional level point to the wisdom of preserving representatives of such areas from timber management or other resource-altering activities...	
Smartwood Programme		Environmental impacts: Based on the identification of key biological areas, roughly 10 % of the total area under forest management (not including stream or roadsides buffers) is designated as a conservation zone	
Soil Association		In natural forests, sufficient areas containing representative biodiversity must be set aside and given complete protection.....	
CIFOR			Ecologically sensitive areas, especially buffer zones along water courses, are protected

APPENDIX 4 EXAMPLES OF EXISTING STANDARDS

The examples on the following pages are excerpts from standards developed by the following entities:

- * International Tropical Timber Organization (1992)
- * Amazon Cooperation Treaty A.C. (1995)
- * Ministerial Conference on the Protection of Forests in Europe, Helsinki (1994)
- * The Montreal Process (1995)
- * African Timber Organization (1996)
- * Deskundigengroep Duurzaam Bosbeheer (Working Group of Experts on Sustainable Forest Management) (1994)
- * Forest Stewardship Council A.C. (1996)
- * Scientific Certification Systems (1995)
- * Smartwood Programme (1993)
- * The Soil Association Marketing Company Ltd. - Responsible Forestry Programme (1994)
- * CIFOR (1996)

INTERNATIONAL TROPICAL TIMBER ORGANIZATION (1992)

CRITERIA FOR THE MEASUREMENT OF SUSTAINABLE TROPICAL FOREST MANAGEMENT

INTRODUCTION

The list of Criteria and Examples of Indicators below is neither exhaustive nor exclusive. Moreover, all of the Examples of Indicators do not need to be measured to establish sustainability or the degree to which it has been achieved.

It must be emphasized that determinations of sustainability and, therefore, use of the following list must be specific to each nation or each management unit.

SUSTAINABILITY AT THE NATIONAL LEVEL

Criterion

The Forest Resource Base

Examples of Indicators

- * Comprehensive land use planning and provision for the Permanent Forest Estate(PFE).
- * Present area of the PFE in relation to national goals and targets.
- * Plantation establishment targets, present age class distributions, and annual planting regimes.
- * Areas of Protection Forests and Production Forests within the PFE.
- * The representativeness of the protected areas network and the current or planned reservation programme.

Criterion

The Continuity of Flow

Examples of Indicators

- * National production statistics of Forest Products over time.
- * Documentation of logging (area) histories over time.
- * Proposed cutting cycle lengths for major forest types, and standard concession lengths.
- * Regulation of initial harvesting rates in relation to defined cutting cycles and net area of production forest.
- * Regulation of subsequent harvesting in relation to increment data and the net area of production forest.
- * Steps taken to harmonize the first and subsequent cutting cycles and manage the transition from the first to the second cutting cycle.
- * Wood production targets over time from various sources.
- * The availability of silvicultural prescriptions for the major forest types.

Criterion

The Level of Environmental Control

Examples of Indicators

- * Management prescriptions for other non-production components of the PFE.
- * The availability of engineering, watershed protection and other environmental management prescriptions for production forests.
- * Availability of environmental assessment procedures.

Criterion

Socio-Economic Effects

Examples of Indicators

- * Employment patterns and trends.
- * Income generation and distribution patterns.
- * National revenue and expenditure budgets for forest management.
- * Availability of environmental assessment procedures.

Institutional Frameworks

- * Existence of a national forest policy.
- * The relationship of national policy to ITTO Guidelines.
- * Adequacy of the legislative framework to implement national forest policies and management plans.
- * Adequacy of legislation to regulate harvesting and specific instruments, e.g. concession agreements.

The Tropenbos Foundation, 1996 - Hierarchical framework

- * Adequacy of human and financial resources to meet legislative and administrative responsibilities in sustainable forest management.
- * Community consultation.
- * Existence of management plans and provisions for their implementation.

SUSTAINABILITY AT THE LEVEL OF THE FOREST MANAGEMENT UNIT

Criterion

Resource security

Examples of Indicators

- * The legal establishment of forest areas or management units.
- * Existence of a management plan.
- * Clear demarcation of boundaries in the field.
- * The presence or absence of illegal exploitation and encroachment.
- * The duration of concession agreements.

Criterion

The Continuity of Timber Production

Examples of Indicators

- * The presence of clear, official harvesting rules.
- * Long term soil productivity.
- * A pre-logging stand inventory.
- * The number of trees and/or volume of timber per hectare harvested.
- * Provision for monitoring the residual growing stock after logging.
- * Records of annual areas cut over time.

Criterion

The Conservation of Flora and Fauna

Examples of Indicators

- * Protection of eco-systems in the concession or management unit.
- * The extent of vegetation disturbance after logging.

Criterion

An acceptable Level of Environmental Impact

Examples of Indicators

- * Extent of soil disturbance.
- * Extent and spatial distribution of riparian and other watershed protected areas.
- * The extent and severity of soil erosion.
- * Provision for protection of bodies of water.

Criterion

Socio-economic Benefits

Examples of Indicators

- * The number of people employed.
- * The nature and extent of benefits from forestry activities.

Criterion

Planning and Adjustment to Experience

Examples of Indicators

- * Community consultation.
- * Arrangements for Forest Management to take into account traditional forest utilization.

AMAZON COOPERATION TREATY A.C. (1995)

Regional workshop to define criteria and indicators of sustainability for the Amazon forest

TARAPOTO PROPOSAL ON CRITERIA AND INDICATORS OF SUSTAINABILITY FOR THE AMAZON FORESTS

1. NATIONAL LEVEL

CRITERION 1: Socio-economic Benefits

Indicators of Income, Production and Consumption

- a. Economic profitability of management and sustainable use of the forests.
- b. Sustainable production, consumption and extraction of forest products.
- c. Values of forest products from sustainable sources and from unsustainable sources as percentages of Gross National Product.
- d. Employment and direct and indirect income from sustainable activities in the forest sector and generation of forest-based employment in relation to total national employment.
- e. Average *per capita* income in different forest sector activities.
- f. Efficiency and competitiveness of forest product production and processing systems.
- g. Impact of the economic use of forests on the availability of forest resources of importance to local populations.
- h. Relationship between direct and indirect uses of the forests.

Indicators of Investment and Economic Growth in the Forest Sector

- a. Annual investment in plantations, sustainable forest management and conservation in relation to total forest sector investment.
- b. Aggregate value of sustainable forest production.
- c. Rate of return on investment of the distinct economic activities in the sustainable forest sector, compared with rates of return in other sectors of the economy, considering all costs and benefits.
- d. Rate of increase of sustainable recreation and tourism activities.

Indicators of Cultural, Social and Spiritual Needs and Values

- a. Area and percentage of forest lands, in relation to total forest lands area managed to protect cultural, social and spiritual needs and values.
- b. Area and percentage of forest lands used for purpose of supporting local populations.
- c. Level of participation of local populations in the management and in the benefits generated by forest activities.
- d. Development of productive alternatives to illicit crops and mining.

CRITERION 2: Policies and legal-institutional framework for sustainable development of the forests

Indicators:

- a. Appropriate political and legal framework that stimulates sustainable development as a joint effort between the various levels of government and non-governmental groups.
- b. Policies and legal framework for environmental planning through ecological-economic zoning.
- c. Capacity to implement international instruments on which the country is part.
- d. Harmonization and implementation of existing legislation in the country.

CRITERION 3: Sustainable forest production

Indicators:

- a. Extension and proportion of forest lands and forests dedicated to sustainable production in relation to the total permanent production area.
- b. Quantity and proportion of sustainable forest production in comparison with the national total forest production.
- c. Quantity and proportion of units of sustainable production, by area class, in comparison with the national total number of units.
- d. Area and percentage of forest lands managed for recreation and tourism, in relation to total forest area.
- e. Level of diversification of sustainable forest production.

The Tropenbos Foundation, 1996 - Hierarchical framework

CRITERION 4: Conservation of forest cover and of biological diversity

Indicators:

- a. Area, by forest type, in categories of protected areas, in relation to total forest area.
- b. Measures for <in situ> conservation of species in danger of extinction.
- c. Measures for the conservation of genetic resources.
- d. Area and percentage of forest affected by processes or other agents (insect attack, disease, fire, flooding etc.).
- e. Rate of natural regeneration, species composition and survival.
- f. Rate of conversion of forest cover to other uses.
- g. Area and percentage of forest lands with fundamental ecological changes.
- h. Impact of activities in other sectors on the conservation of forest ecosystems (mining, ranching, energy, infrastructure, etc.).

CRITERION 5: Conservation and integrated management of water and soil resources

Indicators:

- a. Measures for soil conservation.
- b. Area and percentage of forest lands managed for environmental protection.
- c. Percentage of forest flooded in relation to the historic range of variation, and maintenance of the relationship between the forest and hydrobiological resources.
- d. Effects of forest conservation on the integrated management of water resources.

CRITERION 6: Science and technology for the sustainable development of the forests

Indicators:

- a. Quantity and quality of adequate technology for forest management and sustainable production.
- b. Level of recuperation and degree of use of autochthonous technologies.
- c. Investment in research, education and technology transfer.
- d. Quantity and quality of research and sustainable development in execution.
- e. Mechanisms for remuneration for traditional knowledge.
- f. Degree of access to technology and information by different social groups.

CRITERION 7: Institutional capacity to promote sustainable development in Amazonia

Indicators:

- a. Quantity and quality of institutions and of their intersectoral and inter-institutional coordination.
- b. Existence of plans and their degree of execution.
- c. Quantity and quality of education and research programs.
- d. Degree of effective participation by civil society (academic institutions, grassroots groups, NGOs, trades unions and the private sector).

2. MANAGEMENT UNIT LEVEL

CRITERION 8: Legal and institutional framework

Indicators:

- a. Forest management plan approved by the competent authorities.
- b. Periodicity of evaluation of management plan implementation and average percentage of implementation.
- c. Legal framework that guarantees the stability of long-term investments in the forest sector.

CRITERION 9: Sustainable forest production

Indicators:

- a. Annual extraction of timber and non-timber forest products compatible with the sustainability capacity of the resource base.
- b. Area and percentage of forest soils affected by significant alterations in physical-chemical properties and erosion.
- c. Effectiveness of systems of administration and control.
- d. Degree of diversification of production.
- e. Degree of utilization of environmentally friendly technologies.

The Tropenbos Foundation, 1996 - Hierarchical framework

CRITERION 10: Conservation of forest ecosystems

Indicators:

- a. Proportion of area of permanent production in areas of environmental protection.
- b. Measures to protect, recuperate and sustainable use wild populations of species in danger of extinction.
- c. Area and percentage of forest affected by processes or other natural agents (insect attack, disease, fire, etc.) and by human actions.
- d. Rates of regeneration and forest ecosystem structure.
- e. Soil conservation measures.
- f. Measures for protection of water courses from forest activities.

CRITERION 11: Local socio-economic benefits

Indicators:

- a. Quality of life of local populations.
- b. Profitability and rate of return of forest management.
- c. Efficiency of systems of production and transformation of forest products.
- d. Impact of the economic use of the forest on the availability of forest resources of importance to local populations.
- e. Amount of direct/indirect employment and income level.
- f. Nature and quantity of benefits deriving from forest management.
- g. Annual quantity of products extracted per hectare.
- h. Aggregate value of production.
- i. Mechanisms for consultation and the effective participation of local communities in the management of forest resources, depending upon the scale of management.

3. SERVICES AT THE GLOBAL LEVEL

CRITERION 12: Economic, social and environmental services performed by Amazonian forests

Indicators:

- a. Contribution to satisfying the global demand for sustainable produced timber and non-timber forest products.
- b. Contribution to the global carbon balance.
- c. Contribution to the global water cycle.
- d. Contribution to the conservation of biological diversity.
- e. Contribution to radiation balance and regulation.
- f. Contribution to the maintenance of cultural values and diversity, and of indigenous and local populations' knowledge.
- g. Contribution to the economy, health, culture, science and recreation.

MINISTERIAL CONFERENCE ON THE PROTECTION OF FORESTS IN EUROPE, HELSINKI (1994)

EUROPEAN CRITERIA AND MOST SUITABLE QUANTITATIVE INDICATORS FOR SUSTAINABLE FOREST MANAGEMENT

- 1. Maintenance and appropriate enhancement of forest resources and their contribution of global carbon cycles**
 - 1.1 Area of forest and other wooded land and changes in area (classified, if appropriate, by forest and vegetation type, ownership structure, age structure, origin of forest).
 - 1.2 Changes in:
 - a) total volume of the growing stock
 - b) mean volume of the growing stock on forest land (classified, if appropriate, according to different vegetation zones or site classes)
 - c) age structure of appropriate diameter distribution classes
 - 1.3 Total carbon storage and changes in the storage in forest stands
- 2. Maintenance of forest ecosystem health and vitality**
 - 2.1 Total amount of, and changes over the past 5 years, in depositions of air pollutants (assessed in permanent plots)
 - 2.2 Changes in serious defoliation of forests using the UN/ECE and EU defoliation classification (classes 2, 3 and 4) over the past 5 years
 - 2.3 Serious damage caused by biotic agents:
 - a) severe damage caused by insects and diseases including a measurement of the amount of damage as a function of loss of growth (or mortality)
 - b) annual area of burnt forest
 - c) annual area affected by storm damage and volume harvested from these areas
 - d) proportion of regeneration area seriously damaged by game and other animals or by grazing
 - 2.4 Changes in nutrient balance and acidity over the past 10 years (pH and CEC); level of saturation of CEC on the plots of the European network or an equivalent national network
- 3. Maintenance and encouragement of productive functions of forests (wood and non-wood)**
 - 3.1 Balance between growth and removal of wood over the past 10 years
 - 3.2 Percentage of forest area managed according to a management plan or management guidelines
 - 3.3 Total amount of land change in the value and/or quantity of non-wood forest products (e.g. hunting and game, cork, berries, mushrooms, etc.)
- 4. Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems**
 - 4.1 Changes in the area of:
 - a) natural and ancient semi-natural types
 - b) strictly protected forest reserves
 - c) forests protected by special management regime
 - 4.2 Changes in the number and percentage of threatened species in relation to total number of forest species (using reference lists, e.g. IUCN, Council of Europe or the EU Habitat Directive)
 - 4.3 Changes in the proportions of stands managed for the conservation and utilisation of forest genetic resources (gene reserve forests, seed collection stands, etc.); differentiation between indigenous and introduced species
 - 4.4 Changes in the proportions of mixed stands of 2-3 tree species
 - 4.5 Proportions of annual area of natural regeneration in relation to total area regenerated
- 5. Maintenance and appropriate enhancement of protective functions in forest management (in particular soil and water)**
 - 5.1 Proportion of forest area managed primarily for soil protection
 - 5.2 Proportion of forest area managed primarily for water protection
- 6. Maintenance of other socio-economic functions and conditions**
 - 6.1 Share of the forest sector from the gross national product
 - 6.2 Provisions recreation: area of forest with access per inhabitant, percentage of total forest area
 - 6.3 Changes in the rate of employment in forestry, especially in rural areas (number of people employed in forestry, logging, forest industry)

THE MONTREAL PROCESS (1995)

CRITERIA AND INDICATORS FOR THE CONSERVATION AND SUSTAINABLE MANAGEMENT OF TEMPERATE AND BOREAL FORESTS

The following six criteria and associated indicators characterize the conservation and sustainable management of temperate and boreal forests. They relate specifically to forest conditions, attributes or functions, and to the values or benefits associated with the environmental and socio-economic goods and services that forests provide. The intent or meaning of each criterion is made clear by its respective indicators. No priority or order is implied in the alphanumeric listing of the criteria and indicators.

Criterion 1: Conservation of biological diversity

Biological diversity includes the elements of the diversity of ecosystems, the diversity between species, and genetic diversity in species.

Indicators:

Ecosystem diversity

- a. Extent of area by forest type relative to total forest area-(a);¹
- b. Extent of area by forest type and by age class or successional stage-(b);
- c. Extent of area by forest type in protected area categories as defined by IUCN² or other classification systems-(a);
- d. Extent of area by forest type in protected areas defined by age class or successional stage-(b);
- e. Fragmentation of forest types-(b).

Species diversity

- a. The number of forest dependent species-(b);
- b. The status (threatened, rare, vulnerable, endangered, or extinct) of forest dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment-(a).

Genetic diversity

- a. Number of forest dependent species that occupy a small portion of their former range-(b);
- b. Population levels of representative species from diverse habitats monitored across their range-(b).

Criterion 2: Maintenance of productive capacity of forest ecosystems

Indicators:

- a. Area of forest land and net area of forest land available for timber production-(a);
- b. Total growing stock of both merchantable and non-merchantable tree species on forest land available for timber production-(a);
- c. The area and growing stock of plantations of native and exotic species-(a);
- d. Annual removal of wood products compared to the volume determined to be sustainable-(a);
- e. Annual removal of non-timber forest products (e.g. fur bearers, berries, mushrooms, game), compared to the level determined to be sustainable-(b).

Criterion 3: Maintenance of forest ecosystems health and vitality

Indicators:

- a. Area and percent of forest affected by processes or agents beyond the range of historic variation, e.g. by insects, disease, competition from exotic species, fire, storm, land clearance, permanent flooding, salinisation, and domestic animals-(b);
- b. Area and percent of forest land subjected to levels of specific air pollutants (e.g. sulfates, nitrate, ozone) or ultraviolet B that may cause negative impacts on the forest ecosystem-(b);
- c. Area and percent of forest land with diminished biological components indicative of changes in fundamental ecological processes (e.g. soil nutrient cycling, seed dispersion, pollination) and/or ecological continuity (monitoring of functionally important species such as fungi, arboreal epiphytes, nematodes, beetles, wasps, etc.)-(b).

Criterion 4: Conservation and maintenance of soil and water resources

This criterion encompasses the conservation of soil and water resources and the protective and productive functions of forests.

Indicators:

- a. Area and percent of forest land with significant soil erosion-(b);

1. Indicators followed by an 'a' are those for which most data are available. Indicators followed by a 'b' are those which may require the gathering of new or additional data and/or a new program of systematic sampling or basic research.

2. IUCN categories include: I. Strict protection, II. Ecosystem conservation and tourism, III. Conservation of natural features, IV. Conservation through active management, V. Landscape/seascape conservation and recreation, VI. Sustainable use of natural ecosystems.

The Tropenbos Foundation, 1996 - Hierarchical framework

- b. Area and percent of forest land managed primarily for protective functions, e.g. watersheds, flood protection, avalanche protection, riparian zones-(a);
- c. Percent of stream kilometres in forested catchments in which stream flow and timing has significantly deviated from the historic range of variation-(b);
- d. Area and percent of forest land with significantly diminished soil organic matter and/or changes in other soil chemical properties-(b);
- e. Area and percent of forest land with significant compaction of change on soil physical properties resulting from human activities-(b);
- f. Percent of water bodies in forest areas (e.g. stream kilometres, lake hectares) with significant variance of biological diversity from the historic range of variability-(b);
- g. Percent of water bodies in forest areas (e.g. stream kilometres, lake hectares) with significant variation from the historic range of variability in pH, dissolved oxygen, levels of chemicals (electrical conductivity), sedimentation or temperature change-(b);
- h. Area and percent of forest land experiencing an accumulation of persistent toxic substances-(b).

Criterion 5: Maintenance of forest contribution to global carbon cycles

Indicators:

- a. Total forest ecosystem biomass and carbon pool, and if appropriate, by forest type, age class, and successional stages-(b);
- b. Contribution of forest ecosystems to the total global carbon budget, including absorption and release of carbon (standing biomass, coarse woody debris, peat and soil carbon)-(a or b);
- c. Contribution of forest products to the global carbon budget-(b).

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

Indicators:

Production and consumption

- a. Value and volume of wood and wood products production, including value added through downstream processing-(a);
- b. Value and quantities of production of non-wood forest products-(b);
- c. Supply and consumption of wood and wood products, including consumption per capita-(a);
- d. Value of wood and non-wood products production as percentage of GDP-(a or b);
- e. Degree of recycling of forest products-(a or b);
- f. Supply and consumption/use of non-wood products-(a or b).

Recreation and tourism

- a. Area and percent of forest land managed for general recreation and tourism, in relation to the total area of forest land-(a or b);
- b. Number and type of facilities available for general recreation and tourism, in relation to population and forest area-(a or b);
- c. Number of visitor days attributed to recreation and tourism, in relation to population and forest area-(b).

Investment in the forest sector

- a. Value of investment, including investment in forest growing, forest health and management, planted forests, wood processing, recreation and tourism-(a);
- b. Level of expenditure on research and development, and education-(b);
- c. Extension and use of new and improved technologies-(b);
- d. Rates of return on investment-(b).

Cultural, social and spiritual needs and values

- a. Area and percent of forest land managed in relation to the total area of forest land to protect the range of cultural, social and spiritual needs and values-(b);
- b. Non-consumptive use forest values-(b).

Employment and community needs

- a. direct and indirect employment in the forest sector and forest sector employment as a proportion of total employment-(a or b);
- b. Average wage rates and injury rates in major employment categories within the forest sector-(a);
- c. Viability and adaptability to changing economic conditions, of forest dependent communities, including indigenous communities-(b);
- d. Area and percent of forest land used for subsistence purposes-(b).

Criteria and indicators for the conservation and sustainable management of temperate and boreal forests—criterion 7

Criterion 7 and associated indicators relate to the overall policy framework of a country that can facilitate the conservation and sustainable management of forests. Included are the broader societal conditions and processes often external to the forest itself but which may support efforts to conserve, maintain or enhance one or more of the conditions, attributes, functions and benefits captured in criteria 1-6. No priority or order is implied in the listing of the indicators.

Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management

The Tropenbos Foundation, 1996 - Hierarchical framework

Indicators:

Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it:

- a. Clarifies property rights, provides for appropriate land tenure arrangements, recognizes customary and traditional rights of indigenous people, and provides means of resolving property disputes by due process;
- b. Provides for periodic forest-related planning, assessment, and policy review that recognizes the range of forest values, including coordination with relevant sectors;
- c. Provides opportunities for public participation in public policy and decision-making related to forests and public access to information;
- d. Encourages best practice codes for forest management;
- e. Provides for the management of forests to conserve special environmental, cultural, social and/or scientific values.

Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to:

- a. Provide for public involvement activities and public education, awareness and extension programs, and make available forest-related information;
- b. Undertake and implement periodic forest-related planning, assessment, and policy review including cross-sectoral planning and coordination;
- c. Develop and maintain human resource skills across relevant disciplines;
- d. Develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and support forest management;
- e. Enforce laws, regulations and guidelines.

Extent to which the economic framework (economic policies and measures) supports the conservation and sustainable management of forests through:

- a. Investment and taxation policies and a regulatory environment which recognize the long-term nature of investments and permit the flow of capital in and out of the forest sector in response to market signals, non-market economic valuations, and public policy decisions in order to meet long-term demands for forest products and services;
- b. Non-discriminatory trade policies for forest products.

Capacity to measure and monitor changes in the conservation and sustainable management of forests, including:

- a. Availability and extent of up-to-date data, statistics and other information important to measuring or describing indicators associated with criteria 1-7;
- b. Scope, frequency and statistical reliability of forest inventories, assessments, monitoring and other relevant information;
- c. Compatibility with other countries in measuring, monitoring and reporting on indicators.

Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services, including:

- a. Development of scientific understanding of forest ecosystem characteristics and functions;
- b. Development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies, and to reflect forest-related resource depletion or replenishment in national accounting systems;
- c. New technologies and the capacity to assess the socio-economic consequences associated with the introduction of new technologies;
- d. Enhancement of ability to predict impacts of human intervention on forests;
- e. ability to predict impacts on forests of possible climate change.

AFRICAN TIMBER ORGANIZATION

DRAFT OF PRINCIPLES, CRITERIA AND INDICATORS FOR SUSTAINABLE MANAGEMENT OF AFRICAN TROPICAL FORESTS

(Presented at the International Experts Working Group meeting on Trade, labelling of forest products and certification of sustainable forest management)

PRINCIPLE 0. (GENERAL POLICY). SUSTAINABILITY OF THE FOREST AND ITS MULTIPLE FUNCTIONS IS A HIGH POLITICAL PRIORITY.

Criterion 0.1. The Government has clear forest development objectives and a realistic action plan to meet them.

Indicator 0.1.1. There is a permanent forest estate governed by laws and regulations which are the basis for its sustainable management. This permanent forest estate is the result of negotiation between all stakeholders within the framework of a procedure of co-ordinated planning of the allocation of lands, based on appropriate and updated information.

Indicator 0.1.2. The Government has a system of reliable, adequate and updated information on the forestry sector (especially a national forest inventory) which enables it to update its action plans and adjust the means of implementation.

Criterion 0.2. The Government allocates adequate means for sustainable management of forests.

Indicator 0.2.1. There is a mechanism for sustained and adequate funding for the management of Government forests.

Indicator 0.2.2. There is a forestry service in charge of the management of all the forests, with adequate staffing to fulfil its mandate.

Indicator 0.2.3. Forest research is allocated sufficient means (human and material) and its results are applied.

Criterion 0.3. Actions are taken by the Government to reduce all types of pressure on the forest.

Indicator 0.3.1. Existing, on-going and future plantations in the national forest plantation plan can contribute to supply the timber sector.

Indicator 0.3.2. The Government implements appropriate programmes to stabilise agriculture.

Criterion 0.4. At international level, the Government has ratified or approved treaties, conventions or recommendations on sustainable development of forests issued especially by such organisations as ILO, CITES, ITTO, FAO, UNCED.

No indicator.

PRINCIPLE I AREAS DEVOTED TO FORESTRY ACTIVITIES OR THE PERMANENT FOREST ESTATE ARE NOT DECLINING.

Criterion I.1. Areas devoted to forestry activities or permanent forest estate are clearly delimited and their boundaries have been well established.

Indicator I.1.1. There exists a map showing the boundaries of the permanent forest estate.

Indicator I.1.2. The boundaries of the permanent forest estate are well marked in the field.

Criterion I.2. Efficient measures have been taken by the authorities to monitor the forest and to protect it against clearing, fire, settlements and illegal gathering of forest products.

Indicator I.2.1. There is a control mechanism (direct or delegated control, type and frequency of control) complied with by the forest service.

Indicator I.2.2. The procedure of control is followed by results. (Mission reports, case files, transactions, condemnations, etc...)

Indicator I.2.3. There is collaboration between the forestry service, agricultural service, public order authorities and other public services concerned in forest management.

Criterion I.3. The Government implements measures in order to promote the participation of various stakeholders (mainly neighbouring villagers) in protecting the forest.

Indicator I.3.1. There is a direct, sustainable, efficient system to interest various stakeholders in protecting the forest against clearing, fires and poaching.

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Indicator I.3.2. Programmes for the enlightenment and education of the rural population are implemented.

PRINCIPLE II. FORESTS ARE ADEQUATELY MANAGED AND DEVELOPED IRRESPECTIVE OF THEIR ROLE.

Criterion II.1. A management plan has been established for the sustainable management of the forest taking into account all its components and functions such as timber production, other forest products, contribution to the well-being of the local people, ecology.

Indicator II.1.1. There is a management plan comprising:

- * Definition of the forest area subjected to sustainable management;
- * Key findings of studies and analyses on all the functions and uses of the forest (timber production, other forest products, farmer-forest relationship, forest ecosystem);
- * Definition of objectives in these various uses, their spatial organisation and their hierarchy;
- * Relevant action plans to meet these objectives;
- * Reference to laws and regulations governing such actions (particularly the national directives on management);
- * economic and financial evaluation;
- * A set of maps allowing a clear summarised overview of the results of studies (vegetation map, forest settlement map, etc.), the objectives (map of working circles) and the action plans (map of blocks for harvesting, coupes, replanting, etc.);

Indicator II.1.2. Management is approved by the Minister in charge of forests.

Indicator II.1.3. Management is effectively implemented.

Indicator II.1.4. The follow-up and the control of the implementation of the management plan are done on the basis of the information included in the appropriate documents.

Criterion II.2. Forestry service and other stakeholders of the sector have enough capacity to properly develop and manage the forest for all its roles (timber production, other forest products, ecology, farmer-forest relationship).

No indicator

Sub-principle IIA. Sustainable timber production (in quantity and quality) is guaranteed.

Criterion IIA.1. Standards for silvicultural and other activities adapted to the specific ecology of the forest and ensuring sustainable management have been developed and are operational.

Indicator IIA.1.1. Adequate effort of investigation is undertaken to define, validate or adjust silvicultural and work standards.

Indicator IIA.1.2. Silvicultural and work standards are explicit and easy to implement, easy to control.

Indicator IIA.1.3. In the area of harvesting, the standards are explicit on:

- * Minimum number of large trees to be retained as seed producers (mother trees) per ha and species;
- * Maximum number of trees to be harvested per ha.;
- * Harvesting techniques for large trees to be removed should be such as to avoid too large gaps.
- * The minimum exploitable diameter for each species.

Criterion IIA.2. Planning and implementation of logging are carried out in conformity with guidelines of the management plan and the contract agreement based on technical and social standards as well as financial specifications.

Indicator IIA.2.1. Operational low-impact felling and skidding techniques are available.

Indicator IIA.2.2. Fully consistent with silvicultural standards, and based on previous inventory, the area to be harvested over the management plan period is assessed and mapped.

Indicator IIA.2.3. Calculations of allowable cut and rotation period are clearly detailed in the management plan and are consistent with silvicultural standards, increment data, prior inventory and harvestable areas, and are established at levels considered compatible with sustainable production of the forest.

Indicator IIA.2.4. The felling and work programme is operational, clear and realistic. Each harvest is subject to prior validation and design.

Indicator IIA.2.5. Felling programmes are adjusted rapidly if the change in data collected on the field is significantly different from that on which the manager's initial estimate is based. The management plan is amended to be consistent with the true data.

Indicator IIA.2.6. Trees to be felled are previously plotted on a map and marked.

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Their selection is in compliance with silvicultural standards and protection measures specific to the particular coupe.

Indicator IIA.2.7. Trees to be felled are previously plotted on a map and conspicuously marked, prior to harvest.

Indicator IIA.2.8. Financial clauses, technical standards for logging and specific arrangements to protect the forest are clearly specified in the management plan compartment register.

Indicator IIA.2.9. The application of provisions of the contract agreement is to be assessed periodically. Non-compliance is penalized.

Criterion IIA.3. Deforested areas are regenerated by natural or artificial means.,

Indicator IIA.3.1. Reforestation is implemented with chosen species in conformity with the specifications of the management plan.

Criterion IIA.4. Infrastructure (roads, bridges, firebreaks, etc...) is designed, established and maintained in such a way that negative impacts on the environment (forest, soil, water course network) are reduced to a strict minimum.

Indicator IIA.4.1. The planning and establishment of infrastructure (primary and secondary roads, timber yards, skidding tracks) takes into consideration the topography of the forest area and the needs of exploitation.

Indicator IIA.4.2. Sizes of infrastructure (primary and secondary roads, timber yards, skidding tracks) are reduced to the barest minimum possible.

Indicator IIA.4.3. Minimum infrastructure required for logging is made permanent.

Indicator IIA.4.4. Measures are taken to ensure that infrastructure established for logging and forest management in general, do not disturb the flow of water in the network of rivers, streams, etc.

Sub-principle IIB. Sustainable production of non-timber forest products is ensured.

Criterion IIB.1. Non-timber forest products and their uses are identified.

Criterion IIB.2. Guidelines for rational harvesting of non-timber forest products are defined and put into practice.

Criterion IIB.3. Research is undertaken in order to define the conditions for a sustainable use of non-timber forest products.

Criterion IIB.4. Guidelines for harvesting of non-timber forest products are monitored, evaluated and can be corrected if necessary.

Principle II B - Criterion 1 to 4 : No indicator.

PRINCIPLE III. THE MAIN ECOLOGICAL FUNCTIONS OF THE FOREST ARE MAINTAINED

Criterion III.1. The capacity of the forest for natural regeneration is ensured.

Indicator III.1.1. Logging is not authorised if the vertical stratification of forest is disturbed.

Indicator III.1.2. Light demanding (pioneer) species do not form dense stands within the forest.

Indicator III.1.3. Actions are taken to assure natural regeneration when necessary.

Criterion III.2. Negative impacts of various interventions on biodiversity are minimised.

Indicator III.2.1. Zones of biological protection where no interference is authorised are created in the permanent forest estate.

Indicator III.2.2. The size of biological reserves is adapted to suit the object of preservation.

Indicator III.2.3. Selection of biological preservation areas should take into account their potential for effective protection.

Indicator III.2.4. Special provisions for the protection of sensitive areas, plains, stream banks, steep slopes should be defined in the management plan.

Indicator III.2.5. The management plans of forest only provide for single - specie or exotic specie plantations when other types of silvicultural action have been considered by forest management experts and abandoned for justified reasons.

Indicator III.2.6. If enrichment plantings are carried out in logged over forests, preference will be given to species that were actually harvested in the forest.

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Indicator III.2.7. Rare or endangered species are protected.

Indicator III.2.8. Non-timber forest products in high demand are the object of conservation and domestication trials.

Criterion III.3. The function of water filtration (protection of water and soils) of the forest is maintained.

Indicator III.3.1. Water system (regime) and quality do not decrease.

Indicator III.3.2. Erosion and other forms of soil degradation are minimized.

Indicator III.3.3. Soil and water restoration programmes are implemented when necessary.

PRINCIPLE IV. THE RIGHTS AND DUTIES OF ALL STAKEHOLDERS SHOULD BE CLEARLY DEFINED, PERCEIVED AND ACCEPTED BY ALL.

Criterion IV.1. All stakeholders have their user or property rights well defined and secure.

Indicator IV.1.1. The methods of access to forest resources are clearly defined and respected by all stakeholders.

Indicator IV.1.2. Stakeholders' tenure rights are clear to all parties and are secure.

Criterion IV.2. All stakeholders participate in forest resources management.

Indicator IV.2.1. Management techniques are well understood and applied by all stakeholders (forestry service, local population, timber industrialists, ...).

Indicator IV.2.2. There is efficient communication between various stakeholders.

Indicator IV.2.3. All the parties involved participate in the management of natural resources in a manner accepted by all.

Criterion IV.3. Forest management has no adverse effect on health.

Indicator IV.3.1. Necessary preventive measures are taken by concessionaires or the managers to minimize and possibly to take into account health risks linked to forest activities.

Criterion IV.4. The demand for goods and services expressed by beneficiaries by stakeholders on the forest is consistent with its capacity to meet it.

Indicator IV.4.1. The needs of the population are taken into account in the management plan.

Criterion IV.5. Sharing of benefits from the forest is considered equitable.

Indicator IV.5.1. Damages caused are compensated for in a fair manner.

Indicator IV.5.2. Wages and other benefits conform to national standards.

Indicator IV.5.3. Forest-dependent people have opportunity to be employed and trained by forest companies.

Indicator IV.5.4. Forest utilisation is based on necessary compromises and complementarities.

Criterion IV.6. There is a procedure for dialogue and conflict resolution between various stakeholders.

DESKUNDIGENWERKGROEP DUURZAAM BOSBEHEER (Working group of experts on Sustainable Forest Management) 1994

EVALUATING SUSTAINABLE FOREST MANAGEMENT

Principles

Forest policies should be harmonised on three levels of administration: on the international, the national and the management unit level.

The international level:

A country's forest policy should be assessed against internationally recognised principles as they are found in the international conventions and treaties endorsed by the production and consumer country alike. They include the Convention on Biodiversity and the Declaration of Forest Principles (Rio 1992).

For sustainable forest policy a number of minimum requirements has to be fulfilled. They include:

- * Recognising the full range of forest functions;
- * Safeguarding the continuity of social, ecological and economic forest functions;
- * Having the essential social infrastructure in place which is necessary for sustainable forest management.
- * Acknowledging and respecting traditional rights.

The national level:

The commitment to these basic principles must be reflected in the policies of the national government. This includes:

- * Endorsing and implementing of international treaties and conventions;
- * Drawing up an adequate system of laws and regulations upholding that system;
- * Collecting information on the extent of deforestation;
- * Having forest management plans.

These principles are worked out in the national criteria. The criteria, indicators and norms discussed here will have to be elaborated and modified before they can be universally applied in all circumstances.

Harmonisation

Policies on the international and unit management level should show cohesion. The national policy should be geared to the local circumstances and to the needs of the local communities. On the other hand, policies on the management unit level should find their point of reference in rules and regulations on the national level.

POLICY CATEGORIES

The comparison of functions with the level of management and with forest categories respectively leads to the conclusion that three types of policy are needed:

- * Ecologically directed policies (in particular for protection of the regulatory functions);
- * Socio-economic policies (to assure the sustainability of the productive functions) and
- * Socio-cultural policies in order to preserve the carrier functions.

CRITERIA, INDICATORS AND NORMS PER POLICY AREA, NATIONAL LEVEL

On the basis of the definition of sustainable forest management and the principles against which a country's forest policy should be assessed the criteria, indicators per policy area are given below. Policy area should be understood to refer to the legal as well as the administrative level.

General

Criterion

- * National management and control mechanisms
A number of general principles are needed to assess the effectiveness and applicability of the various policy measures:
 - General regulations for forest management
 - General control mechanisms
 - General inventories

Information on the ecological situation, land use, the status of ecosystem types and the extent of deforestation and degradation of forests should be readily available.

ECOLOGICALLY DIRECTED POLICY

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Policy aimed at the preservation of biodiversity and protection and management of areas of adequate size and location with different forest ecosystem types.

Criterion

- * National environmental mapping of forest ecosystem types

Indicators

- * Typology
- * Maps of the forested areas to be protected in the Permanent Forest Estate (PFE)

Criterion

- * National forest protection policy

Indicator

- * A national plan

Criterion

- * National environmental quality policy

Indicator

- * Adequate targets and time tables

SOCIO-ECONOMIC POLICY

Policy aimed at the sustainability of forest functions and a fair distribution of costs and benefits among the various forest users.

Criterion

- * Inventory of the various categories of forest use and their importance for the different social groups

Indicators

- * Typology of actual uses and intensity of use
- * Statistics of forest incomes for the various categories of users

Criterion

- * Land use planning which indicates destinations for different forms of land use in relation to forest categories

Indicators

- * Selection criteria for productive forests
- * Selection procedure
- * Maps indicating forest areas
- * Rules and guidelines for protection procedures and implementation
- * Maps indicating sites of conversion forests

Criterion

- * Policy based on the recognition of the multiple use of forests and a fair distribution of costs and benefits among the various forest users

Indicator

- * National forest policy plan

SOCIO-CULTURAL POLICY

Policy aimed at the recognition of forests as a renewable source of energy and as a resource for local communities.

Criterion

- * Planning process directed at information, consultation and participation of local communities

Indicators

- * National socio-cultural policy
- * National policy aimed at the recognition of the cultural integrity of specific social groups, the observation of traditional land use rights and the prevention or fair resolution of conflicts between various categories of forest users

CRITERIA, INDICATORS AND NORMS PER POLICY AREA, MANAGEMENT UNIT LEVEL

Policies on the management unit level should find their point of reference in national rules and regulations on sustainable management. The criteria, indicators and norms on management unit level are also classified according to type of policy.

ECOLOGICALLY DIRECTED MANAGEMENT

Policy aimed at safeguarding sustainability of ecological processes, regulatory environmental functions and the ecological conditions of all forest functions.

Criterion

- * Protecting the size and quality of forest ecosystems

Indicators

- * Identification and recognition of forested areas/management units on regional/local level
- * Inventory of ecosystems etc. on management unit level

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- * Rules providing for acceptable external effects of timber harvest on climate, opening up of forested area, roads, settlers, watershed management, water quality, etc.

Criterion

- * Maintaining the forest's capacity for natural regeneration

Indicator

- * Rules for acceptable disturbance within management unit

Criterion

- * Maintaining the forest's function as a hydrological or orological screen for its surroundings

Criterion

- * Protecting or preserving threatened (tree) species

Indicator

- * Rules for management of unit; procedure for the selection of indicators

SOCIO-ECONOMIC MANAGEMENT

Policy aimed at preserving the forest as a sustainable, renewable source of income for all relevant categories of forest users (for more details see 'ITTO Guidelines for the Sustainable Management of Natural Tropical Forests', chapter 3: Forest Management).

Criterion

- * Guaranteeing basic abiotic and biotic conditions for the production capacity of forest areas

Indicators

- * Production capacity of soil
- * Groundwater regime

Criterion

- * Mapping forest areas and forest functions

Criterion

- * Guaranteeing the continued timber production by means of regulations covering

Indicators

- * Silvicultural systems
- * Harvest and management planning
- * Management reports

Criterion

- * Guaranteeing the continued harvest of other forest products

Indicators

- * Inventory of importance of non-timber forest products
- * Planning and control of harvest of non-timber forest products

Criterion

- * Economic participation of local community in commercial forest use

Indicators

- * Employment
- * Terms of employment
- * Arrangement for share of revenues from timber and non-timber forest products for local community

SOCIO-CULTURAL MANAGEMENT

Policy aimed at recognising and honouring the local community's traditional rights and uses of forests.

Criterion

- * Integrating various forms of sustainable land use

Criterion

- * Putting local knowledge of ecosystem and their sustainable users to optimum use

Indicator

- * Documentation

Criterion

- * Identifying and recognising the forest functions for the local community

Indicators

- * Inventory of forest uses and forest products for local use
- * Inventory of positive and negative effects of timber harvest for welfare and prosperity of local community
- * Arrangements for compensations for loss or damage

FOREST STEWARDSHIP COUNCIL, A.C. (1996)

PRINCIPLES AND CRITERIA FOR FOREST MANAGEMENT

The FSC's Principles and Criteria (P&C) apply to all tropical, temperate and boreal forests, as addressed in Principle #9 and the accompanying glossary. Many of these P&C apply also to plantations and partially replanted forests. More detailed standards for these and other vegetation types may be prepared at national and local levels.

PRINCIPLE #1: COMPLIANCE WITH LAWS AND FSC PRINCIPLES

Forest management shall respect all applicable laws of the country in which they occur, and international treaties and agreements to which the country is a signatory, and comply with all FSC Principles and Criteria.

- 1.1 Forest management shall respect all national and local laws and administrative requirements.
- 1.2 All applicable and legally prescribed fees, royalties, taxes and other charges shall be paid.
- 1.3 In signatory countries, the provisions of all binding international agreements such as CITES, ILO Conventions, ITTA, and Convention on Biological Diversity, shall be respected.
- 1.4 Conflicts between laws, regulations and the FSC Principles and Criteria shall be evaluated for the purposes of certification, on a case by case basis, by the certifiers and the involved or affected parties.
- 1.5 Forest management areas should be protected from illegal harvesting, settlement and other unauthorized activities.
- 1.6 Forest managers shall demonstrate a long-term commitment to adhere to the FSC Principles and Criteria.

PRINCIPLE #2: TENURE AND USE RIGHTS AND RESPONSIBILITIES

Long-term tenure and use rights to the land and forest resources shall be clearly defined, documented and legally established.

- 2.1 Clear evidence of long-term forest use rights of the land (e.g. land title, customary rights, or lease agreements) shall be demonstrated.
- 2.2 Local communities with legal or customary tenure or use rights shall maintain control, to the extent necessary to protect their rights or resources, over forest operations unless they delegate control with free and informed consent to other agencies.
- 2.3 Appropriate mechanisms shall be employed to resolve disputes over tenure claims and use rights. The circumstances and status of any outstanding disputes will be explicitly considered in the certification evaluation. Disputes of substantial magnitude involving a significant number of interests will normally disqualify an operation from being certified.

PRINCIPLE #3: INDIGENOUS PEOPLES' RIGHTS

The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognized and respected.

- 3.1 Indigenous peoples shall control forest management on their lands and territories unless they delegate control with free and informed consent to other agencies.
- 3.2 Forest management shall not threaten or diminish, either directly or indirectly, the resources or tenure rights of indigenous peoples.
- 3.3 Sites of special cultural, ecological, economic or religious significance to indigenous peoples shall be clearly identified in cooperation with such peoples, and recognized and protected by forest managers.
- 3.4 Indigenous peoples shall be compensated for the application of their traditional knowledge regarding the use of forest species or management systems on forest operations. This compensation shall be formally agreed upon with their free and informed consent before forest operations commence.

PRINCIPLE #4: COMMUNITY RELATIONS AND WORKER'S RIGHTS

Forest management operations shall maintain or enhance the long-term social and economic well-being of forest workers and local communities.

- 4.1 The communities within, or adjacent to, the forest management area should be given opportunities for employment, training, and other services.
- 4.2 Forest management should meet or exceed all applicable laws and/or regulations covering health and safety of employees and their families.
- 4.3 The rights of workers to organize and voluntarily negotiate with their employers shall be guaranteed as outlined in Conventions 87 and 98 of the International Labour Organization (ILO).
- 4.4 Management planning and operations shall incorporate the results of evaluations of social impact. Consultations shall be maintained with people and groups directly affected by management operations.
- 4.5 Appropriate mechanisms shall be employed for resolving grievances in the case of loss or damage affecting the legal or customary rights, property, resources, or livelihoods of local peoples. Measures shall be taken to avoid such loss or damage.

PRINCIPLE #5: BENEFITS FROM THE FOREST

Forest management operations shall encourage the efficient use of the forest's multiple products and services to ensure economic viability and a wide range of environmental and social benefits.

- 5.1 Forest management should strive toward economic viability, while taking into account the full environmental, social, and operational costs of production, and ensuring the investments necessary to maintain the ecological productivity of the forest.

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- 5.2 Forest management and marketing operations should encourage the optimal use and local processing of the forest's diversity of products.
- 5.3 Forest management should minimize waste associated with harvesting and on-site processing operations and avoid damage to other forest resources.
- 5.4 Forest management should strive to strengthen and diversify the local economy, avoiding dependence on a single forest product.
- 5.5 Forest management operations shall recognize, maintain, and, where appropriate, enhance the value of forest services and resources such as watersheds and fisheries.
- 5.6 The rate of harvest of forest products shall not exceed levels which can be permanently sustained.

PRINCIPLE #6: ENVIRONMENTAL IMPACT

Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and by so doing, maintain the ecological functions and the integrity of the forest.

- 6.1 Assessment of environmental impacts shall be completed --appropriate to the scale, intensity of forest management and the uniqueness of the affected resources-- and adequately integrated into management systems. Assessments shall include landscape level considerations as well as the impacts of on-site processing facilities. Environmental impacts shall be assessed prior to commencement of site-disturbing operations.
- 6.2 Safeguards shall exist which protect rare, threatened and endangered species and their habitats (e.g. nesting and feeding areas). Conservation zones and protection areas shall be established, appropriate to the scale and intensity of forest management and the uniqueness of the affected resources. Inappropriate hunting, fishing, trapping and collecting shall be controlled.
- 6.3 Ecological functions and values shall be maintained intact, enhanced or restored, including:
 - a) Forest regeneration and succession.
 - b) Genetic, species, and ecosystems diversity.
 - c) Natural cycles that affect the productivity of the forest ecosystem.
- 6.4 Representative samples of existing ecosystems within the landscape shall be protected in their natural state and recorded on maps, appropriate to the scale and intensity of operations and the uniqueness of the affected resources.
- 6.5 Written guidelines shall be prepared and implemented to: control erosion; minimize forest damage during harvesting, road construction, and all other mechanical disturbances; and protect water resources.
- 6.6 Management systems shall promote the development and adoption of environmentally friendly non-chemical methods of pest management and strive to avoid the use of chemical pesticides. World Health Organization Type A and 1B and chlorinated hydrocarbon pesticides; pesticides that are persistent, toxic or whose derivatives remain biologically active and accumulate in the food chain beyond their intended use; as well as any pesticides banned by international agreement, shall be prohibited. If chemicals are used, proper equipment and training shall be provided to minimize health and environmental risks.
- 6.7 Chemicals, containers, liquid and solid non-organic wastes including fuel and oil shall be disposed of in an environmentally appropriate manner at off-site locations.
- 6.8 Use of biological control agents shall be documented, minimized, monitored and strictly controlled in accordance with national laws and internationally accepted scientific protocols. Use of genetically modified organisms shall be prohibited.
- 6.9 The use of exotic species shall be carefully controlled and actively monitored to avoid adverse ecological impacts.

PRINCIPLE #7: MANAGEMENT PLAN

A management plan - appropriate to the scale and intensity of the operations - shall be written, implemented, and kept up to date. The long term objectives of management, and the means of achieving them, shall be clearly stated.

- 7.1 The management plan and supporting documents shall provide:
 - a) Management objectives.
 - b) Description of the forest resources to be managed, environmental limitations, land use and ownership status, socio-economic conditions, and a profile of adjacent lands.
 - c) Description of silvicultural and/or other management system, based on the ecology of the forest in question and information gathered through resource inventories.
 - d) Rationale for rate of annual harvest and species selection.
 - e) Provisions for monitoring of forest growth and dynamics.
 - f) Environmental safeguards based on environmental assessments.
 - g) Plans for the identification and protection of rare, threatened and endangered species.
 - h) Maps describing the forest resource base including protected areas, planned management activities and land ownership.
 - i) Description and justification of harvesting techniques and equipment to be used.
- 7.2 The management plan shall be periodically revised to incorporate the results of monitoring or new scientific and technical information, as well as to respond to changing environmental, social and economic circumstances.
- 7.3 Forest workers shall receive adequate training and supervision to ensure proper implementation of the management plan.
- 7.4 While respecting the confidentiality of information, forest managers shall make publicly available a summary of the primary elements of the management plan, including those listed in Criterion 7.1.

PRINCIPLE #8: MONITORING AND ASSESSMENT

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

- 8.1 The frequency and intensity of monitoring should be determined by the scale and intensity of forest management operations as well as the relative complexity and fragility of the affected environment. Monitoring procedures should be consistent and replicable over time to allow

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- comparison of results and assessment of change.
- 8.2 Forest management should include the research and data collection needed to monitor, at a minimum, the following indicators:
 - a) Yield of all forest products harvested.
 - b) Growth rates, regeneration and condition of the forest.
 - c) Composition and observed changes in the flora and fauna.
 - d) Environmental and social impacts of harvesting and other operations.
 - e) Costs, productivity, and efficiency of forest management.
 - 8.3 Documentation shall be provided by the forest manager to enable monitoring and certifying organizations to trace each forest product from its origin, a process known as the 'chain of custody'.
 - 8.4 The results of monitoring shall be incorporated into the implementation and revision of the management plan.
 - 8.5 While respecting the confidentiality of information, forest managers shall make publicly available a summary of the results of monitoring indicators, including those listed in Criterion 8.2.

PRINCIPLE #9: MAINTENANCE OF NATURAL FORESTS

Primary forests, well-developed secondary forests and sites of major environmental, social or cultural significance shall be conserved. Such areas shall not be replaced by tree plantations or other land uses.

- 9.1 Trees planted in natural forests may supplement natural regeneration, fill gaps or contribute to the conservation of genetic resources. Such plantings shall not replace or significantly alter the natural ecosystem.
- 9.2 The use of replanting as a technique for regenerating stands of certain natural forest types may be appropriate under certain circumstances. Guidelines on the acceptable intensity and spatial extent of tree planting will be addressed in national and regional forest management standards to be approved by the FSC. In the absence of such national or regional standards, guidelines developed by the certifier and approved by the FSC will prevail.

PRINCIPLE #10: PLANTATIONS

Plantations shall be planned and managed in accordance with Principles and Criteria 1-9, and Principle 10 and its Criteria. While plantations can provide an array of social and economic benefits, and can contribute to satisfying the world's needs for forest products, they should complement the management of, reduce pressures on, and promote the restoration and conservation of natural forests.

- 10.1 The management objectives of the plantation, including natural forest conservation and restoration objectives, shall be explicitly stated in the management plan, and clearly demonstrated in the implementation of the plan.
- 10.2 The design and layout of plantations should promote the protection, restoration and conservation of natural forests, and not increase pressures in natural forests. Wildlife corridors, streamside zones and a mosaic of stands of different ages and rotation periods, shall be used in the layout of the plantation, consistent with the scale of the operation. The scale and layout of plantation blocks shall be consistent with the patterns of forest stands found within the natural landscape.
- 10.3 Diversity in the composition of plantations is preferred, so as to enhance economic, ecological and social stability. Such diversity may include the size and spatial distribution of management units within the landscape, number and genetic composition of species, age classes and structures.
- 10.4 The selection of species for planting shall be based in their overall suitability for the site and their appropriateness to the management objectives. In order to enhance the conservation of biological diversity, native species are preferred over exotic species in the establishment of plantations and the restoration of degraded ecosystems. Exotic species, which shall be used only when their performance is greater than that of native species, shall be carefully monitored to detect unusual mortality, disease, or insect outbreaks and adverse ecological impacts.
- 10.5 A proportion of the overall forest management area, appropriate to the scale of the plantation and to be determined in regional standards, shall be managed so as to restore the site to a natural forest cover.
- 10.6 Measures shall be taken to maintain or improve soil structure, fertility, and biological activity. The techniques and rate of harvesting, road and trail construction and maintenance, and the choice of species shall not result in long term soil degradation or adverse impacts on water quality, quantity or substantial deviation from stream course drainage patterns.
- 10.7 Measures shall be taken to prevent and minimize outbreaks of pests, diseases, fire and invasive plant introductions. Integrated pest management shall form an essential part of the management plan, with primary reliance on prevention and biological control methods rather than chemical pesticides and fertilizers. Plantation management should make every effort to move away from chemical pesticides and fertilizers, including their use in nurseries. The use of chemicals is also covered in Criteria 6.6 and 6.7.
- 10.8 Appropriate to the scale and diversity of the operation, monitoring of plantations shall include regular assessment of potential on-site and off-site ecological and social impacts, (e.g. natural regeneration, effects on water resources and soil fertility, and impacts on local welfare and social well-being), in addition to those elements addressed in principles 8, 6 and 4. No species should be planted on a large scale until local trials and/or experience have shown that they are ecologically well-adapted to the site, are not invasive, and do not have significant negative ecological impacts on other ecosystems. Special attention will be paid to social issues of land acquisition for plantations, especially the protection of local rights of ownership, use or access.

SCIENTIFIC CERTIFICATION SYSTEMS (1995)

THE FOREST CONSERVATION PROGRAM

A. PROGRAM ELEMENT: TIMBER RESOURCE SUSTAINABILITY

Consistent with SCS FCP protocol, Evaluation Teams employ the following criteria pertaining to timber resource sustainability.

CRITERIA

A.1 Harvest Regulation

This criterion is concerned with the regulation of the harvest and regulation of the forest structure (e.g., age-class and geographic distribution of stands) over time. This criterion is pertinent to operations that involve frequent harvesting (e.g., annual); small ownerships commonly harvest intermittently. Of concern is the resource-level strategy that is developed and followed in order to achieve a sustained production of harvestable volume and value from the forest. The evaluation focuses on key issues: the chosen strategy for regulating presently unbalanced forest structures; rotations and yields; robustness of the regulation strategy; compliance with the strategy; etc.

Field indicators around which observations and other supporting data are gathered include:

- * actual yields per acre as compared to predicted yields;
- * current and projected merchantable inventory volumes per acre, particularly in stands that will be scheduled for harvest over the next 30 years;
- * target age of crop trees under selection management;
- * rotation lengths, relative to stand ages approaching maximum mean annual increment;
- * the extent to which current harvest levels are justified by allowable cut effects (i.e., taking credit now for projected future growth levels);
- * actual annual harvest levels as compared to planned levels;
- * species composition, by volume, of the annual harvests compared to planned levels;
- * annual softwood harvest volume as a percent of total annual harvest as compared to softwood inventory volume as a percent of total inventory volume:
- * size class distribution of stands, stratified by broad species classes;
- * historical rates of stand type conversion (as determined from stand maps typed from aerial photographic interpretation), particularly from the high valued to mid- and low- valued types;
- * average annual harvest levels compared to growth levels.

A.2 Stocking and Growth Control

This criterion is concerned with stand-level issues and the extent to which stand conditions are consistent with successful long-term harvest and forest structure regulation. The focus is on the extent to which an operation's silvicultural and harvesting systems maintain stands in a well stocked, productive condition. The robustness of the regulation strategy (i.e., the extent to which planned future harvests will, in fact, be attainable) is fundamentally reliant upon the maintenance of full and vigorous stocking at the stand level. The Team gives attention to two issues:

- * Management of the current merchantable growing stock to prolong its longevity/availability through the conversion period to a sustainable forest structure.
- * Patterns and composition of regeneration and young stand development that determine future yields and the sustainability of current harvest levels (FSC P&C 6.3).

Field and management indicators around which observations and other pertinent data are gathered include:

- * design and execution of stand treatments and consistency with projected yields;
- * harvesting priorities at the stand and individual tree level (e.g., is the forest being high-graded by patterns of routinely harvesting the best stocked, most vigorous stands or trees within stands?);
- * stocking levels and species composition of young stands;
- * extent to which the original diversity of natural forests in both species and structure is maintained through the silvicultural prescriptions that are applied including the use of tree planting (FSC P&C 9.1, 9.2);
- * extent to which field foresters possess and are applying current silvicultural knowledge;
- * extent to which prescriptions are tailored to individual stand conditions and markets;
- * extent to which expedient prescriptions such as diameter-limit harvesting are routinely applied;
- * extent and effectiveness of pre-commercial and commercial stand treatments, particularly measures taken to control hardwood occupancy on sites historically occupied by softwoods;
- * damage to residual stand during partial harvest entries; and
- * adequacy of residual stocking after partial harvests.

A.3 Pest and Pathogen Management Strategy

In recognition of the overriding influence that pest and pathogen activity can have on overall forest health in forests throughout the world, the Evaluation Team considers the extent to which the managing foresters have sought to learn lessons from past outbreaks/episodes and have incorporated these insights into current and future management strategies in an effort to ameliorate adverse effects from future outbreaks/events. The Team's focus is on the measures taken to produce stand conditions less susceptible to devastating mortality from pest and pathogen activity.

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Broad categories of evaluation include:

- * incorporation/recognition of inevitable pest/pathogen epidemics into the regulation strategy;
- * biological and silvicultural control measures being taken;
- * financial provisions for the cost of future protection programs; and
- * future protection and salvage priorities.

Field and management indicators around which observations and other supporting data are gathered include:

- * pre- and post-harvest softwood species composition, particularly the extent to which high risk species and stand conditions are being systematically reduced through the setting of harvesting priorities and plantation composition;
- * explicit efforts to manage for natural pest predators such as bird species, and modification of prescriptions to increase structural diversity that provides favourable habitat for natural predators; and
- * tendency of foresters, when asked to rely on future insecticide spraying as the principal strategy for surviving the next epidemic. (FSC P&C 6.6).

A.4 Forest Access

Effective and comprehensive management of a working forest requires an adequate, well-maintained road access network. This is not to imply that an entire ownership must be roaded as the working forest component may not comprise the entire ownership. An appropriately-scaled and maintained road system is also not excessive for the access that is needed to implement a management program, as roadways can, in aggregate, occupy significant land area that otherwise could support productive stands of commercial trees and allied vegetative and wildlife species.

The Team's evaluation of the road network is at both the landscape/network and individual road segment levels. The focus is on the adequacy of the network and the appropriateness of road design, layout, and maintenance. Maintenance of drainage structure and roadway surfaces is critical to minimizing adverse ecological effects of a road network.

Field and management indicators around which observations and other supporting data are gathered include:

- * average miles of haul roads per acre, roughly estimated;
- * average area accessed per mile of new spur road;
- * observed circumstances where lack of access has limited desired management prescriptions;
- * road right-of-way widths;
- * condition of culverts, water bars and roadway surfaces;
- * road bank vegetative management (e.g., seeding); and
- * runoff drainage patterns during storms.

A.5 Harvest Efficiency and Product Utilization

An important element of sustainable forest management operations is the avoidance of undue waste and inefficiency in the process of growing, harvesting, and marketing wood products. Wasteful practices detract from the maximum long-term utilization of the marketable resources yielded by a well-managed working forest, which in turn diminishes true sustainability. (FSC P&C 5.1, 5.3). Issues addressed by the Team include:

- * marketing strategies and the extent to which forest products are marketed for their highest-valued uses;
- * product wastage and residual stand damage; and
- * an appropriate balance between aggressive product utilization and ecological considerations.

Field and management indicators around which observations and other supporting data are gathered include:

- * conditions of landings and log decks;
- * incidence of sound logs not being trucked out of the woods;
- * frequency of excessive falling damage to harvested trees;
- * extent of 'skinned' residual trees or trees with tops broken during harvesting operations;
- * appropriateness, from a maximum value realization standpoint, of the end uses (and sale prices) of harvested logs; and
- * harvesting decisions driven by short-term low-value product realization at the expense of long-term productivity.

A.6 Management Plan and Information Base

While the Team's evaluation places the greatest weight on actual and projected forest conditions, it nonetheless recognizes that exemplary and sustainable forestry is not ad hoc timber harvesting and that management should be guided by an effective and operational written plan that provides the long-term context and continuity for the actions taken at any point in time. Further, effective management must be based upon a solid information base. True management, as opposed to opportunistic exploitation, is built upon working knowledge of resource conditions and the effects of the full range of human interventions. (FSC P&C 7.1, 7.2). (See Appendix 5 for an outline presentation of suggested elements of a forest management plan that would provide full compliance with FSC P&C 7.1).

Field and management indicators around which observations and other supporting data are gathered include:

- * breadth, depth, and currency of the forest plan;
- * written guidelines for the avoidance of minimization of environmental impacts (e.g., soil erosion) of management activities such as road building and harvesting. (FSC P&C 6.5);
- * extent to which the forest plan is used by field foresters;
- * extent to which aggregate harvesting activities are reconciled to the forest plan;
- * extent and accuracy of field data; sources, frequency of updates, quality and utility of type maps; appropriateness and adequacy of typing system; extent to which data acquisition provides knowledge of potential environmental impacts of management activities; (FSC P&C 6.1, 8.1,

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- 8.2, 8.4);
- * monitoring procedures for acquiring information on plan attainment and resource conditions (FSC P&C 8.1, 8.2., 8.4); and
- * adequacy of planning response to natural catastrophes (i.e., fires) both in terms of developing incident-specific resource stabilization and recovery plans and in terms of adjusting the forest management plan to reflect the effects of these stochastic events.

B. PROGRAM ELEMENT: FOREST ECOSYSTEM MAINTENANCE

This program element is concerned with the extent to which the natural forest ecosystems indigenous to the ownership are adversely impacted during the process of managing, harvesting, and extracting timber products. In the course of managing for timber production, sustainable forestry operations explicitly and vigorously incorporate consideration of non-timber components of the forest ecosystem into management programs and practices, and seek to minimize the alteration of natural forest ecosystem conditions and processes.

Consistent with SCS Forest Conservation Program protocols, the Evaluation Teams employ the following criteria, or their equivalents, pertaining to forest ecosystem maintenance.

B.1 Forest Community Structure and Composition

From the standpoint of maintaining all elements of a natural forest ecosystem, the full range of seral stages from early regeneration to old growth, both in total acreage and geographic dispersion, is highly desirable. Beyond seral stage representation, fully adequate ecosystem maintenance requires that the full range of tree and other vegetative species associated with the natural forest is maintained in self-sustaining proportions within the working forest. (FSC P&C 6.3) Another dimension of the fundamental quality of ecological diversity is the maintenance of diversity of stand sizes and configurations.

Field and management indicators around which observations and other supporting data are gathered include:

- * seral stage distribution across watersheds or other geographic units larger than a single stand but smaller than an entire management district (i.e., landscape-level diversity);
- * age, size and species diversity of trees within a stand;
- * presence/absence and diversity of indigenous shrub, ground cover, herbaceous, and non-commercial tree species;
- * degree/extent of "green retention" after harvesting operations; and
- * vertical diversity; i.e., number of canopy layers.
- * use of exotic species and genetically engineered organisms ³ (FSC P&C 6.8, 6.9)

B.2 Long-Term Ecological Productivity

This criterion is concerned with effects of management activities on the ability of the forest, over time, to sustain key biological components and ecological functions at levels associated with maximum long-term biological productivity. (FSC P&C 6.3.)

Field and management indicators around which observations and other supporting data are gathered include:

- * length of managed rotations relative to ecological rotations;
- * management efforts designed to maintain the nutrient capital of managed areas (e.g., woody and green retentions);
- * extent of soil damage during harvesting operations - e.g., compaction, rutting, erosion, mass soil movements on steep sites;
- * extent and appropriateness of whole tree logging; and
- * excessive exposure of soils to harsh micro-climatic stress.

B.3 Wildlife Management Actions, Strategies, and Programs

In every bio-region of the world, key wildlife species have also emerged as important indicators of the overall health of forest ecosystems. Accordingly, the evaluation includes an explicit focus of the ownership's wildlife management policies and programs, including the extent to which wildlife and wildlife habitats are considered, protected, and enhanced during the course of timber management operations and as a distinct element of overall management of the forest. (FSC P&C 5.5.)

Field and management indicators around which observations and other supporting data are gathered include:

- * regular involvement of wildlife biology expertise, preferably a certified wildlife biologist, in the forest management program, either as consultants or as regular employees;
- * extent of acquisition, analysis, and utilization of data concerning wildlife populations, habitat conditions and species requirements;
- * degree of integration of wildlife concerns into management prescriptions (e.g., habitat connectivity considerations);
- * degree of retention of desirable habitat features such as vegetation suitable as wildlife food, hard and soft mast, standing trees suitable for cavity nesting, large downed logs for shelter, and horizontally and vertically diverse cover vegetation;
- * status of working relationships with state wildlife officials; and
- * extent and condition of wildlife-oriented special management areas, especially those associated with threatened or endangered species. (FSC P&C 6.2)

B.4 Watercourse Management Policies and Programs

Because of the beneficial human uses of water which are fundamentally influenced by the management of forested watersheds in the headwaters of

³ Genetically engineered organisms 'does not apply to hybrid' or 'plus' tree species/varieties resulting from breeding programs.

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our rivers and streams, and because of the enhanced robustness and diversity of life forms (both vegetative and wildlife) associated with and dependent on riparian areas, the evaluation also includes a focused examination of the ownership's policies, programs, and practices for maintaining and enhancing the condition of watercourses located within the property. Of concern is the extent to which the bio-physical functions of watercourses are protected from the adverse affects of timber harvesting and road building (FSC P&C, 5.5)

Field and management indicators around which observations and other supporting data are gathered include:

- * effectiveness of design and execution of watercourse buffer policies (e.g., width, canopy retention policies, frequency of entry);
- * extent and effectiveness of stream restoration projects;
- * frequency and nature of Land Use Regulation Commission violations;
- * effectiveness of design and maintenance of stream crossings;
- * frequency of stream crossings within harvest areas;
- * location and layout of roadways near watercourses;
- * road bank vegetative management in areas near watercourses; and
- * extent of observable roadway rainfall runoff into watercourses.

B.5 Pesticide Use: Practices and Policies

To many people (particularly those living in and around working forests), the use of chemical pesticides in forestry operations is of special concern, both from a public health standpoint and from the standpoint of the correlative relationship between the use of chemicals and reductions in bio-diversity (e.g., pesticide use in establishing monoculture plantations). For many, the use of chemical pesticides is considered to be fundamentally incongruent with the concept of sustainable forestry.

SCS does not subscribe to the point of view that sustainable forestry, by definition, precludes the use of chemicals. However, a fundamental programmatic observation is that chemical pesticides are often misapplied and that many industrial forestry operations have become inappropriately dependent upon the broadscale use of chemicals. The objective in a will-managed forest is to minimize the use of chemical pesticides, applying them as a management tool only in very limited circumstances and under carefully controlled conditions. The use of chemicals as an expediency or as an indispensable facet of broadly applied silvicultural prescriptions is fundamentally incompatible with the precepts of sustainable forestry. Pesticides that have been banned under international agreements shall be categorically precluded from use. (FSC P&C 6.6)

Field and management indicators around which observations and other supporting data are gathered include:

- * frequency of pesticide use and stated reasons for their use;
- * extent to which silvicultural methods minimize the need for pesticides (e.g., avoidance of clearcutting and other measures designed to limit hardwood incursion) (FSC P&C 6.6);
- * effectiveness of use - i.e., locational accuracy of application, appropriateness of timing, efficacy of vegetative results;
- * use of targeted versus broadcast aerial insecticide spraying, and;
- * policies and procedures for proper use and disposal of hazardous materials. (FSC P&C, 6.7)

B.6 Ecosystem Reserve Policies

Concerns for bio-diversity and the strategic retention of scarce ecotypes at risk on a local or regional level point to the wisdom of preserving representatives of such areas from timber management or other resource-altering activities. An ownership committed to sustainable forestry will seek to inventory candidate areas and to identify and execute appropriate mechanisms for assuring the protection of key areas. (FSC P&C, 6.2, 6.4) Although one option is for the landowner simply to establish reserves, shouldering alone the financial opportunity costs of foregone commodity production, such independent action is not mandatory. Other appropriate mechanisms include fee simple transfer of title (sale or charitable donation) to other entities whose purpose is resource protection and sale of reserve (i.e., non-management) easements.

Field and management indicators around which observations and other supporting data are gathered include:

- * extent (i.e., total number, acreage, and distribution) to which areas of ecological significance are afforded protection, either as retained reserves or non-managed areas, or through transfer to other ownerships dedicated to preserving those areas;
- * permanence of retained set-aside areas and susceptibility to inadvertent damage or future change in commitment; and
- * observed circumstances in which ecologically important areas were substantially altered through harvesting.

C. PROGRAM ELEMENT: FINANCIAL AND SOCIO-ECONOMIC CONSIDERATIONS

This program element is concerned with two non-biophysical issues.

First, this program element addresses the financial viability of the ownership structure and management program. Financial viability is the linchpin of a long-term commitment to the principles and practices of sustainable forestry. Sustainable forestry, or any management regime, will only be practised over the long run if it is capable of producing financial returns adequate to serve the financial needs and exigencies of the ownership. Without financial viability, it is merely a matter of time before: a) non-sustainable practices are instituted, or, b) the property is acquired by another ownership which may or may not continue the commitment to sustainable forest management. Under either circumstance, an SCS certification would be invalidated. Accordingly, certification above a score of 80 would not be granted to an ownership if there exist financial circumstances that substantially call into question the continued commitment to the policies and practices that were evaluated.

Also addressed in this program element is the socio-economic dimension of sustainable forest management - the human dimension of forest land use and the goods and services yielded from the forest. Sustainable forestry must sustain the social and economic benefits created by the forest. Special emphasis is placed upon sustaining the historical patterns of benefit, particularly to local and regional populations (including employees, contractors,

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neighbours, and local communities) who have derived utility from the forest, either directly or indirectly. As with the other program elements, the social-economic evaluation must be prospective as well as historical. The key question is the extent to which current and historical levels and patterns of human benefit will be sustained into the future.

Consistent with SCS Forest Conservation Program protocol, the following financial and socio-economic criteria are employed.

C.1 Financial Stability (FSC P&C 2.1, 5.1)

A management program exposed to the financial pressures of needed cash flow beyond levels the program produces (pressures often associated with the servicing of capital debt) will inevitably be replaced by less sustainable management driven by short term cash generation. This is an inherently unstable condition and incompatible with the standards of a certified forest ownership.

Financial and organizational indicators considered by the Team include:

- * ownership structure and vertical integration, if any, where the log requirements of a mill owned by the company might dictate land management decisions;
- * stability of ownership structure;
- * cash flow demands of the company, related to factors such as servicing of debt or capital demands of individual owners/stockholders;
- * accounts payable performance or other financial performance data such as might be available through sources such as Dun & Bradstreet reports (e.g., current assets to liabilities ratios, long-term liabilities, working capital);
- * review of company's annual financial statements which provide information such as annual return on investment rates, etc.;
- * evidence that financial considerations dictate or drive land management decisions; and
- * management philosophy of corporate officers as revealed through interviews and/or written statements.

C.2 Community and Public Involvement

The focus of this criterion is the extent to which the forest lands under evaluation contribute to the economic and social well-being of the most directly affected local communities and the general region in which the forest is located. (FSC P&C, 4.4) The interface between the subject ownership and the surrounding communities and regional economies is related to:

- * the sale of timber products;
- * access to the subject property by the general public for recreation (addressed in another criterion);
- * payment of taxes (e.g., property, income and payroll);
- * employment from within the local and regional workforce;
- * purchase of goods and services in support of the operation's land management activities;
- * corporate contributions and other forms of support of community and civic programs;
- * involvement of the ownership's employees in community affairs;
- * recognition of community rights and expectation with respect to the forest; and
- * where applicable, the extent to which indigenous peoples are compensated for the application of their traditional knowledge regarding the use of forest species in forest operations (FSC P&C, 3.4)

In short, the focus of this criterion is on the extent to which the subject operation and employees thereof are a "good neighbour".

Field and management indicators around which observations and other supporting data are gathered include:

- * company policies designed to encourage employee participation in community programs;
- * corporate contributions to charitable causes;
- * employee participation in local, state, and regional professional and natural resource organizations;
- * employee participation in ad hoc and standing public/private committees dealing with land management and forestry issues;
- * efforts to hire from within the local and regional workforce (FSC P&C 4.1);
- * efforts to support local business when making decisions about the sale of wood products or in purchasing decisions; (FSC P&C, 5.2) and
- * procedures for identifying and protecting areas of special cultural, economic or religious significance (FSC P&C, 3.3)

C.3 Public Use Management

Of concern in this criterion are the efforts taken to facilitate but also manage the use of the forested property by local people such as hunters, fishermen, hikers, campers and fire-wood gatherers. Consistent with the recognized human dimension to sustainable forestry, sound forest management facilitates human use but manages that use so as to assure an appropriate balance with other uses which may be in conflict (e.g., timber harvesting and resource protection).

The operation must consider and provide for the continuance of legal or customary tenure or use rights of local communities and indigenous peoples, if such rights duly exist. Where claims of such rights are in dispute, appropriate mechanisms must be employed for resolving the disputes. (FSC P&C 2.2, 2.3, 3.1, 3.2, 4.5)

Field and management indicators around which observations and other supporting data are gathered include:

- * policies guiding the extent to which the general public has access to company lands for recreational purposes;
- * barriers and inducements to public recreational use;
- * management of public use to control resource damage (FSC P&C 6.2); and
- * in selecting sites for developed recreation or other special uses, efforts taken to minimize avoidable opportunity costs in terms of foregone timber production capability.

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C.4 Investment of Capital and Personnel

To be viable in the long run, sustainable forestry requires ongoing investment in the management program. Two principal vectors of investment are: 1) the professional workforce (investment in attracting and retaining competent professionals and in maintaining the currency of their knowledge and skill base); and 2) large capital items such as roads, harvesting equipment, plantations, stand improvements, and resource protection programs. Sustainable forestry, as opposed to opportunistic resource utilization, involves active, ongoing investment in the health of the forest and the mechanisms for efficiently producing marketable products, at minimum impact to the environment.

Field and management indicators around which observations and other supporting data are gathered include:

- * average annual expenditures on pre-commercial silvicultural prescriptions such as planting, vegetation control and timber stand improvement (e.g., spacing control);
- * expenditures on or commitment to ongoing employee training and education; and
- * financial support or investment in improved harvesting machinery.

C.5 Employee and Contractor Relations

Most directly impacted by the management of a forested property are those employed (either directly or as independent contractors) to work on the property. Additionally, it is their long-term economic well-being that is most directly at risk in the event that timber management activities are not sustainable.

Field and management indicators around which observations and other supporting data are gathered include:

- * employee wages and benefits as compared to industry norms in the region;
- * average tenure of workforce;
- * employee work attitudes and general morale;
- * opportunities for employee participation in (and/or organizational structure to get employee input on) management decisions and policy formulation;
- * contract harvest/hauling rates compared to regional norms;
- * average daily compensation of woods crews relative to regional industry norms and to pre-service contract era;
- * safety records of employees and contract woods crews;
- * contractor attitudes about the company, based upon past experiences, and
- * stability of relationships with woods contractors.

SMART WOOD PROGRAMME (1993)

GENERIC GUIDELINES FOR ASSESSING NATURAL FOREST MANAGEMENT

Since early 1991, when the first edition of these guidelines was publicly circulated, the Rainforest Alliance has developed the criteria below as a minimum acceptable measure for assessing the sustainability and impacts of logging operations applying to be certified by **Smart Wood**. The development of these criteria, and all other **Smart Wood** certification activities, have been based on three broad concepts:

- 1) all operations must maintain environmental functions, including watershed stability and conservation of biological resources;
- 2) planning and implementation must incorporate sustained yield production for all forest products based on an understanding of, and documentation related to, local forest ecology;
- 3) all activities should have a positive impact on the well being of local communities.

GENERIC INFORMATION AND CRITERIA FOR NATURAL FORESTS

- 1.0 **General Information** (answer all items, write unknown where applicable)
 - 1.1 Name of source.
 - 1.2 Address or location of main office(s).
 - 1.3 Name of person(s) in charge of forest management operations.
 - 1.4 Name, size (in hectares) and location of each forest management area.
 - 1.5 Managed by (government, company, community, other).
 - 1.6 What is total volume (actual or estimated, preferably in cubic meters) of timber produced? please be specific about the different type(s) of product being produced.
 - 1.7 Types of processing facilities owned or managed by the applicant (please be specific)?
 - 1.8 What percentage of timber supply comes from:
 - o forest land that is directly managed by the applicant,
 - o forest land that is managed by a known third party, or,
 - o open market log or timber purchases?
 - 1.9 Who owns the land where forest management operations take place (e.g. government, company, community, individual)?
 - 1.10 What type of forest access or ownership agreement exists (titled land, concession, customary use right, other, please be specific)?
 - 1.11 What type of forest is being managed? Primary forest? Secondary forest? Plantation? (NOTE: assessment of plantation areas will be done using separate plantation guidelines)
 - 1.12 How many hectares/acres total are being managed?
 - 1.13 Are there management plans? If so, how many and covering how many hectares/acres?
 - 1.14 What percentage of total volume of timber comes from each type of forest?
 - 1.15 Roughly, what area of forest is being harvested on each year?
 - 1.16 Year in which logging operations began?
 - 1.17 Do logging operations include construction of roads into new forest areas?
 - 1.18 Principal mode of timber extraction (mechanical or manual, specify equipment used).
 - 1.19 Are areas of exceptional biodiversity known to exist in vicinity of logging?
 - 1.20 Which local communities are involved with/affected by logging activities: (please name communities and type of people, e.g. indigenous forest peoples, migrant farmers, other)?

For each of the following criteria, indicate the number which most applies:

- 0 = not applicable
- 1 = strongly unfavourable
- 2 = more unfavourable than favorable
- 3 = neutral
- 4 = more favorable than unfavourable
- 5 = strongly favorable

In assigning values to specific criteria, assessors or auditors should take into consideration national norms and regulations, the scale of the operations, and international guidelines.

- 2.0 **Forest Security**
 - 2.1 Land tenure is clear and legally secure.

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- 2.2 Land is dedicated by owners to long-term forest management.
- 3.0 **Management Planning**
- 3.1 A multi-year forest management plan is written and available.
- 3.2 An annual operating or harvesting plan is available and used in the field.
- 3.3 The management plan includes:
 - i) management objectives;
 - ii) analysis of inventories of target species and factors affecting their population;
 - iii) a plan of proposed silvicultural interventions;
 - iv) maps which describe harvest areas, conservation and/or buffer zones, haul roads, log landings, and primary skid trails;
 - v) a plan for forest protection against fire, pests, encroachment, etc.;
 - vi) description of measures for environmental protection, including soil conservation and watershed protection, conserving biological diversity, and use of toxic materials;
 - vii) a plan for forest product utilization and marketing;
 - viii) description of the consultation process with affected communities and its results;
 - ix) a plan for periodic monitoring and reporting, which shows how management prescriptions will be changed based on new information.
- 3.4 Maps and work plans are produced at adequate scale and provide operational guidance for management activities and facilitate on-site monitoring.
- 3.5 Technical specifications for road design and conservation structures have been written.
- 3.6 Non-timber forest products have been inventoried and their management is incorporated into the planning process.

4.0 **Sustained Yield Management**

- 4.1 Rationale behind silvicultural prescriptions is well-documented, i.e. based on site-specific field data or published analyses of local forest ecology or silviculture, and government regulations.
- 4.2 Annual allowable cut (AAC), by area or volume, has been set based on conservative and well-documented estimates of growth and yield.
- 4.3 AAC is being followed in the forest.
- 4.4 Silvicultural prescriptions (pre-, during, and post- harvest) are being adhered to.
- 4.5 Growth rates, stocking, and regeneration are being monitored by a suitable continuous forest inventory system.
- 4.6 Actions to ensure quantity and quality of future crop, through either natural or planted regeneration, are being implemented.
- 4.7 Post-logging assessments take place to assess the impact of harvesting on future crop trees and the forest, preferably within 12 months after harvesting.

5.0 **Environmental Impacts**

Biological Conservation:

- 5.1 Field assessments of non-timber forest products and biological resources appropriate to the scale of the operation have been considered in annual operating plans.
- 5.2 Biological conservation is explicitly considered in annual operating plans.
- 5.3 Timber species on either local and/or international endangered or threatened species lists (e.g. CITES appendix 1, national lists) are not being harvested.
- 5.4 Other threatened, rare, endemic or endangered species, or their habitat, are explicitly being taken into consideration during planning and harvesting activities (e.g. dens, or nesting and roosting trees protected, openness to research on biological issues, etc.).
- 5.5 Based on the identification of key biological areas (through 5.1 above), roughly 10% of the total area under forest management (not including stream or roadside buffers) is designated as a 'conservation zone', i.e. land or forest to be conserved in its natural state without logging.
- 5.6 Conservation zone is preferably a contiguous block, though it may be a series of smaller blocks linked by corridors as wide as the average height of forest canopy in a mature forest (over 75 years).
- 5.7 Conservation zones are clearly demarcated on maps and in the field and timber felling controlled so as not to take place in these areas.

Control of chemicals:

- 5.8 A constant effort is made to reduce or eliminate the use of chemicals in the forest.
- 5.9 Chemicals banned in Europe, U.S. and target country are not used.

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Road Construction:

- 5.10 Topographic maps have been prepared well before logging or road construction which specify areas which are suitable for all-weather harvesting or dry-weather only; and indicate locations for extraction (or haul) roads, loading ramps (or log yards), main skid (or snig) trails, drainage structures, streamside and roadside buffer zones, and conservation areas.
- 5.11 No road fill is placed in stream courses.
- 5.12 Road surfaces are well drained, culverts large enough to avoid ponding, water bars are installed where roads are abandoned.

Tree Felling:

- 5.13 No timber harvesting is taking place in highly erodible areas or within pre-designated buffer zones for rivers and streams, with a minimum protection (or buffer) zone equal to twice the width of perennial stream courses (e.g. if stream is 20 meters wide, buffer zone should be 20 meters on each side), and with a minimum buffer of 10 meters on each side.
- 5.14 No tree felling is taking place on slopes exceeding 35 degrees measured over 100 meters (exception: cable yarding, degree slope dictated by documented local experience and conditions).
- 5.15 Harvest trees are marked prior to logging.
- 5.16 Future harvest (crop) trees have been marked or explicitly taken into consideration.
- 5.17 Directional felling techniques are being used (i.e. trees are felled parallel to or in the direction of skidding).

Skidding:

- 5.18 Front end of logs is lifted off ground during mechanical skidding.
- 5.19 Skid trail gradients do not exceed 25 degrees.
- 5.20 Specifications in terms of skid trail width and location have been set and are being followed.

Post Harvest Protection:

- 5.21 In-migration, settlement, hunting, and timber extraction along logging roads is controlled.

Product Processing:

- 5.22 Waste from processing plants (e.g. sawmill, factory) is being properly disposed of.
- 5.23 Use of chemicals is minimized and controlled in processing center.

6.0 Community Relations

- 6.1 Local communities are given first preference in logging and other forest management activities in terms of ownership, management, labour pool, agroforestry, etc.
- 6.2 Local organizations directly affected by forestry activities are given an opportunity to participate in forest management planning.
- 6.3 Local communities' traditional rights to own, manage or use forest resources have been formally recognized.
- 6.4 Fuelwood needs of local communities are being met locally.
- 6.5 Regulated access given to local communities to forest for timber and non-timber forest products.

For privately owned/managed concessions:

- 6.6 Community lands excluded from commercial concession area; boundaries redrawn if necessary.
- 6.7 Traditional and legal rights of communities are documented in written agreements and honoured, with maps showing protected areas of limited harvesting.
- 6.8 Proposed harvesting operations described to affected communities in public meetings in advance, and begun only after agreements documented legally.
- 6.9 Community-concession relations monitored by a board locally constituted that processes grievances and imposes compensation for harvesting damage to communities.
- 6.10 Local non-governmental organizations involved in legal training, negotiations, monitoring of community concession agreements.
- 6.11 Compensations provided to local communities for damage to crops, game, trees, land, other managed resources, impairment of essential environmental functions (water quality), or loss of income.

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7.0 Employee Relations

- 7.1 Wages and other benefits (health, retirement, worker's compensation, housing, food) are fair and consistent with (not lower than) prevailing local standards.
- 7.2 Worker safety is considered and conditions are fair and consistent with local norms (not a higher than normal accident rate).

8.0 Economic Viability

- 8.1 Based on local experience and markets, stumpage rates or other rents being paid to landholders are at or above the norm (i.e. average), and are perceived by landowners to be a positive incentive for encouraging long term forest management.
- 8.2 Stumpage paid is sufficient to cover costs of maintaining land as forest.
- 8.3 Revenue received is sufficient to financially support post-harvest management activities such as road maintenance, silvicultural treatments, and long-term forest health and growth and yield monitoring.

9.0 Optimizing Forest Potential

- 9.1 Forest operations encourage the utilization of lesser-known, or less-commonly utilized, plant species for commercial and subsistence uses.
- 9.2 Forestry operations seek the 'highest and best use' for individual tree and timber species.

10.0 Tracing and Tracking

- 10.1 Documentation of management activities on all forest blocks should be kept in a form that makes it possible for monitoring and certification to occur.
- 10.2 Certified forest products should be clearly identifiable through marks or labels, or separate documented storage, at all stages of processing and distribution.
- 10.3 Documentation of source and destination for all forest products must be available at all intermediate storage yards (e.g. log yards), processing and distribution centres.

THE SOIL ASSOCIATION MARKETING COMPANY LTD. - RESPONSIBLE FORESTRY PROGRAMME (1994)

RESPONSIBLE FORESTRY STANDARDS

The Generic Standards form the basis of the Timber Certification and Labelling System, defining Responsible Forestry, and laying down criteria which must be met and maintained when timber and timber products are described as Responsibly Produced.

PRINCIPLE 1: ENVIRONMENTAL IMPACT: Forest management minimises negative impacts on the biodiversity, soils, water and landscape of the forest and adjacent areas.

Planning for conservation of biodiversity

1. Management must minimise adverse impacts on the conservation and wildlife value of the management and surrounding areas.
2. Following site assessment, areas of special biological and genetic importance must be managed appropriately in order to prevent damage or disturbance, and access to them may be restricted.
3. In natural forests, sufficient areas containing representative biodiversity must be set aside and given complete protection. The minimum area must be large enough to maintain viable populations of key species. The provisions for local consultation apply (see Principles 3 and 4).
4. Selection of trees for harvest, harvesting rates and methods must be controlled to conserve populations of individual species, and the range of genetic variability, as assessed by pre- and post-harvesting assessments.
5. In selection systems, selection of trees for harvest, harvesting rates and methods must be controlled to conserve populations of individual species, all life-cycle stages and the range of genetic variability, as assessed by pre- and post-harvesting assessments.
6. The Convention on International Trade in Endangered Species (CITES) must be respected in all cases of international trade (see Appendix 1).
7. Specific management regimes must be implemented for particular timber species, rare, threatened or important plant or animal species, or particular habitat types where sufficient information is available.
8. Recommended
 - (a) In natural forests, the scale of felling should be commensurate with the natural dynamics of the forest type and the area under consideration;
 - (b) The movement of key plant and animal species between reserved and harvested areas should be maintained by retaining corridors of uncut forest based on streambanks with links up slopes and across ridges to connect adjoining catchments, connecting any large patches of forest which will not be harvested;
 - (c) Linked areas of open space (at least 10% of the area) should be maintained in plantations, where appropriate.
9. Prohibited
 - (a) Commercial timber extraction is prohibited in environmentally strategic forests e.g. those necessary for watershed protection or wildlife conservation.

Roads and firebreaks

1. Planning, location, design, construction and maintenance of roads, bridges, quarries, waterway crossings, firebreaks and permanent landings must be carried out so as to minimise adverse impacts on soils, water and landscape.
2. Roads must be fitted to the topography so that a minimum of alterations to the natural features will occur.
3. The number of stream crossings must be minimised.
4. Timing of construction of roads should allow for the proper consolidation of the road before use.
5. Appropriate equipment should be used, operators should know what is required and all operations should be properly supervised.
6. Valley bottom roads and tracks must be kept as far back from the stream as possible, must be kept out of streambanks.
7. Streamcrossings should be at right angles to the stream, should be planned before operations begin and should be shown on relevant maps.
8. Road clearing should be of a minimum width, but sufficient to allow the road to dry.
9. Embankments and cuttings must be stabilised to resist erosion.
10. Roads must have adequate camber and carriageway ruts must be repaired.
11. Culverts must not obstruct the migration of fish, create fast water velocities or stream beds unsuitable for fish.
12. Recommended
 - (a) Wherever possible roads should be located on natural benches, ridges and flatter slopes;
 - (b) Cuts and fills should be balanced along the road so that as much of the excavated material as is practicable can be deposited in the roadway fill sections;

- (c) Steep approaches to bridges or waterway crossings should be avoided.
 - (d) Road grades, culvert location and run off should be designed so that discard filters through undisturbed forest soil;
 - (e) Roads not in use by forest vehicles and machines should be closed;
 - (f) Drains must not drain into natural watercourses. Where this is unavoidable, regularly emptied silt traps must be installed.
 - (g) Inspection of roads and drains immediately after rain.
13. Restricted
- (a) Road construction in steep, narrow valleys, slip-prone or other unstable areas, natural drainage channels, streambanks and areas of other value should be avoided.
14. Prohibited
- (a) Roads must not be aligned through environmentally sensitive areas;
 - (b) Damage to fisheries by in-stream road construction or gravel extraction;
 - (c) Extraction of gravel from watercourses without consent of water regulatory authority, riparian owners, tenants and fishery interests.

Harvesting

1. Felling, extraction and collection of logs must minimise damage to biodiversity, soils, water, landscape and sites of cultural heritage.
2. Complete closure of forest operations must be effected in extreme conditions where there is risk of environmental damage.
3. Training must be adequate, incentives for good practice appropriate and supervision competent.
4. Harvesting machinery and techniques must be matched to forest conditions, and to the dimensions of the products being harvested.
5. Biodiversity should be routinely maintained by the retention of marginal habitats e.g. streamside vegetation, vegetation on rocky outcrops, swamps and heaths.
6. Forestry operations must, if appropriate, aim for a mixture of compartments differing in size, shape, species, date of planting and felling, in harmony with the landscape.
7. When archaeological sites or artifacts are located during operations, all relevant authorities must be notified and the site recorded prior to further disturbance.
8. Harvesting provides an opportunity to enhance the environmental benefits of plantations by modifying their structure and composition. Systems which use small clearfell areas, selective felling and create varied age class must be considered.
9. Prohibited
 - (a) Harvesting machinery must not enter streambanks except at designated and designed stream crossings (unless under conditions listed in 17. below). The number of such crossings must be minimised;
 - (b) Natural watercourses must not be altered to facilitate harvesting. If watercourses are accidentally dammed, the impediments should be broken as soon as possible.

Felling

10. The choice of felling system must be appropriate to the ecology of the forest.
11. The scale and size of felling coupes must be in sympathy with the form and scale of the landscape.
12. Recommended
 - (a) Trees should be marked for direction of felling, on the stump and the trunk for post-felling assessment, to minimise damage to residual stand;
 - (b) The visual impact of operations should be minimised by retaining trees as a screen, careful siting of landings, roads and extraction routes, and not aligning roads and extraction routes to viewpoints;
 - (c) Retention of standing and fallen dead wood habitats, appropriate to the local situation.
13. Restricted
 - (a) Extensive clearfelling, except for the creation of specialised habitats and where ecologically appropriate;
 - (b) Felling within streambanks, to the maintenance of streamside vegetation.
15. Prohibited
 - (a) Pushing lop and top into streambanks.

Extraction and collection of logs

15. The impact of timber extraction on soils must be minimised by:
 - (a) Minimising extraction distances and the area covered by extraction routes and landings;
 - (b) Planning and building extraction routes before felling, during the appropriate season and with adequate drainage to minimise environmental impact;
 - (c) Minimising bare soil exposure;
 - (d) Ensuring landings are well drained;
 - (e) Rehabilitating landings and extraction routes when no longer operational;
 - (f) Ceasing extraction when soils are saturated;
 - (g) Use of brash mats, where appropriate.
16. Recommended
 - (a) Maximum use of extraction systems to minimise machine disturbance, such as winch, arch and skyline;
 - (b) Soils are rested after heavy rainfall and there is an interval before operations recommence;
 - (c) Extraction routes approach landings from below to shed water.
17. Permitted
 - (a) Existing tracks within streamside reserves may be used if:
 - (i) Conditions are dry;
 - (ii) Lop and top is placed on the track before use;
 - (iii) Use is specified in the management plan;
 - (b) Ripping to improve structure of compacted soils during rehabilitation of landings, roads and tracks.
18. Prohibited
 - (a) Whole tree extraction;
 - (b) By-passing extraction routes closed due to wet weather.

Site selection and preparation for plantations

1. The Responsible Forestry Programme favours an increase in forest cover, but only where more ecologically or socially appropriate land use systems are not affected.
2. When establishing plantations, existing appropriate land use by local communities must be maintained, unless alternatives are agreed with the full consent of the local communities involved.
3. The purpose (or purposes) of plantations must be clearly defined before planning and preparations begin.
4. Planning for plantations must involve careful assessment of the capability of the site to support repeated harvesting, taking account of nutrient budgets and hydrology, in order that land is protected against soil erosion and runoff, soil processes which enhance fertility are favoured and the use of external inputs is minimised.
5. The need for fire management and pest control must be considered.
6. Sensitive areas eg streamside, should be identified before work begins, and excluded from planting.
7. Existing vegetation should be retained where it is advantageous to do so eg for biodiversity, as buffer zones to prevent erosion, as filtration strips or as shelter for newly planted trees.
8. The siting of plantations should maximise the conservation of biodiversity eg conform to national policies for the conservation of biodiversity.
9. Both general siting and internal design should take into consideration effect on the landscape.
10. Recommended
 - (a) In deciding the siting of any plantation, consideration should be given to its position relative to external areas of natural forest. The plantation may serve as a bridge or corridor for species' movement. Retention of areas of natural forest within the boundaries can facilitate this process, in addition to maintaining biodiversity.
11. Permitted
 - (a) Ploughing arable land to break plough pans.
12. Prohibited
 - (a) Plantations must not be established where there are social or environmental reasons for not doing so. These include local opposition, the presence of important or sensitive ecosystems; areas of high or unique biological diversity; planned conservation or protection areas or where there are possible adverse effects on an important water catchment area;
 - (b) Deliberate drainage of wet areas or bodies of water to make site uniform.

Planting

1. The species and genotypes chosen for plantations must be those most likely to satisfy the objectives and to grow well on the sites available. Attention should be paid to matching the planting material to the local climate and soils, and assessing risks of fire, and of pests and diseases.
2. Land set aside for plantations may be colonised naturally by useful forest species. Such regeneration should be used to advantage where it satisfies the objectives of management.
3. Where a native genotype satisfies the objectives of a plantation project, it should be preferred for reasons of conservation of

- local biodiversity.
4. Prompt reforestation following harvesting is required to maintain long term productivity and water quality and reduce visual impact.
 5. Planting stock must be suited to site conditions and properly handled and planted for high initial vigour.
 6. The most effective and appropriate establishment procedures must be used to ensure trees are established as rapidly as possible.
 7. Planting adjacent to special sites eg streamsides, existing forested areas (see Prohibited below) must be in sympathy with the continuing value of those sites.
 8. Adjoining permanent or periodically flooded areas must be incorporated into the streamside reserved area, rather than being planted.
 9. In plantations, opportunities must be taken to modify the species composition and dimensions to provide for local needs, by planting or retaining trees or other species of plants which are valued locally or by encouraging animals that may be hunted or fished.
 10. Recommended
 - (a) Stands of mixed species are to be preferred, unless the objective of management is the production of uniform, high quality timber or fibre, or the growth of monocultures is ecologically appropriate;
 - (b) If understorey species are to be planted, species native to the site should be used.
 11. Permitted
 - (a) Restoration of degraded natural forest areas through planting.
 12. Restricted
 - (a) Enrichment planting for upgrading the timber potential of poorly stocked forest, resulting in negative impacts on local biodiversity.
 13. Prohibited
 - (a) Special sites eg streamsides, within a planting scheme must not be planted.

Pollution control

1. Responsible Forestry aims to minimise the use of chemicals in the forest by the use of appropriate site, species and genotype selection, and to prevent inadvertent pollution if and when they are used.
2. Pest and disease control shall primarily be conducted by a combination of:
 - (a) An appropriate choice of species and sites;
 - (b) A balanced rotation of silvicultural practice to break pest and disease cycles;
 - (c) In plantations, the creation of a diverse ecosystem within and around the crop to encourage natural predators.
3. People, water resources, flora and fauna must be protected from contamination by chemicals:
 - (a) Chemicals must only be used when absolutely necessary to achieve defined management aims;
 - (b) Only the correct chemicals must be used and must be properly applied to prevent avoidable contamination of the food chain and ecosystem;
 - (c) Chemicals must be used only in minimum effective quantities, with strict observation of controls and regulations;
 - (d) All equipment for the transport, storage and application of chemicals must be maintained in a safe and leakproof condition;
 - (e) Training and appropriate equipment must be provided to all operators;
 - (f) There must be a contingency plan detailing action to be taken in the event of pollution.
4. Fuel tanks and stores must be located so that spillages from damage, defects or refuelling will not enter watercourses.
5. All non-biodegradable waste (including oil) must be removed from the forest.
6. Nursery practice must minimise the use of chemicals by the maintenance of high standards of hygiene and preventative measures to avoid infection. Growers wishing to produce chemical-free ('organic') seedling should consult the Soil Association's Organic Standards.
7. Recommended
 - (a) Pesticides should be used as part of an integrated pest management system, including habitat management; selecting less vulnerable species, selecting sites away from other pest habitats;
 - (b) Physical barriers eg fencing to exclude browsing animals from regenerating/planted areas.
8. Permitted
 - (a) Chemical treatments to remove non-native, invasive species which, if left unchecked, may reduce biodiversity and the ability of the forest to provide required products and services;
 - (b) Pheromone traps for monitoring pest levels;
 - (c) Biological pest control using licensed naturally-occurring organisms;
 - (d) Mechanical traps, barriers and sound;

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- (e) Seeds and planting stock may be treated with chemicals, provided that:
 - (i) The treatment is not banned for use in the same operation in any country;
 - (ii) The users of such seeds can show to the satisfaction of the Certification Committee that they were unable to obtain on the market non-treated seeds or stock of an appropriate variety of the species in question;
 - (iii) Accurate records are kept containing details of the substances used as a seed or seedling dressing;
 - (iv) The dressing does not include mercurial, organochlorine or organophosphate dressings, or any other long-lasting chemical which may accumulate in the food chain;
 - (f) Chemical repellents to exclude pests from regenerating areas;
 - (g) Wetting/sticking agents for sprays;
 - (h) Chemical repellents to exclude pests from regenerating/planted areas.
9. Restricted
- (a) Control of vertebrate pests by poisoning;
 - (b) Aerial application of pesticides, herbicides and fertilisers.
10. Prohibited
- (a) The storage of prohibited materials on Certified units;
 - (b) Seed and seedling dressings based on mercurial, organophosphate and organochlorine compounds (including Gamma HCH, Lindane and BHC), or other long-lasting chemicals which can accumulate in food chains or the ecosystem;
 - (c) Application of chemicals within 10m of watercourses and 30m around reservoirs and lakes;
 - (d) Application if heavy rain is expected, during wet weather, of frozen snow-covered ground or ground which has baked dry during a drought;
 - (e) Disposal of chemicals into watercourses or lakes by burying; washing of equipment in watercourses;
 - (f) Soaking of seedlings treated with chemicals in drains of watercourses prior to planting;
 - (g) The use of genetically engineered organisms.

PRINCIPLE 2: SUSTAINED YIELD: Yields of forest products and services are sustainable in the long term

- 1. The method of calculation of the annual allowable cut must be detailed in the management plan.
- 2. The annual allowable cut must be stated explicitly in the management plan and any sales contracts or concession licences.
- 3. On the basis of available data on regeneration and growth, the annual harvest, rotation length, felling cycle and harvesting sizes must be set to safe, conservative levels.
- 4. Selective felling and thinning regimes must not lead to a reduction in genotypic variation.
- 5. Harvesting limits on species, sizes, total volumes, coupe size and spacing must be set to an appropriate level to ensure a sustainable yield, and adhered to. Where existing data are insufficient these limits must be conservatively set.
- 6. Trees to be retained for future extraction, or as seed sources, must be clearly marked to minimise damage during harvesting and extraction.
- 7. In selection systems a sufficient number of seed trees must be retained to ensure that species composition is not adversely affected.
- 8. Selection criteria and marking must be explicit and robust to ensure work is carried out effectively and the defined management aims are met.
- 9. Recommended
 - (a) Extraction rates should be set to meet requirements, not necessarily to maximise yields;
 - (b) Species specific annual allowable cuts should be stated where there is sufficient information.

PRINCIPLE 3: LAND RIGHTS: Legal land rights of indigenous and traditional peoples are established and enforced. Customary use rights to the forest are maintained.

- 1. Before any forestry operations start, the land rights of indigenous and traditional peoples in the area must be fully recognised, defined and secured, in a manner acceptable to the local communities.
- 2. Before a forestry operation under outside management commences near an indigenous or traditional community's lands, the community's lands must have been physically demarcated, under the control of the community.

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3. Forestry operations under outside management operating on, or near, lands occupied by indigenous or traditional peoples must:
 - (a) Provide documentary evidence of the agreements with the local communities under which management is entitled to manage the forests;
 - (b) Provide information on the identity, location and population of all indigenous and traditional peoples living in the vicinity of the management area or claiming customary rights to the management area;
 - (c) Provide evidence or statements from the representative organisations of local indigenous or traditional communities defining the extent of their territories, with maps;
 - (d) Provide the indigenous or traditional communities with evidence of the concession area, with maps.
4. In case of a dispute or disagreement between the indigenous or traditional community and the operators concerning land rights, forestry operations must be halted until the dispute is resolved.
5. Indigenous and traditional communities' use rights to the concession area - such as rights of way, use of common land, and usufructuary rights - must be respected and upheld.
6. Prohibited
 - (a) Encroachment on lands recognised under Criterion 1 above as subject to claim by indigenous or traditional communities is prohibited without the community's express consent and subject to its control.

PRINCIPLE 4: LOCAL CONTROL, CONSENT AND BENEFIT: Indigenous and traditional communities control forestry activities on their lands. Forestry operations receive the full and informed consent of local communities, enhance their long-term social and economic well-being and do not reduce their ability to make use of the forest in any way.

Control and consent

1. Indigenous and traditional peoples control forest management operations on their lands as defined in principle 3: Land Rights, 1, unless they choose to delegate management to other agencies with free and informed consent, expressed through their own representative organisations, in their own language(s) and using their chosen interpreters.
2. Managers must provide evidence that forestry operations have received the full and informed consent of local communities, including any nearby indigenous and traditional communities, using the processes defined in 1.
3. Restricted access areas in forests used by local communities must be agreed through consultation with those communities.
4. When establishing plantations, existing appropriate land use by local communities must be maintained, unless alternatives are agreed with full consent of the local communities involved.
5. Forest managers must provide evidence of a management structure controlling forestry operations eg committees, lines of decision, meetings, levels of responsibility and authority.
6. Forest manager must provide evidence of a management structure controlling forestry operations eg communities, lines of decision, meetings, levels of responsibility and authority.
7. The representative organisations of indigenous and traditional peoples and local communities with which the forest managers are in contact must be identified.
8. Recommended
 - (a) To prevent the damage that forestry operations in one area can have on another eg disturbance to watersheds and wildlife, buffer zones should be established to protect indigenous and traditional lands from external interference;
 - (b) In countries where local communities are less physically dependent of forests but value the forest for aesthetic, spiritual or recreational reasons, approval of representative organisations eg councils, citizens groups and local environmental groups should still be obtained;
 - (c) Active participation by local communities in planning and implementation of forestry management on state lands should be encouraged;
 - (d) Where lands are privately owned or otherwise not in control of local communities, mechanisms for regular communication between local communities and management should be established, to generate trust through transparency of actions, facilitate exchange of information and opinions, and to provide a forum (with the aid of independent facilitators) for grievances to be aired.
9. Prohibited
 - (a) Activities on indigenous and traditional lands against the wishes of the communities in question, and not subject to their control;
 - (b) Damage to indigenous and traditional resources on, or near, indigenous and traditional lands. Inadvertent damage must be compensated as determined by the indigenous and traditional communities themselves;
 - (c) Forestry operations should not be undertaken where there are socio-economic reasons for not proceeding, eg local opposition, insufficient labour or important cultural or archaeological sites.

Cultural heritage

The Tropenbos Foundation, 1996 - Hierarchical framework

1. The cultural heritage of local communities must be considered in all stages of forest management:
 - (a) Local communities must give their full and informed consent to any operations on culturally significant sites;
 - (b) Areas of archaeological, religious, historical or other cultural sensitivity must be identified from existing knowledge, archival research, or archaeological surveys;
 - (c) Sites of cultural significance must be protected through identification, recording, assessment and appropriate management;
 - (d) If culturally sensitive areas are identified, surveys must be undertaken before operations start;
 - (e) The historically, culturally and ecologically important characteristics of a forest must be distinguished and separately appraised.

Labour, health and safety

1. Employment conditions must be the same for local and non-local employees doing the same job.
2. Local communities must have access to any health or education services provided through forestry activities.
3. Housing, sanitation, education and health care provided for employees must be adequate and culturally appropriate.
4. Employees must have the right to organise ie join trade unions and undertake collective negotiations regarding terms and conditions of employment.
5. There must be mechanisms for dialogue between workers and management, including culturally-appropriate worker's representation.
6. There must be adequate, and implemented, safety measures, and the provision of appropriate safety equipment.
7. There must be assured compensation benefits in case of accidents.
8. Recommended
 - (a) Statement of wages and salary scales, insurance provision;
 - (b) Statement of employment policy and labour relations;
9. Statement of accidents and deaths of employees and their causes in the last 12 months, and compensation awarded.

Economic gains

1. The Standards aim to ensure that the benefits of Responsible Forestry accrue as closely as possible to the forest.
2. Local communities shall be fairly compensated for commercial exploitation of their intellectual property and forest products, in accordance with prior agreements.
3. Forestry operations must be managed in such a way that they aim to increase the opportunities for economic activities among local people, eg:
 - (a) Employment in line with International Labour Organisation conventions;
 - (b) Opportunities for subsidiary enterprises and small scale industries;
 - (c) Employment and training opportunities, where appropriate skills are available, must be offered to local communities before seeking workers further afield.

PRINCIPLE 5: ECONOMIC POTENTIAL: Forest management encourages an optimal and efficient use of all forest products and services, in order to ensure a wide range of environmental, social and economic benefits.

1. Information must be available on the range of the forest's potential products and services, including the role of forest products in the local economy (whether as trade goods or for subsistence) and the regional, national or international economies. This information may be contained in research papers/reports, surveys or as local unwritten knowledge, and could include:
 - (a) A list of traditional-use forest plants and animals;
 - (b) The extent of utilisation of 'lesser known' timber species, and other wood products such as fuel wood, small-diameter timber, forage, brash and chippings;
 - (c) The extent to which primary forest products are being processed locally and regionally, and their economic importance to local communities;
 - (d) The efficiency and economic viability of marketing of forest products locally, regionally and internationally.
2. Forestry operations must not significantly reduce the value derived locally from all forest products and services.
3. Forest managers must aim to minimise waste associated with harvesting operations and reduce damage to other forest resources.
4. Forest management must aim to strengthen and diversify the local economy, avoiding dependence on a single forest commodity.

5. Recommended
 - (a) Cost-benefit evaluations of particular production activities should be undertaken where sufficient information is available;
 - (b) Where appropriate, culturally appropriate and efficient processing operations should be established to increase added-value as locally as possible. Such processing operations should eventually be financially self-sustaining.

PRINCIPLE 6: MANAGEMENT AND MONITORING: A written management plan appropriate to the scale of the forestry operation defines the ownership of the forest and describes the ecology of the forest and its human communities. It states the objectives of management and how they will be achieved, explains how the long-term maintenance of forest products, services and social benefits is assured and specifies monitoring procedures.

Management plan

1. The aim is to promote efficiency and transparency of forestry operations through the preparation and implementation of a set of written intentions.
2. A written management plan must be available, detailing the management aims, the planned activities and all the relevant laws and policies within which the plan operates. The management plan:
 - (a) Must be clearly written, specific and detailed;
 - (b) Must give detailed information for the relevant country or region and general plans for the duration of the cutting cycle;
 - (c) Must be updated regularly;
 - (d) Must be available to all interested parties, within the accepted norms of commercial confidentiality;
 - (e) Must be fully implemented.
3. The activities in the management plan must comply with the requirements set out under specific headings in the previous part of this document.
4. The management plan must include the following information:
 - (a) The name of the individual, community, cooperative or company managing the forest and the names of the owners and licensees;
 - (b) A description of all the uses of the forest in addition to timber production, eg production of non-timber forest products, recreation, watershed stabilisation, conservation;
 - (c) A statement of management objectives and ranked priorities including reasons for timber harvesting with a list of possible end products, whether for national or international export or local consumption, the quantity and species of timber to be harvested, both short-term (over the period of the harvesting operation) and long-term (over the period of the cutting cycle);
 - (d) A description of the timber production area and forest of concession, including:
 - (i) Size and location, with clear definition of boundaries and existing access shown;
 - (ii) The timber resource, including
 - (1) results of any inventories;
 - (2) information on regeneration and growth rates, using either yield tables of growth and yield models where these exist;
 - (3) Estimates of volumes and species of timber to be harvested;
 - (4) Estimates of present and future age or size class distribution, given the site conditions expressed as a histogram or distribution function;

Biological/ecological context

- (iii) Climate, topography, geology, soils, and catchment areas;
- (iv) Forest type or types including:
 - (1) Species composition and distribution for all affected species ie harvested timber species and other plant species important in the local economy and likely to be affected by harvesting;
 - (2) Structure of the existing forest and of harvested areas ie range of size and age classes, creeper growth, type of regeneration, previous harvesting or management regime;
- v) Abundance and distribution of key animal and plant species eg rare or endangered species, species important in the local economy or important for the functioning of the forest ecosystem;
- vi) Protected sensitive areas, areas excluded from production activities and all areas with a statutory designation, with a definition of their boundaries, and details of protective measures and/or management regime;

Socio/cultural context

- (vii) Evidence of legal title, customary rights or lease agreements to the land (including duration of leasehold in the latter case);
 - (viii) Location of human settlements or delineation of areas inhabited by migratory groups, population size and ethnic/cultural identity;
 - (ix) Description of legal and customary land and use rights claimed by communities living in or near the timber production area;
 - (x) Mechanism for indigenous communities' control of, and local communities' participation in, decision-making;
 - (xi) Evidence of consultation with indigenous and local communities, citizens' groups or NGOs and statutory bodies with names and addresses of relevant representative organisations;
 - (xii) Details of any ongoing dispute concerning the actual or proposed forestry operations, and any other relevant disputes;
 - (xiii) Details of sites of archaeological, historical, religious, cultural or landscape importance in the area and relevant protection requirements;
- (e) Workplans for the period of the concession and the cutting cycle, detailing:
- (i) The selection, felling and extraction of timber;
 - (ii) The construction, maintenance and rehabilitation of roads, bridges, extraction routes, landings, and firebreaks;
 - (iii) The regeneration of harvested species;
 - (iv) Environmental protection, including protected areas and restoration;
 - (v) Fire management and control;
 - (vi) Pest, disease and weed control;
 - (vii) Control of settlement, including details of forest closure procedures;
 - (viii) Contingency plans for all aspects of operations: from chemical spillage to plans for action if monitoring indicates unacceptable adverse impacts on biodiversity;
- (f) A description of research being undertaken or planned in the area, eg concerning management, timber production, marketing, biology/ecology, cultural studies, including research being carried out by outside agencies or individuals;
- (g) A description of any technical difficulties expected, and the proposed methods of overcoming them.
5. Recommended
- (a) Employment details:
- (i) Personnel: number of staff employed, whether local or outsiders, and distribution within hierarchy, employment policy, range of salaries, range of qualifications, employment benefits;
 - (ii) Labour relations and employee protection eg unions, mechanisms for communication between workers and management, provision of safety training and equipment;
 - (iii) Incentives and opportunities for educating and training staff about good forest management as outlined in these Standards;
- (b) Fireprone areas, or those in which fire is an integral feature of the ecology of the forest, may require additional management and planning activities. A fire management plan should be prepared and included in the management plan, based on a simple map and consideration of:
- (i) Known ignition sources;
 - (ii) Direction of main threat;
 - (iii) Fuel, distribution and flammability;
 - (iv) Ecological features and processes in the forest;
 - (v) Special features eg archaeological sites, rare fire susceptible flora;
 - (vi) Local assets requiring protection;
 - (viii) Access, firebreaks and fuel reduction measures;
 - (ix) Fire detection and suppression procedures;
 - (x) Resources for control and suppression.
- 6) Permitted
- (a) The details required in the management plan may be compiled from a number of different sources eg forms submitted for other purposes, such as grant application forms.

Monitoring

1. The aim is to lead to growth of knowledge about the impacts and benefits of forestry operations in an area and how negative impacts might be avoided through management action.
2. Present knowledge of the factors controlling the abundance and distribution of plant and animal species in forests is limited. All available information should be used to characterize the current biodiversity of the forest ecosystem. Deficiencies in knowledge should be identified and assessment and monitoring programmes instituted, appropriate to the scale and resources of forestry operations and the effects to be monitored; results should be used to modify management as necessary.

The Tropenbos Foundation, 1996 - Hierarchical framework

3. Monitoring and surveying are essential to assess natural processes and the effects of management.
4. Survey methods may be simple and based on easily-obtained information eg fixed point photography. Procedures must be consistent and replaceable over time to allow comparison and assessment of change.
5. The results of the monitoring programme must be used in day-to-day management.
6. Recommended
 - (a) Before forestry operations begin a monitoring system should be developed to cover the most important variables of forest and management performance, site productivity, and environmental and social effects, and initial (baseline) measurements should be made;
 - (b) The features to be monitored, and periodicity of monitoring, should be stated explicitly in the management plan. The following should be assessed:
 - (i) The quality and quantity of water resources;
 - (ii) Soil compaction, structure and fertility;
 - (iii) Damage to the residual stand;
 - (iv) Regeneration of affected species;
 - (v) The effect of harvesting on biodiversity:
 - (1) Plants and animals species, including aquatic habitats (names, abundance, distribution, habitat requirements, biology, ecology, behaviour);
 - (2) Diversity of plant and animal communities and habitats, allowing comparison of pre- and post-harvesting data;
 - (3) Interaction of timber species and other plant and animal species: including other timber species, other species providing non-timber forest products, pollinators, herbivores, seed dispersal agents, seed predators, symbionts, commensals, in such a way as to allow comparison of pre- and post-harvesting data;
 - (c) The management plan should contain details of the methodologies of monitoring/evaluation procedures and environmental impact assessments concerning timber production, harvesting and other activities addressed within the management plan, with an explanation of how the results will be used to revise and update the management plan;
 - (d) Sampling regimes should be established in both harvested areas and unharvested areas;
 - (e) Monitoring programmes should include provision for continued assessment of local interests, perceptions and attitudes.

CIFOR TESTING CRITERIA AND INDICATORS FOR THE SUSTAINABLE MANAGEMENT OF FORESTS: PHASE 1. FINAL REPORT

The following are the common principles, criteria and indicators identified after analysis of the underlying issues in the C & I proposed by the test teams in Indonesia, Côte d'Ivoire and Brazil:

POLICY

Principle: Policy, planning and institutional framework are conducive to sustainable forest management.

Criterion: There is sustained and adequate funding for the management of forests.

Indicators:

- * Policy and planning are based on recent and accurate information.
- * Effective instruments for inter-sectoral co-ordination on land use and land management exist.
- * There is a permanent forest estate (PFE), adequately protected by law, which is the basis for sustainable management, including both protection and production forest.
- * There is a regional land use plan or PFE which reflects the different forested land uses, including attention to such matters as population, agricultural uses, conservation, environmental, economic and cultural values.
- * Institutions responsible for forest management and research are adequately funded and staffed.

ECOLOGY

Principle: Maintenance of ecosystem integrity.

Criterion: Ecosystem function is maintained.

Indicators:

- * No chemical contamination to food chains and ecosystem.
- * Ecologically sensitive areas, especially buffer zones along water courses are protected.
- * No inadvertent ponding or waterlogging as a result of forest management.
- * Soil erosion is minimised.

Criterion: Impacts to biodiversity of the forest ecosystem are minimised.

Indicators:

- * Endangered plant / animal species are protected.
- * Interventions are highly specific, selective and are confined to the barest minimum.
- * Canopy opening is minimised.
- * Enrichment planting, if carried out, should be based on indigenous, locally adapted species.

Criterion: The capacity of the forest to regenerate naturally is ensured.

The Tropenbos Foundation, 1996 - Hierarchical framework

Indicators:

- * Representative areas, especially sites of ecological importance, are protected or appropriately managed.
- * Corridors of unlogged forest are retained.

SOCIAL ENVIRONMENT

Principle (implied): Forest management maintains fair intergenerational access to resources and economic benefits.

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

Indicators:

- * Tenure/use rights are well defined and upheld.
- * Forest dependent people share in economic benefits of forest utilisation.
- * Opportunities exist for local people/forest dependent people to get employment and training from forest companies.

Principle (implied): Stakeholders, including forest actors, have a voice in forest management.

Criterion: Stakeholders/local populations participate in forest management.

Indicators:

- * Effective mechanisms exist for two way communication related to forest management among stakeholders.
- * Forest dependent people and company officials understand each other's plans and interests.

Criterion: Forest dependent people/stakeholders have the right to help monitor forest utilisation.

Indicator :

- * Conflicts are minimal or settled

PRODUCTION OF GOODS AND SERVICES

Principle: Yield and quality of forest goods and services sustainable

Criterion: Management objectives clearly and precisely described and documented.

Indicator :

- * Objectives are clearly stated in terms of the major functions of the forest, with due respect to their spatial distribution.

Criterion: A comprehensive forest management plan is available.

Indicators:

- * Maps of resources, management, ownership and inventories available.
- * Silvicultural systems prescribed and appropriate to forest type and produce grown.
- * Yield regulation by area and/or volume prescribed.
- * Harvesting systems and equipment are prescribed to match forest conditions in order to reduce impact.

The Tropenbos Foundation, 1996 - Hierarchical framework

Criterion: The management plan is effectively implemented.

Indicators:

- * Pre-harvest inventory satisfactorily completed.
- * Infrastructure is laid out prior to harvesting and in accordance with prescriptions.
- * Reduced impact felling specified/implemented.
- * Skidding damage to trees and soil minimised.

Criterion: An effective monitoring and control system audits management's conformity with planning.

Indicators:

- * Continuous forest inventory (CFI) plots established and measured regularly.
- * Documentation and records of all forest management activities are kept in a form that makes it possible for monitoring to occur.
- * Worked coupes are protected (e.g. from fire, encroachment and pre-mature re-entry)
- * Tree marking of seed stock and potential crop trees.