Expert Consultation on Global Forest Resources Assessment 2000

Kotka III

Proceedings of FAO Expert Consultation on Global Forest Resources Assessment 2000 in Cooperation with ECE and UNEP with the Support of the Government of Finland (Kotka III)

Kotka, Finland, 10–14 June 1996

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Metsäntutkimuslaitoksen tiedonantoja 620
The Finnish Forest Research Institute. Research Papers 620
Helsinki 1996

Available from: The Finnish Forest Research Institute **METLA**
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FIN-00170 Helsinki
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Photographs: Erkki Oksanen / **METLA**

ISBN 951-40-1541-X
ISSN 0358-4283

Gummerus Kirjapaino Oy
Jyväskylä 1997

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Preface

FAO Expert Consultation on Global Forest Resources Assessment 2000 in cooperation with ECE and UNEP with the support of the Government of Finland (Kotka III) was held at the Kotka College of Forestry and Wood Industry from 10 to 14 June 1996. Two previous meetings on the forest resources assessment had taken place there in October 1987 and May 1993.

The consultation was attended by 45 participants from 32 countries. Its technical preparation was taken care by FAO in cooperation with ECE. The Government of Finland supported the travel and per diem of 17 participants from developing and economically disadvantaged countries. Finland was also responsible for local arrangements, such as meeting rooms, secretariat facilities, local transportation, study tour, printing, computing etc.

Regarding the officers of the Consultation, Mr. A. Nyyssönen (Finland) was elected Chairman and Messrs. P. Csoka (Hungary) and V. Sosa Cedillo (Mexico) Vice-Chairmen. Messrs. H.G. Lund (U.S.A.) and Saw Win (Myanmar) were elected Rapporteurs. A number of other participants functioned as chairmen and rapporteurs in various sessions and working groups.

These proceedings are intended to inform the decision-makers and inventory specialists about the conclusions and recommendations of the Consultation. The views of the experts attending the consultation are expressed also in the background material included in the proceedings. Institutions receiving the proceedings are requested to forward them to the persons concerned in the country for reference purposes.

Agenda and Timetable

Provisional Agenda

Expert Consultation on Global Forest Resources Assessment 2000

Kotka, Finland, 10–14 June 1996

1.0 Opening of the meeting (plenary)

Representatives of the Government of Finland, FAO, ECE and UNEP welcome participants. Participants introduce themselves briefly with an indication of their specialization, organization and position within their organization.

Adoption of the meeting agenda.

Election of chair, vice-chair and rapporteur for the meeting. (Chairs and rapporteurs for working groups will be elected later.)

2.0 Objectives of the expert consultation on global forest resources assessment (plenary)

For information. Orientation, background and goals for the expert consultation -- to propose a methodological and operational framework for the implementation of the Global Forest Resources Assessment 2000.

3.0 Mandate for the global forest resources assessment 2000 (plenary)

For information. Background and objectives for the Global FRA 2000 including recommendations of the FAO's Committee on Forestry, work of the Intergovernmental Panel on Forests and international processes on Criteria and Indicators for Sustainable Forest Management at national level, as well as global change issues, conventions and new technological developments.

4.0 Review of the forest resources assessment 1990 (plenary)

For information and discussion. Presentations providing various perspectives on the strong and weak points of the Global FRA 1990.

4.1 Lessons Learned from the Global Forest Resources Assessment 1990

Presentations by participants from developing and industrialized countries, FAO, ECE and a non-governmental organization.

4.2 Feedback from Participants on the Global Forest Resources Assessment 1990

Dialogue in plenary providing participants the opportunity to state their views.

5.0 Progress on formulation of the global forest resources assessment 2000 (plenary)

For information. Reports on progress in the formulation and development of the Global FRA 2000.

5.1 Results of FAO/ECE Meeting of Experts on Global Forest Resources Assessment (1993 Meeting in Kotka, Finland)

5.2 Report from FAO Rome

5.3 Report from UN ECE / FAO Geneva

6.0 Main features of the global forest resources assessment 2000 (Global, Temperate/Boreal and Tropical) (plenary)

For information. Presentations on:

6.1 Users and Their Needs

6.2 Approach and Components of the Global Forest Resources Assessment 2000

6.3 Definition of Common Core of Information Needs for a Global Framework

7.0 Related activities (plenary)

For information. Presentations on important activities and programmes of relevance to the Global FRA 2000.

7.1 EFICS (Forestry Terminology) Study

7.2 Washington Remote Sensing Meeting in Support of FRA 2000

7.3 Intergovernmental Panel on Climate Change (IPCC) Programme

7.4 TREES (Remote Sensing) Programme

8.0 Concepts, parameters, definitions and methods of data collection (plenary and working groups)

Items for discussion and group work.

Themes for groups will be discussed and adopted, groups will be formed and chairmen and rapporteurs for working groups elected.

8.1 Groupwork on Specific Inventory Parameters

Groups to work on providing recommendations on the content, feasibility of implementation and priority of parameters, guidance on the chronology of programme elements, major methodological considerations, funding needs and possibilities for partnership agreements. Support to groupwork will be provided by specialists who are prepared to work with groups and provide briefing materials. Themes for groupwork will be agreed upon in the meeting. They are likely to include

- the global core of concepts, definitions and classifications
- geographic disaggregation
- biomass assessment
- forest area assessment
- forest degradation
- biological diversity assessment

- compatibility between criteria and indicators of sustainable forest management and inventory parameters of forest resources assessment
- other(s) to be defined

As data collection and reporting techniques vary greatly between developing and industrialized countries for the FRA and considering the need for integration of results from both into a "global synthesis", each working group should develop 3 sets of recommendations; 1) for developing countries (tropical and non-tropical), 2) for industrialized countries and 3) for the global core.
8.2 Plenary Session on Recommendations
Working groups will present their findings and recommendations in plenary.

9.0 Action plan and partnership arrangements (plenary)

9.1 Timetable and Programming for the Global Forest Resources Assessment 2000

Development of a preliminary plan for the Global Forest Resources Assessment 2000. Session in plenary.

9.2 Resource Needs and Partnerships

Identification of resource needs and possible partnership agreements needed to carry out the Global FRA 2000.

10.0 Study tour

Half-day forestry study tour conducted by the host country.

11.0 Conclusions and recommendations concerning the global forest resources assessment 2000 (plenary)

Plenary session to review and adopt the conclusions and recommendations of the consultation.

12.0 Presentations on forest inventory programmes in specific countries and organizations

Participants are invited to make 10 minute presentations on the specific inventory programmes in their countries and organizations. Sessions will be voluntary and informal and held Tuesday and Wednesday evenings.

Provisional Timetable

The meeting will begin in Kotka on 10 June 1996 at 0900 hours and end in Kotka on 14 June at 1300 hours. Sessions will take place from 0830 to 1200 and from 1330 to 1730. Evening sessions will take place for those wishing to make presentations on the forest inventory programmes in their country.

Monday, June 10 (Morning)

1.0 Opening of the meeting (plenary)

2.0 Objectives of the expert consultation on global forest resources assessment 2000 (plenary)

3.0 Mandate for the global forest resources assessment 2000 (plenary)

4.0 Review of forest resource assessment 1990 (plenary)

4.1 Lessons Learned from the Global Forest Resources Assessment 1990

4.2 Feedback from Participants on the Global Forest Resources Assessment 1990

Monday, June 10 (Afternoon)

5.0 Progress on formulation of the global forest resources assessment 2000 (plenary)

5.1 Results of FAO/ECE Meeting of Experts on Global Forest Resources Assessment (1993 Meeting in Kotka, Finland)

5.2 Report from FAO Rome

5.3 Report from ECE/FAO Geneva

6.0 Main features of the global forest resources assessment 2000 (Global, Temperate/Boreal and Tropical) (plenary)

6.1 Users and Their Needs

6.2 Approach and Components of the Global Forest Resources Assessment 2000

6.3 Definition of Common Core of Information Needs for a Global Framework

7.0 Related activities (plenary)

7.1 EFICS (Forestry Terminology) Study

7.2 Washington Remote Sensing Meeting in Support of FRA 2000

7.3 Intergovernmental Panel on Climate Change (IPCC) Programme

7.4 TREES (Remote Sensing) Programme

Monday, June 11 (Evening)

Sightseeing and Reception

Tuesday, June 11 (Morning) through Wednesday, June 12 (Afternoon)

8.0 Concepts, parameters, definitions and methods of data collection (plenary and working groups)

8.1 Groupwork on Specific Inventory Parameters

8.2 Plenary Session on Recommendations

Tuesday, June 11 and Wednesday, June 12 (Evening)

Voluntary presentations on forest inventory programmes of specific countries and organizations.

(Participants may schedule 10 minute presentations as desired. Rooms and audio-visual equipment will be provided.)

Thursday, June 13 (Morning)

9.0 Action plan and partnership arrangements (plenary)

9.1 Timetable and Programming for the Global Forest Resources Assessment 2000

Development of a preliminary plan for the Global Forest Resources Assessment 2000. Session in plenary.

9.2 Resource Needs and Partnerships

Identification of resource needs and possible partnership agreements needed to carry out the Global FRA 2000.

Thursday, June 13 (Afternoon)

10.0 Study tour

Half-day forestry study tour conducted by the host country.

Friday, June 14 (Morning)

11.0 Conclusions and recommendations concerning the global forest resources assessment 2000 (plenary)

Plenary session to review and adopt the conclusions and recommendations of the consultation.

Friday, June 14 (13:00 hours)

End of Meeting

Organization for Presentations

Organization for Presentations – Expert Consultation on Global FRA 2000
Kotka, Finland

	AGENDA ITEM	PRESENTER	MODERATOR	WORK METHOD	COMMENT
1.0	OPENING OF THE MEETING (9:00–9:45)	1. Jan Heino 2. JP Lanly 3. Nyyssönen 4. K.Prins 5. A.Singh	Lanly	Plenary	– formalities to be conducted – chairs to be elected – clear with A. Singh
2.0	OBJECTIVES OF THE EXPERT CONSULTATION ON GLOBAL FOREST RESOURCES ASSESSMENT 2000 (9:45–10:00)	Lanly	Nyyssönen	Plenary	JP Lanly to speak then open the floor
3.0	MANDATE FOR THE GLOBAL FOREST RESOURCES ASSESSMENT 2000 (10:15 - 10:30)	Janz	Nyyssönen	Plenary	
BREAK (10:30–10:45)					
4.0	REVIEW OF FOREST RESOURCES ASSESSMENT 1990		Csóka	Plenary	limit all presentations to 10 minutes for this section
	4.1 Lessons Learned from the Global Forest Resources Assessment 1990		Csóka	Plenary	
	• Overview	K. Prins, K.D. Singh		Presentation in Plenary	
	• Viewpoint of Industrialized Countries	P. Csoka	Csóka	Presentation in Plenary	
	• Viewpoint of Developing Countries	Sosa-Cedillo	Csóka	Presentation in Plenary	
	• Viewpoint of Non-Governmental Organizations	Nigel Dudley	Csóka	Presentation in Plenary	
	4.2 Feedback from Participants on FRA 90		Csóka		Csoka to Moderate
LUNCH BREAK (12:15)					
5.0	PROGRESS ON FORMULATION OF THE GLOBAL FOREST RESOURCES ASSESSMENT 2000		Sosa		
	5.1Results of FAO/ECE Meeting of Experts on Global Forest Resources Assessment (1993 Kotka Meeting)	A. Nyyssönen	Sosa	Presentation in Plenary	
	5.2 Report from Rome	K.Janz	Sosa	Presentation in Plenary	

	5.3 Report from ECE/FAO Geneva	A.Korotkov	Sosa	Presentation in Plenary	
6.0	MAIN FEATURES OF THE GLOBAL FOREST RESOURCES ASSESSMENT 2000	Tim Peck	Kit Prins	Plenary	– should identify roles and contexts of presentations
BREAK (1/2 hour break not later than 15:30)					
7.0	RELATED ACTIVITIES		Janz		
	7.1 EFICS (Forest Terminology Study)	R. Päivinen		Presentation in Plenary	
	7.2 Washington Remote Sensing Meeting in Support of FRA 2000	G. Lund		Presentation in Plenary	
	7.3 Intergovernmental Panel on Climate Change (IPCC) Programme	K.D. Singh		Presentation in Plenary	
	7.4 TREES (Remote Sensing) Programme	F. Achard		Presentation in	
8.0	CONCEPTS, PARAMETERS, DEFINITIONS AND METHODS OF DATA COLLECTION		K.D. Singh	plenary	– Introduction to themes and organization of groups in plenary
	8.1 Groupwork on Specific Inventory Parameters • various groups			Specific topics addressed in workgroups	
	8.2 Plenary Session on Recommendations			Plenary	
9.0	ACTION PLAN AND PARTNERSHIP ARRANGEMENTS				
	9.1Timetable and Programming for the Global Forest Resources Assessment 2000	Prins, Davis	Csóka	Plenary	
	9.2 Resource Needs and Partnerships	Singh	Sosa-Cedillo	Plenary	
10.0	STUDY TOUR		A.Nyyssönen	Tour	
11.0	CONCLUSIONS AND RECOMMENDATIONS CONCERNING THE GLOBAL FOREST RESOURCES ASSESSMENT 2000	Lund, Saw Win	A. Nyyssönen	Plenary	
12.0	PRESENTATIONS ON FOREST INVENTORY PROGRAMMES IN SPECIFIC COUNTRIES AND ORGANIZATION		Csóka Sosa	Night sessions on Wedn. and Tuesday	Need singh-up sheet and organizations, scheduling for night sessions

Opening

Opening Statement

Jan Heino
Special Adviser
Ministry of Agriculture and Forestry, Finland

Distinguished experts, ladies and gentlemen,

It is a privilege for me to have the task to warmly welcome you to Finland and to Kotka. The name of this town will now for the third time within ten years be connected to the preparations for the global forest resources assessment. We hope that this environment and these facilities again will be satisfactory and contribute to a fruitful and enjoyable meeting.

The interest in forest surveys in Finland is rather old. National forest inventories were initiated 75 years ago owing to the fear of a shortage of wood raw material for the expanding forest industries and the rural population. National forest inventories repeated at regular intervals have provided information on Finnish forests and their structure. We have found regular national forest inventories essential for using forest resources sustainably. This experience, shared by many other countries, is also one basis for our international forestry cooperation. During the preparations for and after the UNCED-meeting in Rio Finland emphasized especially the significance of national forestry plans and programmes. Thus, it is a part of our international forestry policy to encourage the work of FRA 2000 and related activities in the field of forest inventories and forest management planning.

In the forestry context Finland is a producer country, heavily dependent on her exports of forest industry products. More than 50 % of the net export earnings are derived from this sector. Eighty per cent of Finnish forest industry production is exported. Forestry and the forest industry provide jobs for almost 100 000 Finns. Indirectly many times this number of people are dependent on forestry for their livelihood. Thus, from the socio-economic point of view, this sector is of the utmost importance to Finland.

The forest ownership structure further illustrates the importance of this sector for a great number of Finns. Non-industrial private ownership or family forestry as we like to call it, dominates. About two thirds of the forested area is owned by 300 000 private persons, this privately owned area accounting for some 75% of the total annual timber growth. Today, total growth exceeds the annual cut by some 30 million m^3. Forest surveys and planning, research, and systematic forest management are the key reasons for this development. The total volume of wood in Finnish forests amounts to two billion m3, which is the highest volume ever registered.

To further illustrate the present status of forestry and forest policy in Finland I would like to shortly present the ongoing forest policy reform. Decisions made at the UNCED and Helsinki Conferences have had an important impact on the development of forest policy in Finland. Two years ago we launched a new environmental programme for forestry. The programme was confirmed by the Ministry of Agriculture and Forestry and the Ministry of Environment two years ago. This was the starting point for an overall forest policy reform that can be divided into three parts: 1. state forestry, 2. forestry organisations and 3. the acts on silviculture and financing of forestry measures.

The reform aims at enhancing biodiversity and promoting all forms of forest usage. The Act concerning the Forest and Park Service, the organisation responsible for managing the Finnish state forests, came into effect at the beginning 1994. The new act requires the Forest and Park Service to apply the principles of sustainable forest management including the conservation of biological diversity in state forestry. Furthermore, the Forest and Park Service was changed into a business like state enterprise.

The forestry organisations responsible for promoting and supervising forestry were restructured by March 1996 already. The new forest law concerning the organisations broadens the tasks for them and now they have to promote, among other things, the preservation of biodiversity also· Another objective of the Government was to simplify the administration and to reduce governmental expenditure. The two existing forestry centres at the national level were merged into one service and expert centre. The regional forestry boards are now called forestry centres and their number is reduced to fourteen units. They are, under the auspices of the Ministry of Agriculture and Forestry, in charge of implementing the forestry legislation.

The final stage of the third part of the reform started one month ago, when the Government´s proposals for a new Act on Silviculture and a new Act on Financing of Forestry Measures were given by the president to the Parliament. As new elements these acts, for example stipulate that preservation of the biological diversity should be enhanced.

Forest authorities would, according to the new legislation, bear overall responsibility for forest matters in wood production forests, nature conservation and biodiversity matters included. Nature conservation authorities, on their part, would be responsible for all nature conservation affairs. The Nature Conservation Act, which is also undergoing reform, would focus upon establishing and managing protected areas.

Ladies and gentlemen,

The issue of criteria and indicators for sustainable forest management is one of the main priorities in the work of the Intergovernmental Panel on Forests, which was established a year ago under the aegis of the United Nations Commission on Sustainable Development. Finland supports and facilitates this important work. Related to the activities of the Panel an Intergovernmental Seminar on Criteria and Indicators for Sustainable Forest Management (ISCI) will be held in Helsinki in August, 1996. The Seminar will promote and encourage the national implementation of criteria and indicators for sustainable forest management and it will study the further development of criteria and indicators, as well as their possible comparability and international compatibility.

Assessment of forest resources and criteria and indicators for sustainable forest management are interlinked. The monitoring of sustainability within forestry depends, above all, on what kind of data are available for this purpose. On the other hand, criteria and indicators could have an important role in improving the scope of forest assessments and statistics. Information systems already contain a vast amount of information on different aspects of sustainable forest management. It is important that criteria and indicators for sustainable forest management are in a realistic way linked to the development of forest and other related information systems. I believe that the Kotka III Meeting will provide valuable contribution in this respect. I have noticed that one item on your extensive agenda is the correspondences between criteria and indicators for sustainable forest management and inventory parameters of forest resource assessment.

Dear participants! On behalf of the Ministry of Agriculture and Forestry I would like to thank all institutions and persons involved in the preparations for this meeting. A lot of preparatory work has been done in Rome, Geneva, Helsinki and Kotka. Finally, I once more wish all of you a most successful meeting and a pleasant stay in Finland.

Opening Remarks

Jean-Paul Lanly
Director
Forest Resources Division
FAO

Dear colleagues,

I am pleased to welcome you on behalf of FAO, the Food and Agriculture Organization of the United Nations, and of Dr Dave Harcharik, the Head of the Forestry Department of the Organization.

Let me first thank, on behalf of FAO and the other UN agencies cooperating with FAO in the organization of the meeting, that is the UN Economic Commission for Europe and the United Nations Environment Programme, and on your behalf, the Government of Finland for its strong and effective support in the preparation and holding of our consultation. I would like to mention particularly the Ministry of Agriculture and Forestry which has funded and taken care of all the local arrangements, and the Ministry of Foreign Affairs and its Department for Development Cooperation which has facilitated the participation of many of you who have come from far away countries. Our thanks should go first and foremost to two eminent Finnish foresters who are sitting at the head table, I mean Mr Jan Heino, Special Adviser to the Minister of Agriculture and Forestry, who has been instrumental in securing from the Government of Finland the financial and logistic support to our consultation; and Professor Aarne Nyyssonen, who is well known to most of you and a most respected figure of the international community of forest inventory and forest management experts. It is a pleasure for me to convey to them our gratitude for their indefatigable support in the organization of this consultation. And I would like to extend our thanks to their staff who worked hard with them to prepare our meeting.

FAO would like also to put on record its appreciation for the excellent cooperation it has enjoyed for decades from the UN Economic Commission for Europe in the field of global forest resources assessment. We are fortunate to have with us this week the two main ECE actors of this programme, I mean Messrs Kit Prins and Alex Korotkov who both have worked hard for the preparation of our consultation. Likewise, for the last twenty years, FAO has had a fruitful association with UNEP in this field and I am pleased to welcome here Mr Ashbindu Singh of the Global Resources Information Database programme of this Organization.

Thanks are also due to three resource persons who have been instrumental in preparing a solid base for our deliberations this week. Mr Tim Peck is well known to many of you and has been for many years Chief of the Timber Section, and then Director of the FAO/ECE Agriculture and Timber Division in Geneva, and in this capacity responsible for the ECE part of the Global Forest Resources Assessment. In the paper he has prepared, within the framework of a contract between FAO and the European Forestry Institute, Mr Peck has proposed a framework for the Global Forest Resources Assessment which we will use as a main reference document throughout the meeting. Ms Susan Iremonger, of the World Conservation Monitoring Centre, has drafted for us an important paper on the assessment of environmental parameters. Finally, Mr Patrice Mengin-Lecreulx of the French Office National des Forêts, has looked into the correspondences between national and global inventory parameters and indicators of sustainable forest management at national level. Mr Tim Peck and Ms Susan Iremonger are here this week with us to facilitate our discussions.

In a few moments, following the opening session, I will present under item 2 of our agenda the objectives of our consultation. I will therefore not detail them now. Suffice to say that FAO, ECE and UNEP which have responsibilities in the assessment of the world's forests expect from this unique gathering of experts in forest assessment from all regions clear guidelines for the next round for the year 2000 of the global forest resources assessment. Your recommendations will be then conveyed to the important forthcoming international forestry meetings, including the third session of the Intergovernmental Panel on Forests, the FAO Regional Forestry Commissions and the next Committee on Forestry which is to take place in March next year.

This consultation follows the completion of the Forest Resource Assessment for the year 1990 for which a full set of the reports will be made available to you; and the holding three years ago, in this same location, of the "Kotka II" meeting whose conclusions and recommendations will also serve as reference for our work.

For the sake of brevity I would stop here, thanking again our hosts for their generous support and hospitality; and wishing all of us a most fruitful meeting in this splendid and functional set up of the Forestry Training Centre in Kotka.

Introductory remarks in the opening session were presented also by Mr. C.F.L. Prins, FAO/ECE, and Mr. A. Singh, UNEP.

Objectives of the Consultation

Jean-Paul Lanly

Background

As part of its mandate FAO, in partnership with other intergovernmental organizations, must provide the international community with objective, reliable information on the state of the world's forests and the changes occurring to them.

It has done it at regular intervals since its inception, more than 50 years ago, with the help in particular of the UN Economic Commission for Europe, and from the late 70's that of the United Nations Environment Programme. There was the series of the World Forest Inventories published at 5-year intervals from 1958 to 1963, then the 1980 FAO/UNEP Tropical Forest Resources Assessment which was complemented by a review of the non-tropical world with the same reference year; and, last but not least, the 1990 Forest Resources Assessment, whose last publication has just been issued.

The distribution of work between the two main actors, i.e. FAO and UN-ECE is the following:

- UN-ECE is responsible for the implementation of the assessment for the ECE region (Europe and North America) and for the rest of the industrialized world (Australia, Japan, New Zealand), through its Timber Section in Geneva working in close cooperation with the FAO forestry officers based in Geneva;
- FAO, and particularly its Forest Resources Division at Headquarters, is responsible for the implementation of the assessment for tropical and non-tropical developing world; and for the global synthesis amalgamating the results of the three main parts of the assessment, for the industrialized world, for the tropical (developing) world and for the non-tropical developing world respectively.

Work consists in the compilation of information gathered by concerned national institutions at national level supplemented in the case of the developing countries by data generated under the coordination of FAO from interpretation of satellite imagery.

Over the years there has been a continuous improvement and expansion of these global assessments in order to adapt to new demands and needs for information from the part of the various segments of the international community. Additional information required relate in particular to the emerging concerns related to the sustainability of forest management and global environmental issues, such as conservation of biological diversity, impact of forests and forest management on climate change, and health and vitality of forests. There is also the attention given worldwide to the formulation and application of criteria and indicators of sustainable forest management and the need to capture in forest resources assessment work at national and global levels as much of the information needed for estimating these indicators as possible.

I do not think that I need to stress for you the priority which should be given to the assessment and monitoring of forest resources at national and global levels. The importance of knowing precisely at any moment the state of the world's forests – through "systematic observations" of forests to use the expression used in Chapter 11 of UNCED's Agenda 21 – cannot be overemphasized. This is increasingly recognized in the intergovernmental fora, in particular within the framework of the UN Commission on Sustainable Development and of its Intergovernmental Panel on Forests (IPF), which are giving to FAO and its partners a renewed mandate and guidance in this field.

Without waiting for the final recommendations of the IPF, FAO, as well as UN-ECE and UNEP, have been giving increasing attention to the subject (in fact we would like governments and the donor community to do likewise, and put their priorities more in accord with what they say in international fora in this field). In December 1992, FAO and UNEP organized jointly an expert meeting on environmental parameters in global forest resources assessment, whose recommendations were taken up here, in May 1993, at the "Kotka II" meeting. Indeed, what we should do during this week, is basically to finalize and, in a certain way, "operationalize" the outcome of "Kotka II" meeting to secure a sound methodological basis for the new round of Global Forest Resources Assessment for the year 2000 (GFRA 2000).

Goal of the consultation

Put somewhat differently, we could say that the goal of our meeting is to provide the various concerned actors – FAO, ECE and UNEP as main coordinating organizations, national institutions and other international organizations concerned – with a common core set of parameters and methodological elements to be used for the design and implementation of GFRA 2000.

It is indeed essential that the world community of forest inventory specialists which is represented here agrees on this minimum "package", evidencing a scientific and technical consensus. The agreement will then be brought to the attention of the intergovernmental bodies concerned (such as IPF, COFO, Regional Forestry Commissions) with a view to secure their endorsement. This is the more important as the subject has been increasingly politicized during the last ten years or so, and there is therefore the need to bring to bear on the GFRA 2000 the collective knowledge and wisdom of those who know and carry out forest resources assessment at national level.

Special considerations

Two important considerations need to be kept in mind. First a consensus among different parties can be reached only if every party is prepared to compromise in order that the final outcome reflect the broad range of physical, socioeconomic and institutional conditions prevailing in all countries of the world. Let us not forget that GFRA 2000 should provide the world community with a picture as consistent and homogeneous as possible of the world's forests and their trends. This requires that all countries agree to the same concepts and methodological approaches as far as reporting of their own information for inclusion in GFRA 2000 is concerned. Countries will of course continue to use their concepts and methods for their own needs, but what is required is adjustment of the data they generate for the specific purpose of GFRA 2000.

The second consideration relates to the concepts of partnerships and synergy among actors. No one organization can implement, nor should implement, GFRA 2000 by itself. FAO, UN-ECE and UNEP have particular responsibilities in this field, but must rely on the contribution of many national and international institutions and programmes which are competent in one or several fields related to global forest resources assessment. Our meeting should tackle also this issue and propose "strategic alliances" among institutions to improve and broaden the scope of the assessment.

Background documentation

Our deliberations will be based essentially on the conclusions and recommendations of the "Kotka II" meeting (which take into account the outcome of the 1992 Nairobi meeting), on the documentation related to the Forest Resources Assessment 1990, on the results of the meeting on remote sensing for global forest resources assessment which was held in Washington in March this year; and on three papers prepared specially for our meeting by Messrs Peck and Mengin-Lecreulx and Ms Iremonger which I have presented briefly in my opening remarks.

I hope this short introduction has been useful to set the general stage for our meeting. Mr Janz, from FAO, will present now to you the mandate for and objectives of the Global Forest Resource Assessment 2000 in order to provide a more detailed background for our discussions this week.

Mandate for the Global Forest Resources Assessment 2000

Klaus Janz
Senior Forestry Officer
Forest Resources Division
FAO

The general frame

FAO's mandate in forest resources assessment is laid down in article I of the FAO Constitution: "The organization shall collect, analyze, interpret and disseminate information relating to nutrition, food and agriculture. In this text the term "agriculture" and its derivatives include fisheries, marine products, forestry and primary forest products".

More specific guidance has been given by the 10th session of the Committee on Forestry (COFO) in 1990, which stated "The scope of the FAO Forest Resources 1990 Project should be expanded to provide coordination and support for national continuous forest resources inventories and to undertake global forest resources monitoring programme" and recommended "that FAO maintain a permanent capability to provide information on the state of forest resources worldwide on a continuing basis" (paragraphs 55 and 56 of the report).

One of the four programme areas (D) of the forestry chapter (11) of UNCED's Agenda 21 is mostly devoted to the assessment and systematic observations of forests. In the section "basis for action" it is stated that "assessment and systematic observations are essential components of long-term planning, for evaluating effects, quantitatively and qualitatively, and for rectifying inadequacies. This mechanism, however, is one of the often neglected aspects of forest resources, management, conservation and development. In many cases, even the basic information related to the area and type of forests, existing potential and volume of harvest is lacking. In many developing countries, there is a lack of structures and mechanisms to carry out these functions."

An in-depth review of the 1990 Forest Resources Assessment (FRA90) project in April 1992 recommended that there should be a continuous assessment of all forests and that the FAO Regular Programme should fund a greater part of this work than hitherto. It also recommended a shift in emphasis towards country capacity building. The 11th meeting of the Committee on Forestry (March 1993) and the 103rd session of the FAO Council endorsed these proposals.

- Article 1 of constitution 31/5/96
- COFO – "continuous"; shift in emphasis towards country capacity building
- Agenda 21 – the context of long term strategy
- IPF – "widening"

Below I will deal with the regional and global levels, come back to the national level (capacity building) later.

The issues at international level

- Forest area
- Forest area change
- Supply of industrial wood
- Supply of wood for local consumption
- Carbon cycle
- Biological diversity
- Deforestation and its causes
- Land/vegetation degradation incl. hydrology
- Forest health

The task for this meeting

Agree on data content, methods, definitions

Regarding data content

Conditions for parameters to be included:

- relevant within the above issues at international lavel
- measurable
- available in a majority of countries
- can be assessed with the available tools
  in industrialized countries questionnaire
  in developing countries
  – data collection based on existing reliable information and
  – sampling of high resolution satellite data
  in all countries combining various data sources (requires usually georeferencing).

Report

Final Report

Expert Consultation on Global Forest Resources Assessment 2000

Kotka, Finland, 10–14 June 1996

Background

1. The Expert Consultation on Global Forest Resources Assessment 2000 (Kotka III) was convened by FAO, in cooperation with UN/ ECE and UNEP and with the support of the Government of Finland, in Kotka from 10 to 14 June 1996. Its main objective was to propose a framework for the Global Forest Resources Assessment 2000 (FRA 2000) which is to provide the international community with an objective evaluation of the situation and trends of the world's forests and other wooded lands by the year 2000.

2. The meeting took place in the context of an increasing interest worldwide on the state of the forests in all regions, as demonstrated by the importance given to the subject of forest conservation and development at UNCED and in its follow-up. It followed the publication in 1995 of the last reports of the Forest Resources Assessment 1990 coordinated by FAO and ECE and the holding in the same town of Kotka in May 1993 of the FAO/ECE Meeting of Experts on Global Forest Resources Assessment ("Kotka II"). It was held between the second and third sessions of the Intergovernmental Panel on Forests (IPF) set up by the UN Commission on Sustainable Development, which includes in its programme of work the review of the subject of periodic assessment of forests at the global level.

3. The meeting took note of the importance given worldwide to the subject of global forest resources assessment. It therefore *urged* all governments as well as the international organizations concerned, including donor agencies, to give it the necessary priority by allocating sufficient means and funds, to provide the world community with the information it needs on the situation and evolution of the world's forests , in particular to ensure that the high level debate on forests is based on the best possible information.

4. The meeting noted the importance of working in partnership with all interested parties to achieve major goals, such as the FRA 2000. Some of the important partners are the secretariats for the Conventions resulting from UNCED. The Kotka III meeting itself was an excellent example of constructive partnership between countries and between organisations. In this context the generous offer of the remote sensing community, articulated at the Washington meeting on remote sensing support to FRA 2000 in March 1996 was particularly welcomed, alongside the continuing cooperation between FAO and the EU TREES project. (Among the important partners are the secretariat for the conventions resulting from UNCED.)

5. The meeting expressed concern that the Forest Resources Assessment 1990 had perhaps not had the influence it deserved in policy circles, possibly because of shortcomings in presentation, public relations and marketing. It urged the secretariat to raise the political and media profile of the FRA process by making the publication (and its supporting documentation and data bases) as attractive and user friendly as possible and by devoting time to the public relations aspect when presenting and disseminating its results.

6. The meeting considered it was important for Global FRA 2000 to capture as many as possible of the indicators of sustainable forest management (SFM) identified by the on-going international processes on the formulation and application of criteria and indicators of SFM. It identified 15 indicators (out of a total of 80 indicators of the various regional processes) relevant at the global level which could be estimated by FRA 2000 and a few others which could be assessed in part (Annex 1). The meeting noted that there was already good agreement in different sets of criteria and indicators, but recommended further harmonization.

7. The objectives of the meeting were to agree on ways in which the quality of information already included in FRA 90 could be improved and on how to respond to new information needs. Parameters to be included should meet the following conditions: (i) relevant and useful at international level and (ii) possible to assess with the available data acquisition tools at acceptable cost.

Global framework for FRA 2000

8. The meeting reviewed the global framework on the basis of a draft prepared by Mr. T. Peck, papers prepared by Mr. P. Mengin-Lecreulx and by WCMC (presented by Ms. S. Iremonger) as well as a voluntary contribution by WWF (prepared by Mr. N. Dudley and Mr. C.

Elliott), and work in groups during the meeting. The proposed Global Framework for the FRA 2000 is presented in this report (Annex 2).

9. The conclusions of the meeting on the major topics discussed by the working groups are set out briefly below.

Wood supply

10. The meeting identified the information needed to address the issue of sustainable management of forests for the supply of industrial wood and other wood, notably fuelwood. It identified suitable data acquisition methods and rated the feasibility and the importance of including each new parameter. Some of the new parameters proposed require special studies to be made. Such studies need to be specified and suitable actors and sponsors found.

Biological diversity

11. The meeting recognised the conceptual and practical difficulties of directly measuring biological diversity, but noted that considerable progress in understanding the situation and trends for biological diversity in the world´s forests could be made by including in the global framework questions on the following:

- "naturalness" (breakdown into natural forest, semi-natural managed and used forest and plantations)
- protection status (using IUCN categories to improve comparability and reduce duplication)
- fragmentation (using remote sensing)
- better information on forests by ecofloristic zone, as well as protected status by ecofloristic zone (by remote sensing)

Forest degradation

12. The meeting identified the main factors of forest degradation, as distinct from deforestation, (burning, overexploitation for wood, overgrazing, air pollution) and its various forms (fragmentation, reduction in crown cover, changes in species composition and stand structure) and proposed that an attempt be made to estimate burned areas and fragmentation provided additional means could be secured. The meeting also proposed that other indicators of forest degradation, such as changes in crown conditions, spectral reflectances, etc, be considered for the subsequent international FRA.

Climate change

13. The meeting identified some important indicators to be included in FRA 2000, as well as the information sources, shortcomings and acquisition methods. While some of the relevant information needed for assessing the forest aspects of climate change may not be available, the meeting strongly recommended the inclusion in future assessments of enquiries on these parameters. A general agreement was reached on the need to support research on assessments of volume/biomass and volume/biomass change for vegetation both above and below ground. The on-going processes of FCCC and its subsidiary bodies, especially bodies on technical advice and IPCC, as well as activities on the "greenhouse gas inventory" should be reviewed and taken into consideration by the FAO/ECE. While remote sensing techniques alone may not be adequate for the global assessment of carbon sequestration, FAO´s methodology on multi-date remote sensing techniques and field studies (applied in the FRA 1990) could nevertheless be used in FRA 2000. It was recommended that links be established to activities related to assessment of other components of total biomass, e.g. soils.

Non-wood goods and services

14. The meeting recognised the enormous difficulties of collecting global comparable information on goods and services which were often site specific and highly diverse in their characteristics. It was proposed to combine the non-wood goods and services into 6 major groups (food and medicine, fodder and forage, industrial extracts, protection, social and economic, aesthetic, cultural and spiritual) and to request for each major group a short description, an indication of their relative and absolute importance, changes in supply and demand, and indications of quantity and value supplied. The meeting asked the FAO/ECE team of specialists on non-wood goods and services to address this topic and make suggestions drawing on its own experience of the area.

Contribution of remote sensing

15. The meeting noted that existing and soon to be completed digital data sets on a global scale derived from remote sensing and GIS analyses and generated by institutions other than the FAO and ECE could be used for satisfying some of the information needs of the Global FRA 2000. Some of these data sets could be made available to the FAO and ECE at no cost. The meeting also recommended that the

FAO and ECE work closely with other institutions in the development of specific new digital data sets and in the design and implementation of remote sensing programmes for estimating forest resources for FRA 2000. Specific recommendations concerning possible collaborators and parameters to be sampled by remote sensing were made (see the report of the corresponding Working Group in the proceedings).

Adjustment of national data

16. Adjustment of national data to a common agreed set of definitions and to a common reference year is needed within the framework of the Global Forest Resource Assessment 2000 in order to secure an acceptable degree of comparability. However, adjusting data to common definitions and a common point of time is difficult and needs further research and development of methodology.

17. The meeting made *the following recommendations* for FRA 2000:

a) The secretariat should provide guidelines and definitions so that countries can adapt their data to fit the requirements.
b) Countries should be encouraged to adjust their data as far as possible to the common definitions and common reference years, describing precisely both how the data were collected and how they were adjusted.
c) Countries should submit adjusted data for a specified reference period, as well as the sources data from which they are derived. The most recent data should preferably not be older than 10 years.
d) The secretariat should present national data as provided by individual countries. However, when necessary, and after consultation and consent with the national correspondent, it may present its own adjusted estimates, provided they are identified as such, and the adjustment/estimation method is specified.
e) The secretariat aggregates the national data collected as described above. In addition it should add an indication of the reliability of the regional and global totals, by quantifying an interval which is likely to include the "true" value. This interval should take into account all deviations from common definitions, assessment periods and methods.
f) Countries should provide an indication of the conformity of their data to the common agreed standards, which will be used in estimating the interval which is likely to include the "true" value.
g) Countries should be encouraged to develop or modify their inventory methods so that they can provide results according to the common standards. This requires that these common standards and definitions remain constant over time.

Methods of work

18. In order to cope with new information requirements it is necessary to use new data acquisition mechanisms or to use established mechanisms more intensively. The following new needs were identified:

a) In the developed countries data must be made more consistent, comparable and comprehensive. Compared with FRA 1990 (TZ) this implies considerably more analysis and validation by the secretariat of data received from countries and an intensified follow up dialogue with country correspondents.
b) It should be evaluated whether the sampling of high resolution satellite data which was applied in the tropical countries in FRA 1990 should be extended to cover all regions.
c) For developing countries a network of regional and national correspondents should be established to associate countries in the assessment process and to collect data that are available in countries (e.g. areas available for wood supply).
d) Organizing existing information from various sources using GIS should be extended to the developed countries, e.g. to assign forest areas to ecofloristic zones.

Global Framework

19. After reconciliation of the recommendations of the groups, the meeting approved the global framework for the FRA 2000, which is reproduced in the Annex 2 (definitions to be added later).

Cooperation between international organisations

20. The meeting made the following recommendations concerning cooperation between UNEP, FAO and ECE:

- UNEP should participate in the FRA 2000
- UNEP and FAO should collaborate with other agencies in developing improved methodologies for estimating state and change with regard to forest biomass
- UNEP and FAO should cooperate in the preparation of global forest vegetation database and global ecoregion database using Global Land Cover Characteristics Database (GLCCD) being developed at the EROS Data Centre Sioux Falls
- UNEP and FAO should devote special attention to harmonisation of the numerous remote sensing and GIS databases concerning forests
- UNEP and FAO should work together in facilitating access to forest resource data to a wide variety of users around the world.

21. The meeting recommended that its conclusions and recommendations be brought to the attention of the intergovernmental bodies and mechanisms concerned particularly those of FAO, ECE and UNEP, – and in particular the FAO Committee on Forestry – in order that they be informed and advise on the formulation and implementation of the Global FRA 2000.

22. Likewise the meeting requested FAO, as lead agency for item III.1 on forest resources assessment of the programme of work of the IPF, to convey the meeting results to the third session of this latter body which is to be held in Geneva from 9 to 20 September 1996.

Annex 1

Indicators for Global Forest Resources Assessment 2000
Recommendations of the Group on Criteria and Indicators

Indicators of sustainable forest management at the national level which are most pertinent at regional and global levels and are recommended for assessment by FRA 2000:

a. Area of forest (1)
b. Area of other wooded land (2)
c. Area of forest by naturalness (7)
d. Area of forest plantations by categories of species (4 – partially)
e. Forest areas converted to other uses (9)
f. Total forest biomass above ground (10)
g. Total carbon stock in forests (13 – derived from above)
h. Total volume of growing stock (14)
i. Changes over time of total volume of growing stock (20)
j. Changes over time of total forest biomass (16 – derived from above)
k. Changes over time of total carbon stock (17 – derived from above)
l. Area of forest and other wooded land available for wood production (57)
m. Area of forest by ownership (6)
n. Area of forest in protected areas (according to IUCN classes – 26)
o. Area of forest and other wooded land burned annually (38)

(numbers in parentheses are the ranking number of the indicator in the consolidated list of 80 indicators of the four international processes — Helsinki, Montreal, Tarapoto and DryZone Africa — shown in table 1 of the consultant report of Mr. Mengin-Lecreulx's)

Additional indicators for which "attempts" at assessment should be made or which may be assessed partially by FRA 2000:

a. Fragmentation of forests
b. Biomass of forest types (broadleaf and coniferous, partially covered in FRA table 5)
c. Change in defoliation over past 5 years (if not FRA 2000, then later)
d. Quantity and/or total value of harvested non-wood goods and services (to be confirmed)
e. Area of forest and other wooded lands managed primarily for soil protection (to be confirmed)
f. Area of forest and other wooded lands managed primarily for water

protection (to be confirmed)

g. Area of forest and other wooded lands managed primarily for tourism and amenity (to be confirmed)
h. Maintenance of cultural, social and spiritual values (to be confirmed)

Annex 2 Global Framework for the FRA 2000

List of tables:

Table FRA 1
Area of forest and other wooded land

(1000 ha)

Total area
- Inland water
- Land
  - Forest and other wooded land
    - Forest
      - Natural forest
      - Semi-natural managed and used forests
      - Plantations
    - Other wooded land
      - Natural wooded land
      - Semi-natural managed and used wooded land
  - Land other than forest and wooded land

Table FRA 2
Protection status

(1000 ha)

Forest
- in IUCN categories 1 and 2
- in IUCN categories 3, 4 and 5
- other

Other wooded land
- in IUCN categories 1 and 2
- in IUCN categories 3, 4 and 5
- other

Table FRA 3
Ownership
(1000 ha)

Forest
- In public ownership
  - Available for wood supply
  - Not available for wood supply
- In traditional ownership
  - Available for wood supply
  - Not available for wood supply
- In private ownership
  - Available for wood supply
  - Not available for wood supply

Table FRA 4
Ecofloristic zones
(1000 ha)

Total Land
Of which:
Forest and Other Wooded Land
Tropical rainforest zone
Tropical moist deciduous forest zone
Tropical dry deciduous forest zone
Tropical very dry deciduous forest zone
Tropical desert zone
Other tropical and sub-tropical forest land
Hill and montane zone
Dry (Mediterranean type) temperate forest zone
Temperate forest zone
Boreal zone

Notes: classification to be finalised in cooperation with agency carrying out remote sensing, notably as regards the last 4 zones. (The first 6 zones are those used in FRA 1990.)

Table FRA 5
Wood supply potential
(1000 ha)

Forest
- Available for wood supply
  - Predominantly coniferous
  - Predominantly broadleaved
  - Predominantly bamboos, palms etc.
  - Mixed
- Not available for wood supply

Table FRA 6
Changes over time

(1000 ha)

	Late 1980s	Late 1990s	Av. annual change
Forest			
A. BREAKDOWN BY NATURALNESS			
– Natural forest			
– Semi-natural managed or used forest			
– Plantations			
B. BREAKDOWN BY WOOD SUPPLY POTENTIAL			
– Available for wood supply			
– Not available for wood supply			
C. BREAKDOWN BY PROTECTION STATUS			
– Legally protected (IUCN categories 1–5)			
– Other			

D. CHANGE MATRIX

	Forest, 1980s	Other wooded land, 1980s	Other land, 1980s
Forest, 1990s			
Other wooded land, 1990s			
Other land, 1990s			

E. CHANGE IN VOLUME OF GROWING STOCK

Total growing stock on forest (1000 m3, over bark)

Table FRA 7
Growing stock and biomass

A. TREE VOLUME (GROWING STOCK, ABOVE GROUND) ON FOREST (1000 m3, over bark)

- Coniferous
- Broadleaved
- Other (bamboos, palms, etc.)

Total on forest
of which:

- on land available for wood supply
    - Coniferous
    - Broadleaved
    - Other (bamboos, palms, etc.)

B. ABOVE GROUND BIOMASS ON FOREST AND OTHER WOODED LAND AND TREES OUTSIDE THE FOREST (1000 tons, oven-dry)
Total above ground tree and other woody biomass

- Above ground tree biomass (growing stock only) on forest
    - Coniferous
    - Broadleaved
    - Other (bamboos, palms, etc.)
- Other above ground tree biomass
- Other above ground woody biomass

Table FRA 8
Fellings and removals

(1000 m^3 annual average over assessment period)

	Fellings (over bark)	Removals (under bark)
Total		
– On forest available for wood supply		
– Coniferous		
– Broadleaved		
– Other (bamboos, palms, etc.)		
– Other fellings (on other wooded land and from trees outside the forest)		

(questions as in draft)

Table FRA 9
Fires on forest and other wooded land

(annual average over assessment period)

Number
Area burned (1000 ha)

Table FRA 10
Non-Wood Goods and Services

Element	Short description	RI	AI	Supply change	Demand change	Quantity	Value
Food and medicines							
Fodder and forage							
Industrial extracts							
Protection							
Social and economic							
Aesthetic, cultural and spiritual							

(NB Insert extra column before "Quantity" entitled "Specify good/service")

Short description = a 5-line description of the details and importance of each NWGS

RI = relative importance: ranked from 1 (most important) to 6. If two NWGS elements are of equal importance, they should both be given the same score. This evaluation should take account of both economic and non-economic values.

AI = absolute importance of each NWGS, measured on a scale of 1–3:

- 1 = vitally important – ie plays an irreplaceable role
- 2 = of medium importance (ie a broad category that is neither 1 nor 3)
- 3 = virtually or completely unimportant

Supply change = changes in supply of the goods or services, scored:

- \+ = increasing
- O = static
- \- = decreasing

Demand change = changes in demand for the goods and services, scored:

- \+ = increasing
- O = static
- \- = decreasing

Quantity = quantitative figures if available (eg production levels, volume, area,, visitor numbers, etc)

Value = quantitative figures if available.

Drafts for Working Group Reports

Management of Forest for Production

Work Group Report 1

1.1. Framework

The group, for lack of time, dealt only with wood production and left production of non-wood goods aside. It listed parameters of relevance and ranked their importance. For each parameter it indicated suitable/possible data acquisition methods and ranked feasibility. For practical reasons findings were shown separately for industrialized and for developed countries.

1.2. Recommendations

1.2.1. Feasibility ranking:

1. Already included or easy to add
2. Requires additional resources and/or development of methods
3. Same as (2), but results will be incomplete – not good for global core
4. Incomplete and costly or low priority and difficult.

1.2.2. Importance ranking:

H: High
M: Medium
L: Low

1.2.3. Data acquisition method:

Qu: Questionnaire
FO: FORIS (collection and analysis of existing reliable information)
RS: Sampling of high resolution satellite data
Or: Organization of existing information (using GIS)
S: Special studies
Oth: Activities of other actors

The symbols I, D and X are used, meaning application recommended in the industrialized world, the developing world or generally, (I) means results will be incomplete.

A certain amount of arbitrary judgement is involved in the feasibility and importance ranking.

Data acqusition methods for FRA parameters, their feasibility and importance

Parameter	Data acquisition method						Feasibility		Importance	
	Qu	FO	RS	Org	Sp	Oth	Ind	Devg	Ind	Devg
Change in area										
* forest	(I)	D	X			X	2	1	M	H
* available forest	(I)		X	I	D		2	4	M	H
Growing stock in										
* available forest	I	D		D			1	2	H	H
* natural/plantations	I	D		D	D		3	3	M	H
Available yes/no										
* area and enforcement	I	D		D			1	3	H	H
Ownership, four classes	I	(D)			D		1	4	H	L
Ecofloristic zone map					X	X				
Data by ecofloristic zone	I			X			2	1	L	H
Vegetation maps high resolution	I				X	X	3	3	M	H
Removals ind/fuel										
* in forest	I			D	D		1	2	H	H
* outside forest	(I)			D	D		1	2	H	H
Species groups in available forest										
* area	I	D		D			2	3	M	M
* volume	I				D		2	3	M	M
Increment	I				(D)	X	1	4	H	H
Knowledge of wood processing industry					X	X	4	4	H	H
Numbers of people employed in and dependent of forest					X	X	4	4	M	M
Age or maturity	I				X	X	4	4	H	H
Population change						X	1	1	H	H
GNP change						X	1	1	H	H
Geographic location		D		X	I		1	1	H	H
Reliability of information	I	D					1	1	H	H

1.3. Participants

Mr J. Barton (New Zealand), Chair,
Mr K. Janz (FAO), Rapporteur
Mr V.B. Ambia (Papua New-Guinea), Mr H. Bautista (Ecuador), Mr G. Lund (USA), Mr V. Sosa Cedillo (Mexico), Mr D. Wright (G.B.).

Health and Vitality of the Forest and the Role of Forests on Global Change

Work Group Report 2

Two tasks were assigned to the working group 2: (1) Health and vitality of the forest, and (2) The role of forests on global climate change.

2.A. Health and Vitality

2.A.1. Framework

The understanding of the group concerning health and vitality of the forests is that it represents the interpretation of current condition as it relates to an optimal one.

Several modifiers of vegetation were identified, amongst which: fires, pollution, insect disease, animal damage (grazing), acid deposition, catastrophic events (wind throw, drought, flood, earthquakes, hurricane, avalanche, volcanic activity) etc.

Possible indicators of vegetation health/vitality include changes in crown condition, spectral reflectance, percentage of vegetation cover, and the increment.

After considering the possible level of information on each of the identified vegetation modifiers, i.e.

- level (A) : information available in all countries,
- level (B) : some effort is required to include the information on FRA 2000,
- level (C) : information is desirable, but difficult to get (project funding dependant),
- level (D) : information is desirable, but “impossible” to get for FRA 2000.

The working group recommend that:

- 1. only information on fires should be included in the next assessment (FRA 2000),
- 2. each country should make strong efforts to include information on the remaining items, to be inserted into future assessments.

2.A.2. Methods

The information on fires should include average number of possible fires during the period 1990 and 2000, and their geographical distribution (by state, ecoregion etc). One source of information on fires which is largely used is provided by the thermal band of the AVHRR sensor in the NOAA satellite. Although AVHRR provides relevant information on fires, it does not seem generally suitable for providing information on the burnt area.

2.A.3. Recommendations

2.A.3.1. Identification of need for assistance

Brazil is proposing a workshop during 1996 to discuss possible operational systems for fire detection and area quantification. FAO may adopt the recommendations of the experts at this workshop for their next assessment. See footnote for the contact person in Brazil[1].

2.A.3.2. Complementary information

Some points for consideration regarding this topic are raised in reference document (1), such as:

- Teledetection security devices should be examined, while keeping in mind certain points:
    - how long does the passing of a fire remain detectable on satellite (depends on the season), and therefore when is the right moment to film the images?
    - the necessary images must be available at the right moments (problems of clouds, particularly in tropical areas).

Teledetection should enable to find the endangered areas rather than assessing the areas set on fire.

Reporting to the reference document (1), the criteria Health and Vitality of the Forest was considered not relevant at a regional or global level in the framework of the evaluation of global forest resources. The indicators identified in (1) were (refer to Table 1: National, Regional and Global Forest Indicators):

- areas (and % of forest) affected by insect "attacks" or illness, divided up
- according to seriousness (measured by growth loss or death rate),
- forest area and other wooded land (and % of forest) burnt annually,
- annual area of wind throw due to storms and % of forest concerned,
- volumes taken from these samples of wind throw,

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[1] Thelma Krug: National Institute for Space Research (INPE), Earth Observation, tel: (55)(12)(325.6450); fax: (55)(12)(325.6460).

- area of forest (and % of forest) affected by:
  - clearing,
  - permanent flooding,
  - salinisation,
  - drought,
  - aeolian erosion,
  - competition of exotic species,
  - encroachment of shrub species,
  - consequences of specific polluting concentrations or due to ultraviolet B
  - radiation,

beyond a certain threshold

- change in defoliation through the last 5 years,
- area of "forest land" (and %) biologically impoverished,
- % of regeneration area with serious damage caused by wild fauna or grazing,
- % of forest ecosystems with and without regeneration.

Of the above indicators, only area of forest affected by clearing was considered of importance at a regional or global level (level 1), for boreal and temperate forests out of Europe. Most of the remaining indicators (12 out of 16) were assigned level 3 (no importance at a regional or global level). The report points out that 14 out of the 16 indicators cannot be assessed at a global level, and should not be taken into account at a regional or global level (in the framework of the evaluation of forest resources).

In Table 2 of Appendix 1 in reference document (3) (also page 157 of (4)), the quantification of the burned areas over forest cover is considered to be an essential parameter to the assessment of biodiversity, carbon cycle, hydrological cycel, forest condition and land cover/land use. The key player is the remote sensing community. The number and distribution of fires in that report is appointed as a desirable (accessory) information for biodiversity. Since the meaning of fires to biodiversity is different for distinct ecosystems, this needs to be further evaluated.

2.A.3.3 Proposal to reference document

To include an additional Table to account for the fire numbers and their distribution (spatial, by forest type, by ecoregions ???)

2.A.4. References documents

P. Mengin-Lecreuix (1996) Indicators of Sustainable Forest Management, at a National Level and Possibilities to Assess them in the Framework of National, Regional and Global Forest Inventories.

T.J. Peck (1996) Main Features for the Framework of the Global Forest Resources Assessment.

WCMC (1996) Proposals for Parameters Regarding Environmental Aspects and the Quality of Forest Resources and Forest Management for the Forest Resources Assessment 2000.

FAO/ECE Meeting of Experts on Global Forest Resources Assessments. KOTKA II Proceedings.

Workshop on Remote Sensing Support for the Global Forest Resource Assessment (FRA-2000 – Remote Sensing). (1996). Proceedings. Washington, D.C. 12–14 March.

Table I Vegetation modifiers, data source, shortcomings and availability of information.

MODIFIER	DATA SOURCE	SHORTCOMINGS	HOW TO ACQUIRE
FIRES	Country fire reports	May not have area Affected veg. types	Ask countries for data. Include in the questionaire
POLLUTION	Ground surveys Differentiate crown condition	High cost/time consuming	USA: Forest Health Assessment Training EUR: Forest Condition Report
DISEASE and INSECT ATTACK	EUR: part of CROWN CONDITION USA: separate, but may be combined		Country Reports
CATASTROPHIC EVENTS	Special surveys Remote Sensing	Unpredictable May not be of long term interest	Special studies some countries
ANIMAL DAMAGE	Grazing reports Field surveys	Not available for some countries	Reports of Country Agriculture Depts.
ACID DEPOSITION	European Monitoring Environmental Pollution Long Range Transboundary Air Pollution (LRTAP)		USA: Forest Health Monitoring Program Training EUR: Forest Condition Report

2.B. The role of forest on global climate change

2.B.1. Framework

The Global Climate Change (or Carbon-Budget, as the working group proposed to name it) is a result of many processes taking place in many sectors of a country, where forest change plays a significant role.

Within the forest sector, it is essential to include changes in :

- vegetation biomass (above and below ground),
- soil carbon,
- forest harvesting,
- end use of products.

For carbon budget, it is necessary to capture the change process associated with the change, viz. starting and ending states. Thus, it is important to separate replacement of an existing forest with another fores, crop from a plantation on land which did no support before.

Further, changes need to be geo-referenced by ecological zones (or regions) to analyze the process of wood-decomposition/decay and soil carbon changes.

2.B.2. Complementary information

Reference document (3) (KOTKA II) includes the report of working group 2 on parameters related to biomass. It was noted there that biomass assessment there was seen on the context of global carbon cycle, implying that both the state and change of the total biomass should be considered. The components of total biomass were identified as follows :

- *above ground*: stems, branches, stumps, dead trees, shrubs, ground vegetation,
- litter; and
- *below ground*: tree roots, other roots, organic material of mineral soils, peat.

Related to the isue of carbon cycle/climate change, reference document (5) classsifies the following parameters as essential: land cover, land cover change, volume/biomass, volume/biomass change. Some approaches to the production of these parameters are presented in reference document (5), although there is no agreement on their use at all levels (global, geographic region, sub-region, country, sub national unit). However, for a global assessment, the use of high-resolution multi-date imagery to support a sample survey (> 20%) seems fully adequate and highly reliable to assess land cover and land cover change. As far as volume/biomass and volume/biomass change in concerned, (5) indicates a three-phase survey approach (phase I: NOAA + GOES); phase II: high resolution sample; phase III: field sample) as a fully adequate and highly reliable source of information.

2.B.3. Recommendations

2.B.3.1 Biomass/volume

The working group agrees that research is strongly needed on biomass/volume and biomass/volume change, and that it will only be available if sufficient project funding is provided to the research groups. The change in biomass in OWL and TOFL was classified as (D) level information (desirable, but impossible to get for FRA 2000). For those countries committed under Agenda 21, estimates of biomass in forest land will be provided on the basis of specific study sites (either based on allometric equations, destructive experiments etc). It was agreed on the group that remote sensing techniques may not be adequate for the global assessment of carbon sequestration, although FAO's methodology based on time series and remote sensing multidate (difference value for country) applied on the 1990 assessment may be refined for FRA 2000. It is strongly recommended that efforts be made to include information on other relevant parameters to global change such as soils (for which there is hardly any information available), removals (for which there exists incomplete data) and end use forest (for which research is still needed).

2.B.3.2 Global Change

The working group on Global Change have identified some important indicators to be included in FRA 2000, as well as the source of information, shortcomings and acquisition methods (refer to Table x) in Appendix Y. Most of the relevant information needed may not be available to be included in the next FAO assessment, but the working group makes strong recommendations to ensure their inclusion in future reports. There seems to be general agreement on the need to support research to assess volume/biomass and volume/biomass change for both vegetation above and below ground. Information for the next assessment may come from some specific country field studies; it is understood that remote sensing techniques alone may not be adequate for the global assessment of carbon sequestration. However, FAO's methodology based on multi-date remote sensing techniques and field studies, applied in the 1990 assessment, could be used in FRA2000. It is strongly recommended that efforts be made to include information on other relevant parameters to global change such as soils (for which there is hardly any information available), removals (for which there exists incomplete data) and end use forest (for which research is still needed).

Table II Indicators, source of information, availability and action to be taken.

INDICATORS	SOURCE OF INFORMATION	SHORTCOMINGS	HOW TO ACQUIRE
CHANGE IN AREA BY ECOZONES	Global Land Cover Characterization Database (GLCCD)*	End of 1997	Decision by FAO to use it or not
CHANGE IN AREA	Country or Sampling with Remote Sensing	Available at the end of 1999 May not be available on OWL and/or TOFL	Questionnaire Stratified sample with R.S. Statistical investigation required
CHANGE IN BIOMASS	Country reports Field samples Modelling	Available at the end of 1999	Support country studies on the effect of cover change on biomass estimates
Vegetation above			FAO contact research group
Vegetation below			Sampling by R.S. may not be adequate for Global Assessment of Carbon Sequestration Work with difference value for country (time-series) or R.S. multidata
SOILS	Research	Hardly none	Soils Dept. Assistance
REMOVALS (fuelwood + source)	Country reports FIRE/Fuelwood	Incomplete data	
END USE FOREST	FAO Forest Products	Not for FRA 2000 (ECE, ITTO, LCI)	Research needed

OWL = OTHER WOOD LAND
TOFL = TREES OUTSIDE FOREST LAND
R.S. = REMOTE SENSING

******Global Land Cover Characterization Data Base* (GLCCDB): is an international effort designed to characterize global land-cover at a 1 km resolution using multi-source data, both coarse-resolution Advanced Very High Resolution Radiometer (AVHRR) imagery satellite data and acncillary data. The databases will be developed to cover North America, South America, Europe/Asia, Africa, and Australia/Oceania. The global AVHRR data will consist of composites over an 18-month time span (Ref. Document (5); pg. 35).

2.4. Participants

Mr H. G. Lund (USA), Chair

Ms T. Krug (Brazil), Rapporteur

Mr F. Achard (EEC), Mr M. Amano (Japan), Mr F. P. Cox Zanartu (Chile), Mr P. Csoka (Hungary), Mr A. N. Filipchuk (Russia), Mr F. Schmitz (Germany), Mr A Singh (UNEP), Mr K.D. Singh (FAO).

Biodiversity

Work Group Report 3

3.1. Framework

The group considered the draft global framework for the FRA 2000 from the point of view of biodiversity, taking as a starting point the report of Kotka II and the draft framework prepared by Tim Peck. It noted that many terms and concepts are still the subject of debate in the scientific community. The group endorsed the Kotka II proposals on scope and objectives, but concentrated discussion on more operational matters. It considered that it was realistic and desirable that FRA 2000 collect and publish the following information on the global level, although it noted that the approaches proposed are experimental, will need considerable explanation and consultation and should be reviewed in the light of experience. For convenience, most of the suggestions are presented in terms of modifications to the Peck draft (table references are to this document)

3.2. Recommendations

3.2.1. Forest estate

Table GFRA 1, which at present combines information on forest area, species, protection status and wood supply potential should be simplified and the protection and wood supply questions put in separate tables. Therefore the wood supply and protection questions should be transferred to other tables.

Change to GFRA 1: Delete references to "available/not available for wood production" and "legally protected/other".

Change to GFRA 2: Remove shading on "available/not available", recognising that this is now the first time this information is collected.

The group preferred the wording "Available for wood supply" rather than "Available for wood production" as "production" could be read as referring to biological production (yield) rather than harvest or fellings, which was intended.

3.2.2. Forest types/ecofloristic zones

The group considered it of great importance to collect information on forest type/ecofloristic zone and supported the Kotka II proposal that data for ecofloristic zones should continue to be collected for the tropical zones and this coverage extended to include the temperate and boreal forest. To obtain this information in the most economic and standardised format, without the problems which might arise from asking countries to apply on a national basis internationally defined ecofloristic zones, it would be desirable to use the remote sensing data set offered by the EROS data centre. EROS is preparing a world vegetation map which would have several (about 50) forest types, which could be aggregated into 5–10 major ecofloristic zones. The group suggested that the FRA 2000 should include: ??????

- a world map of the ecofloristic zones identified in table GFRA 3, ensuring
- continuity with data for the tropics in FRA1990,
- a table by country indicating major forest types and ecofloristic zones
- occurring in each country (no area data by country),
- a table indicating the area of each ecofloristic zone.

The non-publication of country specific data on ecofloristic zones avoids the potential confusion arising from lack of exact correlation between remote sensing data supplied by EROS and a country´s own estimate of its own ecofloristic zones obtained from other sources with other definitions. Countries might also be invited to supply national information on ecofloristic zones. In later FRA work (FRA 2010) it should be possible to obtain comparable data, by country on forest type/ ecofloristic zones.

If the remote sensing data are available, table GFRA 3 becomes unnecessary and should be deleted.

3.2.3. Protection status

In order to expand the information on protection status (previously in table GFRA 1), insert new table as follows:
Table GFRA X, Protection status:

Forest land :
- in IUCN categories 1–2,
- in IUCN categories 3–5,
- other.

Other wooded land :
- in IUCN categories 1–2,
- in IUCN categories 3–5,
- other.

Definitions: to be taken from IUCN

3.2.4. Authenticity/naturalness

Insert new table as follows:

Forest:
- natural forest,
- semi-natural managed forest,
- plantations.

Definitions:

Natural forests: forests with natural species and ecological processes and for which there has been continuity over a very long period (e.g. 250 years).

Semi-natural managed forests: forests where management has substantially altered the structure and ecological processes of the forest. (This is a wide category including everything not contained under natural forest or plantations)

Plantations: forests for intensive wood production; planted or artificially regenerated and made up of exotic species and/or monocultures. (This includes plantations both for fuelwood and for industrial wood)

Given the wide spectrum of forest types and management systems, as well as the difficulty of defining the terms, countries would be urged to provide a full explanation of the criteria they had used to assign different forest classes to each authenticity category. These explanations would be included in the final published version of the FRA 2000, with the resulting figures

3.2.5. Fragmentation

FAO was urged to examine the possibility of using a global remote sensing data set to examine measures of fragmentation (e.g a perimeter/area ratio) on a continent wide basis. The group believed that such measures were relevant to biodiversity, although interpretation of the significance of the results was difficult and indeed would vary according to the circumstances. It also recognised the possible problems which might arise from effects of scale. The group considered that provision should be made to enable countries to provide their own information on an optional basis. Concern was expressed about the standard of these data, but it was recognised that this invitation might be an important stimulus to countries to start collecting and analysing their own remote sensing data.

3.2.6. Non-wood services

The group was unable, for reasons of time to consider this topic, but recommended it be the subject of group discussion on Wednesday.

3.2.7. Data acquisition

Ecofloristic zones: remote sensing, in cooperation with EROS, and country replies (optional)
Protection status: FRA 2000 enquiry
Authenticity/naturalness: FRA 2000 enquiry
Fragmentation: remote sensing, and country data (optional).

3.3 Participants

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Vegetation / Land Degradation

Work Group Report 4

4.1 Background

The group reviewed the proposal of Annex IV of the Kotka II proceedings (p. 43 ii). Based on the discussions the group decided to base further recommendations on the use of the term "land cover" and abandon the term "land use". This decision was mainly based on the fact that land use cannot be detected by remote sensing tools.

To be able to distinguish between deforestation and degradation the group set up a chart (Fig. 1), which reflects the differences in the use of the two terms.

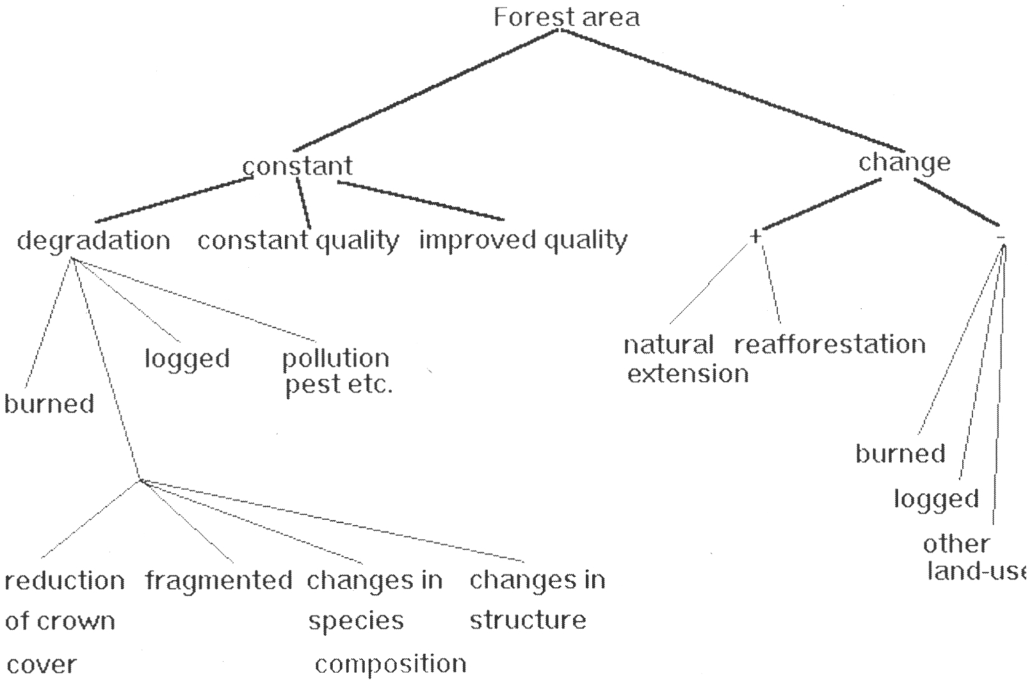

Fig. I Degradation versus deforestation

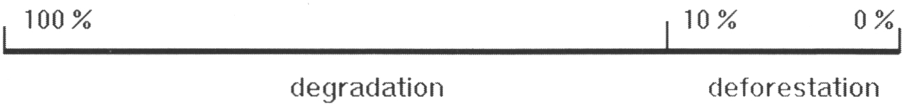

Fig. II Deforestation versus degradation

4.2. Recommendations

4.2.1. Changes to Tim Peck's draft

Table 1:
Degradation could result in a shift from forest land to other wooded land. To be able to distinguish between deforestation and degradation should be considered to be a change of forest cover down to a minimum threshold of 10 percent. Every change resulting in a forest cover of less than 10 percent is considered to be deforestation.

Table 2:
No proposal, no objections

Table 3:
The tropical zoning has to be modified to allow for the separation between closed ("high") forests and mixed forest-grassland formations (e.g. wooded savannas, cewrrados, etc.).

Table 4:
Part A: Reporting a change of forests originally consisting of indigenous species by forests consisting of introduced species or (mixed species) plantations would provide an indicator of a change of species composition which may constructed as a form of degradation.

Part B: The class "decrease of forests land" should be split up into two classes:

- changed to other wooded land (indicator of degradation)
- changed to other land use classes.

Table 5:
no proposal, no objections

Table 6:
no proposal, no objections.

4.2.2. Data acquisition

Information	Remote sensing, low resolution	Remote sensing high resolution and aerial photo	Available maps	Sample based surveys	Sample based surveys and remote sensing
Burned	NF	F		F[1]	F[2]
Logged	F	F		F[1]	F[2]
Others	NF	F		F[1]	F[2] ?
Fragmented	NF	F		F[1]	F[2]
Reduction of tree species	NF	NF		F[1]	F[2] ?
Reduction of crown cover	NF	F		F[1]	F[2]
Change in structure	NF	NF		F[1]	F[2] ?
Avaibility	Available (TREES, FIRS, US-GS, etc.)	Not available on global level	Big difference in geographic regions, incomplete cover, scale dependent		

[1] No total (geo-referenced) cover, "only"statistics
[2] Same as [1], but more precise results
?: Can not be decided, need further research

F: Feasible
NF: Not Feasible

4.2.3. Priorities and Feasibility/Timing

Information	Priorities	Feasibility/Timing
Burned	***	b
Logged	***	b
Others	**	c
Fragmented	***	b
Reduction of tree species	***	c
Reduction of crown cover	***	b
Change in structure	**	c

* optional
** desirable, accessary
*** essential, indispensable

a: feasible for FRA 2000
b: requires additional funds and efforts
c: research needed, not for FRA 2000

4.2.4. Need for Assistance and Future Research

Much of the information needed to quantify forest degradation cannot be provided in a consistent and uniform manner by the individual countries. Contributions such as wall-to-wall maps from agencies and institutions working on the supra-national or global level is needed.

For many of the attributes to be assessed to quantify forest degradation the techniques and methods are already available. For some attributes further research is needed.

One of the first steps would be to specify further the information needs regarding forest degradation with reference in particular to the minimum size of areas, where changes have to be detected. Based on this latter specification the funds necessary to met the objectives can be quantified.

4.3. Participants

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Mr J.P. Lanly (FAO) and Mr M. Köhl (Switzerland), Rapporteurs,
Mr Z. Ahlafi (Morocco), Mr S.Gueye (Sénégal), Mr R. Michalak (Poland), Mr H. Santoso (Indonesia), Mr U Saw Wyn (Myanmar).

C&I of Sustainable Forest Management

Work Group Report 5

5.1 Recommendations

The group agreed that it was important for FRA 2000 to capture as many as possible of the indicators of SFM identified by the ongoing international process involved in identifying and applying C&I at national level.

It considered it was a way to improve the usefulness of FRA 2000 and to show that the forest resource assessment community wanted to contribute to the assessment of the sustainability of forest management worldwide.

It reviewed the secretariat document "Indicators of SFM at National Level and Possibilities to assess them in the Framework of National, Regional and Global Forest Inventories". The document reviews the indicators identified in the Helsinki, Montreal, dry zone Africa and Tarapoto processes, and assesses the possibility of estimating them in national, regional and global assessments.

The group agreed that the indicators derived from ITTO process should also be considered, and was able to do it, thanks to the list drawn by the Malaysian Forestry Department.

The group agreed also that the indicators to be looked at in priority should be those referring the following criteria:

situation and trends of forest resources
biological diversity
forest health and vitality
production of wood and forest products
soil and water protection
social and economic functions

Leaving aside the qualitative indicators related to the policy, legal and institutional frameworks.

The group reviewed first *Table II* listing the indicators of SFM at national level identified by these processes which were considered "most pertinent at regional and global levels" in the secretariat document, and came to the following recommendations:

Indicator	Recommendation
Area of forest Area of OWL	To be assessed by FRA 2000 – Efforts to be made to harmonize definitions
Area of forest by naturalness) (natural, semi-natural, plantations	To be assessed by FRA 2000 – (support to recommendation of WG 3 of 11 June)
Area of forest plantations by categories) of species (indigenous/exotic)	To be assessed by FRA 2000 – Attempts should be made to estimate success/survival rates by countries/groups of species
Forest areas converted to other uses (part of deforestation)	Change matrices as developed for tropical countries in FRA 1990 to be worked out for all regions in FRA 2000
Total forest biomass (above ground)	To be assessed by FRA 2000 – More research is needed to make estimates more precise
Total carbon stock in forest	To be derived from the previous indicator
Total volume of growing stock	To be assessed by FRA 2000 – Efforts to be made to harmonize definitions (minimum diameter !)
Change over time of total volume of GS	To be assessed by FRA 2000 – To be added to Peck's GFRA 5 table
Change over time of – Total forest biomass – Total carbon stock	To be derived from the previous indicator
Percentage of FOWL managed according to plans/guidelines	To be assessed by FRA 2000 – A strict definition of "managed"and "plans/guidelines"is required
Area of FOWL available for wood production	To be assessed by FRA 2000 – Efforts to be made to harmonize definitions

The group then reviewed the whole list of the 80 indicators of the four processes shown in *Table I* to check whether other indicators than those in *Table II* should be estimated by FRA 2000. ***It recommended that an attempt should be made by FRA 2000 to assess the following additional indicators**:*

- Area of forest by ownership
- Fragmentation of forests
- Biomass by forest types (broadleaved/coniferous, partly covered by Peck's table 5B)

- Area of forests in protected areas (according to IUCN classes)
- Area of FOWL brunt annually
- Change of defoliation over the past 5 years (if not in FRA 2000 then in successive assessments)
- Quantity and/or total value of harvested NWGS (to be confirmed or otherwise by WG2 of 12 June)
- Area of FOWL managed primarily for soil protection (same as above)
- Area of FOWL managed primarily for water protection (same as above)
- Area of FOWL managed primarily for tourism and amenity (same as above)
- Maintenance of cultural, social and spiritual values (same as above)

5.2. Participants

Mr P. Csoka (Hungary), Chair,

Mr J.P. Lanly (FAO), Rapporteur,

Mr M Amano (Japan), Mr E Cyrus (Costa Rica), Mr S. B. Mohamad Ismail (Malaysia), Mr A. Singh (UNEP), Mr A.I. Sletnes (Norway), Ms T. Veltheim (Finland), Mr D. Wright (G.B.), Mr I. Yobwa (Zaire).

Reconciliation

Work Group Report 6

The revised set of tables for the global framework were reviewed, taking account of suggestions by working groups. Recommendations: see Annex 2 of the main report (p. 45-49).

Participants

Mr H.G. Lund (USA), Chair
Mr K. Prins (FAO), Rapporteur,
Mr V.B. Ambia (Papua New-Guinea), Mr H. Bautista (Ecuador), Mr K. Janz (FAO), Mr T. Peck, Mr R. Penny (Australia), Mr V.Sosa Cedillo (Mexico).

Non Wood Goods and Services

Work Group Report 7

7.1 Background and Reference Documents

Non Wood Goods and Services are revelant for issues related to the global forest resources assessment. The group took full consideration of the background and following reference documents.

- Report of the Kotka-II meeting,
- WWF proposals (by Nigel Dudley and Chris Elliot),
- WCMC proposals (By Susan Iremonger),
- FRA-1990 (temperate zone), volume II,
- Helsinki criteria and indicators,
- Montreal criteria and indicators,
- IUCN and TRAFFIC papers.

7.2 Parameters

The following non wood products were listed :

- 1.food (incl. berries, fruits, sago etc.),
- 2. rubber, gum,
- 3. oil palms,
- 4. medicine,
- 5. forage/fodder,
- 6. chemicals.

The following non wood services were listed :

- 1. recreation,
- 2. protection (avalanche, erosion, water, shelter),
- 3. genetic resources and reserves,
- 4. tourism,
- 5. carbon storage/climate change,
- 6. homeland, shelter, living,
- 7. jobs, employment,
- 8. cultural and spiritual values,
- 9. nature conservation,
- 10. educational + research possibilities,
- 11. income generation,
- 12. aesthetic values, scenic beauty,
- 13. hunting, fishing,
- 14. grazing.

The group realised that some of these products and services may be overlapping, but may also be incomplete.

7.3 Recommendations

The products and services were then grouped into 7 major classes, of which the first 6 were considered relevant for the task assigned to the group. Any such simplification runs the risk of distorting the information; the group considered any further simplification would produce meaningless or partial results. The number of categories have been chosen to give a balance between providing a good approximation of the total picture and not making the research over-complicated for either the corrrespondents or end users.

Products:
- 1. Food and medicines: (product 1 3 and 4),
- 2. Fodder/forage(product 5),
- 3. Industrial extracts (product 2 and 6).

Services:
- 4. Protection (service 2,6),
- 5. Social and economic (services 1, 4, 7, 10, 11, 13 and 14),
- 6. Aesthetic, cultural, spiritual (services 8 and 12),
- 7. Biodiversity (services (3, 5 and 9).

Biodiversity was considered to have been taken care of already in other parts of the questionnaire. These elements will require further description in the questionnaire.

The group discussed if only quantitative data is to be acceptable or if qualitative data should be accepted as well. The group found that it is likely that very few countries will have quantitative data available. Some judgement of qualitative data will therefore be necessary. However, there is a high demand for information regarding NWGS. This leads the group to recommend that qualitative data must be accepted. However it is imperative that the countries can give very short descriptions. Long descriptions are unlikely to be able to be compiled or redistributed.

In order to compare between countries, it is essential to have an absolute scale. However, this is hard to define and the group therefore suggested the use of a relative scale and a very simple absolute scale; the latter does little more than identify the most and least important NWGSs.

Acquisition of information will be via questionnaires, existing data (such as that already collected by FAO and IUCN) and if possible through use of consultants.

We recommend that these issues are further discussed by the FAO/UNECE team of specialists on NWGS.

7.4. Participants

Mr N. Dudley (WWF), Chair
Mr E. Sollander (Sweden), Rapporteur
Mr. H.J.L Custers (Netherlands), Mr. S. Gueye (Senegal), Ms N. Hamza (France), Mr. A. Korotkov (ECE), Mr. Santoso (Indonesia), Mr. F. Schmitz (Germany).

Remote Sensing Applications and Adjustments

Work Group Report 8

8.1. Recommendations

8.1.1 Remote Sensing Applications

1. EROS-Data Center global maps can be used for the following purposes:

- Map showing forest cover within each eco-floristic zone
- Table that shows forest land area in each eco-floristic zone
- Table that lists area of different forest types (as provided by EROS data center) in each eco-floristic zone
- Try to analyze forest cover of protected area (assigned by IUCN) by overlaying protected areas and EROS maps.

2. Sample based approach in accordance with FRA 1990 should be extended to a global study combining multi-temporal low and high resolution date

- fragmentation analysis
- produce change matrices on the global, regional and sub-regional level and by eco-floristic zone

3. An expert panel should be set up that assists FAO/ECE in the development of methods for fragmentation analysis and sample based approaches.

8.1.2. Adjustments

1. Updating data to a common point in time and converting data to common definitions need further research and methodology development; at the moment the currently available techniques do not allow updating and conversion.

2 FAO/ECE provide definite guidelines and systems of nomenclature (definitions) with the questionnaires so that the countries can adapt their data to fit the requirements.

3. The time intervals to which the data submitted by individual nations relate have to be specified. The oldest data from individual

countries should not be older than 10 years.

4. The countries have to adjust their data as far as possible to the common definitions. They have to specify how the data were collected and adjusted. The countries have to specify if they submitted uncorrected data or if they made corrections according to the common definitions and reference period.

5. FAO/ECE presents national figures as provided by the individual countries and does not report any national figures adjusted by FAO/ECE.

6. FAO/ECE combines the national figures to regional and global figures. The national figures have to sum up to the regional/global estimates.

7. In addition FAO/ECE adds an indication of the reliability of the regional and global figures by quantifying an interval within which the "true" value is located with a certain probability. The interval should take into account all uncertainties according to deviations from FAO/ECE definitions, differences in assessment periods and differences in assessment methods.

8. The countries should provide an indication of the accordance of their data with respect to FAO/ECE standards, which will be utilized in estimating the "confidence" intervals.

9. The countries should be asked to develop or modify their inventory methods in way that they can provide results according to FAO/ECE standards. This requires that FAO/ECE keeps its own standards and definitions constant over time.

8.2. Participants

Mr E. Tomppo (Finland), Chair,
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Background Papers

Proposal for the Framework of the Global Forest Resources Assessment

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N.B. Part II of this paper, which is concerned with the temperate/boreal forest resources assessment 2000, including proposals for the framework, is contained in a separate document.

Introduction

1. The purpose of this paper, as defined in the Terms of Reference for its preparation, is to "*prepare a background paper to be presented to the Expert Consultation of Forest Resources Assessment to be held in Kotka, Finland, in June 1996. The paper should cover the traditional core areas of the Forest Resources Assessment and include relevant classifications and definitions. It should consist of the following two components:*

(1) final version of the 'draft framework for the Global Forest Resources Assessment 2000' (GFRA-2000);
(2) final version of 'draft framework for the Forest Resources Assessment 2000 for developed countries'."

2. More specifically, the paper should make concrete proposals for parameters to be included in GFRA-2000, including relevant classifications and definitions at (i) the global level; and (ii) for developed countries. The proposals should maintain to the largest possible extent comparability in terms and definitions with those used in earlier assessments. The paper should also identify remaining problems and indicate, to the extent suitable, options to solve them, for consideration by the Expert Consultation.

Background

3. Two steps were undertaken before proposals were prepared for the draft frameworks:

(1) Relevant documentation was reviewed, notably the FAO/ECE Assessments 1980 and 1990 (temperate zones) and the FAO

Forest Resource Assessment 1990 (global synthesis), the "Kotka-II" proposals and recommendations, and the work of the FAO/ECE Team of Specialists on Forest Resource Assessment 2000;

(2) The strong and weak features of the 1990 assessments (global and temperate/boreal) were identified, as well as the difficulties met and the missed opportunities in carrying out those assessments.

4. The first draft of this paper was discussed at the Second Meeting of the FAO/ECE Team of Specialists on Forest Resource Assessment, held in Geneva in April 1996. At that meeting comments were made on the draft proposals for the frameworks of the global and temperate/boreal forest resources assessments, which have been taken into account in the present document.

5. Further valuable assistance in preparing the document was provided by a sub-group of the Team of Specialists, consisting of Mr. Peter Csoka (Hungary), Mr. Eric Sollander (Sweden) and Messrs. Kit Prins and Alex Korotkov (Timber Section, ECE Trade Division); and by Mr. Klaus Janz (Forest Resources Division, FAO).

Review of relevant documentation

6. With the time and resources available, it may not have been possible to identify and review all relevant documentation. A list of some of the more important documents is given in Appendix 2. Recommendations and suggestions in these documents for the next forest resource assessment can be divided into a number of categories:

(1) concerning the *institutional aspects* (need for capacity-building, greater use of national correspondents, need for additional resources at national and international level, avoidance of duplication at the international agency level, etc.);
(2) concerning *general aspects* (increasing importance on non-wood functions, need to take account of international agreements such as UNCED, Helsinki and Montreal processes, need for streamlining, etc.);
(3) concerning *specific aspects* of the assessment (scope, coverage, terms, definitions, etc.).

7. Whilst not overlooking the institutional aspects (1), this analysis deals mainly with (2) and particularly with (3).

8. With regard to the *general aspects*, recommendations have been made on the following matters:

(a) more emphasis should be given to the *quality* of the data collected;

and consequently to concentrating, at least in global assessments, on a limited number of parameters;

(b) the basic *terms and definitions*, including those for forest land, other wooded land, standing volume, growing stock, biomass, fellings, removals, etc., should be agreed and applied by all countries to ensure global comparability; changes to terms and definitions should, however, be kept to a minimum in order to maintain *comparability with previous assessments*;

(c) more emphasis should be given to information about *the non-wood functions* of the forest, although recognizing the difficulty of obtaining quantitative data on these that are reliable and comparable;

(d) careful attention should be given to *the needs of information users* for internationally comparable data. It was generally recognized, however, that these needs had yet to be systematically analyzed and in any case may change over time, and therefore this gap should be closed as a matter of priority;

(e) more effort should be given to obtaining information on *changes over time*, especially in developed countries where this information is often inadequate;

(f) it would be desirable to distinguish *ecofloristic zones* in all regions, provided acceptable definitions could be agreed and applied;

(g) it would be desirable to present *geo-referenced information;*

(h) it would be desirable *to harmonize the year/period* (common reference year) to which countries' data applied in all regions: but adjustment of data by extrapolation from national data relating to another year/period should be the countries' responsibility, not the compilers';

9. Without attempting to be comprehensive, recommendations on more *specific aspects* included the following:

(a) a starting point should be universal agreement on terms and definitions for *forest* and *other wooded land* (consideration should be given to finding more appropriate terms for these);

(b) *among the elements to be included in the global assessment* should be: *forest cover* by area (with sub-categories*); forest use* by area (with sub-categories); *growing stock* (volume); *biomass* (mass); *forest resources available for wood production* (area); *forest condition* (forest health and forest damage) (presumably area); *indicators of environmental and other non-wood goods and services* (even if qualitative and not quantitative);

(c) distinguish between *coniferous, broadleaved and mixed* (it is assumed this means mixed coniferous and broadleaved) forest and other wooded land;

(d) incorporate parameters for*: sustainability; biodiversity; "quality*" (e.g. "authenticity", "naturalness"). It is recognized, however, that all these are difficult to define and measure. Other parameters that could be considered include site quality, stand density, economic accessibility, wood quality of growing stock, evaluation of the forest resource;

(e) *change data* should relate not only to *forest cover* but also to *forest use*, and include changes *between* categories of forest and other wooded land, e.g. between production forest and protection or conservation forest (terms not defined at this stage);

(f) data should be given on "*plantations*" (defined in the tropical FRA 1990 as stands established artificially by afforestation or reforestation, in the latter case involving the replacement of the previous crop by a new or essentially different crop);

(g) information should be provided about "*non-forest plantations*" that are potential sources of wood or have a potential carbon storage role in addition to their primary product (e.g. rubber, palm oil, fruits, nuts) or function (soil conservation, etc.). Such information should be given separately from that for forest and other wooded land;

(h) methods for quantifying *biomass* should be standardized.

10. No doubt the lists of recommendations in paras. 8 and 9 are incomplete, but they should be enough to provide a starting point for drafting recommendations on the framework of the global forest resources assessment 2000, especially when taken in conjunction with the brief evaluation below of the previous assessments. The recommendations need to be put in the context of the issues which they are intended to address, in order to assign priorities to them.

Evaluation of previous assessments

(1) Forest Resources Assessment 1990: Global Synthesis (GFRA-90)

11. This assessment combined the results of three separate assessments: tropical developing countries; non-tropical developing countries; and developed countries. The methods of assessment and the types of information collected were quite different. For the *developing countries* (tropical and non-tropical), the basic data published by FAO in table 3 of the GFRA-90 were as follows:

Land area (hectares)
  – Forest and other wooded land
    – Forest
      – Natural
      – Plantation
    – Other wooded land;

whilst for *developed countries*, the data published were:

Land area (hectares)
  – Forest and other wooded land

- Forest
  - Exploitable
  - Unexploitable
- Other wooded land.

12. Neither the set of information on natural and plantation forest in the developing countries, on the one hand, nor exploitable and unexploitable forest in the developed countries, on the other, provide the basic information about species groups, coniferous and broadleaved. It could be argued that this is more accurately shown in terms of growing stock or biomass, rather than area, however, this distinction is not even made in the tables in GFRA-90 showing growing stock and biomass data, where the following information for both developing and developed countries is presented in table 5:

Forest area (hectares)
Volume (cubic metres and cubic metres/ha)
Biomass (metric tons and m.t./ha).

13. Table 4 of the GFRA-90 also shows *change data* as follows:

For *developing countries*:

Status of forest and other wooded land in 1990 (hectares)
- Annual change 1980–1990 (hectares and per cent)
- Status of natural forest in 1990 (hectares)
  - Annual change 1980–1990 (hectares)
- Status of plantations in 1990 (hectares)
  - Annual change 1980–1990 (hectares);

and for *developed countries*:

Status of forest and other wooded land in 1990 (hectares)
- Annual change 1980–1990 (hectares and per cent).

14. For the *developing countries*, FAO used a combination of remote sensing and ground observation techniques, as well as available statistical information (literature services) to provide a consistent set of data on change, which also allowed changes between different categories of land cover to be recorded (closed forest, open forest, long fallow, fragmentation forest, shrubs, short fallow, other land cover, water, plantations, and total). For the *developed countries*, FAO/ECE depended on change data provided by the countries themselves and asked only for changes between forest and other wooded land (FOWL)in total and non-forest land (total increase in FOWL, total decrease in FOWL and net change). The results were not consistent and of variable quality.

15. In brief, it can be said that among the major drawbacks of GFRA-90 were:

- the lack of comparability in the basic data between the developing and developed countries. This problem existed because of differences both in the definitions used and in the parameters reported on;
- the absence of data on species groups (coniferous and broadleaved);
- the unsatisfactory quality of the data on area change for the developed countries.

16. It may also be questioned whether the information in the tables of GFRA-90, supplemented by that given in the text, which is more specific to regions or sub-regions and therefore not intended to be universally comparable, is enough for the purposes for which globally comparable information is needed. This cannot be answered without a clearer idea of who are the users of such information and what are their information needs. Some indications are provided in the reports and recommendations of various bodies (see list of references), although these are of a rather general nature and do not necessarily take into account the "collectability" of the information called for. This is the case, for example, with information relating to forest sustainability and biodiversity.

17. Any improvement in comparability must start with internationally common terms and definitions of the basic elements of the assessment: *forest and other wooded land*, and its main components: *forest* and *other wooded land*. For the assessments of the tropical and temperate *developing* countries, the following definition of *forests* was used:

> *Forests are ecological systems with a minimum crown coverage of land surface (here assumed as 10 percent) and generally associated with wild flora, fauna and natural soil conditions; and not subject to agronomic practices. For the present assessments, a tree is defined as a woody perennial with a single main stem (except in coppice crops where multiple stems replace a single stem), a more or less definite crown and a minimum height of more than 5 metres on maturity. Only forest areas of more than 100 ha (minimum area) are considered. Forests are further subdivided according to their origin into two categories:*
>
> *i) Natural forests are a subset of forests composed of tree species known to be indigenous to the area;*
> *ii) Plantation forests (which) refer to:*
> *a) Forests established artificially by afforestation on lands which previously did not carry forest within living memory;*
> *b) Forests established artificially by reforestation of land which carried forest before and involving the replacement of the indigenous species by a new and essentially different species or genetic variety.*

18. For *developed* countries, the definition of *forest* was as follows:

> *Forest land: with tree crown cover (stand density) of more than*

about 20 percent of the area. Continuous forest with trees usually growing more than 7m in height and able to produce wood. This includes both closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground and open forest formations with a continuous grass layer in which tree synusia cover at least 10 percent of the ground.

Included are:

a) All plantations, including one-rotation plantations, primarily used for forestry purposes ("forestry" being broadly defined as activities related to the production of wood and other goods and services of the forest);
b) Small areas normally forming part of the forest area which are unstocked as a result of human intervention or natural causes but which are expected to revert to forest;
c) Young natural stands and all plantations established for forestry purposes which have not yet reached a crown density of more than 20 percent;
d) Forest roads, cleared tracts, firebreaks and other small open areas, as well as forest nurseries that constitute an integral part of the forest;
e) Forests in national parks, nature reserves and other protected areas such as those of special scientific, historical or cultural interest;
f) Areas of windbreak and shelterbelt trees larger than 0.5 ha in extent.

Excluded are:

a) "Trees outside the forest" (as separately defined);
b) Areas not meeting the conditions of forests as described above, even if administered by a Forest Authority.

19. Features where there are important differences between the definitions include: *the minimum crown cover; minimum tree height; and minimum area.*

20. The definition of *other wooded land* is particularly important as it marks the dividing line *between forest and other wooded land* and *other land.* That used for *developing* countries was:

Other wooded land includes the following two categories:

I) Forest fallow refers to all complexes of woody vegetation deriving from the clearing of natural forest for shifting agriculture. It consists of a mosaic of various succession phases and includes patches of uncleared forests and agricultural fields which cannot realistically be segregated and accounted for area-wise, especially from satellite imagery. Forest fallow is an intermediate class between forest and nonforest land uses. Part of the area *which is not under cultivation may have the appearance of a secondary forest. Even the part currently under cultivation sometimes has the appearance of forest, due to the presence of tree cover. Accurate separation between forest and forest fallow may not always be possible;*

ii) *Shrubs refer to vegetation types where the dominant woody elements are shrubs of more than 50 cm and less than 5 metres height on maturity. The height limits for trees and shrubs may be interpreted with flexibility, particularly where the minimum tree and maximum shrub heights may vary between 5 and 7 metres approximately.*

21. For *developed* countries, *other wooded land* was defined as follows:

> *Land which has some forestry characteristics but is not forest (as defined in para. 18 above). It includes: open woodland and scrub, shrub and brushland, whether or not used for pasture or range. It excludes land occupied by "trees outside the forest" (as elsewhere described). "Open woodland" is land with tree crown cover (stand density) of about 5–20 percent of the area. "Scrub, shrub and brushland" is land with scrub, scrub or stunted trees where the main woody elements are shrubs (usually more than 50 cm and less than 7 m in height), covering more than about 20 percent of the area, not primarily used for agricultural or other non-forestry purposes, such as grazing of domestic animals.*

22. An important consideration raised in the definition for developing countries is the expanding use of satellite imagery, and the possibilities or difficulties for distinguishing between land categories on satellite photos. Neither set of definitions makes a clear distinction between *forest cover* and *forest use*.

(2) *The Forest Resources of the Temperate Zone: Volume I – General Forest Resource Information* (FRA(TZ)-90) (UN-ECE/FAO, 1992a)

Proposal for a draft framework for the global forest resources assessment 2000 (GFRA-2000)

23. Underlying the proposal are the following principles, which may be taken as the criteria for the selection of the attributes to be included in the framework:

1) comparability should be retained to the fullest extent possible with previous assessments, particularly the 1990 one;
2) the information requested can be assessed with the available tools at acceptable cost;
3) the proposal should be restricted to what is considered necessary to collect at the international level;

4) it should be based on internationally acceptable terms and definitions, in order to allow comparison between countries;
5) it should follow as far as possible the recommendations of "Kotka II" with regard to classification and definitions;
6) the framework should be sufficiently robust that it should not require major alterations for subsequent assessments.

24. The Expert Consultation on Forest Resources Assessment 2000 ("Kotka III") should consider whether these principles can be accepted; and, if not, adapt them as necessary and then examine and make changes to the proposed framework on the basis of the agreed principles.

1. Classification and definitions for the global assessment

25. It is proposed that the classification for the global forest resources assessment 2000 is presented under six main headings:

1. Land cover and use
2. Forest land ownership
3. Forest land by main ecofloristic zones
4. Changes in forest land area over time
5. Above-ground tree and other woody biomass
6. Fellings.

26. Where possible, the definitions being proposed for use in the global assessment are taken from those in FAO's *"Towards a common framework for world forest resources assessments"* (FAO, 1989); its *"Forest resources assessment 1990: Global synthesis"* (FAO, 1995b); or the recommendations from "Kotka II", *"Proceedings of FAO/ECE Meeting of Experts on global forest resources assessment"* (Nyyssönen, 1993). Account has also been taken of other more recent work, including that of the first and second meetings of the FAO/ECE Team of Specialists on Forest Resources Assessment 2000.

27. The proposals for the classification, terms and definitions to be used in the global forest resources assessment 2000 are set out in full in Appendix 1.

2. Classification and definitions for the temperate/boreal assessment (see separate document)

Comparisons with 1990 assessments

28. Among the important recommendations for the Assessment 2000 was one that it should be streamlined and simplified, compared to the

1990 assessment; and that the introduction of new elements should not be at the expense of the traditional core subject of the Assessment.

1. Global forest resource assessment 2000

(I) *Streamlining and simplification*

29. The GFRA-90 contained only a small number of elements, far smaller, in fact, than in earlier FAO assessments. This meant that the scope for streamlining was virtually non-existent. However, the separation of forests into natural and plantations, given for the developing countries in GFRA-90, has been dropped, because it is not felt to be universally applicable (this could of course be retained in the regional assessments for developing countries). The main simplification has been to ensure that the core information collected for the developing countries and the developed countries would be the same, which was not altogether the case in GFRA-90.

(ii) *Introduction of new elements*

30. It is being proposed to introduce the following new elements:

- Separate the area of forest land into (i) that available for wood production; and (ii) that not available for wood production;
- Separate forest land available for wood production by species groups (coniferous, broadleaved, other, mixed);
- Forest land and other wooded land not available for wood production should each be divided into (i) that which is legally protected, and (ii) other;
- Give separate information on publicly and privately owned forest land;
- Add elements on ecofloristic types (only available for developing countries in GFRA-90);
- Add elements on change in forest land area to show the type of change, such as that in forest land available for wood production according to indigenous and introduced species, and in forest land not available for wood production according to whether it is legally protected or not;
- Add volume of growing stock on forest land for the species groups: coniferous, broadleaved and others;
- Separate data on mass of tree and other woody biomass between growing stock on forest land, other above-ground tree biomass and other above-ground woody biomass; and add elements on species groups for mass of growing stock on forest land;
- Add elements on fellings.

31. It may be felt that these additions do not go far enough in responding to the recommendations to include information on, e.g. biodiversity, sustainability, and non-wood goods and services. It

should be recalled, however, that the mandate for this paper is to deal with the "traditional" sectors of forest resources assessments. Furthermore, these considerations will be taken up under other items of the Expert Consultation's agenda, when it will also need to be considered whether the possibility yet exists for the collection of such data on a globally consistent basis.

2. Temperate/boreal assessment (see separate document)

Conclusions

32. The Expert Consultation will be invited to agree on the framework for the Global Forest Resources Assessment 2000, including the criteria for the selection of attributes, classification, terms and definitions. This paper offers proposals for the "traditional" components of the framework, which may be used as a basis for its discussions and decisions. Before doing so, the Consultation should first agree on the criteria for establishing the framework, which were set out in para. 23, particularly comparability with previous assessments, limitation of the number of attributes to those that are strictly needed at the international level, and the international acceptability of the terms and definitions.

33. Among the key matters for the Expert Consultation to address are:

1) Terms and definitions for, and hence the distinction between, *forest land* and *other wooded land*;
2) Terms and definitions for, and hence the distinction between, *forest land available for wood production and forest land not available for wood production*;
3) Whether to include information *on forest land by main ecofloristic zones*, and if so, the relevant terms and definitions;
4) Criteria, notably minimum top and breast height diameter and the inclusion of branches, for defining and measuring *growing stock*; and, in order to maintain internal consistency, also *fellings*;
5) Whether information on *increment* should be excluded from the global assessment;
6) What should be the procedure to adjust national data to a *common reference year or period and assess changes over time in a reliable manner*?;
7) Whether, for information *on changes over time*, the proposed approach to compare data between the latest and previous assessment periods will provide satisfactory results, especially in the developed countries; if not, whether there is a better alternative.

Appendix I

Framework for the global forest resources assessment 2000

Table GFRA – 1

Land cover and use (area)

Purpose: To provide information on: the share of forest and other wooded land (FOWL) in countries' total land area; the areas of the main categories of FOWL; the species distribution of forest land available for wood production; the areas of FOWL that are legally protected.

Country:_________________________ Assessment period:_________________________

Total area
  – Inland water
  – Land area
    – Forest and other wooded land
      – Forest land [1]
        – Available for wood production [2]
          – Predominantly coniferous
          – Predominantly broadleaved
          – Predominantly bamboo, palms, etc.)
          – Mixed
        – Not available for wood production [2]
          – Legally protected
          – Other
      – Other wooded land [1]
          – Legally protected
          – Other
    – Other land

Notes:

1. *Objections have been raised to the terms "forest (land)" and "other wooded land" used in previous assessments (Nyyssönen, 1993; Kuusela, 1994). No alternatives that can be considered more satisfactory have been put forward, however. It is proposed to retain the original terms for the sake of continuity.*

2. *"Forest land available for wood production" is comparable with "exploitable forest (land)" used in the 1990 assessment of the temperate zones (FRA(TZ)-90); and "forest land not available for wood production" is comparable to "unexploitable forest" in that assessment.*

Terms	Definitions
Assessment	**The year or years during which the national forest period inventory or other method of data collection was carried out.**
Total area	**Total area of country, including area under inland water bodies.**
Inland water	**Area occupied by major rivers, lakes and reservoirs.**
Land area	**Total area excluding inland water.**
Forest land	**Land under natural or planted stands of trees (see definition) with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 ha, whose primary use is forestry (see definition). The trees should be able to reach a minimum height of 5 m at maturity *in situ*.** *Includes*: closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground and open forest formations with a continuous vegetation layer in which tree crown cover exceeds 10 percent; plantations primarily used for forestry purposes, including rubberwood plantations and cork oak stands; areas normally forming part of the forest land area which are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to stocked forest; young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 10 percent; forest roads, cleared tracts, such as firebreaks and other small open areas, as well as forest nurseries that constitute an integral part of the forest land; forest land in national parks, nature reserves and other protected areas such as those of specific environmental, scientific, historical, cultural or spiritual interest; windbreaks and shelterbelts of an area of more than 0.5 ha and width of more than 20 m.
Tree	**A woody perennial with a single main stem, or in the case of coppice with several stems, having a more or less definite crown**. *Includes*: bamboos, palms and other plants meeting the above criterion.
Forestry	**Activities related to the management of forest and other wooded land for the production and supply of wood and/or other goods and services of forest and other wooded land.**
Other wooded land	**Land which serves some of the purposes of forestry, land either with crown cover of 5–10 percent of trees able to reach a height of at least 5 m at maturity *in situ*; or crown cover of more than 20 percent of trees not able to reach a height of 5 m at maturity *in situ*; or with shrub or bush cover of more than 20 percent.**

Shrubs and bushes	**Woody perennial plants, generally of more than 0.5 m and less than 5 m in height and without a definite crown.**
Trees outside the forest	**Trees on land not defined as forest and other wooded land.** *Includes*: trees on land that fulfils the requirements of forest and other wooded land except that the area is less than 0.5 ha; trees able to reach a height of at least 5 m at maturity *in situ* where the stocking level is below 5 percent; trees not able to reach a height of 5 m at maturity *in situ* where the stocking level is below 20 percent; scattered trees in permanent meadows and pastures; permanent tree crops such as fruit trees and coconuts; trees in parks, and gardens, around buildings and in lines along streets, roads, railways, rivers, streams and canals; trees in shelterbelts of less than 20 m width and 0.5 ha area.

Note:

> *It will be necessary to examine carefully whether the above definitions provide sufficiently clear and workable distinctions between (i) forest land* and other wooded land; and (ii) *between forest and other wooded land and other land. Regarding (i), the main criteria are the percentage (more or less than 10 percent) of trees able to reach a height of at least 5 m at maturity* in situ *and an area (more or less than 0.5 ha). Whether the distinction in (ii) is clear depends on whether the term trees outside the forest needs to be more precisely defined. In particular, it needs to be decided whether forest land and other wooded land of less than 0.5 ha should be excluded from forest and other wooded land, as is proposed here, as was the case in FRA(TZ)-90 (described as "small woodlots of less than 0.5 ha").*

Forest land available for wood production	**Forest land where any legal, economic or environmental restrictions do not have a significant impact on wood production (including cork).** *Includes*: areas where, although there are no such restrictions, harvesting is not taking place, for example areas included in long-term utilization plans or intentions.
Forest land not available for wood production	**Forest land where legal, economic or environmental restrictions do have a significant impact on wood production (including cork).** *Include:* (a) forest land with legal restrictions which totally exclude or severely limit wood production, *inter alia* for reasons of environmental and biodiversity conservation, e.g. national parks, nature reserves and other protected areas such as those of special environmental, scientific, historical, cultural or spiritual interest; (b) forest land where physical productivity or wood quality is too low or harvesting and transport costs to the nearest market are too high to warrant wood harvesting, apart from occasional cuttings for auto-consumption.

Coniferous	**All trees classified botanically as *Gymnospermae***
Predominantly coniferous forest	**Forest land on which more than 75 percent of the tree crown cover consists of coniferous species.**
Broadleaved	**All trees classified botanically as *Angiospermae*.** They are sometimes referred to as non-coniferous.
Predominantly broadleaved forest species.	**Forest land on which more than 75 percent of the tree tree crown cover consists of broadleaved species.**
Predominantly bamboos, palms, etc.	**Forest or other wooded land on which more than 75 percent of the tree crown cover consists of species other than Gymnospermae or Angiospermae.** Species include tree-form members of the bamboo (*Gramineae*), palm ( ), fern ( ), families, etc.
Mixed forest	**Forest land on which neither coniferous, nor broadleaved land nor other species groups account for more than 75 percent of the tree crown area.**
Other land	**Land not primarily used for forestry purposes.**

Table GFRA-2

Forest land ownership (area)

Purpose: To provide information on the structure of the public and private ownership of forest land.

- Forest land [1]
  - Available for wood production
    - Publicly owned
    - Privately owned
  - Not available for wood production
    - Publicly owned
    - Privately owned

Table GFRA-3

Land in the main ecofloristic zones (area)

Purpose: To provide general information on the area of land in the different ecofloristic zones.

- Land area
  - In the tropical rainforest zone
  - In the tropical moist deciduous forest zone
  - In the tropical dry deciduous forest zone
  - In the tropical very dry deciduous forest zone
  - In the tropical desert zone
  - In the tropical hill and montane zone
- Other tropical and sub-tropical forest land
  - Dry (Mediterranean-type) temperate forest land
  - Temperate forest land
  - Boreal forest land

Note:

1. *Attributes which are shaded in this and subsequent tables have already appeared in previous ones.*

Terms	Definitions
Publicly owned	Belonging to State or other public bodies. The State *includes* national and regional governments. Other public bodies *include* municipalities, communities,government-owned corporations, indigenous peoples' councils.

Privately owned	Owned by: private individuals, families, co-operatives or corporations engaged in agriculture or other occupations as well as forestry; private forest (wood-processing) industries; private corporations and other institutions (religious, educational, pension or investment funds, etc.).
Tropical rainforest zone	Tropical rainforest zone alias wet zone is representing lowlands with pluvial regime (more than 2000 mm/yr of rain);
Tropical moist deciduous forest zone	Tropical moist deciduous forest zone alias moist zone is representing lowlands with tropical moist regime (1000–2000 mm/yr of rain with a short – less than 3/4 months – dry season);
Tropical dry deciduous forest zone	Tropical dry deciduous forest zone alias dry zone is representing lowlands with tropical moist regime (1000–2000 mm/yr of rain with a long – more than 6/7 months – dry season);
Tropical very dry deciduous forest zone	Tropical very dry deciduous forest zone alias very dry zone is representing lowlands with tropical dry regime (500–1000 mm/yr of rain);
Tropical desert zone	Tropical desert zone is representing lowlands with less than 500 mm/yr of rain;
Tropical hill and montane zone	Tropical hill and montane zone represents lands within the altitude range of 1000–3000 meters. Due to their relative small size (on a pantropical scale) the rainfall regime is not considered for further breakdown;
Other tropical and sub-tropical forest land	Land not included in any of the other zones specified.
Dry (Mediterranean-type) forest lands	Forest land characterized by evergreen and clerophyllous tree species ssociated with dry, hot summers.
Temperate forest land	Forest land with predominantly broadleaved, mixed and on certain sites, e.g. higher elevations, coniferous tree species associated with mild or cool climatic conditions and precipitation around the year.
Boreal forest land	Forest land in the northern latitudes with predominantly coniferous tree species associated with harsh winter conditions and short growing seasons.

Table GFRA-4

Changes in forest land area over time

Purpose: To provide information on the changes in the area of the main categories of forest land over a given period and on the main components of the changes.

A. Forest land in latest and previous assessment periods (area)

	Latest period [1]	*Previous period* [1]
	(.........)	(.........)
– Forest land		
– Available for wood production		
– Indigenous species		
– Introduced species		
– Not available for wood production		
– Legally protected		
– Other		

B. Changes in forest land area

(average annual change in area between assessment periods)

- Net change between assessments periods [2], being a combination of:
  - Total decrease in forest land
  - Total increase in forest land
    - Man-made forest, including plantations
    - Natural extension

Note:

1. *The definition of assessment period is given with table GFRA-1. It is assumed that the data given in this table for the latest period correspond with those given in other tables of the enquiry, being the latest available. It is important that the year or years of the assessment periods be shown. Unless otherwise indicated, it will be assumed that the last year of the assessment period (e.g. 1995 in the case of an assessment period of 1990–1995) is taken when calculating changes over between one period and the other.*

2. *Change should be recorded as the annual average over the period between the previous and latest assessments. It is suggested that the period between the two assessments is sufficiently long, e.g. a minimum of five years, in order to obtain a reliable indication of the long-term rate of change. It is essential that the definition of the attributes is identical for the two assessment periods.*

Terms	Definitions
Indigenous species	**Tree species or genotypes which have evolved in the same area, region or biotope where the forest stand is growing and are adapted to the specific ecological conditions predominant at the time of the establishment of the stand.** May also be termed autochthonous species or native species.
Introduced species	**Tree species occurring outside their natural biotope, area or region.** May also be termed non-indigenous species or exotic species.
Total decrease in forest land	Consists of two elements: (i) Complete loss of tree cover and transfer of the forest land to other uses than forestry or to no identifiable use during the time between the two assessment periods; (ii) Degradation of the forest during the time between the two assessment periods to a point where tree crown cover falls below 10 percent and the land thus becomes classified as "other wooded land".
Total increase in forest land	Consists of two elements: (i) Establishment of new forest during the time between the two assessment periods on land previously classified as "other land" as a result of silvicultural measures (e.g. afforestation) or natural extension (see definition); (ii) Up-grading of other wooded land into forest land during the time between the two assessment periods as a result of silvicultural measures or natural regeneration, including restoration after shifting cultivation.
Man-made forest, including plantations	**Forest established during the time between the two assessment periods resulting from silvicultural measures including tree planting and seeding.** *Excludes*: Areas of other wooded land established by silvicultural measures on former other land.
Natural extension	**Forest created during the time between the two assessment periods resulting from natural seeding (self-sown seed), sprouting, suckering or layering.** *Excludes*: Areas of other wooded land established on former other land by natural extension.

Table GFR -5

Above-ground [1] tree and other woody biomass and growing stock

Purpose: To provide information on the volume (for forest land only) and mass of tree and other woody biomass, thereby indicating the role played by this major part of the forest ecosystem in carbon sequestration and storage.

A. Volume [2] of tree biomass on forest land (volume overbark)

- Above-ground growing stock on forest land [3]
  - Coniferous
  - Broadleaved
  - Other (bamboos, palms, etc.)

B. Mass of above ground biomass on forest and other woodedland and trees outside the forest (m.t. oven-dry)

- Total above-ground tree and other woody biomass
  - Above-ground growing stock on forest land [3]
    - Coniferous
    - Broadleaved
    - Other (bamboos, palms, etc.)
  - Other above-ground tree biomass
  - Other above-ground woody biomass

Notes:

1. *Consideration may be given to whether to add below-ground woody biomass (stumps and roots) in order to obtain a figure, even if approximate, of total carbon storage in tree and woody biomass. To do so would require the availability of acceptable factors with which to convert above-ground biomass to total tree and woody biomass.*
2. *Volume data were not included in the Global Forest Resources Assessment 1990. It is proposed that they are in the GFRA-2000, at least for growing stock on forest land. Apart from being valuable information in themselves, these data are generally the starting point for the calculation of biomass data in oven-dry metric tons by use of appropriate conversion factors.*
3. *The volume and mass of above-ground growing stock on forest land relate to precisely the same attribute but are expressed in different units (m^3 o.b. in part A. of the table and m.t. o-d. in part B.)*

Terms	Definitions
Above-ground tree and woody biomass	**Mass of the above-ground woody part of trees, shrubs and bushes (wood, bark, branches, twigs).** *Excludes*: stumps and roots (below-ground biomass), foliage, flowers and seeds.
Growing stock	**Above-ground volume (or mass) of living trees with stems above a top and breast height diameter of 7 cm.** *Excludes*: dead trees, standing or lying on the forest floor.

Note:

> *Attempts to obtain international agreement on standard minimum diameters for the measurement of growing stock (as well as of standing volume and increment, which it is proposed should not be covered by the GFRA-2000), have been unsuccessful in the past. In the developed countries, 7 cm is the most commonly used minimum diameter, both for top and at breast height, and it is proposed that this is used for the GFRA-2000. A possible alternative might be 0 cm diameter, which is used in a few countries or 10 cm diameter, which is used in many tropical countries.*

Other above-ground tree biomass	**Above-ground biomass of all trees, living or dead, on forest and other wooded land and trees outside the forest, other than that of the growing stock on forest land.** *Includes*: parts of those trees included under growing stock on forest land that are of less than 7 cm diameter.
Other above-ground woody biomass	**Above-ground biomass of shrubs and bushes on forest and other wooded land.**

Table GFRA-6

Fellings

(Annual average during assessment period)

Purpose: To provide information on the volume of wood being cut annually as an indicator of the intensity of the wood utilization function of the forest resource [1].

- Total fellings (volume overbark)
  (on forest and other wooded land and trees outside the forest)
  - On forest land available for wood production
    - Coniferous
    - Broadleaved
    - Other (bamboos, palms, etc.)
  - Other fellings

Question: Do the fellings data conform with the definition given below, namely measured to a minimum diameter of 7 cm? [2]

YES/NO

If NO, please state the definition used and estimate the volume of fellings of more than 7 cm diameter:

....

....

....

Total fellings of > 7 cm diameter ....m³ overbark

Fellings of > 7 cm diameter on forest land available for wood production ....m³ overbark

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Notes:

1. *It would have been useful to collect data on Net Annual Increment (NAI) with which to compare fellings and growing stock data, in order to obtain an indicator of the forest balance. However, NAI figures are not available or not reliable in many countries, notably those with extensive areas of still natural or unused forests. It is proposed therefore not to include a question on NAI in the global assessment. Fellings data will nevertheless be valuable as an indicator of harvesting intensity when compared with area and growing stock, notably for forest land available for wood production.*
2. *Especially in the case of fuelwood and other wood harvested for household or agricultural use, large quantities of fellings are of less than 7 cm diameter. Consideration should be given to whether a minimum diameter should be specified (see definition below). The reason for proposing a minimum diameter for fellings is to retain comparability with other attributes, such as growing stock and NAI, although for the purposes of the global assessment, this may be deemed unnecessary.*

Terms	Definitions
Fellings	**Volume of all trees, living or dead, to a minimum diameter of 7 cm that are felled during a given period, whether or not they are removed from the forest, other wooded land or other felling site.** *Excludes*: felling residuals which are left in the forest or other wooded land or at felling site and are not salvaged at the time of felling or later ("unrecovered fellings"); silvicultural and pre-commercial thinnings and cleanings of less than 7 cm diameter, whether left in the forest or not.

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Appendix III Symbols

cm	centimetre
ha	hectare
m	metre
m^3	cubic metre
m^3 o.b.	cubic metre, overbark
m^3 u.b.	cubic metre, underbark
m.t. o-d.	metric ton, oven-dry

Proposals for Parameters Regarding Environmental Aspects and the Quality of Forest Resources and Forest Management for the Forest Resources Assessment 2000

Prepared by WCMC under contract from FAO.

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1. Introduction

1.1. Background

As we approach the end of the 20th century we are aware of the vast changes that have taken place in the last 100 years, and wonder what waits the world after the year 2000. Global population levels are higher than ever before: in terms of density there were about 12 people per km^2 of land surface on the globe in the year 1900; in the year 2000 there will be 48 people per km^2 (WRI, 1994, IIASA, 1994; UN Population Bureau 1994). Natural land cover has been converted by this massive human population into intensive agriculture and cities, both to feed the growing population and to satisfy the consumer demand for other goods and services. Alongside this process has been a concurrent increase in technological knowledge, which has allowed productivity levels from farming that dwarf former maximum productivity. This knowledge has also given us insight into the processes underlying the sustainability of life on this planet, and this has brought about the realization that present trends of population increase and land conversion cannot continue. So urgent and pertinent has this issue become that a number of major international initiatives are currently underway to attempt to pull the earth back from the ultimate conclusion of present trends.

One of the major issues in the conversion of land from its natural state is the process of forest decline and change. Forests have a major role in the maintenance of global climate stability, including the balance of the cycles of the essential elements of life: oxygen, carbon, hydrogen and nitrogen, among others. International initiatives (such as UNCED, the CBD, the CSD, Agenda 21 and the Helsinki and Montreal Processes) are demanding a concerted effort on the part of national governments and international bodies, specifically to control the decrease in global forest cover and quality. Signatory governments to these initiatives are bound by law to aid and contribute to the initiatives to the best of their respective capacities. The process is experiencing some growing pains, however, in that the requirements defined by the initiatives (e.g., the Helsinki and Montreal processes on criteria and indicators of sustainable forest management) may exceed the capacities of the national forest departments. This issue is being addressed by UN agencies, which are currently involved in capacity-building programmes.

FAO has been instrumental in gathering and disseminating information on the world's forest resources since it first published a Forest Resources Assessment (FRA) in 1948. To date there have been six of these, the last two having the reference years of 1980 (FAO, 1988) and 1990 (FAO, 1995) (Singh and Janz, 1994). Because of the increased interest in the forest resource (above), FAO has been under pressure to expand the scope of their FRA for the year 2000. A number of particular recommendations have been made, the major ones being to (a) harmonize the data between countries and regions so that they are directly comparable, and (b) expand the scope of the assessment to include the non-wood aspects of forest services, goods and benefits. The difficulties with the former have principally arisen because of the different methods of data collection for the industrialized countries and the less developed countries. In part these differences were due to the different reporting capacities of the regions, in part to the different sources of funding for the two studies. The second requirement has come about because in the past the FRAs were mainly concerned with reporting timber statistics, and did not systematically include many of the other functions and products of forests, of which the global community is now much more acutely aware.

With the massive increase of the human population and the inverse growth in forest cover and condition, the global community has initiated a movement to promote the sustainable use of forests. According to Woodwell (1993), the maintenance of forest cover at between 75–90% of present cover is probably necessary to sustain global systems. For temperate and boreal regions there have been the Helsinki and Montreal processes, which have established lists of criteria for sustainable forest management, and indicators to be used to monitor the criteria. European countries are bound by law to follow the guidelines established by the Helsinki protocol; the other temperate and boreal regions of the world are part of the Montreal process, but this is not yet a legally binding instrument. ITTO has drawn up some guidelines for criteria and indicators of sustainable management in the tropics. Sustainable management often infers the utilization of more benefits of the forest resource than just timber. Some studies have shown that in this way the forest system is more productive, over a longer period (truly sustainable management would mean an indefinite period of use), than if the forest were clear-cut for timber alone and then used for agriculture (Peters et al., 1989; Swanson, 1991). The returns from the latter often appear higher because the subsidies afforded to farmers/forest logging companies occlude the true economic yields of the land (Pearce and Moran, 1994).

The vision of the FRA 2000 is of a more holistic view of forests which will give an insight into the global state of forest systems, their composition and function. Through creating a global picture of forests, FAO will enable each nation in the world to see itself as a piece in the global biospheric system, to see its forests as a resource to be valued not only for timber production and trade but also as the source of the water that gives life to the human population, a provider of fuel, fibre and shelter materials as well as a variety of foodstuffs, a facility for recreation and relaxation, and the refuge for rare and endangered species (particularly those unique to that country, for which the nation thus bears ultimate responsibility). It will be apparent that no country is functioning as an isolated unit, and the water, wildlife and even the weather systems are influenced by land use policies and practices of neighbouring countries and even by nations on other continents.

A principal concern for the FRA 2000 is to provide data on forest type and distribution. In the past this has been done to varying degrees and not in a harmonized manner across the globe. The reason that the identification of forest type has become such an issue is that it helps to clarify the aspects of forest function and forest benefits most difficult to quantify: the non-wood parameters. Forest type determines its standing biomass, its contribution to carbon sequestration, the role it plays in re-cycling the earth's water resources, the non-wood products it can afford to a nation and the variety of biodiversity that it supports. In addition to species composition of the forest, its dominant trees and the physiographic location (upland, swamp), the stage of growth of the trees will all influence aspects such as how much water is being transpired. This will be particularly relevant in an even-aged plantation forest. To address the biodiversity issues in particular, the naturalness of the forest is important, as is forest patch size. Ideally forest patches set aside for nature conservation should be large enough to perpetuate all species that are a natural part of the system. This means that the forest must contain a population of each species that is large enough, and that has a gene pool large enough, to ensure the healthy propagation of the species indefinitely. In many areas this is no longer possible because the forest fragments are too small or too impoverished to thrive on their own. However, modern techniques of forest and protected areas management can help, for example by providing links between the forest fragments that allow for species mobility and communication.

1.2. General methodological developments for the FRA

The purpose of this paper is to identify the major additional parameters which will need to be quantified or otherwise depicted in the assessment, and how FAO could go about obtaining these data. Among the major issues are the following aspects of forest systems: biodiversity and nature conservation, non-wood forest products, watershed protection, forest quality, health and management, sustainability, biomass and carbon sequestration. These issues have already been addressed by teams of specialist which were gathered together in two meetings: (a) in Nairobi, from which a very comprehensive report with numerous recommendations for FAO was produced (UNEP/FAO, 1993), and (b) in Kotka, from which a report was produced with recommendations which built upon those made at the previous meeting (Nyyssönen, 1993). The present paper assesses the recommendations made at these meetings, makes some amendments needed because of progress made on certain issues (e.g., world forest cover data from remote sensing), and prioritises the parameters for the purposes of the FRA 2000.

The data-gathering and data-managing processes and methods that FAO currently uses for its FRA studies will need to be re-examined and possibly re-structured. This has been suggested already in FAO reports (FAO, 1996; Lorenzini, 1996). It will definitely need to include making strong links and platforms for data interchange with a number of organisations and agencies not currently a part of the regular programme. FAO, however, is in the strongest position to make these links: it has an international mandate to gather the forest statistics from each nation and to produce a global synthesis. This has been reinforced by recent statements by the Intergovernmental Panel on Forests and other international fora. It has been suggested that the UN agencies should designate one central data-gathering centre to which all governments send all their statistics related to natural resources. This would simplify the procedure for the national governments, thus probably enhancing the response rate to questionnaires (Lund, pers. comm., 1996).

At a meeting of experts on the monitoring and management of the global environment which examined in particular environmental information needs (WRI, 1993), problems of integrating and harmonising data were highlighted. Particular problems flagged were the differences in geographical unit which ecological and sociological data are collected: the former often according to a natural unit such as a watershed, the latter according to political and administrative boundaries.

In its effort to broaden the scope of the FRA, FAO should concentrate on three important areas: (a) the official national reporters, (b) the regional and national FAO employees and (c) the other international data-gathering bodies which deal with information relevant to forests. The first two categories should be made fully aware, possibly even by written guidelines, that items in the FAO questionnaires for the FRA will need their collaboration with departments outside of the forestry sector, in particular the department dealing with nature conservation. Further regional investigations will be needed to gather the scattered data on items such as non-wood forest products, which generally will not be available from any one body, but from various sources such as IUCN and WWF offices. The third category involves bodies such as the UN Framework Convention on Climate Change and the ITTO, to which governments are obliged to report on certain parameters of their natural resources (see Johnson, 1996, for the development in the methods of collecting statistics employed by ITTO). FAO should liaise closely with these organisations to ensure that the data are gathered in a form that is consistent with the parameter requirements of FAO's FRA.

2. Parameters for inclusion in FRA 2000

Mainly the information for the parameters to be included in the FRA 2000 will come from two sources. The first is the country reporters, who will be asked to answer questions in a questionnaire. The principal hurdle with regard to the questionnaire is to make it simpler, yet have it address a broader range of forest-related issues (Prins, 1995): it must include the more functional parameters which are now needed. The second source of information will be the remote sensing forest cover maps and the GIS analyses carried out with these.

Throughout this paper we refer to the different public sectors which generally have control over forest areas as the Nature Conservation Department and the Forest Department. These may not be known under these exact names in each country, but the idea behind is to obtain data for (a) forests which are managed by the section of the government which has principal responsibility for nature conservation (e.g., a Parks Department, a Natural Heritage Department), and (b) those that are managed by the sector which has principal responsibility for timber production. Countries which have difficulties distinguishing these two should notify FAO for advice.

Parameters discussed in the rest of this paper are presented below in a synoptic form: the table shows the parameter with "feasibility rank" assigned. The feasibility rank takes into account the presence or absence of a procedure for obtaining and incorporating the information, the availability of the information, the relative expense of the information and the availability of people or organisations capable of obtaining, analysing or otherwise handling the data for FAO.

For comparison, the reader is referred to Appendix 1, which shows the table presented at the meeting of experts on FRA in 1993 (Bones, 1993), and also Appendix 2 which gives an example of the presentation of non-quantitative information for conservation.

2.1. Forest cover estimates

The principal data source

For the FRA 2000 there will be two sources of forest cover data. There will be the country reporting procedures, which in the 1990 and 1980 assessments accounted for the forest cover statistics presented for the industrialised nations, and there will be the data gleaned from the remote sensing effort, which in the 1990 assessment was confined to the tropical developing countries alone. Both methods of data collection have their individual strengths. For the FRA 2000, the former will be a source of the data on forest ownership and management details, and certain forest quality estimates as well as the other parameters relating to non-wood benefits. Its uses will be dealt with in greater detail in other sections of this report.

Forest cover and type statistics should principally be based on remotely-sensed data for the FRA 2000. At the meeting on the use of remote sensing for the FRA held in Washington DC (Päivinen et al., 1996), it was concluded that the world vegetation map which is being made by the EROS Data Centre (EDC), in conjunction with the USGS and GLCCD, will be made available for FAO to use in the FRA 2000. The map will be derived from AVHRR imagery and enhanced and spot-checked for accuracy by drawing on the data from the EU TREES programme, the NASA pathfinder programme, WC-MC's composite world forest map and other sources.

The advantage of the EDC mapping project is that it is based on a uniform, repeatable, source, and it will have covered the whole globe in time for the 2000 assessment (EDC has agreed to make the data available at the end of 1997). For this reason the forest cover and type statistics should be taken from this source for all the countries in the world. The data may be enhanced with information from national sources, but the baseline of forest type cover must be established from satellite, if we are to be able to assess forest cover and change in a scientific and controlled manner into the next century.

Table 1. A synopsis of the parameters suggested for inclusion in the FRA, indicating feasibility*

From Box:		
2	■	The structural land cover type (as in Table 2) by ecological zone (global).
2	■	The estimated global change in land cover over the last 20 years, or whatever length of time the Landsat sampling data permit
3	■	The detailed forest vegetation class cover for each country
4	■	Amount of these forest types in existence before anthropogenic disturbance, and percentage of the original amount remaining
From Box 2:		
1	■	Area of forested land, by sector
1	■	Number of employees (public sector)
1	■	Area of concession land: total, number of concessions, average concession, minimum and maximum concession
1	■	Area of natural/semi-natural forest (including forest with "enrichment planting"), subdivided into broadleaved, needleleaved, mixed and coppice
1	■	Area of land planted as mixed species stands (> 2 spp), subdivided into native species, exotic or both.
1	■	Area of land planted as monospecific stands, subdivided into native species or exotic.
1	■	Percentage of areas managed particularly for nature conservation that have officially delineated buffer zones.
From Box 3:		
4	■	The average biomass of each land cover type in each country.
4	■	The total biomass for each land cover type in each country.
4	■	The per annum average change of total biomass in each country for the last 10 years and the previous 10 years.
4	■	Land cover types in each country which have had field surveys carried out specifically for the purpose of estimating the biomass of the system.
4	■	The percentage of forested land used for gathering fuelwood in each country – by sector, private and public, the latter subdivided into Forest Department land and Nature Conservation Department land.
4	■	The percentage of the total fuelwood gathered that comes from (a) forested lands, (b) other wooded land and (c) or other land cover types.
4	■	The number of people in each country that make their main source of income from gathering and trading fuelwood, or making charcoal.
From Box 4:		
3	■	Species used in NWFPs in the categories of food, medicines,crafts, building materials.
4	■	Quantities of the main products in the above categories.
3	■	CITES Appendix II species used as NWFPs, and volumes traded.
2	■	Data from IUCN, TRAFFIC and other non-governmental projects should be fully utilised.
2	■	Locations of major forest gene pool resources for wild relatives of major food crops.
4	■	Special studies on NWFPs that contribute in a major fashion to the economy and survival of rural populations.

Table 1. A synopsis of the parameters suggested for inclusion in the FRA, indicating feasibility*.continued....../

From Box 5:		
2	■	Percentage of forest within protected areas.
2	■	Location and sizes of forest pieces of particular conservation concern.
3	■	Estimation of the endangerment status of each forest type of particular concern.
2	■	Percentage of forested managed areas that have species lists, with the main taxa of species indicated.
2	■	Percentage of areas managed particularly for nature conservation that have officially delineated buffer zones around them, and the width of the zone.
4	■	Number of visitor days per annum in the areas managed for nature conservation or recreation.
4	■	Amount of tax levied visitors to support protected areas.
2	■	Number, locations and area statistics of forested areas managed specifically for soil and watershed protection.
2	■	Number, locations and area statistics for forested areas managed specifically by or for indigenous peoples.
2	■	Number, locations and area statistics of forested lands managed specifically for their religious or spiritual significance.
4	■	An estimate of how much the forests of the catchments contribute to the water supplies.
4	■	An estimate of how much forests contribute to the maintenance of the water supply to the major population centres of the world.
From Box 6:		
3/4	■	Number of forest-occurring species of selected taxa in the country.
3/4	■	Number of endemic and/or restricted range forest-occurring species.
3	■	Number of globally threatened forest-occurring species
2/4	■	Number of forest "hot spots" (those which contain a significant area of forest) in each country.
2/4	■	Number of forest "hot spots" confined to each country.
2/4	■	Percentage of forest cover included in "hot spots".
2/4	■	Percentage of forest "hot spots" included in protected areas
2	■	Percentage of forested management units which have any kind of biological inventory.
3	■	Percentage of the forested land area represented by these inventoried pieces.
2	■	Are the inventories repeated?
2	■	Are permanent plots used for the inventories, or are different pieces of land inventoried each time?
2	■	Are species lists of trees, other plants and/or animals included in the inventory? What types?
2	■	Are abundance estimates included in the inventories? For what groups?
3	■	Have there been surveys carried out in the forests by national or international scientific research institutes? What area of forest was included in these surveys? Are any of these in the categories of ecological surveys, forest product surveys or social economics surveys?
1	■	Is remote sensing used in the forest monitoring systems? What items are monitored in this way – Forest area? Forest health or condition? Other?
From Box 7:		
2	■	Amount of land with natural forest cover in a predominantly agricultural area
2	■	Amount of land with natural forest cover in an area predominantly managed for silviculture.

Table 1. A synopsis of the parameters suggested for inclusion in the FRA, indicating feasibility*.continued....../

2	■	Amount of land with natural vegetation cover in predominantly urban or built over land.
1	■	Main pressures on forested land (question to the public sector departments on ranking the main pressures on their forested land (see Box 7)).
3	■	size class distribution of the fragments – <5km^2, 5–10km^2, 10–25km^2, 25–50km^2, >50km^2
3	■	special analysis of fragments less than 5km^2
3	■	perimeter to area ratio
3	■	area of core forest defined by buffer
3	■	"wilderness" evaluation
From Box 8:		
1	■	Number of countries that are signatories to CBD
1	■	Number of countries with NFAP
1	■	percentage of projects in the NFAP which have been initiated/completed
1	■	Number of countries with National Biodiversity Action Plans
1	■	Number of countries with Protected Areas Systems Plans
1	■	Number of countries officially involved in the process for establishing international criteria and indicators of sustainable management
1	■	Number of countries with areas of certified forest
1	■	Number of countries national sustainable management standards
1	■	Number of countries with established national working groups on sustainable management
Recommendation from Section 3:		
		FAO should work towards linking its spatial and statistical databases on forests and timber to other databases which have information related to the forest system. These other databases are both within and outside of FAO.

* Feasibility is ranked using numbers as follows:
1 = Feasible and affordable in terms of the previous FRAs
2 = Feasible with additional funding
3 = Possibly feasible but needing funding as a separate study
4 = Feasible only with special case studies

The higher resolution "sampling" effort which resulted in the forest cover change estimates for the tropical developing countries in the 1990 assessment (FAO, 1996) should be extended to cover the non-tropical developing countries and the industrialised nations. There were about 120 sampling units, each one with two or three present and historical Landsat images, used to calculate the forest cover change in the tropics in the 1990 assessment, and also to make an accuracy assessment of the lower-resolution imagery from which the forest cover of the entire tropical belt was taken.

The plans for the analysis in the FRA 2000 include a more intensive sampling regime, of perhaps 250 sampling units. However, these plans are solely for the tropical belt. Unless this sampling programme is extended to the entire coverage of the world's forests, the depth and uniformity, and indeed the utility of the resources assessment will be severely handicapped. The imagery exists: it is a question of funding to carry out the analyses required. It is no longer sufficient to focus on the world's tropical forests: the assessment must be a truly global synthesis of the best available data. A baseline set of data is needed for the year 2000 so that well-founded estimates of conversion from forest, or to forest, or from one forest class to another can be made and repeated.

The utility of forest type class differentiation

It has been established that the FRA 2000 needs to cover more completely the non-timber goods and services of forests (Nyyssönen, 1993; Palmberg-Lerche, 1994). For nature conservation and the assessment of the diversity resources of forests, an essential data requirement is forest type class, or forest vegetation category. In the 1990 FRA the forest cover was determined as that over 10% crown cover in developing countries and over 20% crown cover in the industrialised nations. There was also a category of "other wooded land", which allowed for shrubby and more open formations. The country reporters for the industrialised countries gave data for "coniferous", "broadleaved" and "coppice" categories, as well as for "exploitable" and "non-exploitable" forests. Data for developing nations were presented for categories of "plantation" and "natural", and the GIS analysis used delineations of broad Ecofloristic Zones based on Sharma (1986; 1988) and Lavenu et al. (1988) to yield forest cover data by zone.

The structural categories into which the land cover of the world should be divided in the EDC data set were defined at the remote sensing meeting (Päivinen et al., 1996) (see below). Structural characteristics are perhaps sufficient for the determination of the timber resources in a forest. More detail is needed for determining the non-timber resource. Three initiatives may be used together to ensure maximum utility for the EDC map. These are the Ecofloristic Zones of FAO, the EDC vegetation classification efforts and the inter-agency project on land cover by UNEP, FAO, WCMC, ITE, ITC and WAU. This more detailed map of forest type and composition would be a tool for the quantification of biodiversity loss through forest decline. It would contribute to the current international efforts to define criteria and indicators of sustainable forest management (Helsinki and Montreal Processes, ITTO's sustainable management programme).

As a corollary to this study, it must be pointed out here that there has been an increase in international interest to show the original forest cover of the earth. This idea was also proposed by Lund (1993) at the last meeting of experts for FRA in Kotka. It would be useful to create a baseline map showing the probable original forest cover of the earth before the onset of major human interference with natural systems. Using baselines such as these, better estimates of forest loss to date may be drawn up and shown in the FRA 2000 as a landmark dataset for the turn of the millennium.

Table 2. Main structural types outlined for use in the FRA 2000 (Päivinen et al., 1996), "Forest" referring to land with over 10% tree crown cover and over 5m in stature* (Korotkov, 1996).

Closed forest	>70% crown cover**
>40% crown cover**	
Open forest	10–40% crown cover**
Forest/shifting cultivation	
Other wooded land	– shrubs – short fallow agriculture
Man-made woody vegetation	
Other land cover	

* WCMC recommends that using only >70% for closed forest and a lower height limit should be investigated in coordination with other land cover work.

** these include fragmented patterns.

Box 1. Parameters recommended for the FRA on the subject of land cover estimates. Each point refers to a global or a globally sampled data set.

- The structural land cover type (as in Table 2) by ecological zone
- The estimated global change in land cover over the last 20 years, or whatever length of time the Landsat sampling data permit
- The detailed forest vegetation class cover for each country
- Amount of these forest types in existence before anthropogenic disturbance, and percentage of the original amount remaining

2.2. Forest management

This section will address issues which will supplement and complement the data derived from the remote sensing analysis described above. The data in this section will come from the country reporters, the FAO regional representatives and the research by the FAO FRA team, who will follow guidelines on what is required, specifically for forest composition and ownership information. At a very basic level, the reporters and FAO staff should provide data on amount of forested land in the public and in the private sectors, subdividing the public sector into lands controlled by the Forest Department and those which are controlled by a Nature Conservation Department[1]. The principal uses for which the forest areas are managed should be determined, such as for watershed protection, for timber production, etc. In the case of nature conservation areas, buffer zones are important for protecting the integrity of the core forest. Whether there are buffer zones for these in each country should be determined, and the sizes of these.

If possible the number of employees in each sector should be given, to permit an estimate of amount of land in relation to the number of employees in each sector. In some countries significant amounts of land will be leased to concessionaires. The reporter should give the amount of land of this nature, the number of concessionaires, the average size of a concession and the minimum and maximum sizes of these.

Although the remote sensing data will give global forest coverage, it will not give any indication of management effort. This section will need to address this issue, and primarily will need to obtain data on forest origin, or plantings. The following categories are recommended:

A. *Natural/semi-natural forests* (including forest with "enrichment planting"): Subdivided into four: broadleaved, needleleaved, mixed and coppice

B. *Mainly artificial forests*
   1. area of land planted as mixed species stands, subdivided into native, exotic or both;
   2. area of land planted as monospecific stands, subdivided into native or exotic.

There are a number of additional management questions of a non-quantitative nature. These questions include an assessment of what type of data are collected in the forest inventories –items to check are species lists (trees, other plants, animals), species abundance estimates, whether there are permanent plots for inventories or if different areas are used in different surveys, have there been repeat surveys, is there a monitoring system that the survey data are used for, is remote sensing used for monitoring, what percentage of the forests/ forest types have been surveyed, have there been scientific surveys carried out by national or international research institutes, how many

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[1] Nature Conservation Department and Forest Department here and throughout the paper to the government offices with principal responsibility for nature conservation with control lands with forests, and government offices with primary responsibility for timber production which control lands with forests, respectively. These may be known by different names in each country, and if the national correspondent has trouble discriminating between the two he/she should contact FAO for assistance.

of these have been ecological surveys, forest product surveys, social economics surveys.

It is tempting here to advocate an attempt to estimate the contribution of the forests to GNP. Ultimately FAO will be required to make a model relating all of the different forest parameters to each other and to come up with an estimate of the contribution of forests to GNP. However, there are various pitfalls in this, most of which relate to the non-timber benefits of forest. It is not possible for economists routinely to calculate the dollar value of watershed protection or of the provision of a recreational forest facility. The most practicable measurement might be the workforce employed in the forest sector.

2.3. Carbon sequestration/biomass/fuelwood

Carbon and biomass

Carbon is released into the atmosphere indirectly through the logging of forests, and as deforestation increases so does the release of carbon. Concern has grown over the increase of carbon in the atmosphere because it is directly linked with global warming and climate change (Pearce and Moran, 1994). Carbon stored in forest biomass far exceeds that stored by the land cover that generally replaces a cut forest (shifting or permanent agriculture, pasture), deforestation thus yielding a net gain in carbon to the atmosphere of about 100–200 tonnes of carbon per ha (Brown and Pearce, 1994). Recent studies (e.g., Fankhauser, 1994) which have estimated the cost of damage wrought by global warming to be in the region of US $ 20 per tonne of carbon released. This extrapolates to be between $ 600 and $ 4,400 per ha of forest converted. Potential gains from timber prices for the same areas have been estimated much lower than the global damage costs, a situation that gives rise to the idea of "carbon credits". An industrialised country which is a net carbon source, generally through burning fossil fuels can pay countries that are net carbon sinks to have them keep their forest cover.

When first mooted these ideas seemed very radical and have to date not been officially acted upon. However, the process is still being studied and this interaction stemming from interdependence between countries may well become an official process, regulated by an intergovernmental body.

For this study on the parameters required for the FRA 2000, it was determined at the 2nd meeting of the team of specialists on the temperate and boreal FRA (UNECE/FAO, 1996b) that the majority of the data dealing with carbon sequestration and biomass would come directly from the UN Framework Convention on Climate Change (UNFCCC), to which over 130 countries would be reporting on these parameters. There would be no justification and no need for

Box 2. Parameters recommended for the FRA on the subject of forest ownership and management. Items should be presented for each country by public and by private sector, the public sector being subdivided as described above (see Footnote 1).

- Area of forested land
- Number of employees (public sector)
- Area of concession land: total, number of concessions, average concession, minimum and maximum concession
- Area of natural/semi-natural forest (including forest with "enrichment planting"), subdivided into broadleaved, needleleaved, mixed and coppice
- Area of land planted as mixed species stands (> 2 spp), subdivided into native species, exotic or both.
- Area of land planted as monospecific stands, subdivided into native species or exotic.
- Area of forested land in the different sectors managed primarily for: (a) timber production, (b) biodiversity conservation, (c) watershed or soil protection, (d) recreation, (e) biomass production, (f) non-wood forest products (as part of a forest or in a plantation such as rubber)
- Percentage of areas managed particularly for nature conservation that have officially delineated buffer zones.

Questions relating to forest inventory:

- For what % of your forested management units do you have any kind of inventories?
- What % of the forested land area do these inventoried pieces represent?
- Are the inventories repeated?
- Do you use permanent plots for your inventories, or are different pieces of land inventoried each time?
- Do your inventories include species lists of trees, other plants and/or animals? What types?n Do your inventories include abundance estimates? For what groups?
- Have there been surveys carried out in the forests by national or international scientific research institutes? What area of forest was included in these surveys? Are any of these in the categories of ecological surveys, forest product surveys or social economics surveys?
- Is remote sensing used in your forest monitoring systems? What items are monitored in this way – Forest area? Forest health or condition? Other?

FAO to demand that the countries report twice on the same parameters. However, biomass data presented in the FRA will need to address specific questions, and these should be communicated to the UNFCCC so that the required data can be solicited from national sources (see section 1.2 for suggestion for a single UN agency responsible for all the natural resources statistics).

Methods of converting various forest inventory parameters to biomass have been presented and their merits and pitfalls carefully explained by Brown (1996). The environmental community will want biomass figures both as snapshot estimates of global or country biomass status and perhaps more particularly as estimates of biomass change over time. Has a country or region increased or decreased its land cover biomass, and in each case, what type of land cover conversions have contributed to this. Again, national inventories can play a role here, but in addition, remotely sensed land cover estimates can be used to calculate biomass status and change.

Remotely-sensed estimates of biomass and its change rely heavily on field surveys which have calculated the vegetation biomass, per vegetation type, for at least one point in time. Using spatial land cover data, total biomass figures can be extrapolated from the field surveys for the region under investigation, and if there are land cover data for two different dates, preferably at least 5 years apart, the change in biomass brought about by any land cover changes may be calculated. For the FRA 2000 the EDC global coverage may be used for making some crude calculations, supported by the "sampling" with Landsat for changes from one land cover type to another, in restricted areas (see section 2.1).

Field work required to make the initial calculations for biomass estimates must be well planned, because in different land cover systems different parts of the vegetation contribute different percentages to the total biomass. For example, it has been found in more mature forests that the contribution of understorey shrubs, vines and herbaceous plants is generally less than about 3% of the aboveground biomass (Lugo, 1992), whereas in secondary or disturbed forests the fraction may be as high as 30% (Brown and Lugo, 1990). Brown (1996) gives very specific methodologies for the collection of field data for biomass estimation. The collection of biomass data of a sufficient level of accuracy for understanding the trends and limits of carbon sequestration will need a sizeable capacity-building activity on the part of the international forestry community.

Fuelwood

Wood is the major energy source in many countries (FAO, 1990), and acute fuelwood scarcity has been identified as a major global problem (United nations Economic and Social Council, 1996). For example it has been estimated that fuelwood from trees and shrubs accounts for over 60% of Lesotho's energy requirements. In El Salvador, annual consumption of forest products for energy production is estimated at 4.9 million m^3. The predominant use of wood in Haiti is for fuel, with 75% of the country's energy consumption provide by biomass.

Fuelwood was covered in the FRA 1990 as a percentage of each country's fuel supply that was fed by wood. FAO should retain this parameter for its FRA 2000. It is questionable whether countries would be able to provide more detailed quantitative data on this subject, because much fuelwood would be collected and used on a subsistence basis, and never reach the open market, from which there may be statistics available. However FAO should include in its questionnaire a question on percent of forested land, by sector (private, public, the latter subdivided into forest department and nature conservation department) which is used for the gathering of fuelwood. Capacity building may be required to enable the respondents to answer this question.

We recommend that FAO liaise with the Climate Change initiative to see what they cover in their surveys. For the future, data from localised studies on fuelwood should be amassed and analysed for general patterns and trends. Liaison should be made with international organisations such as IUCN and IIED which carry out research on an ongoing basis on fuelwood and other social uses of natural resources.

2.4. Non-wood forest products

NWFPs include all goods of biological origin derived from forest or any land under similar use, and exclude wood in all its forms. Agenda 21 and Forest Principles adopted at the UNCED identified NWFPs as an important area requiring further attention, as a major contributing factor to environmentally sound and sustainable development. Agenda 21 also recommended that the FAO Global System for the Conservation and Utilisation of Plant Genetic Resources for Food and Agriculture be strengthened and reviewed, in harmony with the Convention on Biological Diversity. Of particular relevance in this discussion is the role of the FAO Global System in relation to wild food resources.

Box 3. Parameters recommended for the FRA 2000 on the subjects of carbon sequestration, biomass and fuelwood.

- The average biomass of each land cover type in each country.
- The total biomass for each land cover type in each country.
- The per annum average change of total biomass in each country for the last 10 years and the previous 10 years.
- Land cover types in each country which have had field surveys carried out specifically for the purpose of estimating the biomass of the system.
- The percentage of forested land used for gathering fuelwood in each country – by sector, private and public, the latter subdivided into Forest Department land and Nature Conservation Department land.
- The percentage of the total fuelwood gathered that comes from (a) forested lands, (b) other wooded land and (c) or other land cover types.
- The number of people in each country that make their main source of income from gathering and trading fuelwood, or making charcoal.

Three important ways of classifying NWFPs are:

By function –	e.g. food; medicinals; building materials; fuel; clothing; ornamentals.
By taxonomic group –	e.g. reptiles (class: Reptilia) orchids (family: Orchidaceae); mangos (genus: *Mangifera)*
By level of use –	subsistence (including local market); national commercial; international trade.

It is also important to distinguish between:

- genetic resources (including wild relatives of utilised species)
- wild resource species (directly utilised species)

Information on NWFP resources, harvests, processing and trade is generally scarce and diverse (Lintu, 1995) and is not currently collated systematically at an international level. Detailed analyses of use are almost invariably localised and have limited scope for extrapolation, at least in quantitative terms. The extent to which information on NWFPs is held at a national level, for example by forestry departments, and to which it could practically be standardised should be assessed for potential inclusion in FRA. The work of the Forest Resources Division of the FAO Forestry Department will be useful in this respect.

Data are more widely and systematically available for international trade than for national use, for example for species listed in the CITES Appendices. Under the terms of the Convention export permits are required for trade in species listed in Appendix II of the Convention and such permits should only be issued if the trade is considered to be non-detrimental to the survival of the species. Both exports and imports should be reported by the parties concerned to the CITES Secretariat on an annual basis. CITES trade data are maintained on behalf of the CITES Secretariat by WCMC. A wide range of animal and plant species is listed in Appendix II, including many exploited forest-occurring species.

For a range of NWFPs Customs statistics are available although these often lump a range of different products and species together and can thus be difficult to interpret. In the case of both CITES data and Customs statistics, extrapolating from export figures to harvest is usually problematic because of unquantified losses between collection and export and because for most NWFPs there is at least a component of domestic use. Nevertheless, if interpreted carefully, export statistics can be used to give some insight into wild harvest particularly in allowing comparisons between different countries.

Because of the difficulty of assessing biodiversity use outside the cash economy, there is a very strong tendency to underestimate rural dependency on biodiversity resources. A major role of the FRA should be to try to redress this balance. Two particularly important areas which should be examined are the use of biodiversity resources as wild foods and medicines. Wild foods include bushmeat which may be of great significance in some parts of the world, not only in terms of its provision of protein to the local population but also in the impact its harvest may have on biodiversity. IUCN has a number of field projects on NWFPs, and FAO is strongly urged to incorporate the results of these systematically into its information on NWFPs. TRAFFIC also carries out studies on NWFPs, emphasising the trade aspect.

Priority information required as part of the FRA includes: the diversity and utilisation of NWFP at a national level, volume and value in domestic and international trade, assessment of the contribution to the national economy and national wellbeing.

Wild resource species: Domestic use and resource assessment

An attempt should be made to build up a picture of NWFP use in each country by gathering together existing data sources and searching relevant literature, using that in FAO offices as a starting point. There will undoubtedly be some detailed quantitative data from case studies, but it is extremely unlikely that reliable figures for overall national use will be obtainable in any but a few instances. Therefore information should be presented in the form of short summary paragraphs for each country. Major gaps in knowledge should be highlighted.

Wild resource species: International trade

For CITES-listed species, export by volume of major groups of forest-occurring species, principally: reptiles (skins); reptiles and amphibians (live specimens); tortoises and turtles (meat, shells); birds (live specimens); orchids (wild-collected only); possibly medicinals.

For other groups of NWFPs, export by volume according to Harmonized Commodity Description and Coding System Categories should be recorded (see for example Table 7.4 "NWFPs most prominent in world trade, with three main markets" in FAO, 1995).

Genetic resources

In this context we consider the wild relatives of domesticated animals, plants and fungi. Wild relatives can be classified in terms of how closely related they are to domesticates. Wild varieties or populations of domesticated species should be accorded highest priority for assessment and conservation. Other members of the same species group within a genus are of second highest priority while the remaining members of a genus containing domesticated species are of third priority. Species more distantly related than this (e.g., species of other genera within the same family) are generally of much more minor significance.

Data on the distribution and status of wild relatives of domestic species are often very incomplete, particularly for plants. For this reason it is recommended that regional overviews be prepared for the most important domesticated species. A preliminary list of such species is presented in WCMC (1994) (Table 4: Major Food Crops; Table 5: Domestic Livestock). Summary data on the status of the species concerned should be presented (IUCN Threatened Species Categories). Where more detailed information is available, national breakdowns of this information should be presented, highlighting the major genetic resources in each country.

Existing FAO initiatives

Of relevance here are initiatives on NWFPs within the Forestry Department and on Plant Genetic Resources undertaken by the Commission on Plant Genetic Resources.

The Forestry Department of FAO formerly (from 1954 to 1971) published information on NWFPs in the Yearbook of forest products statistics. Following UNCED, consideration has been given to resuming the collection of international statistics (Padovani, 1995).

The Forest Resources Division of the FAO Forestry Department in Rome has a programme element to promote and develop NWFP. Activities under this are:

1) Information gathering, analysis and dissemination through a newsletter and series of expert reports on selected NWFPs or general policy issues relating to their production and international trade.
2) Proposed databank development with two components, agencies involved with NWFP and production statistics on NWFP. A questionnaire has been prepared to collect information on the agencies involved.
3) Networking through regional workshops, collaboration with other organisations (including Royal Botanic Gardens, Kew and WCMC) and support for project formulation.

The Third Session of the FAO Commission on Plant Genetic Resources recommended that a Report be prepared on the State of the World's Plant Genetic Resources, initially covering information on major crops and commodities and key forest species. The objectives include:

- to identify gaps in the current knowledge and understanding of the extent of diversity, availability and utilisation of plant genetic resources;
- to identify gaps in existing databases.

The Report will be presented at the Fourth International Technical Conference in June 1996. Preparation has been through a country-driven process. A Global Plan of Action on Plant Genetic Resources for food and agriculture is also being prepared with programmes and activities aimed at filling in gaps, overcoming constraints and facing emergency situations identified in the Report on the State of the World's Plant Genetic Resources. It will be valuable to consider to what extent the Report and Global Plan of Action will provide or stimulate collection of information on wild food plants or wild resources which could be fed into the FRA. Traditionally the work of the Commission has concentrated on *ex situ* conservation activities and the maintenance of comprehensive databases to support this. There has been little progress on in situ conservation of wild relatives of cultivated plants. The 1997 FAO Worldwide Consultation on Protected Areas will include a review of the role of protected areas in the *in situ* conservation of the full range of plant and animal genetic resources (including wild crop relatives) and will identify technical criteria and guidelines.

It is of great importance in both cases that information gathered under these initiatives be fed into the FRA at an early stage. The data requirements of the FRA may themselves help to shape both these programmes.

2.5. Legally designated areas for nature conservation or other forest management

For the FRA 1990, WCMC contributed a study on tropical managed areas, which quantified the contribution of the forestry, wildlife and other public sectors to nature conservation in the tropics (WCMC, 1993). It showed that much of the world's forest used for nature conservation is in fact in the forestry sector: thus both the forestry sector and the nature conservation sector of national governments are

Box 4. Parameters recommended for the FRA 2000 on the subject of non wood forest products (NWFPs).

- Species used in NWFPs in the categories of food, medicines,crafts, building materials.
- Quantities of the main products in the above categories.
- CITES Appendix II species used as NWFPs, and volumes traded.
- Data from IUCN, TRAFFIC and other non-governmental projects should be fully utilised.
- Locations of major forest gene pool resources for wild relatives of major food crops.
- Special studies on NWFPs that contribute in a major fashion to the economy and survival of rural populations.

directly responsible for the protection of the species diversity of the forests. Since that project the databases have been further expanded through contributions to the databases by national governments. The United Nations List of National Parks and Protected Areas (1993) was published using this data source, and the 1996 edition is in preparation.

This global coverage of protected areas is unique and permits GAP analyses which show the amount of different ecosystem types that are included in protected areas. This may be used as a powerful planning tool for national and regional governments, showing the gaps in the coverage of the ecosystems of a country by a protected areas system plan. A study of this type was carried out recently by Murray et al. (1995) for the tropics using FAO's Ecofloristic Zone designations. A more detailed analysis of the Indo-Malayan Realm has been carried out (Asian Bureau for Conservation, 1996) and a feasibility study for a European analysis was carried out by WCMC in 1995. For FRA 2000, a truly global analysis of this type should be carried out – not limited to the tropics. The detailed, mapped, forest classification (see section 2.1) will permit the tracking over time of the unique forest types of the world, as they expand and contract, as they come under protection or are excluded from protection.

Besides studies related to areas managed principally for their biological diversity, three other principal categories of protected area are those managed (a) specifically for watershed and soil protection, (b) specifically for or by indigenous peoples, and (c) specifically for their religious or spiritual significance. As regards (a), many countries have watershed departments in their governments, and should be asked for data on the amount of water produced in the catchment area, the amount of the catchment with forest, soil erosion figures and any change observed. The central question perhaps for the FRA to address is how much does forest contribute to the regulation and volume of the water supply. In particular, how much does forest contribute to the maintenance of the water supply to the major population centres of the world. It may be possible to glean some information relating to watersheds from the EDC land cover data set, using it in conjunction with a digital terrain model and spatial population data. In addressing (b) and (c) the primary question is to determine how much forested land is managed particularly in these categories, and to develop a spatial data set of these. The relationship of the indigenous people with the forest will be intricately linked to the use of non-wood forest products, which is addressed in section 2.4.

The economic importance of many protected areas is difficult to quantify. Indicators that can be used to estimate the role of these in the local and national economies are (a) number of visitor days per annum and (b) number of government employees working in this sector.

2.6. Forests and biodiversity

Biodiversity can be can be considered at three levels: genetic diversity, species diversity and ecosystem diversity. This section concerns itself with species and ecosystem diversity, although the latter is also addressed in section 2.1 through the vegetation mapping discussion. Too little is known about diversity at the genetic level for it to be of use as a parameter in a global FRA (Wilcox, 1995).

Two types of measurements are needed for the FRA 2000 to indicate status of forest biodiversity and trends. For the first, a measure of each country's biodiversity will be necessary, in terms of the species that the forests support. Such measures are important for geographical comparisons as the basis for planning and priority setting to maintain biodiversity and to provide baselines for tracking changes in diversity through time. The second, the trends, may be addressed by investigating the levels of threat to forest systems and therefore their likelihood for change. Levels of threat may be measured through data on numbers and percentages of threatened species. This measure may be expected to change with time and can therefore serve as an indicator to be tracked over successive FRAs.

Theoretical issues

For each country, two separate issues are important. The first is how rich in species a country's forests are; the second is how unique those species are – essentially how many endemic species or restricted

Box 5. Parameters recommended for the FRA 2000 on the subject of forest types important for nature conservation, their locations, cover and endangerment status. These parameters should be presented for each country and for the globe, unless otherwise indicated.

- Percentage of forest within protected areas.
- Location and sizes of forest pieces of particular conservation concern.
- Estimation of the endangerment status of each forest type of particular concern.
- Percentage of forested managed areas that have species lists, with the main taxa of species indicated.
- Number of visitor days per annum in the areas managed for nature conservation or recreation.
- Number, locations and area statistics of forested areas managed specifically for soil and watershed protection.
- Number, locations and area statistics for forested areas managed specifically by or for indigenous peoples.
- Number, locations and area statistics of forested lands managed specifically for their religious or spiritual significance.
- An estimate of how much the forests of the catchments contribute to the water supplies.
- An estimate of how much forests contribute to the maintenance of the water supply to the major population centres of the world.

range species there are. These two measures can be combined, but there is no one compelling way of doing this. WCMC have prepared a preliminary National Biodiversity Index which takes into account both richness and endemism, and which can also make use of incomplete data-sets (WCMC, 1992). This index takes into account species diversity in all habitats, not just forests but the methodology could equally be used to derive a forest diversity index.

A country's forests may have high overall diversity either because there is a wide range of different forest types, each with its own distinct biota (e.g. the U.S.A.), or because individual forest types are highly diverse (e.g. lowland tropical moist forest). The former is generally related to the size of the country, the latter not necessarily so. Countries with very high forest diversity usually combine these two. It is possible to derive measures of diversity which take into account the size of the country; these give an indication of how rich or important a country's forests are per unit area.

Practical considerations

Knowledge of biodiversity is very incomplete, and very unevenly distributed, in that some subsets of biodiversity (for example particular groups of organisms such as conifers or birds) and parts of the world are far better known than others. It is therefore impossible to produce complete measures of biodiversity for each country in the world, or for each country's forests. Measures of biodiversity are therefore based on extrapolation from samples or subsets. For a global assessment it is important to make full use of the most widely available datasets even if these only represent a relatively small part of overall biodiversity. At present the groups for which most data are available globally are higher vertebrates. Amongst plants, a global data set on trees (not a taxonomic grouping) is currently being assembled. Global data sets otherwise exist for a small number of relatively small taxa (e.g. palms, cycads). As knowledge improves, it will be possible to incorporate more datasets into biodiversity measures. It is important to stress here that for studies such as the FRA 2000 valuable qualitative, non-quantitative information can be presented where figures are not available (see Appendix II). Data available by major taxonomic group are shown in Table 3.

Most national level data that are available combine both forest and non-forest species. For the FRA it is important to try to distinguish between these, but this severely limits the number of groups that can be dealt with. Forest species can be divided into forest-occurring and forest-dependent species. It is easier and less contentious to identify the former than the latter and for this reason it is recommended that analysis is confined to forest-occurring species.

The use of GIS in identifying biodiversity "hot spots".

There have been some efforts recently to identify the biodiversity "hot spots" of the world. These are areas of particular biodiversity interest, and may be overlaid with forest data sets to indicate areas of forest important for conservation. For example, the Endemic Bird Areas (EBA) of the World and the Centres of Plant Diversity (CPD) could be used in conjunction with the results of other, more detailed studies of particular regions.

EBAs are areas which contain at least 2 restricted-range bird

Table 3. Data availability for the major taxonomic groups.

	No. of forest occurring species	No. of endemic and/or restricted range forest species	No. of threatened forest species.
Birds	Data available for all countries. Require compilation and classifying into forest/non-forest.	Data available for all countries. Require classifying into forest/non-forest.	Data available for all countries. Require classifying into forest/non-forest.
Mammals	Data available for all countries. Require compilation and classifying into forest/non-forest.	Data available for all countries. Require classifying into forest/non-forest.	Data available for all countries. Require classifying into forest/non-forest.
Reptiles	Data incomplete.	Data available for most countries. Require classifying into forest/non-forest.	Data incomplete.
Amphibians	Data incomplete.	Data available for all countries. Require classifying into forest/non-forest.	Data incomplete.
Invertebrates	Data very incomplete.	Data available for a small number of groups (dragonflies, swallowtail butterflies). Require classifying into forest/non-forest.	Data very incomplete.
Trees	Data to be completed by end of 1997.	Data to be completed by end of 1997.	Data to be completed by end of 1997.
Other plants	Data very incomplete.	Data very incomplete.	Data very incomplete.

species (those whose distribution covers less than 50,000 square kilometres). These have been reasonably accurately mapped and classified according to their major habitat type. They have also been ranked according to conservation importance. In the absence of similar data for other taxonomic groups, EBAs provide a useful measure of the importance for biodiversity of particular geographic areas.

A joint WWF/IUCN project has identified and mapped over 200 Centres of Plant Diversity (CPD) worldwide. The criteria for choosing sites are:

- the area is evidently species-rich, even though the number of species present may not be accurately known;
- the area is known to contain a large number of species endemic to it.

The following characteristics have also been considered:

- the site contains an important genepool of plants of value to humans or that are potentially useful;
- the site contains a diverse range of habitat types;
- the site contains a significant proportion of species adapted to special edaphic conditions;
- the site is threatened or under imminent threat of large-scale devastation.

The criteria have not been uniformly applied across the world. Moreover no size criteria have been imposed, so that CPDs vary in size from a few tens of square kilometres to over one million square kilometres. This seriously limits their use for analysis and comparison.

It should be possible by overlaying the EBA layer with the global forest cover layer to show the areas of forest which are most likely to be important for nature conservation, and likewise with the CPD layer. In addition to being able to show the locations of these, the numbers of forests which occur in EBAs and CPDs may be determined, and the areas (ha) which are in question. This may be used as a tool for planning future protected areas or for managing those that already exist. However, caution is urged here because it is wrong to assume that because an area is important for bird conservation that it will automatically be a priority for other groups of animals and for plants, and therefore the limitations of the data set should be properly recognised by the interpreter of the analysis. However, there is potential to develop the information gathered under the EBA and CPD projects to obtain very significant and useful results.

Sources of information and potential overlap with reporting requirements for other UN organizations

Detailed biodiversity information is often not available within forest departments. If national forest departments are to be expected to gather this information, they will need to be given guidance as to which other national institutions to contact. Much of the information, particularly on threatened species (the IUCN Red Books and Red Lists) has already been synthesised by international organisations (WCMC, IUCN, BirdLife International, the Nature Conservancy-US) and is thus readily available. UNEP is a partner organisation of WCMC and IUCN is a partly governmental organisation so that the data have at least some degree of governmental sanction. Moreover, the data gathered under the aegis of these organisations has already been largely standardised and checked, so that it may be expected to be globally consistent.

Improving information

Increasingly, information on biodiversity in forests (and elsewhere) should be expected to be gathered and analysed at a national level. A major function of the FRA should be a country by country assessment of the state of forest inventorying. Forest inventories dealing with aspects of biodiversity other than timber species should be assembled and analysed at national level. Where forest inventories are very incomplete, either geographically or in the forest attributes they measure, recommendations for improvement should be made and, where appropriate, technical assistance should be offered. Questions regarding forest inventory which should be posed to all forest departments are shown in Box 7.

Many of the aspects of biodiversity discussed here form part of the reporting requirements under the Convention on Biological Diversity (ratified by 144 nations as of 8th March 1996). Data collection can therefore serve a dual purpose, so that with adequate coordination within countries duplication of effort can be avoided.

For how many managed areas in the world are there species lists? For what categories of animals and plants do they exist?

Species lists from managed areas facilitate the estimation of the non-timber forest resource.

2.7. Pressures on the forest, forest health and fragmentation

One aspect of forest quality that is particularly important for the role of forest in biodiversity conservation is the spatial continuity of

Box 6. Parameters to be used in the FRA 2000 on the subject of species biodiversity of forests.

Species data

- Number of forest-occurring species in the country. This provides a direct measure of the richness of forest-based biodiversity in each country.
- Number of endemic and/or restricted range forest-occurring species. This gives a direct measure of the uniqueness of forest-based biodiversity.
- Number of threatened forest-occurring species (see below). This provides a measure of the threat forest-based biodiversity is under. This could be further refined to number of threatened endemic forest-occurring species.
- Number of forest "hot spots" (those which contain a significant area of forest) in each country.
- Number of forest "hot spots" confined to each country.
- Percentage of forest cover included in "hot spots".
- Percentage of forest "hot spots" included in protected areas

Forest inventory data

- Percentage of forested management units which have any kind of biological inventory.
- Percentage of the forested land area represented by these inventoried pieces.
- Are the inventories repeated?
- Are permanent plots used for the inventories, or are different pieces of land inventoried each time?
- Are species lists of trees, other plants and/or animals included in the inventory? What types?
- Are abundance estimates included in the inventories? For what groups?
- Have there been surveys carried out in the forests by national or international scientific research institutes? What area of forest was included in these surveys? Are any of these in the categories of ecological surveys, forest product surveys or social economics surveys?
- Is remote sensing used in the forest monitoring systems? What items are monitored in this way – Forest area? Forest health or condition? Other?

forests. Deforestation not only removes forest cover, it also disrupts the continuity of the remaining forest and affects ecological processes within it. Remaining forest is often fragmented; forest fragments may not be large enough to be effective habitat units for many species, and the viability of their component populations may be limited by isolation from other forest areas, which restricts gene flow through pollination and dispersal. Remaining forests (both fragments and large blocks) are also affected by proximity to the forest-nonforest interface. These "edge effects" may be ecological, including influences on microclimate (e.g., Kapos, 1989; Camargo and Kapos, 1995) and changes in species composition, or anthropic as they relate to pressures and the probability of further disruption of the forest by human activity. Forests near edges are far more likely to be heavily exploited and disturbed by people than those in distant core areas.

Some of the questions about pressures on the forest resource will

Box 7. Parameters recommended for the FRA 2000 on forest fragmentation and other pressure elements.

(A) The public sector departments which manage forested lands should be asked to indicate in from the list below the magnitude of the problem that each issue poses to the management of the forests in their sector.

Fire
Pests and diseases
Invasive alien species
Airborne pollutants/
acid precipitation
Illegal timber harvest
Agricultural encroachment/
clearance
Poaching/illegal collecting
Fuelwood extraction
Forest conversion (large scale)
Natural catastrophes (flood,
hurricane)

Suggested ranking system:
*** this pressure is a major management problem
** this pressure causes some forest degradation
* this is a minor problem for management

(B) Land conversion parameters, from the UNEP/Moscow State University study.

- Amount of land with natural forest cover in a predominantly agricultural area
- Amount of land with natural forest cover in an area predominantly managed for silviculture.
- Amount of land with natural vegetation cover in predominantly urban or built over land.

(C) Forest fragmentation

- size class distribution of the fragments – $<5km^2$, $5–10km^2$, $10–25km^2$, $25–50km^2$, $>50km^2$
- special analysis of fragments less than $5km^2$
- perimeter to area ratio
- area of core forest defined by buffer
- "wilderness" evaluation

be answered by the results of the GIS analysis which will show the land categories to which forested land has been converted. A more direct way of gaining an impression of the nature of the pressure type is to ask the national reporters to indicate some of the main problems. The most useful form in which to have the data categorised is perhaps by sector: the questions that follow should be answered for both the Forest Department sector and the Nature Conservation Department sector. The questions to be listed may appear as depicted in Box 7, and the respondent should be required to indicate using a ranking system (one is suggested) what are the relative importances of the different pressure types in the different sectors.

Approaching the forest health and pressure issue from a GIS analysis standpoint, it would be interesting to overlay the EDC map of forests with the UNEP/Moscow State University World map of present day landscapes (Milanova and Kushlin, 1993) which will soon be released in digital form. The map is divided into polygons all of which are assigned three main parameters: natural landscape zone, orography class and degree of transformation, the last of which is further subdivided. Using these latter land use subdivisions it would be possible to determine the amount of forest (per country, per region or for the whole globe) which is in each particular land conversion category (e.g., arable irrigated land, silvicultural plantation land, extracting-industrial land).

An indication of the fragility of the forest system and its overall health as a functioning ecosystem can be gained from an examination of the sizes of the forest patches. The smaller the forest patch the less chance each species population has of survival in the long term. A number of measures can be taken using the remotely sensed forest data, which will give different perspectives on the integrity of the patches of forest in each country. This may then be used to form a picture of fragmentation parameters in each region or for the globe.

Firstly, the forest polygons may be divided into size classes by forest type. Using the AVHRR-derived data from the EDC, a size class of less than five km^2 would probably be the smallest category discernible. However in some countries, particularly those with low forest cover, patches much smaller than 5 km^2, indeed even patches less than 1 km^2 are very important for services such as fuelwood production. Patches of this size will not be discernible with the AVHRR data, but would have a much better chance of being identified using higher resolution imagery. It would be possible therefore to make a study of the smaller patches using the Landsat image samples, and make an extrapolation from these figures to areas not covered by the higher resolution imagery. Taking this a step further, a threshold size for the discernability of fragments could then be determined for each imagery type. It may then be possible using correlation analyses of spectral signatures to estimate presence of very small fragments using the AVHRR.

Perimeter to area ratios have been used to calculate the probable integrity of nature conservation areas. High ratios indicate that there is less area unlikely to have been impacted by activities or systems outside of the reserve. Reserves with lower ratios may have some "core" or central area that is buffered from the external disturbances by the areas nearer the perimeter. Forests buffered from outside influences are more likely to have intact ecosystem functionality. This and another method were tried for the tropical countries in the FRA 1990 (FAO, 1993). The other method used a system of buffering forest polygons internally using a 10 km wide band, and "core" forest areas which were encircled by the inner limit of the buffer were quantified. This method limits the number of fragments that will show any area results to the larger polygons, because the patch must be over 20 km wide in certain places for the core to be determined at all.

Particularly for determining value for nature conservation and certain types of scientific research, forest polygons can be analysed for their "wilderness" value. This takes into account their remoteness from human activities. Wilderness estimation is carried out by overlaying forest polygons with locational data of human settlements, evidence of access (roads, railways, rivers), and presence of structures (pilons, radio broadcasting towers, etc.). The analysis can be rendered more sophisticated by addition of population density data.

2.8. Policy instruments

A national overview of participation in global forest policy initiatives and acceptance of global conventions and agreements is recommended. This will provide an initial indication of government commitment to monitoring the quality of forest resources, management and related environmental aspects.

Under the Tropical Forestry Action Programme of FAO and UNDP, National Forestry Action Plans were prepared for some tropical forest countries in the 1980s. Details on progress made towards the targets set through these plans could be requested, including an analysis of the proportion of recommended actions which have (a) received funding and (b) been implemented to date. In addition, whether each country has drawn up Biodiversity Action Plans or Protected Areas System Plans should be determined. These items all contribute to the ability of the government to evaluate, manage and adequately monitor its forests.

Since 1990 a number of high-profile international initiatives have been instigated in order to develop criteria and indicators for sustainable forest management. The Helsinki and Montreal Processes are concerned with temperate and boreal forests, whilst FAO and UNEP are facilitating a series of expert meetings in the tropics. Regional meetings in Central America, the Caribbean and the Far East are planned towards the end of 1996. These will work towards establishing a set of criteria relating to forest policy and management issues for the tropics. Results of these meetings will contribute to discussions on tropical country information for the FRA 2000, just as the

Helsinki and Montreal Processes have contributed to the FRA discussions on temperate and boreal regions (Korotkov, 1996).

Many of these global initiatives have been driven by the need to report to the UN Commission on Sustainable Development (CSD) as part of an ongoing review of forests, the first report of which was scheduled for mid 1995. Some measure of a country's involvement in the relevant criteria and indicator initiatives should be included as part of the FRA process. For example, CIFOR have recently completed the first phase of a project aimed at testing criteria and indicators in a number of tropical countries with close support from national forest departments. Projects of this nature pinpoint the needs for capacity building to help countries meet the needs of the international standards set for sustainable management.

Stemming from concern over dwindling natural resources (mainly in industrialised nations) and interest in sustainable resource management and conservation, there is an increasing consumer demand for timber and other forest products which have been produced from a sustainably managed resource. In response to a growing need for some sort of rationalised system to ensure that such products can be clearly and correctly identified, the Forest Stewardship Council has emerged as one of the main bodies responsible for overseeing this process (Dudley et al., 1996). In attempting to develop a worldwide standard of recognised and respected Principles of Forest Management, FSC have produced a generic set of principles and criteria which apply to all tropical, temperate and boreal forests. Individual countries have been encouraged to prepare more detailed standards for national and locally relevant application, using the generic set as guidelines. This is being achieved through the formation of national working groups composed of a range of interested parties, in order that agreement may be reached on a suitable set of standards.

To date less than 30 sites worldwide have been certified under FSC standards, although this is set to increase rapidly as more countries succeed in developing national standards. Whilst in the long term, data such as the area of certified forest as a percentage of the total forest area will undoubtedly provide valuable information for future FRAs, in the short term an indication of progress towards setting national standards will be more appropriate. Information currently available would include which certification standards are being used, (if any), if a national working group on criteria for sustainable management has been set up and how far they have progressed towards agreement.

Information on sustainably managed forests is widely scattered at present, although WCMC and FSC are currently developing a proposal to establish a database of FSC-certified sites. This will provide a central repository for data on each site, including details of location and area, forest type, and by and to which standards it has been certified. Detailed information on the species being harvested, the products and where they can be purchased will also be held, along with contact details for national working groups. Databanks such as these will prove a valuable source of information for the FRA process (see section 3).

3. An integrated system of information management and dissemination

As the FRA becomes a broader, more environmental effort, with an objective of contributing to models of global resource supply and utilisation, it will be addressing concerns related to (a) the enormous amounts of data being collected and stored, (b) keeping databases current and (c) linking information systems to produce a more integrated and forest system-oriented analysis. Already the Intergovernmental Panel on Forests has called for a more continuously-updated information system, which would be capable of feeding a report such as the FRA at intervals shorter than 10 years. An effort at outlining the possible structure of an integrated data management system for some FRA data has already been made (FAO, 1996; Lorenzini, 1996).

At the close of the 20th century we are aware of the causes of many environmental problems. We also know how to assemble technology capable of storing and processing data about these problems. However, we are less good at keeping our data up to date, particularly in cases where they are drawn from many, sources. We are even less good at using our data to influence environmental management and policy. The "science" of multi-stakeholder information systems (often termed "information networks") is still relatively young. However, recent experiences show that the greatest challenges are organisational, not technological (UNEP/WCMC 1996). By focusing on the

Box 8. Parameters to be used in the FRA 2000 on the subject of policy instruments.

- Number of countries that are signatories to CBD
- Number of countries with NFAP
- percentage of projects in the NFAP which have been initiated/completed
- Number of countries with National Biodiversity Action Plans
- Number of countries with Protected Areas Systems Plans
- Number of countries officially involved in the process for establishing international criteria and indicators of sustainable management
- Number of countries with areas of certified forest
- Number of countries national sustainable management standards
- Number of countries with established national working groups on sustainable management

processes involved in creating environmental information, as opposed to concentrating on data, international efforts such as the Biodiversity Data Management Project of UNEP and WCMC (UNEP and WCMC, 1996), and the Forest Resource Accounting Project (IIED, WCMC and ODA) are rapidly developing the field.The latter aims in particular to increase the capacity of national forest agencies in their information management.

One of the main characteristics of successful information systems is active participation of stakeholders ("network participants") during the development process, enabling the complex jurisdictional and organisational issues associated with co-operation to be resolved. Participation generates trust, encouraging stakeholders to "buy into" the process of keeping critical data maintained. A further characteristic of successful information systems is that they support decision-making processes. This important characteristic is sometimes overlooked, particularly in cases where too much emphasis is placed on "gap filling" exercises which do not necessarily reflect the needs of decision-makers. Information is an expensive commodity, and in developing information systems we are duty-bound to specify their purpose very carefully. For instance, what environmental concerns does the system really address? For what audiences is it planned? How do we know whether it has succeeded?

Co-operative networks of data providers and users are the main ingredients of environmental information systems. For data to flow easily from one location to another, network participants must feel comfortable exchanging data. The principle of "custodianship" is very useful in this regard. It provides a framework for selecting which agency (or other body) is best placed to manage a dataset – a crucial step towards ensuring that data remain actively maintained. Custodianship needs to be carefully managed to work in practice. This is normally achieved by establishing a "network hub" to which all data providers ("custodians") report. The hub can be a special-purpose agency, a major custodian, or simply a committee of stakeholder representatives. The hub has many functions in addition to managing custodianship. One of these is to co-ordinate the production and delivery of information by stakeholders.

For the hub to succeed in mobilising diverse sources of data, efficient mechanisms are needed to regulate data exchange. These are often referred to as data exchange standards. An important point is that the hub does not insist that data are managed in any particular way; it does, however, recommend that when agencies exchange data they do so in standard ways which save a great deal of effort in data conversion.

Often the hub does not manage data itself. Instead, it receives copies of specific data from custodians on a regular or "need to have" basis. The role of the hub is to facilitate integration of these data into the required types of information. An attractive outcome of this arrangement is that most information generated by the network is produced by, or at least drawn to the attention of, a single management structure. This makes it possible to compile large amounts of information and publish it efficiently using technologies such as the Internet. The quality of information created by the network depends on the quality of the underlying data provided by custodians. Clearly, this is linked to the institutional capacity of the custodians and, in many cases, may have to be enhanced by means of staff, training, equipment and long-term investment.

Provided that organisational challenges are adequately addressed, it is clear that major environmental information systems can be built on the basis of just a few principles. These can be applied equally at the global, regional, national, or local levels; they can also be applied to components of a single organisation, to a series of organisations, or a mixture.

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Appendix 1. Table from Bones (1993), in Nyyssönen (1993), page 179.

Table 2. Identification of parameters needed to esses major global environmental issues. The Parameters are ranked according to importance to the assessment.

PARAMETERS	Bio diversity (Ecosystem & levels)	Carbon Cycle	Hydro logical Cycle	Forest condition (health, disturbances)	Land Cover Land use	Key Player
Ecofloristic zones					*	FRA ICTV
Forest cover						Remote sensing community
– forest/nonforest	***	***	***	***	***	
– burned areas	***	***	***	***	***	
– logged areas		***	***			
– regeneration	**	***	***			
– biomass degraded areas		***	***			
– forested						
Forest categories:						
– potential forest; vegetation type	***					
– actual forest vegetaion type	***	***	***		**	
– administrative/legal status	***					WCMC FAO/FRA
– management type	**	**				
– plantation/natural	***	***			***	
Fires (numbers, distribution)	**					Rem.S.Comm.
% of vegetaion cover					***	Rem.S.Comm.
Crown cover/leaf index		*	***	***	**	Rem.S.Comm.
Tree species composition		**		**		Nat.FlorInv
Diameter distribution			***			–"–
Stad Height			*	*		–"–
Stand structure		*		*		–"–
Soil characteristics/ topography				**		FAO/UNESCO Nat. Soil Surveys
soil organic matter		***				
texture & slope						
Sosioeconomic factors (pop, density, infrastructure a.o.)	**	***	***	***	***	UNSO/FRA

1 ***: essential, indispensable, **: desirable, accessory, *: optional

Source: GEMS Report Series No. 17, Nairobi, Feb. 1993.

Appendix 2. Extract from Table 7 of WCMC (1994), to show types of data that can be useful even though they are not numeric.

BIODIVERSITY DATA SOURCEBOOK

Table 7. Forests in the tropics

	Country size	Forest and wood-land	Annual deforest.	Forest cover	FI	Map scale	Description of forests
	(thousand square kilometers)						
ASIA							
Bangladesh	130	7.7	0.4 3.9 %	6[2] *9.7*	1.1	0.5	There are patches of rainforest in the east, in the Chitta-gong and Sylh regions, and vestiges of monsoon forest in the north.
Brunei	5.3	4.6	0.02 0.4 %	4.6 *4.7*	1.8	-	The country is largely covered with a mosaic of lowland rainforest and inland swamp forest. There is a small amount of montane fore in the south-east.
Cambodia	177	122	1.3 1.0 %	62 *113*	-	-	There are lowland and montane monsoon and rainforests and inland swamp forests. The main rainforest areas are in the Cardamom and Elephant Ranges in the west.
China	9,326	1,5554	-	- *26*	-	-	Most moist forests is lowland monsoon in Hanain and southern Guangxi patches of lowland rainforest occur in southern parts of Hanain, Guangxi and Yunnan montane forest in Yunna
India	2,973	517	3.4 0.6 %	287 *228*	1.8	1	Tropical moist forest is found in the Andaman and Nicobar islands, the Western Ghats and the greater Assam region with small remnants in Orissa. More than half is semi-evergreen.
Indonesia	1,812	1,095	12 1.0 %	864 *1,179*	1.3	2.5	Most forests are evergreen rainforests, except for those of eastern Java, Madura, Bali, the Lesser Sundas, southern Sulawesi ar southern Irian Jaya which are monsoon forests. There are also extensi swamp forests and montane forest particularly in Sumatra and Irian Jaya
Laos	231	132	1.3 0.9 %	104 *125*	1.5	1	There are evergreen rainforests and monsoon forests, both lowland and montane. The most extensive mature moist forests are no mainly in southern and central parts.
Malaysia	329	176	4.0 2.0 %	176 *200*	1.1	1	In Peninsular Malaysia most forest is lowland rainforest; there is also montane forest, swamp forest and some semi-deciduous forest in th extreme north-west. Sabah and Sarawak also have extensive lowlar rainforest; Sarawak has large areas of swamp forest and montane forest, th latter principally in the east.
Myanmar	658	289	4.0 1.3 %	287 *312*	-	-	Lowland and montane rainforest, mostly semi-evergreen, occurs on west-facing mountain slopes in the east, west and north. More centra there are monsoon forest, many degraded.
Philippines	298	78	3.2 3.3 %	76 *66*	1.2	2	The eastern part of the country has lowland and montane rainforest, the western side lowland and montane monsoon forests. The mo extensive remaining areas are in Luzon and Mindanso.
Singapore	0.6	0.04	0 0	- 0.02	-	-	A 70ha area of lowland rainforest remains on Bukit Timah, along with another 50ha of fragments in the central catchment area. Remaining forest is secondary and abandoned plantation.

odiversity	Factors affecting forests	Area prot.	% prot.	% cover in SML
		(thousand hectares)		
versity was formerly high but is now duced. Endemism is low.	Over 95 % of original forest cover has been cleared. Shifting agriculture is the main cause of forest loss.	31	3 %	32 %
versity is very high; regional endemism is irly high, with many Bornean endemics. ational endemism is low.	The forests are relatively little disturbed. There is some local demand for timber.	49	10 %	40 %
ie forests are little studied. Diversity can be expected to be high, . can regional endemism. National endemism is probably low as ecies are shared with other countries, particularly Vietnam.	1986 estimates of tree-quarters of the original forest cover cleared and only 10 % of primary forest remaining. The central plain is mostly deforested. Shifting cultivation is the major cause of forest loss.	-	-	-
versity in the forests is high; endemism is oderate.	Over 90 % of original forest is believed to have been lost. Clearance for shifting and settled agriculture are the main causes of forest loss, although unsustainable logging is also important.	-	-	-
versity is high; endemism is high in the Western Ghats, rticularly among amphibians and reptiles. Many regional demics shared between W Ghats and Sri Lanka. gional endemism in NE India is high amongst some groups.	Between 50 % and 75 % of forests have been lost. Shifting agriculture, logging, over-grazing and hydroelectric projects are the major causes of forest loss.	820	5 %	39 %
versity and endemism are both extremely high. The country ntains some of the most diverse forests in the world and ans two major biogeographic realms; many of the ands have large numbers of endemic species.	An estimated 30 % of original forest has been lost. Shifting agriculture is the major cause of forest loss. Uncontrolled logging damages the forest structure and in some areas makes them vulnerable to fire. Transmigration from Java and Bali has had a major effect in some areas.	10,657	9 %	67 %
e Forests are incompletely known, but are lieved to have high diversity and moderate demism with fairly high regional endemism.	Between 45 % and 55 % of moist forest has been cleared or degraded. Shifting cultivation is the major cause of forest loss although uncontrolled logging has recently become significant.	-	-	-
versity is very high with moderate endemism; est Malaysia has a significant number of rnean endemics, shared with Kalimantan donesian) and Brunei.	In peninsular Malaysia nearly 50 % of the forest has been cleared; the major cause of forest loss is clearance for large-scale agriculture. In Sabah over half the forest and in Sarawak around 30 % has been cleared; in the latter shifting cultivation is the major problem while in Sabah both settled and shifting agriculture following logging are important.	1,118	6 %	79 %
versity is very high; national endemism is generally low, hough there is significant regional endemism, rticularly in the northern forests.	Around half the forest has been cleared; current deforestation rates are extremely high; largely owing to shifting cultivation and unsustainable logging.	134	0.4 %	87 %
versity is very high and endemism is extremely high.	65–70 % of original forest cover has been cleared; shifting agriculture and unsustainable logging practices are the major causes of forest loss.	56	1 %	38 %
versity is impoverished but otherwise typical of wland Malesian dipterocarp rainforest. Endemism is ry low.	Over 95 % of forest cover has been cleared. Less than 0.2 % of primary forest remains. Encroachment for building and increased recreational use are the main threats.	2	100 %	0

WWF Proposals for Consideration of Forest Quality in the Temperate and Boreal Forest Resource Assessment (TBFRA-2000)

Nigel Dudley and Chris Elliott

Introduction

The TBFRA 2000 is being planned in a different context from its predecessors. Forests are high on the agenda of politicians and the media after UNCED, the Helsinki and Montreal Processes and the Intergovernmental Panel on Forests. In addition, the multiple roles of forests in providing a wide range of goods and services for society have been increasingly recognised. Expectations are high that the TBFRA-2000 (and the FRA as a whole) will address these issues.

WWF has being promoting work on forest quality for several years. At the first meeting of the Team of Specialists for the TBFRA 2000 in April 1995, it was agreed that forest quality should be included in the assessment. This paper briefly reviews key concepts in forest quality, showing that they can help to provide a broader framework for examining forest functions. The paper then makes a number of proposals for how the TBFRA 2000 could incorporate questions on forest quality in the assessment, to satisfy the expectations mentioned above. The criteria and indicators developed under the Helsinki and Montreal processes have been used as reference points wherever possible.

Forest Quality

Unlike the situation in tropical forests, the total global area of temperate forests is actually expanding. This has often been a cause of complacency about the status of temperate forests. However the "quantity" of forests as measured in hectares or cubic meters is not everything. Around the world, natural forests are being replaced with plantations or intensively managed forests which do not have the same value in terms of reservoirs of biodiversity and forest functions, even if the same area of land is covered with trees. This is not to say that plantations or intensively managed forests have no place in forestry. However, some measure is needed to distinguish a plantation from a natural forest.

In research commissioned by WWF, Dudley (1992) has outlined four elements of forest quality:

a. Authenticity

Authenticity is a measure of how closely a forest corresponds to the natural forest of the area, and how closely it mirrors natural ecosystem functions. In ecological terms, it is a way of defining optimal conditions for the conservation of biodiversity. Five main components are important:

- *natural composition* of trees and other flora and fauna;
- *natural spatial variation* of trees with respect to age, size variety, spacing and presence of dead or decaying timber;
- *continuity of forest* (ie the length of time forest has existed on the site);
- *integration of forest into the broader landscape*; (under natural conditions some forest types will not contain continuous tree cover. There will be a mosaic of covered and open areas as a result of natural disturbances such as storms, fires and treefalls. Forest edges and the overall landscape mosaic are thus important aspects of forest quality).
- *management practices which mimic natural ecological processes;* (in principle, if management practices imitate natural processes many of the objectives of conservation will be achieved. However these natural processes vary considerable from region to region. For example, fire is very important in boreal forests but much less common naturally in tropical moist forests. Also, in some areas (eg in parts of Europe) forests have been modified over such a long period that we no longer have a clear idea of what the original forests would look like).

b. Forest health

Forest health should be considered with respect to both disease and pollution damage. Three main elements are important:

- *tree health;* (it is natural for a proportion of trees to be diseased or dying. Major infestations of pests can also occur naturally. However the main focus of this element is on unnatural tree decline due to human activity. For example, in Europe, decline of several species including beech (*Fagus sylvatica*) and oak (*Quercus rober*) and some conifers has been linked to air pollution.
- *health of forest flora and fauna*; The health of other components of the forest ecosystem in addition to trees is important. Air pollution

damage to epiphytic lichens has been well documented, as well as losses of birds insects and fungi requiring the presence of dead timber, when this is no longer present.

- *resilience* in the face of changing conditions; (forests are subject to changing conditions whether in the short term (eg droughts, disturbance, fragmentation) or in the long-term (eg climate change). creating and protecting forests with the resilience to withstand these changes is an important part of maintaining a healthy forest resource).

c. Environmental benefits

This is one of the better recognised elements of forest quality. It includes elements that extend beyond the boundaries of the forest, such as:

- *biodiversity and genetic resources* some aspects of biodiversity conservation are covered by the criteria for authenticity discussed above. However special conservation measures for individual species may be necessary in situations where natural forests are heavily depleted;
- *soil and watershed protection;*
- *impacts on other habitats* in areas where extensive reforestation is carried out to counter past deforestation, quality management must involve an assessment of what habitats are affected when forests are established;
- *local climatic benefits* forests can have a significant impact on local climatic regimes. Deforestation, reforestation and forest management all affect this;
- *carbon sequestration and climate stabilisation* concerns about climate change have led to suggestions of planting forests to sequester carbon. The extent to which this will lead to net reductions of carbon dioxide in the atmosphere will depend on management practices and on how the forest products form the forests are used.

d. Other social and economic values

This element covers a broad range of values to humans ranging from commercial products to cultural considerations.

- *wood products including pulp, timber and fuelwood.* Overall, FAO estimates that the annual contribution of forest products to the world economy is approximately US$ 400,000 million;
- *non-timber products including fruit, nuts, game animals, medicines etc.* The value of these products, especially in tropical forests, can often exceed those of timber products.
- *employment in the forest and surrounding area.* Employment includes both direct work in the forest, and indirect employment through support workers, service industries etc.
- *recreation, aesthetic and cultural values.* The role of forests in this

respect is very important in Europe and North America. It is increasingly recognised elsewhere.

- *homelands and territories for indigenous peoples.* The role of forests as territories for indigenous forest dwellers has been ignored in the past in many countries. Belatedly, it is now receiving more attention.
- *educational value, and role of forests in scientific research.* This includes both formal and informal education, in the sense of providing information to the general public. A proportion of both natural and managed forests need to be protected as "reference forests" for the purposes of scientific research.

Reconciling the different elements of forest quality

It is clear from the elements listed above that not all the elements of forest quality can be maximised on a given site. For example there are clear conflicts between maximising the economic from timber products and maintaining the authenticity of the forest ecosystem. A nature reserve and an eucalyptus plantation may both have high value to humans but the reserve will score high on biodiversity protection and low on the economic value of timber production, whereas the reverse will be true of the plantation. It is clear that we need forests for both biodiversity and timber production. A well designed forest policy will have to make room at the landscape level for these sometimes conflicting benefits. Forest quality can more easily be maximised at the landscape level that the site level.

From a conservation perspective, the priority will be on allocating sufficient areas for biodiversity conservation, indigenous peoples and soil and water conservation *first*, then seeing where commercial production can be accommodated. Biodiversity and indigenous people cannot be moved around, so their needs should be addressed first in a planning framework.

Introduction to WWF paper

In the following paper, WWF proposes a series of questions to address forest quality in the TBFRA-2000. These are divided into two categories, following proposals in the Montreal Process.

- Indicators followed by an "a" are those for which most data are available and will be answerable by many of the countries receiving the questionnaire.
- Indicators followed by a "b" are those which may require the gathering of new or additional data, and/or a new programme of systematic sampling or basic research. Many countries will *not* be able to answer these questions with quantitative data for TBFRA-

2000. They are included for two reasons:

- as an indication of future data requirements and as a framework for helping develop national forest monitoring processes;
- for response in non-quantitative form for TBFRA-2000, perhaps as a one-paragraph reply, or by examples.

This leads to a more general statement about the TBFRA-2000. In previous assessments, most of the information has been in quantitative, and thus comparable, form. This remains difficult, if not impossible, for some measures of forest quality. WWF believes that, for many of the users, the appearance of some information in qualitative, and thus strictly non-comparable, form is perfectly acceptable, and we have devised some of our questions accordingly.

WWF's suggested questions are listed below. We note that there are probably too many for the questionnaire, and that selection will be necessary. In an appendix, the questions are put into context through comparison with the quantitative and descriptive indicators of the Helsinki Process and, where appropriate, the Montreal Process.

Following the summary of questions, some general points regarding the organisation and execution of TBFRA-2000 are made.

Main references and sources are listed at the end of the document.

Acknowledgements

We are grateful for comments from many colleagues in WWF. Our study also benefitted considerably from an informal workshop at IUCN on 10 May 1996, attended by Tim Peck, Kit Prins and Alex Korotkov of the UN/ECE Timber Division, and Per Rosenberg and Jean-Paul Jeanrenaud of WWF International.

Summary of questions

- What is the area of forest and other wooded lands, with respect to vegetation type, age structure and origin? [Data should be collected by vegetation type, then subdivided by age class and by origin. We suggest adding the following elements to a table on *Forests and Other Wooded Land by Forest and Vegetation Type, Age Structure, and Origin of Forest.*]

Description	Total forest and other wooded land	Coniferous	Deciduous	Mixed
Age class:				
– 0–10				
– 11–20				
– 21–40				
– 41–60				
– 61–80				
– 81–100				
– 101–120				
– 121–140				
– >140				
– uneven aged (where <80% of growing stock can be fitted into a 20 year time span)				
Origin:				
– Native origin: forests of >80% trees native to the region and site				
– Introduced origin: forests of >20% non-native species.				
Plantations:				
– Area of plantations				

- Does your country have a National Forest Policy which identifies conservation and sustainable management of forests as specific objectives?
- Does your country carry out periodic forest-related planning and assessment of national forest resources?
- What is the average pollution deposition of sulphur and nitrogen oxides?
- What is the area of forest subject to serious defoliation as defined by classes 2,3 and 4 of the UNECE/EU defoliation classification (in hectares?)
- What has been the change in serious defoliation over 5 years:
  - increasing

  - stable
  - decreasing?
- What is the area subject to serious damage by biotic and abiotic factors
  - by pests and diseases
    - native
    - introduced
  - by fire
    - in fire dominant ecosystems
    - in ecosystems that burn rarely under natural conditions
    - natural fires
    - human-induced fires
  - by storm damage
    - volume harvested from storm-damaged areas
  - by game and grazing
    - domestic livestock
    - wild game?

- *For European countries.* Is your country a signatory of CLRTAP?
- Does your country carry out regular monitoring on forest health status and inventories of soil acidification?
- Does the National Forest Policy include the maintenance of forest ecosystem health and vitality as a specific objective?
- Are there any third party, criteria based forest certification schemes in operation in your country which defines sustainability in economic, environmental and social terms?
- If yes, please list the relevant schemes.
- How many hectares of forest land have been certified under such schemes in your country?
  - public ownership
  - private ownership
  - divided by certification scheme

- What are the main non timber forest products available from the forest?

Main product Unit	Quantity of annual production	Value of annual production (in the national currency)

- Do regulations require forest management to be based on a management plan or equivalent guidelines?
- Does the National Forest Policy include recreation and non-wood

goods and services amongst its named objectives?

- What is the area of natural forest (as defined by natural species composition (see indicator 1.1), age class (see indicator 1.1), structure and natural regeneration?
  - What are the changes since the last assessment?
- What is the area of ancient semi-natural forest (defined as sites that have been continuously wooded since at least 1600)?
  - What are the changes since the last assessment?
- List the areas of forest in the 6 IUCN categories of protected area, as shown in the table below:

Category 1: Strict nature reserve/ wilderness area (protected area managed mainly for science or wilderness protection)	Category 2: National park (PA managed mainly for ecosystem protection and recreation)	Category 3: National monument/ national landmark (protected area managed mainly for conservation of a specific natural feature)	Category 4: Habitat and species management area (protected area managed mainly for conservation through management intervention)	Category 5: Protected landscape/ seascape (protected area managed mainly for landscape/ seascape protection and recreation)	Category 6: Managed resource protected area (protected area managed mainly for the sustainable use of natural resources)

- What are the total number of forest-dependent species?
- What are the total number of endangered forest species listed in country Red Lists or equivalent:
  - Mammals
  - Birds
  - Reptiles and amphibians
  - Fish
  - Invertebrates
  - Vascular plants
  - Lower plants

- Indicate changes in the last 10 years if available
- Please complement the information given by indicating the data sources and the way the information was collected, eg inventories, national biodiversity surveys etc.
- What is the average area of forest regenerated naturally per year?
- In relation to the total area of regeneration, what is the proportion of natural regeneration?
- Has your country ratified the Convention on Biological Diversity?
  - If yes, what steps have been taken to implement the CBD in the

forest sector?

- Does your country carry out inventories and ecological impact assessments on biological diversity in forests, to assess the impact of forest management?
- Does your country have specific legal instruments to protect representative, rare or vulnerable forest ecosystems?
- Does your country have a specific policy for establishing a representative system of protected areas?
- Does your country have legal requirements for conservation management in forests outside protected areas, including:
  - restrictions on clearcutting
  - requirements not to cut next to rivers and streams
  - requirements not to cut on steep slopes
  - requirements to leave nest trees and other key habitats
  - requirements to leave a proportion of mature trees in the forest
  - requirements to leave a proportion of dead standing timber and down logs in the forest?

- Does your country have legal instruments to ensure regeneration of forests?
  - If yes, are there specific regulations or guidelines regarding type of regeneration (plantation, assisted natural regeneration or natural regeneration)?
- What is the area of forest subject to specific regulations regarding soil and water protection?
- What is this area as a proportion of total forest area?
- Is there specific legal instruments to regulate or limit forest management practices in favour of water and soil conservation?
- What area of forest is subject to soil erosion levels above those expected under natural conditions?
- What is the area of forest legally accessible for recreation?
  - What is the area of forest with access per inhabitant?
  - What is this area as a percentage of total forest area?

- How many recreational visits are made to forests (per person, per year)?
- Is there legislation recognising the customary and traditional rights of local people?
- How many forest related jobs exist in your country?
- What are average wages for forest-related jobs as a proportion of average national wages?
- Is there legal provision for means to resolve access disputes?
- Are there specific legal instruments requiring public access to information on forestry from:
  - government?
  - private sector?

- Are there specific legal mechanisms for public participation in public policy and decision-making on forests?
- Do legally enforceable guidelines exist for landscape planning in relation to forest management and forestry operations?
- Does the national forest policy specifically recognise customary and traditional rights of indigenous people?
- What is the area of forest used for subsistence purposes?
- Does the national forest policy specifically recognise cultural values of forests?
- What area and percentage of forest has high value for:
  - cultural reasons
  - historical reasons
  - aesthetic reasons
  - spiritual or religious reasons?

Some additional notes and suggestions regarding the Temperate and Boreal Forest Resource Assessment - 2000

In addition to the questions proposed above, WWF would like to make a number of organisational suggestions regarding the TBFRA-2000

- *Resources*: in addition to requesting that countries complete the questionnaire, we suggest that they also be asked for copies of key documents summarising some or all aspects of the study. Many countries have prepared relevant documents, – for the Helsinki or Montreal Process, and the 1995 report to the Commission on Sustainable Development, in addition to national statistics and academic papers.
- *Annotated bibliography*: the best of these resources could be included in an annotated bibliography produced as an appendix or companion volume to the TBFRA-2000.
- *Staffing and research*: lack of funding for the Forest Resource Assessment makes it impossible for UNECE or FAO staff to spend additional time in analysing results, or in following up sources of information for countries which fail to complete the questionnaire in detail. One option for increasing the capacity of the TBFRA-2000 team would be to establish links with a number of masters students, prepared to work on aspects of the assessment as part of their studies. Students could be asked, for example, to help complete country studies through data published elsewhere, carry out basic analysis, etc.
- *Training*: such a development would require some level of training for participants if it were to be successful. One suggestion is that a training workshop might be carried out by the European Forest

Institute.

- *Consultants*: alternatively, it would be worth seeking funding for consultants to help with the compilation of data once the questionnaires have been returned.
- *Intergovernmental Panel on Forests:* a direct approach to the third meeting of the IPF about TBFRA-2000, perhaps through a paper submitted by the UNECE, might be a useful option for raising the political profile of the assessment, and perhaps of attracting additional resources.
- *Publication*: another option for increasing the political profile, and the accessibility, of TBFRA-2000 would be to seek a commercial publisher interested in collaborating on a published version of the final report.

In the remainder of the document, the questions are put into context by comparison with existing criteria under the Helsinki Process.

Criterion 1: Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles.

Quantitative indicators:

Indicator	**SAG comments**	**WWF proposal**
1.1 Area of forest and other wooded land and changes in the area (classified, if appropriate according to forest and vegetation type, ownership structure, age structure, origin of forest)	Better definitions needed for: – classification by forest and vegetation type – classification by age structure – classification by origin of forest	**Vegetation type:** the basic classification should be according to forest and vegetation type, as follows: – Coniferous forests: forests with >75% conifers – Broadleaved forests: forests with >75% broadleaves – Mixed forests: with <75% broadleaves or conifers **Age class:** forests should be classified according to the following age classes: areas under regeneration, 10 or less, 11–20, 21–40, 41–60, 61–80, 81–100, 101–120, >140, uneven aged (forest where <80% of growing stock can be fitted into a 20 year age span) (Sollander 1996). Origin: forest origin should be measured as follows: – Native origin: forests made up of >80% trees native to he region and site; – Introduced origin: forests made up of >20% non-native species. – Plantations: industrial plantations should be defined – as even-aged single and/or non-native tree species planted as a crop – and distinguished from natural and semi-natural forests. (Natural and semi-natural forests are distinguished in 4.1.) – Fragmentation – a fragmentation index should be developed and included in future surveys.
1.2 Changes in:		(Quality issues relating to these points

a) total volume of growing stock		are addressed elsewhere.)
b) mean volume of growing stock on forest land		
c) age structure	More specific explanatory notes are needed for point (c).	
1.3 Total carbon storage and changes in the storage in forest lands	Data is difficult to present	Note: research in the tropics suggests that old-growth forest is more important role in carbon sequestration than previously thought; research from temperate/ boreal regions is still in progress. Carbon sequestration: ideally should be measured as an average over time, eg expected *net* sequestration and storage over 50(?) years, to account for storage and subsequent re-release through use in disposable products, and as fuelwood and other energy sources. Detailed cover in the questionnaire may be unnecessary as this is already well reported under the Framework Convention on Climate Change and this information could be incorporated later.

Descriptive indicators for criterion 1 (examples)

Legal/regulatory framework	**Institutional framework**	**Financial instruments/ economic policy framework**	**Informational means to implement policy framework**
Existence and extent to to which it provides an overall policy framework for conservation and sustainable management of forests. *WWF Comments:* Existence of: – National Forestry Plan – National Biodiversity Plan	Existence and capacity to provide guidelines for national plans or programmes.	Existence and extent to which it permits the flow of capital in and out of the forest sector in response to market signals and public policy decisions.	Existence and capacity recognise the full range of forest values and potential with periodic forest-related planning and assessment of national forest resources. *WWF comments:* existence of: – National Forest Inventory.

Descriptive indicators for indicator 1.1 (examples)

Legal/regulatory framework	**Institutional framework**	**Financial instruments/ economic policy framework**	**Informational means to implement policy framework**
Existence and extent to which it maintains forest resources and prevents forest degradation; clarifies property rights and provides for appropriate land tenure arrangements.	Existence and capacity to carry out integration between land use planning and forest management.	Existence and extent to which it supports mechanisms promoting integration between land use planning and forest management planning.	Existence and capacity to conduct and apply management guidelines for land-use planning in relation to forest resources: to enhance conversion of agricultural and other treeless land to forest land by afforestation.
	WWF Comments: A landscape approach is increasingly seen as important in forest management; ie individual initiatives need to be set in a framework of regional planning.		*WWF Comments*: Agricultural land is not necessarily treeless. Where conversion is going to occur, in general WWF would encourage natural regeneration.

Descriptive indicators for indicator 1.2 (examples)

Legal/regulatory framework	**Institutional framework**	**Financial instruments/ economic policy framework**	**Informational means to implement policy framework**
Existence and extent to which it supports sustainable management while increasing the growing stock of both merchantable and non-merchantable tree species on forest land available for timber production.	Existence and capacity to undertake and develop regular assessment of forest resources.	Existence and extent to which it provides appropriate incentives to support forest policy aiming at bigger growing stock.	Existence and capacity to improve execution of forest resource assessment by acknowledged research institutions or other similar organisations.
WWF Comments: An increased growing stock is not invariably the most desirable option.	*WWF Comments*: assessments should include breakdown into different categories of forest (see indicator 1.1 above).		

Descriptive indicators for indicator 1.3 (examples)

Legal/regulatory framework	**Institutional framework**	**Financial instruments/ economic policy framework**	**Informational means to implement policy framework**
Existence and extent to which it clarifies policies for enhancing the use of forest products for energy	Existence and capacity to develop programmes for enhancing the use of forest products for energy.	Existence and extent to which it provides subventions for the use of wood for energy.	Existence and capacity to enhance studies on the length of the life cycle of wood products; to enhance effectively organised collection of waste paper.
WWF Comments: Increased use of forest products for energy needs to be carefully planned as part of a regional forest and energy policy; uncontrolled development of biomass for energy could have very serious environmental effects.			

Questions for Criterion 1

- Data should be collected by vegetation type, then subdivided by age class and by origin. We suggest adding the following elements to a table on *Forests and Other Wooded Land by Forest and Vegetation Type, Age Structure, and Origin of Forest.*

Description	**Total forest and other wooded land**	**Coniferous**	**Deciduous**	**Mixed**
Age class:				
– 0–10				
– 11–20				
– 21–40				
– 41–60				
– 61–80				
– 81–100				
– 101–120				
– 121–140				
– >140				
– uneven aged (where <80% of growing stock can be fitted into a 20 year time span.				
Origin:				
– Native origin: forests of >80% trees native to the region and site				
– Introduced origin: forests of >20% non-native species.				
Plantations:				
– Area of plantations				

- Does your country have a National Forest Policy which identifies conservation and sustainable management of forests as specific objectives?
- Does your country carry out periodic forest-related planning and assessment of national forest resources?

Criterion 2: Maintenance of forest ecosystem health and vitality.

Quantitative indicators

Indicator	**SAG Comments**	**WWF Proposals**
2.1 Total amount of, and changes over the past 5 years in, depositions of air pollutants (assessed in permanent plots)	Total amounts of sulphur, nitrogen and heavy metals not easily available.	Utilise other data sources for sulphur deposition as appropriate.
2.2 Changes in serious defoliation in forests using the UN/ECE and EU defoliation classification (classes 2,3 and 4) over the last 5 years.		
2.3 Serious damage caused by biotic or abiotic agents: a) severe damage caused by insects and diseases with a measurement of seriousness of the damage as a function of (mortality or) loss of growth; b) annual area of burnt forest and other wooded land; 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.	The word "serious" needs to be defined. Data on volume harvested in storm damaged areas (2.3.c) is not easily available	Definition of "serious" – WWF proposes "above expected natural levels", (noting that these will sometimes be difficult to identify). The Montreal Process refers to "beyond the range of historical variation". Pest attack: a distinction should be made between *native* and *introduced* pests. Fire: if possible, a distinction should be made between forests that are naturally fire-dominant and those which burn rarely under natural conditions. Distinction should also be made between natural and human-induced fires where possible.
2.4 Changes in nutrient balance and acidity over the last 10 years (pH and CEC); level of saturation of CEC on the plots of he European network or of an equivalent national network.	Data on acidity and level of saturation of CEC not easily available. Guidelines should be taken from the ICP-Forest Level II Handbook.	

Descriptive indicators for indicator 2 (examples)

Legal/regulatory framework	**Institutional framework**	**Financial instruments/ economic policy framework**	**Informational means to implement policy framework**
Existence and extent to which it enforces laws and policies related to maintaining forest health and vitality.	Existence and capacity to develop mechanisms for controlling the occurrence of serious damages/ damage agents.	Existence and extent to which it creates appropriate incentives to prevent extreme disruption of ecological processes.	Existence and capacity to strengthen regular field monitoring on forest health status and inventories of soil acidification; to prevent serious damage caused by machinery and forest operations: compaction of soil, injuries into standing trees, etc.
WWF Comments: some of these regulations will be outside the forest sector, eg control of air quality.	*WWF Comments*: These initiatives are the responsibility of both importing and exporting countries.	*WWF Comments*: It should be noted that the cheapest timber, in terms of price per unit, may not be the cheapest option overall when transport, environmental impacts and social costs are included in the calculation.	

Questions for Criterion 2

- What is the average pollution deposition from sulphur and nitrogen oxides?
- What is the area of forest subject to serious defoliation as defined by classes 2,3 and 4 of the UNECE/EU defoliation classification (in hectares?)
- What have been the changes in serious defoliation over 5 years:
  - increasing;
  - stable;
  - decreasing?

- What is the area subject to serious damage by biotic and abiotic factors
  - by pests and diseases
    - native
    - introduced
  - by fire
    - in fire dominant ecosystems
    - in ecosystems that burn rarely under natural conditions

    - natural fires
    - human-induced fires

  - by storm damage
    - volume harvested from storm-damaged areas

  - by game and grazing
    - domestic livestock
    - wild game

- *For European countries.* Is your country a signatory of CLRTAP?
- Does your country carry out regular monitoring on forest health status and inventories of soil acidification?
- Does the National Forest Policy include the maintenance of forest ecosystem health and vitality as a specific objective?

Criterion 3: Maintenance and encouragement of productive functions of forests (wood and non-wood)

Quantitative indicators:

Indicator	**SAG Comments**	**WWF Proposals**
3.1 Balance between growth and removals of wood over the last 10 years.	The difference between the term drain and removals should be explained.	
3.2 Percentage of forest area managed according to a management plan or management guidelines.		Definition of "under active management" is "forest or other wooded land that has been accepted into a nationally or internationally recognized scheme of certification of sustainable forest management,which defines sustainability in economic, environmental and social terms" (Peck, 1996). **WWF strongly supports this proposal, recognising that there are various different certification schemes under consideration and that it is not the Forest Resource Assessment's role to make a value judgement of these schemes.**
3.3 Total amount of and changes in the value and/ or quantity of non wood forest products (eg hunting and game, cork, berries, mushrooms, etc).	It is possible to express trends, not exact numbers.	Comprehensive information on this issue was collected in the 1990 Resource Assessment for some countries (eg Greece, pp 109–126, UNECE/FAO 1993 volume 2); reporting of this quality should be encouraged for all countries.

Descriptive indicators for indicator 3.1 and 3.2 (examples)

Legal/regulatory framework	**Institutional framework**	**Financial instruments/ economic policy framework**	**Informational means to implement policy framework**
Existence and extent to which it encourages forest owners to practice environmentally sound forestry based on a forest management plan or equivalent guidelines.	Existence and capacity to develop institutions and mechanisms advocating environmental and ocial factors as essential elements in wood production; to develop an maintain efficient physical infrastructure to facilitate the delivery of forest goods and services.	Existence and extent to which it supports investment and taxation policies which recognise the long-term nature of investments in forestry; supports non-discriminatory trade policies for forest products	Existence and capacity to improve technologies and plans based on proper forest inventories.
WWF Comments			*WWF Comments:* More informal information networks should be explored and assessed, eg NGOs, the Swedish *Rikare Skog* initiative etc.

Descriptive indicators for indicator 3.3 (examples)

Legal/regulatory framework	**Institutional framework**	**Financial instruments/ economic policy framework**	**Informational means to implement policy framework**
Existence and extent to which it provides legal instruments to regulate forest management practices for recreation and the harvesting of important non-wood forest products.	Existence and capacity to support appropriate organisations for extension services on non-wood benefits.	Existence and extent to which it enables the implementation of guidelines for management of non-wood benefits.	Existence and capacity to develop management plans for non-wood benefits.
WWF Comments			

Questions for Criterion 3

- Are there any 3rd party, criteria based forest certification schemes in operation in your country which defines sustainability in economic, environmental and social terms?
- If yes, please list the relevant schemes.
- How many hectares of forest land have been certified under such schemes in your country?
  - public ownership
  - private ownership
  - divided by certification scheme

- *Assessment of non-timber forest products as in the 1990 assessment, ie as in the Table below and including comments and additional descriptions:*

Main product	**Unit**	**Quantity of annual production**	**Value of annual production (in the national currency)**

- Do regulations require forest management to be based on a management plan or equivalent guidelines?
- Does the National Forest Policy include recreation and non-wood goods and services amongst its named objectives?

Criterion 4: Maintenance, conservation and appropriate enhancement of biodiversity in forest ecosystems

Quantitative indicators

Indicators	**SAG Comments**	**WWF Proposals**
4.1 Changes in the area of a) natural and ancient semi-natural forest types; b) strictly protected forest reserves; c) forests protected by special management regime.	Reference to IUCN classification could be made; it should be mentioned that indicator 4.1 specifically deals with the areas of forests protected for the conservation of biological diversity.	Based on a review of *Results from the Enquiry on Criteria and Quantitative Indicators for Sustainable Forest Management* (11.4.96) it appears that countries are aggregating data on natural and ancient semi-natural forest types. This aggregation substantially reduces the value of this indicator and WWF proposes the following definitions of natural and ancient semi-natural forests: natural forest: natural species composition (see indicator 1.1), age class (see indicator 1.1), structure and natural regeneration. ancient semi-natural forest: the term "ancient semi-natural refers to continuity, ie sites that have been continuously wooded since at least 1600 (Peterken, 1996) For indicators 4.1.b and 4.1.c, reference should be made to the IUCN categories of protected areas.
4.2 Changes in the number and percentage of threatened species in relation to total number of forest species (using reference lists eg IUCN, Council of Europe or the EU Habitat Directive).	It should be defined what species are included in forest-related species.	Use Red Lists and/or key indicator species.
4.3 Changes in the proportion of stands managed for the conservation	In future a reference to the OECD scheme should be made.	Suggestions made in criterion 1.1 are relevant here.

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.	More attention should be paid to the explanatory notes.	**Suggestions made in criterion 1.1 are relevant here.**
4.5 In relation to total area regenerated, proportions of annual area of natural regeneration		**Suggestions made in criterion 1.1 are relevant here.**

Descriptive indicator for criterion 4 (examples)

Legal/regulatory framework	**Institutional framework**	**Financial instruments/ economic policy framework**	**Informational means to implement policy framework**
Existence and extent to which it clarifies the concept of management, conservation and sustainable development of all types of forest, provides for national adherence to international legal instruments.	Existence and capacity to maintain, conserve and appropriately enhance biological diversity at the ecosystem, species and genetic levels; to identify economic value in forests whose management is adjusted in favour of maintaining biological diversity.	Existence and extent to which it creates new resources and incentives to enhance the mechanisms for predicting impacts of human interventions on forests; supports economic value in forests whose management is adjusted in favour of maintaining biological diversity.	Existence and capacity to develop new inventories and ecological impact assessments on biological diversity: to develop tools to assess the effects of forest management on biological diversity.
WWF Comments: countries could be asked to identify their ratification and implementation of the Convention on Biological Diversity.			

Descriptive indicators for criterion 4.1 (examples)

Legal/regulatory framework	Institutional framework	Financial instruments/ economic policy framework	Informational means to implement policy framework
Existence and extent to which it provides for legal instruments to protect representative, rare or vulnerable forest ecosystems.	Existence and capacity to develop and maintain institutional capacity and distribution of responsibilities related to protected areas; maintain degree of implementation of confirmed national forest conservation programmes.	Existence and extent to which it supports the representativeness of protected forests in relation to ecological and regional distribution.	Existence and capacity to enhance measures to re-establish the endemic biological diversity in forests managed for production; apply measures for rehabilitation of degraded forest areas.
WWF Comments: Governments should be asked to quantify their commitment to protecting forest ecosystems, eg: – area under protection; – commitment to establishing new areas under protection (such as commitment to the WWF/ IUCN 10% target); – attempts to establish representative protection; etc.			

Descriptive indicators for criterion 4.2 (examples)

Legal/regulatory framework	**Institutional framework**	**Financial instruments/ economic policy framework**	**Informational means to implement policy framework**
Existence and extent to which it provides for legal instruments to protect threatened species	Existence and capacity to develop and maintain institutional instruments to protect threatened species.	Existence and extent to which it supports implementation of management guidelines to take into account threatened species.	Existence and capacity to construct periodically reviewed lists of threatened forest species; enhance level of knowledge on threatened species/assessments, inventories or research on threatened species.
WWF Comments: The survey should include assessment of both positive and negative changes, ie also include deregulation where relevant.		*WWF Comments*: This should include a number of categories of protection, eg: – protected areas; – partially or voluntarily protected areas; – specific protection within managed forests, eg trees for eagle nests; – protection through management changes, eg selective logging, retention of some dead timber, etc.	

Descriptive indicators for criterion 4.3 (examples)

Legal/regulatory framework	**Institutional framework**	**Financial instruments/ economic policy framework**	**Informational means to implement policy framework**
Existence and extent to which it provides for legal instruments to ensure regeneration of managed forests.	Existence and capacity to develop and maintain institutional instruments to ensure regeneration of managed forests; conduct inventories on proportion of area covered by trees significantly older then the acceptable age of exploitation currently used.	Existence and extent to which it provides for economic incentives for taking account of environmental issues in management planning; conducts inventories/ assessments of bioindicators.	Existence and capacity to take measures to maintain or to re-establish biological diversity in old forests; monitor changes in the proportions of afforested or reforested areas covered by indigenous and introduced species, conifer or deciduous species.
WWF Comments: the type of regeneration needs to be defined, eg: – plantation; – enhanced regeneration; – natural regeneration.	*WWF Comments*: retention of some older trees should be a positive element in enhancing forest quality.		*WWF Comments*: changes in the proportions of afforested or reforested areas covered by indigenous and introduced species, conifer or deciduous species should be a quantitative measure.

Questions for Criterion 4

- What is the area of natural forest (as defined by natural species composition (see indicator 1.1), age class (see indicator 1.1), structure and natural regeneration?
  - Changes since the last assessment
- What is the area of ancient semi-natural forest (defined as sites that have been continuously wooded since at least 1600)?
  - Changes since the last assessment?
- What are the areas of forest in the 6 IUCN categories of protected area, as shown in the table below:

Category 1: Strict nature reserve/ wilderness area (protected area managed mainly for science or wilderness protection)	**Category 2:** National park (PA managed mainly for ecosystem protection and recreation)	**Category 3:** National monument/ national landmark (protected area managed mainly for conservation of a spesific natural feature)	**Category 4:** Habitat and species management area (protected area managed mainly for conservation through management intervention)	**Category 5:** Protected lanscape/ seascape (protected area managed mainly for landscape/ seascape protection and recreation)	**Category 6:** Managed resource protected area (protected area managd mainly for the sustainable use of resources	**Total area** of protected forests

- What are the total number of forest-dependent species?
- What are the total number of endangered forest species listed in country Red Lists or equivalent
  - Mammals
  - Birds
  - Reptiles and amphibians
  - Fish
  - Invertebrates
  - Vascular plants
  - Lower plants

- What have been the changes in the last 10 years if available
- Please complement the information given by indicating the data sources and the way the information was collected, eg inventories, national biodiversity surveys etc.
- What is the average area of forest regenerated naturally per year?
- In relation to the total area of regeneration, what is the proportion of natural regeneration?
- Has your country ratified the Convention on Biological Diversity?
  - If yes, what steps have been taken to implement the CBD in the forest sector?

- Does your country carry out inventories and ecological impact assessments on biological diversity in forests, to assess the impact of forest management?
- Does your country have specific legal instruments to protect representative, rare or vulnerable forest ecosystems?
- Does your country have a specific policy for establishing a representative system of protected areas?
- Does your country have legal requirements for conservation

management in forests outside protected areas, including:
- restrictions on clearcutting
- requirements no to cut next to rivers and streams
- requirements not to cut on steep slopes
- requirements to leave nest trees and other key habitats
- requirements to leave a proportion of mature trees in the forest
- requirements to leave a proportion of dead standing timber and down logs in the forest?

- Does your country have legal instruments to ensure regeneration of forests?
  - If yes, are there specific regulations or guidelines regarding type of regeneration (plantation, assisted natural regeneration or natural regeneration)?

Criterion 5: Maintenance and appropriate enhancement of protective functions in forest management (notably soil and water).

Quantitative indicators

Indicators	**SAG Comments**	**WWF Proposals**
5.1 Proportion of forest area managed primarily for soil protection.	Further clarification is needed to distinguish these areas from those under indicators 4.1 which relates to biological diversity.	Perhaps the 2 should be combined. Cross reference to particular IUCN category. Data are needed for proportion and area, where there is some specific regulation on land use which has been designed to ensure water and/or soil protection.
5.2 Proportion of forest area managed primarily for water protection.	Further clarification is needed to distinguish these areas from those under indicator 4.1, which relates to biological diversity.	

Descriptive indicators for criterion 5.1 (examples)

Legal/regulatory framework	Institutional framework	Financial instruments/ economic policy framework	Informational means to implement policy framework
Existence and extent to which it provides for legal instruments to regulate or limit forest management practices in areas with vulnerable soils.	Existence and capacity to strengthen institutional instruments to regulate or limit forest management practices in areas with vulnerable soils.	Existence and extent to which it supports the preparation of management guidelines for areas with vulnerable soils.	Existence and capacity to conduct inventories and research on soil erosion.
WWF Comments: requires specific question.			

Descriptive indicators for criterion 5.2 (examples)

Legal/regulatory framework	Institutional framework	Financial instruments/ economic policy framework	Informational means to implement policy framework
Existence and extent to which it provides for legal instruments to regulate or limit forest management practices in favour of water conservation or protection of water resources.	Existence and capacity to strengthen institutional instruments to regulate or limit forest management practices in favour of water conservation or protection of water resources	Existence and extent to which it supports the preparation of management guidelines for taking into consideration water conservation in forest management practices.	Existence and capacity to conduct inventories and research on water quality and flow characteristics in relation to land use practices/ forest management.
WWF Comments: requires specific question.			

Questions for Criterion 5

- What is the area of forest subject to specific regulations regarding soil and water protection?
- What is this area as a proportion of total forest area?
- Is there specific legal instruments to regulate or limit forest management practices in favour of water and soil conservation?
- What area of forest is subject to soil erosion levels above those expected under natural conditions?

Criterion 6: Maintenance of other socio-economic functions and conditions.

Quantitative indicators

Indicators	**SAG Comments**	**WWF Proposals**
6.1 Share of the forest sector from the gross national product.	Indicator should inform on changes in the economic value of the forest sector, also without relationship to the GNP. Separation between forestry and the forest industry should be made.	Countries should be invited to report on any data they have on non-monetary value of goods and services, ie including non-quantitative and/or non-monetary assessments.
6.2 Provision of recreation: area of forest with access per inhabitant, percentage of total forest area.	Wording should be changed to forest area legally accessible to inhabitants.	
6.3 Changes in the rate of employment in forestry, notably in rural areas (persons employed in forestry, logging, forest industry).	Separation between forestry and the forest industry should be made.	

Descriptive indicators for criterion 6.1 (examples)

Legal/regulatory framework	Institutional framework	Financial instruments/ economic policy framework	Informational means to implement policy framework
Existence and extent to which it provides for legal instruments to ensure development of the forest sector.	Existence and capacity to develop and maintain efficient physical infrastructure to facilitate the supply of forest products.	Existence and extent to which it ensures new investments in the forest sector to meet future demands.	Existence and capacity to develop and put into practice new improved technology; to conduct market analysis to better fulfil the needs of society.

Descriptive indicators for criterion 6.2 (examples)

Legal/regulatory framework	Institutional framework	Financial instruments/ economic policy framework	Informational means to implement policy framework
Existence and extent to which it recognises customary and traditional rights of local people, and provides means of resolving access disputes.	Existence and capacity to undertake planning and assessment in recreational services on forestry.	Existence and extent to which it supports forestry constituencies to conserve special environmental, cultural, social and scientific values in relation to recreational services.	Existence and capacity to conduct assessment on recreation.
WWF Comments: a specific question regarding this is given below.			

Descriptive indicators for criterion 6.3 (examples)

Legal/regulatory framework	Institutional framework	Financial instruments/ economic policy framework	Informational means to implement policy framework
Existence and extent to which to provides legal instruments for securing income levels in forest sector.	Existence and capacity to develop and maintain human resource skills in all relevant tasks.	Existence and extent to which it supports programmes to ensure employment in rural areas in relation to forestry.	Existence and capacity to secure a fair income from non-wood products coming from rural sources of income.
WWF Comments			

Questions on Criterion 6

- What is the area of forest legally accessible for recreation?
  - What is the area of forest with access per inhabitant?
  - What is this area as a percentage of total forest area?

- How many recreational visits are made to forests (per person, per year)?
- Is there legislation recognising the customary and traditional rights of local people?
- Is there legal provision for means to resolve access disputes?

Concept Area: Research and Professional Education

Descriptive indicators (examples)

Legal/regulatory framework	**Institutional framework**	**Financial instruments/ economic policy framework**	**Informational means to implement policy framework**
Existence and extent to which it provides for national programmes for research and professional education.	Existence and capacity to develop and maintain institutional instruments to enhance forest related research and education.	Existence and extent to which it provides public and private funding for research, educational and extension programmes.	Existence and capacity to guarantee a sufficient number of people educated at different levels of forestry and cross-cutting field of education.

Concept Area: Public Awareness

Descriptive indicators (examples)

Legal/regulatory framework	**Institutional framework**	**Financial instruments/ economic policy framework**	**Informational means to implement policy framework**
Existence and extent to which it provides opportunities for public access to information.	Existence and capacity to strengthen organisations to provide extension services for general public.	Existence and extent to which it guarantees that part of forest revenues are reinvested in informing the public about forests.	Existence and capacity to support teaching and informing of environmental issues and other forestry related subjects.

Concept Area: Public Participation

Descriptive indicators (examples)

Legal/regulatory framework	Institutional framework	Financial instruments/ economic policy framework	Informational means to implement policy framework
Existence and extent to which it provides opportunities for public participation in public policy and decision making on forest.	Existence and capacity to enforce institutional mechanisms for the involvement of local people and NGOs in decision-making.	Existence and extent to which it attracts public outreach and preparatory planning.	Existence and capacity to enhance public participation in decision-making processes related to implementation of forest policy.
WWF Comments: This should be included as a specific question.			

Concept Area: Cultural Values

Descriptive indicators (examples)

Legal/regulatory framework	Institutional framework	Financial instruments/ economic policy framework	Informational means to implement policy framework
Existence and extent to which it provides for programmes and management guidelines which recognise cultural heritage, and customary and traditional rights of indigenous people in relation to forestry.	Existence and capacity to develop and maintain programmes to conserve culturally valuable sites and landscapes.	Existence and extent to which it provides for acknowledgement of cultural values in forest management planning.	Existence and capacity to conduct studies on proportion of culturally valuable sites and sites with special visual value.
WWF Comments: This should include existence of management criteria for landscape planning in forestry operations. In addition, specific questions regarding customary rights of indigenous people, and area of forest used for subsistence, are both needed.	*WWF Comments*: These issues are difficult to quantify, but can be addressed through description and non-quantified means.		

Questions regarding Concept Areas

- Are there specific legal instruments requiring public access to information on forestry from:
  - government?
  - private sector?

- Are there specific legal mechanisms for public participation in public policy and decision-making on forests?
- Do legally enforceable guidelines exist for landscape planning in relation to forest management and forestry operations?
- How many forest related jobs exist in your country?
- What are average wages for forest-related jobs as a proportion of average national wages?
- Does the national forest policy specifically recognise customary and traditional rights of indigenous people?
- What is the area of forest used for subsistence purposes?
- *We need a non-quantitative question on cultural values.*
- Does the national forest policy specifically recognise cultural values of forests?
- What area and percentage of forest has high value for:
  - cultural reasons
  - historical reasons
  - aesthetic reasons
  - spiritual or religious reasons

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Indicators of Sustainable Forest Management at the National Level and Possibilities to Assess them in National, Regional and Global Forest Inventories

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Summary

This study is one of the reference documents developed for the expert consultation on the assessment of global forest resources for the year 2000 (which will take place in Kotka, Finland, 10–14 June 1996).

Two issues are considered:
- the possible correlations, at the country level, between sustainable forest management[1] and parameters which are or can be assessed in national forest inventories;
- indicators applicable at regional and global levels, and their relation with parameters which are or can be assessed in FAO regional and global inventories

This analysis is based on the four main sets of forest indicators which presently exist:
- Helsinki, which concerns European forests (boreal, temperate and Mediterranean);
- Montreal, for boreal and temperate forests outside of Europe;
- UNEP/FAO proposals for dry-zone Africa south of the Sahara;
- Tarapoto proposals for the Amazonian forest.

These indicators can be divided into 7 categories (the last two are outside the scope of this study):
1 state of forest resources and their change
2 biological diversity
3 health, vitality and integrity
4 production of wood and other forest products

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[1] Often called "forest indicators" in the rest of this document.

5 soil and water protection
6 socio-economic functions
7 legal, institutional, economic, scientific aspects

In this preliminary evaluation very few indicators could be considered applicable to the assessment of regional and global forest resources, in the following fields:

- biological diversity;
- health and vitality of forests;
- soil and water protection; and
- socio-economic functions

This is due to several reasons:

- Certain national indicators are not significant at the global level;
- Definitions are inaccurate and can be interpreted differently from country to country, thus making aggregation impossible;
- The measurement of certain indicators is complex and expensive, and therefore cannot be afforded by many countries.

1. Purpose of the study

Several initiatives have been taken at regional and ecoregional levels in the past few years with the purpose of defining sustainable forest management criteria and identifying the corresponding indicators at national level which would allow to monitor the results over time.

These are above all the Helsinki and Montreal processes, the so-called Tarapoto proposals and the UNEP/FAO ones for the regions of dry-zone Africa. Other efforts are under way to study the applicability of already formulated criteria and indicators to the ecological, economic and social conditions of the North African region, of the Middle East and of Central America.

In recent international forums (including the sessions of the Commission on Sustainable Development and its intergovernmental panel of experts, as well as FAO's governing and statutory bodies) emphasis was put on the need to integrate these indicators into forest inventories. It was also recommended that the periodical global forest inventories be reviewed so as to rectify deficiencies concerning the definition of forest policies and improve them in a practical manner.

One of the goals of the expert consultation on global forest resources for the year 2000 (which will take place in Kotka, Finland, 10–14 June 1996) is to consider one of these improvements, i.e. the identification of indicators applicable to regional and global levels and their integration into the inventories at those levels.

This study is one of the reference documents for this meeting and has two objectives:

- to identify at the country level the possible correlations between the iindicators relating to forest management, and the parameters which

are or can be asssessed in national forest inventories;
- to identify the indicators applicable to regional and global levels and consider their possible correlation with the parameters which are or can be assessed in FAO regional or global inventories.

The aim of this preparatory working paper is to be the basis for thought and discussion for the expert consultation not to cover the topic in an exhaustive manner.

2. Indicators at the national level

Four sets of indicators at national level were studied (cf. Appendix 1 and bibliographic references 1 to 4):

Developed countries:
- Helsinki, which concerns European forests (boreal, temperate and Mediterranean);
- Montreal, for boreal and temperate forests outside of Europe;

Developing countries:
- UNEP/FAO proposals for dry-zone Africa south of the Sahara;
- Tarapoto proposals for the Amazonian forest.

Prior to these four initiatives, ITTO had established guidelines for the management of tropical forests (cf. bibliography 9 to 12). However, ITTO did not specifically address indicators and their use (which was not the purpose at the time); this is the reason why this study does not make reference to this work.

A comparison between the four sets of indicators was made in order to identify converging points (cf. Table 1 and bibliography 5).

The indicators can be divided into 7 categories:

Forest resources:
1 state of forest resources and their change
2 biological diversity
3 health, vitality and integrity

Production and protection functions:
4 production of wood and other forest products
5 soil and water protection

Other functions:
6 socio-economic functions

Forest policy:
7 legal, institutional, economic and scientific aspects

The indicators of categories from 1 to 5 could be considered in national, regional and global forest inventories; this is not the case for categories 6 and 7 which are not applicable to this study (however, some indicators concerning socio-economic functions of the forest were taken into account).

Overall, the four sets which represent almost 80 indicators (or proposed indicators)are divided as follows:

Comparison of the four sets of national forest indicators

indicator identified in:	number:
– the 4 sets	5
– 3 sets	9
– 2 sets	25
– 1 only set	51
– total	**80**

These indicators are listed in Table No. 1 with reference to the sources.

3. Indicators applicable at regional and global levels

The 80 indicators have been qualified as follows (cf. Table No. 1)

Should this kind of data be assessed and monitored over time at a regional or global level?

There are three possible answers: yes, to be confirmed, no.

Can the indicator be assessed at regional or global level in the world forest resources assessment?

There are six possible replies:

1. the indicator is already included in the assessment of regional and global forest resources;
2. the indicator is not included in the assessment of regional and global forest resources, or is considered only in certain regions; an estimation can be made at regional or global level;
3. the indicator is not included in the assessment of regional and global forest resources; a rough estimation can be made at regional or global level;

4. the indicator is not part of the assessment of regional and global forest resources; however, an estimation can be made;
5. the indicator cannot be estimated;
6. the indicator is not relevant at regional or global level.

Finally, should the indicator be taken into consideration at a regional or global level in the global forest resources assessment?

There were three possible answers: yes, to be confirmed, no.

This evaluation is the result of the two previous ones; in fact:

- an important indicator which cannot be measured in a reliable manner or at an acceptable cost must not be kept;
- the same is true for an indicator which can be easily measured but which cannot be monitored at regional or global level.

The above classification leads to the following results:

National forest indicators applicable at regional or global levels:

criteria	to be taken into consideration at regional or global level?			total
	yes	to be confirmed	no	
state of forest resources and their change	12	5	5	22
biological diversity	0	1	13	14
health and vitality of the forest	1	1	16	18
production of wood and other forest products	3	1	7	11
soil and water protection	0	2	7	9
socio-economic functions	0	0	6	6
total	16	10	54	80

4. The possibility of measuring indicators in national inventories

Each of the above-mentioned 80 indicators was examined to ascertain the possibility of measuring them in the course of national forest inventories. The results can be found in Appendix 2. In carrying out this exercise, the results of the first test measurements of these indicators in the European countries were taken into accoount (cf. bibliographical references n. 12, 13a, 13b, and 13c).

Five scenarios were considered:

1. reliable assessment methods exist, and the indicator is already included in several national forest inventories;
2. the indicator is generally not included in national forest inventories; however, reliable assessment methods exist or can be developed;
3. the indicator is not included in national forest inventories; however, a rough estimation can be made (through calculation or modelling) based on data of national forest inventories and possibly other information sources;
4. the indicator is not suitable for assessment in a national forest inventory; an estimation can be made based on other information sources;
5. the indicator cannot be estimated.

Overall, the following results were obtained:

The possibility of measuring indicators, by category, in national forest inventories:

possibility of measuring: criteria:	1	1 or 2	2	2 or 3	3	3 or 4	4	4 or 5	5	total
state of forest resource and their change	4	4	1		9		3		1	22
biological diversity			1	1			9	1	2	14
health and vitality of the forest		3	2		1		6	2	4	18
production of wood and other forest products					4		2	1	4	11
soil and water protection						1	6		2	9
socio-economic functions					1		4	1		6
total	4	7	4	1	15	1	30	5	13	80

5. Measuring indicators at regional or global level

The possibility of estimating indicators at a regional or global level was assessed. The complete results are listed in Appendix 2. An extract is shown in Table No. 2 below concerning those indicators which are obviously applicable at a regional or global level (cf. Table No.1)

Six possibilities were formulated (cf. Para. 3):

1. the indicator is already included in the regional and global forest resources assessment;
2. the indicator is not included in the assessment of regional and global forests, or is only taken into account in certain regions; an estimation

at regional or global level can be made:

3. the indicator is not included in the assessment of regional and global forest resources; a rough estimation at a regional or global level can be considered;
4. the indicator is not part of the assessment of regional and global resources; however, an estimation can be made;
5. The indicator cannot be estimated;
6. The indicator is not applicable at regional or global level.

This estimation is usually the result of the compilation of national indicators. In Table 2, we also refer to the possibility of estimating the indicators concerned at country level.

The results are as follows:

Possibility of estimating indicators in forest resources assessements at regional or global levels:

Possibility of estimating criteria:	1	1 or 2	2	2 or 3	3	3 or 4	4	4or 5	5	5 and/or 6	6	total
their change	4	4	1	4	5				1		3	22
biological diversity				1	2		4		6	1		14
health and vitality of the forest		1	1						12	4		18
production of wood and other forest products		3					1	1	6			11
soil and water protection					2			1		6		9
socio-economic functions					1		2		2	1		6
total	4	8	2	5	10		7	2	27	12	3	80

6. Comparison of indicators over time from one country to another

Very often, of major interest is the change in the value of an indicator, as well as the trend of the change, rather than the absolute value of the indicator. Therefore, it is indispensable that the definitions of the information considered and of the parameter are identical, clear and not ambiguous on the two dates considered; in this way it is possible to calculate the difference or a ratio.

Respecting such conditions should not be difficult for a single country. However, the situation becomes complicated when data from different countries are compiled, as the interpretation of a definition may vary from one country to another, just as the reliability of measurements and estimations may vary, if they exist at all.

These are the problems encountered, when regional or global statistics are assessed through aggregation of national data (cf. Bibliography 14 to 17).

7. Remote sensing

The use of remote sensing, as was employed by the FRA90 project (cf. bibliography 18) for developing countries offers interesting prospects for regional or global assessments: definitions and measures were created in order to be homogeneous and comparable from one country to another and at different dates. However, the definitions utilized by remote sensing still have to match the objects which we want to identify and monitor through time.

It is possible to examine the simple variation of a statistic, for example the change in the area of undisturbed forests. It is also possible to assess the nature of this change, for example, which part of the undisturbed forest has become degraded forest and which part has become agricultural land, etc.? This type of result can be presented in the form of a "change matrix". Remote sensing and geographical information systems are valuable tools for the generation of a matrix (when the data is reliable).

8. Preliminary conclusions

In the first place, a small number of indicators could be taken into consideration in regional and global forest resources assessments, in the following fields:

- biological diversity;
- health and vitality of forests;
- soil and water protection;
- socio-economic functions.

This is due to various reasons:

- certain national indicators are not of interest at the regional or global levels;
- definitions which are too vague can be interpreted differently from one country to another, therefore making aggregation impossible;
- the measuring of certain indicators is complicated and expensive, and therefore cannot be afforded by many countries; furthermore, in such cases, it is necessary to see if the importance of the indicator justifies its cost.

The matter should be thought over carefully to see in which way these criteria could be better represented in the regional and global forest resources assessment.

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Table 1: National, regional and global forest indicators

n.: sequential number, from 1 to 80, without relation to the numbering of the four sets of indicators.

Indicators: indicators are taken from one or several of the four reference sets (Helsinki, Montreal, dry-zone Africa, Tarapoto).

H, M, A, T: The indicator comes from one and/or more of the following sets:
H: Helsinki (European forests: boreal, temperate and Mediterranean);
M: Montreal (boreal and temperate forests outside Europe);
A: Africa (forests of dry-zone Africa south of the Sahara);
T: Tarapoto (Amazonian forest)

Importance at regional or global level:
1: yes
2: to be confirmed
3: no

Evaluation at a regional or global level: measuring possibility in the regional or global forest resources assessment:
1: the indicator is already included in the regional and global forest resources assessment;
2: the indicator is not included in the assessment of regional and global forests, or is only taken into account in certain regions; an estimation at regional or global level can be made:
3: the indicator is not included in the assessment of regional and global forest resources; a rough estimation at a regional or global level can be considered;
4: the indicator is not part of the assessment of regional and global resources; however, an estimation can be made;
5: The indicator cannot be estimated;
6: The indicator is not applicable at regional or global level.
This remark is identical to the one in the table concerning the possibilities of measuring indicators in national, regional and global inventories
("RGFI" column stands for "regional or global forest inventory"):

To be considered at regional or global level (in the forest resources assessment):
1: yes;
2: to be confirmed;
3: no.
This evaluation is the result of the two previous ones.

Remark concerning all the codes:
1 (reg) means for instance that this code is applied only at regional level or to certain regions, but not at a global level.

Table 1. National, regional and global forest indicators

n°	indicators	H	M	A	T	importance at regional or global level	assessment at regional or global level	to be taken into account at regional or global level
	STATE AND CHANGE PROCESS OF FOREST RESOURCES:							
	State of forest areas:							
1	forest area	H		A		1	1	1
2	other wooded land area	H		A		1	1	1
3	area of forest and vegetiation types	H	M	A	T	1	1 or 2	1
4	forest plantations area (A and T) by species category (native and exotic) (T)			A	T	1 (reg.)	1 or 2	1 (reg.)
5	forest area by age class (H and M) or by successional stage (M)	H	M			2 (tropical)	2 or 3	2 (tropical)
6	forest area by ownership type	H				3	6	3
7	forest area by origin	H				3	6	3
8	fragmentation of forests		M	A		2	3	2 or 3
	Change process of forest areas:							
9	forest areas converted to other uses				T	1	1 or 2 or 3	1
	State of volumes:							
10	total biomass		M	A		1	1	1
11	biomass according to forest types		M			2	2	2
12	biomass by age classes or successional stages		M			3	3 or 5	3
13	total carbon storage	H	M			1	3	1
14	total standing volume	H				1	1	1
15	average standing volume, possibly by vegetation zones or site classes	H				2	1 or 2	2
	Change process of volumes:							
16	change over time of total biomass			A		1	2 or 3	1
17	change over time of total carbon storage	H				1	3	1
18	absorption and release of carbon dioxide (balance)		M			1	3	1
19	contribution of forest products to carbon balance		M			2	3 or 5	2
20	change over time of total standing volume	H				1	2 or 3	1

n°	indicators	H	M	A	T	importance at regional or global level	assessment at regional or global level	to be taken into account at regional or global level
21	change over time of average standing volume, possibly according to vegetation zones or site classes	H				3	3 or5	3
	State and change of number of trees:							
22	distribution by diameter classes and change process	H				3	6	3
	BIOLOGICAL DIVERSITY							
	Areas:							
23	area of natural forest or forest assimilated as such, and change process	H		A		2	3	3
24	proportion of mixed plantations of 2–3 species, and change process	H				3	5	3
25	area and proportion of ecosystems greatly modified ecologically				T	3	5	3
26	area of strictly protected forest reserves, and forests that are protected by a special management regime, and change process	H		A		2	2 or 3	2
27	area of protected forest zones (with reference to the IUCN typology or other classification), by forest type		M		T	3	3	3
28	area of protected forest zones (with reference to IUCN typology or other classification), classified by age classes or successional stages.		M			3	5	3
29	proportion of plantations managed for the conservation and use of forest genetic resources (genetic reserves, stands set aside for seed collection, etc.), with differentiation between native and introduced species, and change process	H				3	5	3
30	naturally regenerated area / total regenerated, and change process.	H			T	3	5 and 6	3
	Change process of areas:							
31	Annual clearing of forest ecosystems which contain endemic species			A		2	5	3
	Quantities of species and change process:							
32	number of forest species	H	M	A		1	4	3
33	number of endangered forests, and change process	H	M	A		1	4	3

n°	indicators	H	M	A	T	importance at regional or global level	assessment at regional or global level	to be taken into account at regional or global level
34	proportion of endangered species / number of forest species, and change process	H	M			1	4	3
35	proportion of threatened, rare, vulnerable, endangered and extinct species		M			2	4	3
36	number of forest species which have a reduced distribution area compared to their area of origin		M	A		3	5	3
	HEALTH AND VITALITY OF THE FOREST: Areas affected during a given time:							
37	areas (and % of forest) affected by insect attacks or diseases, divided according to seriousness (measured by loss of growth or death rate)	H	M	A	T	3	5 and 6	3
38	forest area and other wooded land (and % of forest) burnt annually	H	M	A	T	2	3 (reg) and 5	2 (reg)
39	annual area of windthrows due to storms and % of forest concerned …	H	M	A		3	5	3
40	… and volumes extracted from these windthrows	H				3	5	3
41	forest area (and % of forest) affected by: – clearing		M			1	1 or 2	1
42	– permanent flooding		M	A	T	3	2	3
43	– salinization		M			3	5	3
44	– drought			A		3	5	3
45	– wind erosion			A		3	5	3
46	– competition of exotic species		M	A		3	5	3
47	– encroachment of shrub species			A		3	5	3
48	– concentrations of specific air pollutants (sulphates, nitrates, ozone) or ultraviolet B radiation beyond a certain threshold		M			2 (reg)	3 (reg) and 5	3
49	change in defoliation (measured by % of defoliated trees) during the last 5 years (distinguishing between the different levels of seriousness)	H				2 (reg)	3 (reg) and 5	3
50	area of « forest land » (and %) biologically impoverished		M			3	5 and 6	3

n°	indicators	H	M	A	T	importance at regional or global level	assessment at regional or global level	to be taken into account at regional or global level
51	% of regeneration area with serious damage caused by wildlife or grazing (H); area affected by grazing (A)	H		A		3	5 and 6	3
52	% of forest ecosystems with and without regeneration			A		3	5 and 6	3
	Quantities of chemical elements:							
53	total quantity, and change during the last 5 years, of deposits of air pollutants	H				2 (reg)	3 (reg) and 5	3
54	change in the balance of nutritional elements and soil acidity (CEC et pH) in the course of the last 10 years	H		A		2 (reg)	3 (reg) and 5	3
	PRODUCTION OF WOOD AND OTHER FOREST PRODUCTS:							
	Areas (or area ratios):							
55	% of managed forests (and other wooded land) (management plan or management guidelines)	H		A		1	1 or 2	1
56	area and % of forests with a « sustained » production objective, in comparison with the forest area under « permanent » production				T	3	5	3
57	area (and « net area ») of forest land available for wood production		M			1	1 or 2	1
58	forest plantations area, with differentiation between native and exotic species		M		T	1 (reg)	1 or 2	1
59	areas of production forests under sustainable management, divided by classes of unit areas; and comparison with total forest area				T	3	5	3
	Wood volumes (or volume ratios of):							
60	relation between increase in wood volume and harvests during the past 10 years	H	M	A		2	4 or 5	2
61	volume (and%) of estimated sustainable forest production compared to total production				T	3	5	3

n°	indicators	H	M	A	T	importance at regional or global level	assessment at regional or global level	to be taken into account at regional or global level
62	total standing volume, within production forests (M and A); differentiating (A): – merchantable species – non-merchantable species – and plantations (native or exotic species)		M	A		2	5	3
63	average consumption of fuelwood per caput and per year			A		1	4	3
	Quantities of other forest products (or quantity ratios):							
64	ratio between annual collection of non-wood forest products and their estimated sustainable production		M			3	5	3
65	quantity and/or total value (and change) of harvest of non-wood forest products: fodder, game, mushrooms, honey, gum, fruits, roots and leaves, medicinal substances, products for handicrafts, etc.	H	M	A		3	5	3
	SOIL AND WATER PROTECTION:							
	Areas (or area ratios) of forests and soils:							
	managed areas:							
66	forest area (and other wooded land), and % of area managed primarily for soil protection	H	M	A	T	2	3	2
67	forest area (and other wooded land), and % of area, managed primarily for water protection, against floods, avalanches, etc.	H	M	A	T	2	3	2
	Soil area:							
68	forest land area (and %) with an « considerable » soils erosion		M			3	4 or 5	3
69	forest land area (and %) with very poor organic content, and / or whose chemical properties have been altered		M			3	5 and 6	3
70	forest land area with compacted soils (and %) and /or whose physical properties have been altered		M			3	5 and 6	3
71	forest land area (and %) with an accumulation of persistent toxic substances		M			3	5 and 6	3

n°	indicators	H	M	A	T	importance at regional or global level	assessment at regional or global level	to be taken into account at regional or global level
	Quantities of water (lengths of water streams, areas of water bodies):							
72	% of the length of water streams located in the forest basins, with abnormal flow (compared to previous variations)		M		T	3	5 and 6	3
73	% of the length of water streams or of the area of water bodies with abnormally impoverished biological diversity (with reference to previous variations)		M			3	5 and 6	3
74	% of the length of water streams or of the area of water bodies , with abnormal values (with reference to previous variations) in pH, quantity of dissolved oxygen, chemical components (electrical conductivity, sedimentation and temperature		M			3	5 and 6	3
	SOCIO-ECONOMIC FUNCTIONS							
	Areas (or area ratios):							
75	area (and % of total forest area) managed with primary objective: – leisure and tourism		M	A	T	2	3	3
76	– maintenance of cultural, social and spiritual values		M		T	2	5	3
77	– management of landscape			A		3	5 and 6	3
78	per caput area of freely accessible forest and % of total forest area	H				2	4	3
	Other quantities:							3
79	volume of wood production; (also: value and added value)		M			1	4	3
80	production of non-wood forest products		M			1	5	3

Table 2. Possibilities of measuring indicators of sustainable forest management in national, regional and global inventories

(most important indicators at regional and global levels)

This table is an extract of Appendix 2, concerning the indicators that are most important at the regional and global levels.

N: sequential number, included between 1 and 80, corresponding to the numbering adopted in Table 1 and in Appendix 2. Only the indicators applicable to the regional and global levels were retained, and the series of numbers is not continuous.

Indicators: indicators extracted from one or several of the four sets of reference (Helsinki, Montreal, dry-zone Africa, Tarapoto).

H, M, A, T: The indicator comes from one and/or several of the following sets:
H: Helsinki (European forests: boreal, temperate and Mediterranean forests);
M: Montreal (boreal and temperate forest outside of Europe);
A: Africa (forests of dry-zone Africa south of the Sahara);
T: Tarapoto (Amazonian forest).

NFI: possibilities of measuring indicators in a national forest inventory (NFI):
1: efficient assessment methods exist; the indicator is already included in several national forest inventories;
2: the indicator is generally not included in national forest inventories; however, reliable assessment methods already exist and others can be developed;
3: the indicator is not included in national forest inventories; nevertheless, a rough estimation can be made (by calculation or modelling) based on national forest inventories and possibly other information sources;
4: the indicator is not suited for an assessment in a national forest inventory; however, a estimation can be made based on other information sources;
5: the indicator cannot be assessed.

RGFI: possibilities of measuring indicators in regional and global forest resources assessment (RGFI stands for "regional or global forest inventory"):
1: the indicator is already included in the regional and global forest resources assessment;
2: the indicator is not included in the assessment of regional and global forests, or is only taken into account in certain regions; an estimation at regional or global level can be made:
3: the indicator is not included in the assessment of regional and global forest resources; a rough estimation at a regional or global level can be considered;
4: the indicator is not part of the assessment of regional and global resources; however, an estimation can be made;
5: The indicator cannot be estimated;
6: The indicator is not applicable at regional or global level.

Remark:
1 (reg.) means for instance that this code is applicable only at regional level or to certain regions, but not at a global level.

Table 2. Possibilities of measuring indicators of sustainable forest management in national, regional and global inventories
(indicators evidently applicable at regional and global levels)

n°	indicators	H	M	A	T	NFI	RGFI	observations:
	STATE AND CHANGE PROCESS OF FOREST RESOURCES: **State of forest areas:**							
1	forest area	H		A		1	1	NFI: Included in national forest inventories (hereafter referred to as « NFI »). RGFI: Included in FAO's regional and global forest inventories (hereafter referred to as « RGFI »). Aggregations are often difficult for the following reasons: – some countries have not adopted FAO's reference definition; – dates for data collection vary (there is a need to carry out adjustments); – some differences can also depend on the method of estimation: measuring is directly effected through planimetry on maps (with minimum area thresholds which can be different), or by making sample estimations. Regional or global remote sensing programmes, with observation of simple parameters (forest area, without trying to refine the classification), can mitigate these difficulties.
2	other wooded land area	H		A		2	1	NFI: Included in some NFI's, but this is not always the case. RGFI: Idem. Check also § 1. The definition of "other wooded land" varies from country to country, thus making regional and global estimations more complicated. This was particularly noted in the forest resources assessment 90 of temperate zones.
3	area of forest and vegetation types	H	M	A	T	1		NFI: forest and vegetation types must be clearly defined. Various kinds of figures will have to be taken into account, and among these, it will be necessary to select those to be considered as indicators. It is possible to distinguish and identify different structures in the field (and therefore during nventories)

n°	indicators	H	M	A	T	NFI	RGFI	observations:
								–woods (regular or irregular); –shrubs; –composite forests. This simple qualitative parameter is (or can be) recorded in the NFI.
						1		Distinctions can be of an ecological or a biogeographical type; for instance (tropical formations): –closed moist forest; –mixed forest and graminaceous formation; –lowland or upland forest, etc. Such notions are generally taken into account in the stratification of inventories.
						4		Different artificialization levels can be taken into account (cf. § 4 and 23): – "natural" forests (virgin, undisturbed); – "semi–natural" forests; – plantations.
						1		Finally, species types can be considered: broadleaved or coniferous forests. Since the species are identified in the NFI, it is easy to identify pure broadleaved and coniferous stands. In the case of mixed stands, some agreements and thresholds must be adopted to determine the dominant type.
							1 or 2	RGFI: Same observations. Aggregation possibilities of national data will depend on the compatibility of the adopted definitions and the standards established by FAO and/or recognized at a global level. In particular, forest areas can be estimated according to ecofloristic areas (indication of climatic vegetation type). It is reminded that the ecofloristic areas were taken into account in the inventory 90 of forest resources of developing countries, as a stratification element to assess deforestation through remote sensing.
4	forest plantations area (A and T) by species category (indigenous and exotic) (T)			A	T	4		NFI: The distinction of types of stands depending on their origin (natural or planted regeneration) does not have the same importance in the temperate and tropica countries The differences between these two types of stands with regard to physionomy, production and biological diversity are by far more significant in the tropical and sub-tropical countries than in the

n°	**indicators**	**H**	**M**	**A**	**T**	**NFI**	**RGFI**	**observations:**
								temperate countries. Statistics are available at a national level; they usually are the compilation of data which are kept by forest administrators. However, the chance of success of plantations is not always taken into account; its calculation does not come under NFI. Note: this indicator is proposed by Tarapoto and does concern, in this case, tropical countries.
							1 or 2	RGFI: Such data is compiled for tropical countries, based on statistics provided by administrators, which are possibly corrected so as to estimate which plantations have been successful. This correction coefficient should be classified by country. Its calculation is not made in NFI's. This data is less important in the case of temperate countries, and presently is not compiled at their level.
9	forest areas converted to other uses				T			NFI: The change of forest areas is implicit in the other indicator groups (comparison of area indicators estimated at a given periodicity). It is a key indicator and it is advisable to find the means to estimate it, even more so in tropical countries, where areas change rapidly.
						1 or 2		The global forest resources assessment of 1990 shows that the change process of forest areas is generally not well known at a global level (FAO Forestry Paper No. 124 – Appendix 2). Comparison of estimates made on different dates can be difficult because definitions or survey methods have changed in the meantime. Remote sensing is the privileged instrument which allows to appreciate such change process. Moreover, it is possible to identify the nature of these changes, by presenting area flows in the form of a transition matrix. The simpler and the fewer are the forest classifications, the more reliable are the results, when the period involved is significant (10 years for example).
								RGFI: For a global scale compilation, the variety of definitions and measurement methods between countries constitutes an additional difficulty. Reminders concerning FRA90: –developed countries: the assessment of the

n° indicators	H	M	A	T	NFI	RGFI	observations:
							change process was made by country for forests and wooded lands as a whole (without distinction between the two); –developing countries: the change process was estimated by country, and both for natural forests and plantations; in addition the change process of forests and other wooded lands (without any distinction between the two) was estimated by sub-region (not by country).
						1 or 2	A method was developed by FAO to estimate the changes and their nature in tropical countries (FAO Forestry Paper No. 130).
						2 or 3	The same global approach could be adopted for temperate countries..
State of volumes:							
10 total biomass		M	A		3		NFI: Volume figures are estimated in NFI's (see § 14). The total biomass and the carbon carbon can be assessed based on these figures. The most relevant indicators should be chosen: volume and/or biomass and/or carbon quantity. The estimate will be more accurate on total volume or rough wood, than on bole volume (many tropical inventories only estimate bole volume). It would be useful to determine the quality of present models and the weaknesses to correct, according to regions and species types (broadleaved/coniferous) There is, for instance, no model for coniferous species in tropical areas (cf. FAO Forestry Paper No. 124). An FAO study is under way on biomass assessment.
						1	RGFI: Same remarks.
13 total carbon storage	H	M			3		NFI: See remarks made in § 10 concerning biomass
						3	RGFI: Idem.
14 total standing volume	H				1		NFI: Volumes are estimated in IFN's.
						1	RGFI: One difficulty in compiling the data is that the

n°	indicators	H	M	A	T	NFI	RGFI	observations:
								definition of volumes (minimum diameter taken into account) can be different from country to country. Some adjustments should be made if needed.
	Change process of volumes:							
16	change over time of total biomass			A		3		NFI: See comments made in § 10 concerning biomass and in § 20 about volume change (difficulties of assessment accumulate). The change process of biomass is only explicitly mentioned in the set of indicators for dry Africa; it is implicit in Montreal.
							2 or 3	RGFI: Idem.
17	change over time of total carbon storage	H				3		NFI: See comments made in § 10 concerning the biomass and in § 20 about volume change (assessment difficulties accumulate). Remark concerning the Helsinki process: out of 31 countries which replied to the survey, only 12 gave an answer for this indicator.
							3	RGFI: Idem. FRA90 / temperate zones : cf. Table 26.
18	absorption and release of carbon dioxide (balance)		M			3		NFI: This indicator corresponds to the previous one (cf. § 17) but is more detailed (knowledge of incoming and outcoming flows and not only the balance). See remarks above (§ 17). Other data must also be combined to assess the flows. To identify the possible contribution of a NFI, the necessary data and its combinations must be determined beforehand. The previous indicator (§ 17) should be sufficient.
							3	RGFI: Idem.
20	change over time of total standing volume	H				1 or 2		NFI: Change of total volumes is the result of the change process of forest areas (remarks made in § 9 therefore apply to this case), and of the change of average volumes per unit area. This change process is normally well known in the case of continuous forest inventories.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
								RGFI: The variety of definitions and measurement methods between countries, the lack of data are additional difficulties for a global scale compilation. The methods of estimating total volumes adopted in successive RGFI's could also have changed. This is yet another difficulty. Therefore comparison of total volumes of tropical forests assessed during the inventories of 1980 and 1990 is dangerous. In order to compensage for the lack of certain data at the national level, a direct estimate of area changes was carried out through remote sensing for tropical countries (cf. § 9). However, remote sensing does not allow to estimate volumes at this scale in a direct manner. Therefore the RGFI remains dependent on NFI results concerning the change process of standing volumes. One alternative remains to be discussed: assessment of volume change (or of the biomass) = estimation of area change (by forest type and ecological zone) x average volume (or biomass) per ha (which is assumed to be constant).
	BIOLOGICAL DIVERSITY HEALTH AND VITALITY OF THE FOREST: Areas affected during a given time:							
41	forest area (and % of forest) affected by: – clearing		M			1 or 2		NFI: This is a particular case of the indicator « forest areas converted to other uses » (see § 9). A period of time must be determined.
							1 or 2	RGFI: Same remarks.
	PRODUCTION OF WOOD AND OTHER FOREST PRODUCTS: Areas (or area ratios):							
55	% of managed forests (and other wooded land), according to a management plan or management guidelines	H		A		4		NFI: See comments made in § 26 Remark: not all forests are managed with a production objective. It could also be possible to try to determine the area managed for this purpose.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
							1 or 2	RGFI: Idem.
57	area (and « net area ») of forest and available for wood production		M			3		NFI: This indicator synthesizes information of different kind and origin: legal, economic, technical (see FAO definition of « exploitable forests », FAO Forestry Paper No. 124).
							1 or 2	RGFI: In the global forest resources assessment of 1990, this indicator was assessed for the developed countries (synthesis of questionnaires); this was not the case for developing countries. There is a great demand for this indicator to be considered in the next global forest resources assessment.
58	forest plantations area, with differentiation between native and exotic species		M		T	4	1 or 2	Simple reminder here. See § 4. Montreal classifies this indicator in the production field, and Tarapoto in that of forest resources.
	SOIL AND WATER PROTECTION:							

Appendix 1: Four sets of indicators at the national level

HELSINKI:

n°	**criteria/ indicator**
1	**maintenance and appropriate enhancement of forest resources and their contribution to the global carbon cycle**
1.1	area of forest and other wooded land and changes in the area (classified, if appropriate, according to forest and vegetation type, ownership structure, age structure, origin of forest)
1.2.a	changes in total volume of the growing stock
1.2.b	changes in mean volume of the growing stock on forest land (classified, if appropriate, according to different vegetation zones or site classes)
1.2.c	changes in age structure or 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 five years in depositions of air polluants (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 five years
2.3	*serious damages caused by biotic or abiotic agents:*
2.3.a	severe damage caused by insects and diseases with a measurement of seriousness of the damage as a function of (mortality or) loss of growth
2.3.b	annual area of burnt forest and other wooded land
2.3.c	annual area affected by storm damage and volume harvested from these areas
2.3.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 of 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 and changes 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.a	changes in the area of natural and ancient seminatural forest types
4.1.b	changes in the area of strictly protected forest reserves
4.1.c	changes in the area of forest 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 of the EU habitat directive)
4.3	changes in the proportion of stands managed for the conservation and utilisation of the 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 species
4.5	in relation to total area regenerated, proportions of annual area of natural regeneration
5	**maintenance and appropriate enhancement of protective functions in forest management (notably 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 social economic functions and conditions**
6.1	share of the forest sector from the gross national product
6.2	provision of recreation: area of forest with access per capita, % of total forest area
6.3	changes in the rate of employment in forestry, notably in rural areas (persons employed in forestry, logging, forest industry)

MONTREAL:

n°	**criteria / indicator**	a: available b: more work to collect
1	conservation of biological diversity	
1.1	*ecosystem diversity*	
1.1.a	extent of area by forest type relative to total forest area	a
1.1.b	extent of area by forest type and by age class or successional stage	b
1.1.c	extent of area by forest type in protected area categories as defined by IUCN or other classification systems	a
1.1.d	extent of area by forest type in protected area defined by age class or successional stage	b
1.1.e	fragmentation of forest types	b
1.2	*species diversity*	
1.2.a	the number of forest dependent species	b
1.2.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
1.3	*genetic diversity*	
1.3.a	number of forest dependent species that occupy a small portion of their former range	b
1.3.b	population levels of representative species from diverse habitats monitored across their range	b
2	maintenance of productive capacity of forest ecosystems	
2.a	area of forest land and net area of forest land available for timber production	a
2.b	total growing stock of both merchantable and non-merchantable tree species on forest land available for timber production	a
2.c	the area and growing stock of plantations of native and exotic species	a
2.d	annual removal of wood products compared to the volume determined to be sustainable	a
2.e	annual removal of non-timber forest products (e.g. fur bearers, berries, mushrooms, game), compared to the level determined to be sustainable	b
3	maintenance of forest ecosystem health and vitality	
3.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
3.b	area and percent of forest land subjected to levels of specific air polluants (e.g. sulfates, nitrate, ozone) or ultraviolet B that may cause negative impacts on the forest ecosystem	b
3.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 important species such as fungi, arboreal epiphytes, nematodes, beetles,wasps, etc.)	b
4	conservation and maintenance of soil and water resources	
4.a	area and percent of forest land with significant soil erosion	b
4.b	area and percent of forest land managed primarily for protective functions, e.g. watersheds, flood protection, avalanche protection, riparian zones	a
4.c	percent of stream kilometers in forested catchments in which steam flow and timing have significantly deviated from the historic range of variation	b
4.d	area and percent of forest land with significantly diminished soil organic matter and/or changes in other soil chemical properties	b

4.e	area and percent of forest land with significant compaction or change in soil physical properties resulting from human activities	b
4.f	percent of water bodies in forest areas (e.g. stream kilometers, lake hectares) with significant variance of biological diversity from the historic range of variability	b
4.g	percent of water bodies in forest areas (e.g. stream kilometers, lake hectares) with significant variation from the historic range of variability in pH, dissolved oxygen, levels of chemicals (electric conductivity), sedimentation or temperature change	b
4.h	area and percent of forest land experiencing an accumulation of persistent toxic substances	b
5	**maintenance of forest contribution to global carbon cycles**	
5.a	total forest ecosystem biomass and carbon pool, and if appropriate, by forest type, age class, and successional stages	b
5.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 / b
5.c	contribution of forest products to the global carbon budget	b
6	**maintenance and enhancement of long term multiple socio-economic benefits to meet the needs of societies**	
6.1	*production and consumption*	
6.1.a	value and volume of wood and wood products production, including value added through downstream processing	a
6.1.b	value and quantities of production of non wood forest products	b
6.1.c	supply and consumption of wood and wood products, including consumption per capita	a
6.1.d	value of wood and non-wood product production as percentage of GDP	a / b
6.1.e	degree of recycling of forest products	a / b
6.1.f	supply and consumption / use of non-wood products	a / b
6.2	*recreation and tourism*	
6.2.a	area and percent of forest land managed for general recreation and tourism, in relation to the total area of forest land	a / b
6.2.b	number and type of facilities available for general recreation and tourism, in relation to population and forest area	a / b
6.2.c	number of visitor days attributed to recreation and tourism, in relation to population and forest area	b
6.3	*investment in the forest sector*	
6.3.a	value of investment, including investment in forest growing, forest health and management, planted forests, wood processing, recreation and tourism	a
6.3.b	level of expenditure on research and development, and education	b
6.3.c	rates of return on investment	b
6.4	*cultural, social and spiritual needs and values*	
6.4.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	a / b
6.4.b	non-consumptive use forest values	b
6.5	*employment and community needs*	
6.5.a	direct and indirect employment in the forest sector and forest sector employment as a proportion of total employment	a / b
6.5.b	average wage rates and injury rates in major employment categories within the forest sector	a / b
6.5.c	viability and adaptability to changing economic conditions of forest dependent communities, including indigenous communities	b
6.5.d	area and percent of forest land used for subsistance purposes	b
7	**legal, institutional and economic framework for forest conservation and sustainable management** (reminder: 20 indicators)	

AFRICA (DRY ZONE SOUTH OF THE SAHARA):

n°	**criterion / indicator**
1	**maintenance and appropriate enhancement of forest resources and their contribution to the global carbon cycle**
1.1	total area of forests, plantations and other wooded land and changes over time
1.2	biomass (and changes over time)
2	**maintenance and appropriate enhancement of biological diversity in forest ecosystems**
	Diversity of ecosystems
2.1	area by vegetation type (natural or plantation forests)
2.2	area of protected forest
2.3	fragmentation of forests
2.4	annual clearing of forest ecosystems which contain endemic species
	diversity of species
2.5	number of species which belong to the forest environment and their change over time
2.6	number of endangered species which belong to the forest environment
2.7	resource exploitation systems used
	genetic diversity
2.8	change of the average number of provenances (and their changes over time)
2.9	number of species which belong to the forest environment with limited distribution area
2.10	population level of key species on their distribution area
2.11	management of genetic resources
3	**maintenance of health, vitality and integrity of forest ecosystems**
3.1	areas and percentage of (natural and artificial) modified forest – with indication of seriousness of the impact – by procedures or agents such as: – bush fires (specifying their frequence) – storms (including windthrows, and floods) – insects and diseases – damage made by game – damage made by domestic animals – competition of introduced plants – drought – damage by wind erosion
3.2	percentage of forest ecosystems with and without regeneration
3.3	changes in the balance of nutritional elements and soil acidity
3.4	degradation of sites by encroachment of shrubs
3.5	trends in crop yields
3.6	percentage of population working in agriculture and animal husbandry
4	**maintenance and appropriate enhancement of production functions of the forests and other wooded lands**
4.1	percentage of forests and other wooded land managed according to a management plan
4.2	total standing volumes
4.3	balance between wood growth and wood removals (and change over time)
4.4	average annual per caput consumption of fuelwood
4.5	harvests of non-wood forest products (and change over time): – fodder (grass layer and grazing) – use of game for subsistence – honey – gum – fruits, roots and various edible leaves – medicinal substances – products for handicraft and other uses

5 maintenance and appropriate enhancement of protective functions in forest management
5.1 areas and percentage of forest and other wooded land managed primarily for the protection of agricultural or pastoral and /or the rehabilitation of degraded land; and important infrastructure works
5.2 areas and percentage of forests and other wooded land primarily managed for the production of water, the protection of watersheds (most relevant indicators at regional and world levels), riparian zones, and against floods
5.3 area and percentage of forests and other wooded land managed primarily for landscape and leisure purposes
6 maintenance and appropriate enhancement of benefits and socio-economic advantages
economic benefits
6.1 value of wood products
6.2 value of non-wood products
6.3 eco-tourism (including income from hunting and recreation)
6.4 share of the forestry sector in GNP
6.5 forest enhancement by primary and secondary industry
6.6 enhancement of biomass for energy
6.7 balance of foreign trade of the forestry sector
6.8 investment in the forestry sector
distribution of benefits
6.9 creation of employment, especially in rural zones
6.10 level of fulfilment of social, cultural and spiritual needs
6.11 benefits obtained by local communities (particularly by women and young people)
6.12 contribution to food security
7 legal, institutional and political framework for sustainable forest management (reminder: 8 indicators)

TARAPOTO (AMAZON FOREST):

n°	**criteria / indicator**
1	socio-economic benefits
1.1	*indicators of income, production and consumption*
1.1.a	economic profitability of management and sustainable use of the forest
1.1.b	sustainable production, consumption and extraction of forest products
1.1.c	values of forest products from sustainable sources and from unsustainable sources as percentage of gross national product
1.1.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
1.1.e	average per capita income in different forest sector activities
1.1.f	efficiency and competitiveness of forest product production and processing systems
1.1.g	impact of the economic use of forests on the availability of forest resources of importance to local population
1.1.h	relationship between direct and indirect uses of the forests
1.2	*indicators of investment and economic growth in the forest sector (reminder: 4 indicators)*
1.3	*indicators of cultural, social and spiritual needs and values*
1.3.a	area and percentage of forest lands, in relation to total forest lands area, managed to protect cultural, social and spiritual needs and values
1.3.b	area and percentage of forest lands use for purpose of supporting local populations
1.3.c	level of participation of local populations in the management and in the benefits generated by forest activities
1.3.d	development of productive alternatives to illicit crops and mining
2	policies and legal-institutional framework for sustainable development of the forests (reminder: 4 indicators)
3	sustainable forest production
3.a	extension and proportion of forest lands and forests dedicated to sustainable production in relation to the total permanent production area
3.b	quantity and proportion of sustainable forest production in comparison with the national total forest production
3.c	quantity and proportion of units of sustainable production, by area class, in comparison with the national total number of units
3.d	area and percentage of forest lands managed for recreation and tourism, in relation to total forest area
3.e	level of diversification of sustainable forest production
4	conservation of forest cover and of biological diversity
4.a	area, by forest type, in categories of protected areas, in relation to total forest area
4.b	measures for « in situ » conservation of species in danger of extinction
4.c	measures for the conservation of genetic resources
4.d	area and percentage of forest affected by processes of other agents (insect attack, disease, fire, flooding, etc.)
4.e	rate of natural regeneration, species composition and survival
4.f	rate of conversion of forest cover to other uses
4.g	area and percentage of forest lands with fundamental ecological changes
4.h	impact of activities in other sectors on the conservation of forest ecosystems (mining, ranching, energy, infrastructure, etc.)
5	conservation and integrated management of water and soil resources
5.a	measures for soil conservation
5.b	area and percentage of forest lands managed for environmental protection
5.c	percentage of forest flooded in relation to the historic range of variation, and maintenance of the relationship between the forest and hydrobiological resources

5.d effects of forest conservation on the integrated management of water resources

6 science and technology for the sustainable development of the forests (reminder: 6 indicators)

7 institutional capacity to promote sustainable development in Amazonia (reminder: 4 indicators)

8–11 management unit level (reminder: 4 criteria and 23 indicators)

12 economic, social and environmental services performed by amazonian forests

12.a contribution to satisfying the global demand for sustainable produced timber and non-timber forest products

12.b contribution to the global carbon balance

12.c contribution to the global water cycle

12.d contribution to the conservation of biological diversity

12.e contribution to radiation balance and regulation

12.f contribution to the maintenance of cultural values and diversity, and of indigenous and local populations' knowledge

1.2.g contribution to the economy, health, culture, science and recreation

Appendix 2: Possibilities of measuring sustainable forest management indicators in national, regional and global inventories

Coding:

No.: sequential number, from 1 to 80 irrelevant to the numbering of the four sets of indicators.

Indicators: indicators taken from one or several of the four sents of reference (Helsinki, Montreal, dry Africa, Tarapoto).

H, M, A, T: The indicator comes from one and/or several of the following sets:
H: Helsinki (European forests: boreal, temperate and Mediterranean forests);
M: Montreal (boreal and temperate forest outside of Europe);
A: Africa (forests of dry-zone Africa south of the Sahara);
T: Tarapoto (Amazonian forest).

NFI: possibilities of measuring indicators in a national forest inventory (NFI):
1: efficient assessment methods exist; the indicator is already included in several national forest inventories;
2: the indicator is generally not included in national forest inventories; however, reliable assessment methods already exist and others can be developed;
3: the indicator is not included in national forest inventories; nevertheless, a rough estimation can be made (by calculation or modelling) based on national forest inventories and possibly other information sources;
4: the indicator is not suited for an assessment in a national forest inventory; however, a estimation can be made based on other information sources;
5: t he indicator cannot be assessed.

RGFI: possibilities of measuring indicators in regional and global forest resources assessment (RGFI stands for "regional or global forest inventory"):
1: the indicator is already included in the regional and global forest resources assessment;
2: the indicator is not included in the assessment of regional and global forests, or is only taken into account in certain regions; an estimation at regional or global level can be made:
3: the indicator is not included in the assessment of regional and global forest resources; a rough estimation at a regional or global level can be considered;
4: the indicator is not part of the assessment of regional and global resources; however, an estimation can be made;
5: The indicator cannot be estimated;
6: The indicator is not applicable at regional or global level.

Remark:
1 (reg.) means for instance that this code is applicable only at regional level or to certain regions, but not at a global level.
MEASURING FOREST INDICATORS IN T NATIONAL, REGIONAL AND GLOBAL INVENTORIES:

n°	indicators	H	M	A	T	NFI	RGFI	observations:
	STATE AND CHANGE PROCESS OF FOREST RESOURCES: **State of forest areas:**							
1	forest area	H		A		1		NFI: Included in national forest inventories (hereafter referred to as « NFI »).
							1	RGFI: Included in FAO's regional and global forest inventories (hereafter referred to as « RGFI »). Aggregations are often difficult for the following reasons: – some countries have not adopted FAO's reference definition; – dates for data collection vary (there is a need to carry out adjustments); – some differences can also depend on the method of estimation: measuring is directly effected through planimetry on maps (with minimum area thresholds which can be different), or by making sample estimations. Regional or global remote sensing programmes, with observation of simple parameters (forest area, without trying to refine the classification), can mitigate these difficulties.
2	other wooded land area	H		A		2		NFI: Included in some NFI's, but this is not always the case.
							1	RGFI: Idem. Check also § 1. The definition of "other wooded land" varies from country to country, thus making regional and global estimations more complicated. This was particularly noted in the forest resources assessment 90 of temperate zones.
3	area of forest and vegetation types	H	M	A	T			NFI: forest and vegetation types must be clearly defined. Various kinds of figures will have to be taken into account, and among these, it will be necessary to select those to be considered as indicators.
						1		It is possible to distinguish and identify different structures in the field (and therefore during

n°	indicators	H	M	A	T	NFI	RGFI	observations:
								inventories) –woods (regular or irregular); –shrubs; –composite forests. This simple qualitative parameter is (or can be) recorded in the NFI..
						1		Distinctions can be of an ecological or a biogeographical type; for instance (tropical formations): –closed moist forest; –mixed forest and graminaceous formation; –lowland or upland forest, etc. –Such notions are generally taken into account in the stratification of inventories.
						4		Different artificialization levels can be considered (cf. § 4 and 23): – "natural" forests (virgin, undisturbed); – "semi-natural" forests; – plantations.
						1		Finally, species types can be considered: broadleaved or coniferous forests. Since the species are identified in the NFI, it is easy to identify pure broadleaved and coniferous stands. In the case of mixed stands, some agreements and thresholds must be adopted to determine the dominant type.
							1 or 2	RGFI: Same observations.
								Aggregation possibilities of national data will depend on the compatibility of the adopted definitions and the standards established by FAO and/or recognized at a global level . In particular, forest areas can be estimated according to ecofloristic areas (indication of climatic vegetation type). It is reminded that the ecofloristic areas were taken into account in the inventory 90 of forest resources of developing countries, as a stratification element to assess deforestation through remote sensing
4	forest plantations area (A and T) per species category (indigenous and exotic) (T)			A	T	4		NFI: The distinction of types of stands depending on their origin (natural or planted regeneration) does not have the same importance in the temperate and tropical countries. The differences between these two types of stands with regard to physionomy, production and biological diversity are by far more significant in the tropical and sub-tropical countries than in the temperate countries.

n°	**indicators**	**H**	**M**	**A**	**T**	**NFI**	**RGFI**	**observations:**
								Statistics are available at a national level; they usually are the compilation of data which are kept by forest administrators. However, the chance of success of plantations is not always taken into account; its calculation does not come under NFI. Note: this indicator is proposed by Tarapoto and does concern, in this case, tropical countries.
							1 or 2	RGFI: Such data is compiled for tropical countries, based on statistics provided by administrators, which are possibly corrected so as to estimate which plantations have been successful. This correction coefficient should be classified by country. Its calculation is not made in NFI's. This data is less important in the case of temperate countries, and presently is not compiled at their level.
5	forest area by age class (H and M) or by successional stage(M)	H	M			4		NFI: *Age classes:* Not easily measurable in a NFI (although it can be done by augering in temperate countries). In addition, this concept (if applied to stands) is only meaningful in the case of homogeneous forests. Other possible alternatives (if an indicator of this type is to be kept): distribution of trees by diameter classes.
						4		One exception: age classes of tropical forest plantations. The data is then held by forest administrators and is not part of a NFI (see § 4). In this case, it might be simpler to consider classifications according to years of planting (absolute values) rather than age classes (which depend on the year of the survey). It is possible to consider age classes according to species groups, classified in accordance with their life time. Successional stages (Montreal set of indicators): Definition of successional stages must be specified.
							2 or 3	RGFI: See notes above.
								Reminder: the assessment of planted areas per age classes was made during the inventory 80 of tropical forest resources.
6	forest area by ownership type	H				3		NFI: This data is usually known at a national level; it

n°	indicators	H	M	A	T	NFI	RGFI	observations:
								can be assessed in a NFI or through other means.
							6	RGFI: This information is not presently compiled at a global level. Would that serve any purpose?
7	forest area by origin	H				4		NFI: The definition and the purpose of this indicator must be specified. Normally, such indicator is not covered in a NFI.
							6	RGFI: Should not normally be taken into account in a global nventory.
8	fragmentation of forests		M	A		3		NFI: The measuring method for fragmentation must be specified. The simplest formula apparently is to list the distribution (in numbers and areas) of forests by area classes. It is possible to take this information from maps processed through a geographical information system. The result depends on the cartographic method; more particularly, where is the breakpoint for counting the existing forests as one or two in number?
							2 or 3	RGFI: Level of detail is too refined for a global compilation. However, a direct assessment could be considered in the framework of a study by remote sensing such as the one carried out for FRA90/ developing countries.
	Change process of forest areas:							
9	forest areas converted to other uses				T			NFI: The change of forest areas is implicit in the other indicator groups (comparison of area indicators estimated at a given periodicity). It is a key indicator and it is advisable to find the means to estimate it, even more so in tropical countries, where areas change rapidly.
						1 or 2		The global forest resources assessment of 1990 shows that the change process of forest areas is generally not well known at a global level (FAO Forestry Paper No. 124 – Appendix 2). Comparison of estimates made on different dates

n° indicators	H	M	A	T	NFI	RGFI	observations:
							can be difficult because definitions or survey methods have changed in the meantime. Remote sensing is the privileged instrument which allows to appreciate such change process. Moreover, it is possible to identify the nature of these changes, by presenting area flows in the form of a transition matrix. The simpler and the fewer are the forest classifications, the more reliable are the results, when the period involved is significant (10 years for example). RGFI: For a global scale compilation, the variety of definitions and measurement methods between countries constitutes an additional difficulty. Reminders concerning FRA90: –developed countries: the assessment of the change process was made by country for forests and wooded lands as a whole (without distinction between the two); –developing countries: the change process was estimated by country, and both for natural forests and plantations; in addition the change process of forests and other wooded lands (without any distinction between the two) was estimated by sub-region (not by country).
						1 or 2	A method was developed by FAO to estimate the changes and their nature in tropical countries (FAO Forestry Paper No. 130).
						2 or 3	The same global approach could be adopted for temperate countries.
State of volumes:							
10 total biomass		M	A		3		NFI: Volume figures are estimated in NFI's (see § 14). The total biomass and the carbon storage can be assessed based on these figures. The most relevant indicators should be chosen: volume and/or biomass and/or carbon quantity. The estimate will be more accurate on total volume or rough wood, than on bole volume (many tropical inventories only estimate bole volume). It would be useful to determine the quality of present models and the weaknesses to correct, according to regions and species types (broadleaved/coniferous) There is, for instance, no model for coniferous species in tropical areas (cf. FAO Forestry Paper No. 124). An FAO study is under way on biomass assessment.
						1	RGFI: Same remarks.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
11	biomass according to forest types		M			3		NFI: See remarks made in § 10 concerning biomass, and in § 3 about forest types.
							2	RGFI: Same remarks.
12	biomass by age classes or successional stages		M			3		NFI: This indicator is important to calculate the absorption and release of carbon dioxide. See remarks made in § 10 concerning biomass, and in § 5 about age classes. The definition of successional stages should be specified.
							3 or 5	RGFI: Same remarks.
13	total carbon storage	H	M			3		NFI: See remarks made in § 10 concerning biomass
							3	RGFI: Idem.
14	total standing volume	H				1		NFI: Volumes are assessed in NFI's..
							1	RGFI: One difficulty in compiling the data is that the definition of volumes (minimum diameter taken into account) can be different from country to country. Some adjustments should be made if needed
15	average standing volume, possibly by vegetation zones or site classes	H				1		NFI: The definition of « vegetation zones and site classes » should be specified. It is suggested to refer to the same forest types as those defined in § 3 above.
							1 or 2	RGFI: Idem.
	Change process of volumes:							
16	change over time of total biomass			A		3		NFI: See comments made in § 10 concerning biomass and in § 20 about volume change (difficulties of assessment accumulate). The change process of biomass is only explicitly mentioned in the set of indicators for dry Africa; it is implicit in Montreal.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
							2 or 3	RGFI: Idem.
17	change over time of total carbon storage	H				3		NFI: See comments made in § 10 concerning the biomass and in § 20 about volume change (assessment difficulties accumulate). Remark concerning the Helsinki process: out of 31 countries which replied to the survey, only 12 gave an answer for this indicator.
							3	RGFI: Idem. FRA90 / temperate zones : cf. Table 26.
18	absorption and release of carbon dioxide (balance)		M			3		NFI: This indicator corresponds to the previous one (cf. § 17) but is more detailed (knowledge of incoming and outcoming flows and not only the balance). See remarks above (§ 17). Other data must also be combined to assess the flows. To identify the possible contribution of a NFI, the necessary data and its combinations must be determined beforehand. The previous indicator (§ 17) should be sufficient.
							3	RGFI: Idem.
19	contribution of forest products to carbon balance		M			4		NFI: The following must be known: – quantity of carbon stored in wood used (quantities of wood harvested and average life duration of each product category); – and fossil energy economies allowed by wood burning whose carbon release is compensated by its storing in the forest biomass. This indicator is the combination of volumes divided into product categories (timber, industrial wood, fuelwood) and other parameters. NFI's, when they enable to assess volume variations (cf. § 20), do not provide information divided between dead wood which is decomposed on the spot, and harvested wood, with the corresponding product categories. Thus production statistics are also necessary.
							3 or 5	RGFI: Idem.
20	change over time of total standing volume	H				1 or 2		NFI: Change of total volumes is the result of the

n°	indicators	H	M	A	T	NFI	RGFI	observations:
								change process of forest areas (remarks made in § 9 therefore apply to this case), and of the change of average volumes per unit area. This change process is normally well known in the case of continuous forest inventories.
							2 or 3	RGFI: The variety of definitions and measurement methods between countries, the lack of data are additional difficulties for a global scale compilation. The methods of estimating total volumes adopted in successive RGFI's could also have changed. This is yet another difficulty. Therefore comparison of total volumes of tropical forests assessed during inventories of 1980 and 1990 is dangerous. In order to compensate for the lack of certain data at the national level, a direct estimate of area changes was carried out through remote sensing for tropical countries (cf. § 9). However, remote sensing does not allow to estimate volumes at this scale in a direct manner. Therefore the RGFI remains dependent on NFI results concerning the change process of standing volumes. One alternative remains to be discussed: assessment of volume change (or of the biomass) = estimation of area change (by forest type and ecological zone) x average volume (or biomass) per ha (which is assumed to be constant).
21	change over time of averagestanding volume, possibly according to vegetation zones or site classes	H				1 or 2		NFI: see comments above (§ 20). 3 or 5 RGFI: Idem.
	State and change of number of trees:							
22	distribution by diameter classes and change process	H				1		NFI: Distribution of trees in diameter classes is a classic inventory result. It is possible to choose the distribution of number of trees or of volumes.
						1 or 2		Change process: see remarks in § 20 if the choice is a volume distribution by diameter classes.
							6	RGFI: Such an indicator would have no meaning at this scale.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
	BIOLOGICAL DIVERSITY **Areas:**							
23	area of natural forest or forest assimilated as such, and change process	H		A				NFI: The purpose of this indicator is to measure the conservation level of biological diversity (Helsinki scientific council). The terminology must be clarified. It is suggested (Helsinki council) to refer to the IUCN classification. In particular:: – they are defined according to which type and which level of human intervention? – referring to which time period? – are the savannahs, the existence of which depend on the regular passage of fire, considered natural? – which is the minimum size of forest clusters which should be taken into account? – etc. Helsinki: 2/3 of the countries which replied gave an estimation of this criteria.
						4		Collecting these estimates will generally take the form of a survey carried out with forest administrators and will not depend on an NFI.
						3		However, the retained classification allowing, it is possible to plan to define natural wooded formations and/or formations having a natural aspect based on data which can be observed in an inventory. This still must be specified with different approaches to match the various regions. For instance: – in the closed moist forest: zones which have never been exploited; – in temperate forests: assessment based on inventory sampling plots of an *x* area containing more than *y* wood species (it would be necessary to reason according to forest clusters where the proportion of inventory sampling plots is beyond a certain threshold). In any case, an assessment of a change process might not always be entirely reliable.
							3	RGFI: Idem.
								On top of previously mentioned difficulties, the quality of national assessments might differ to a great extent. Such an indicator does not appear at the moment in the world forest resources assessment.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
24	proportion of mixed plantations with2–3 species, and change process	H				2 or 3		NFI: The definition must be specified. Does it take into account also the shrub species in the understorey? Based on this definition, it will be necessary to see if such indicator can be taken from forest inventory data . For instance, an estimation based on inventory sampling plots of an *x* area containing more than 2 or 3 wood species. It will be useful to examine if this protocol will enable to estimate the change process of the areas.
						3		It is also possible to adopt the opposite viewpoint, and try to know the area of monospecies forest plantations (cf. § 4).
							5	RGFI: Idem.
								Aside from the previously mentioned difficulties, the interpretation and quality of national assessments could vary greatly. That is why assessment of such an indicator at a global level is not realistic.
25	area and proportion of ecosystems greatly modified ecologically				T	5		NFI: Refer to areas of forest and vegetation types (parag. 3), which actually represent varying levels of biological diversity.
							5	RGFI: Idem.
26	area of strictly protected forest reserves, and forests that are protected by a special management regime, and change process	H		A		4		NFI: What is meant here is the protection of biological diversity; other protection purposes (soils and water) are taken into account elsewhere. This indicator is part of a set of indicators of the same kind related to forest utilization and management: – forest area managed with reference to management guidelines; – area set aside primarily for wood production; – area set aside primarily for hunting activities; – area set aside primarily for the protection of biodiversity; – area set aside primarily for soil protection; – area set aside primarily for recreation; – etc.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
							2 or 3	Management goals are usually very many on each single area. By considering only the fundamental objectives, areas can be added up (the total being the area of forest managed according to management objectives); however, the areas where these objectives (as primary or secondary objectives) are sought are under-estimated. This indicator must be interpreted with great care. In fact, it is preferable to give priority to the biodiversity in ordinary management (wood production objective), rather than trying to reach very high ratios of reserves by carrying out elsewhere a sylviculture which does not take care of the environment. This data is not considered in a NFI. These are statistics which are necessarily known at a national level, as they are the synthesis of the data kept by forest administrators (if they were not known, this would mean there is no management objective). RGFI: It is a question of aggregating the data known at a national level. One of the difficulties might be that a same term can correspond to different situations from one country to another. A common reference is therefore needed. As far as forest reserves are concerned, the IUCN typology can be a reference (cf. § 26). An example concerning the Helsinki process: out of 31 countries which replied to the survey, 2/3 of them gave answers on this indicator for 1980 and 1990, with very different interpretations (extremely variable areas from one country to another).
27	area of protected forest zones (with reference to the IUCN typology or other classification) by forest type		M		T	2	3	NFI: See comments above about forest reserves (§ 26), and forest types (§ 3). If well known categories of reserves are used (maps are available), this information can be collected without any difficulty during inventories. Areas of forest types within the reserves can then be estimated. If the two parameters (reserves and forest types) can be map-drawn, areas can be estimated through a geographical information system (GIS). RGFI: Same comments.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
28	area of protected forest zones (with reference to IUCN typology or to other classification), by age classes or successional stages.		M			4		NFI: See comments above about forest reserves (§ 26), and age classes or successional stages (§ 5). Calculation of age classes in the case of reserves does not seem possible (stands usually uneven). Successional stage concept to be specified. This indicator should be assessed at the level of management unit.
							5	RGFI: Same comments. Does not seem suitable for this scale.
29	proportion of plantations managed for the conservation and the use of forest genetic resources (genetic reserves, stands set aside for seed collection, etc.), with diffrentiation between native and introduced species, and change process.	H				4		NFI: Same types of observations as in § 26. Data held by the administrators and /or the forest research. Therefore they should be easily known at a national level. The Helsinki scientific council suggests to refer to the OECD recommendations. Note: these mainly concern the trade of seeds (identification of countries of origin; besides, only certain species are concerned). Helsinki survey: out of 31 countries which replied, 24 gave an estimation of this indicator.
							5	RGFI: Same remarks. Does not seem suitable for this scale.
30	naturally regenerated area/ total regenerated, and change process.	H			T			NFI: It is necessary to question the relevance of this indicator as a measure of genetic diversity. For instance, the nature and the intensity of maintaining regenerations (whether natural or artificial) strongly condition the level of biological diversity. The compatibility of the areas considered according to the type of treatment is another issue: irregular or selection forest (and in the latter cases, how should the areas be assessed where regeneration is satisfactory?).
						4 or 5		This indicator is not considered in a NFI.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
								More specifically: – essentially annual statistics are required (sum of the new areas which are put under regeneration every year, and not of the areas in the course of regeneration in a given year); – during inventories it is not always easy to recognize a plot in course of regeneration (confusion between a plot of land intended for plantation with an agricultural plot; confusion between seed cutting and heavy thinning, etc.). Should this indicator be retained, it would be advisable to refer to statistics kept by the administrators.
							5+6	RGFI: Same observations. This indicator does not seem suitable at this scale.
	Change process of areas:							
31	Annual clearing of forest ecosystems which contain endemic species			A		3 or 5		NFI: The objective is to measure the loss of forest species (see also § 32 to 36). The relevance of this indicator in relation to the ones that follow must be confirmed. Two levels of geographic information must be superposed: – the map of forest ecosystems containing endemic (plant or animal) species; – the assessment of cleared forests in a reference period. Map of endemic species: which species are taken into account? When is a species considered endemic? How is this map to be elaborated? Such maps are the result of special studies and can exist at a national level, and it could be useful to control these areas on a case-by-case basis. At a global level, maps which cover certain countries and relate to certain groups of species have been prepared by the « world conservation monitoring center ». Significance of cleared forests: this can be assessed in a continuous forest inventory, and through remote sensing(cf. §9).
							5	RGFI: Same remarks. This indicator cannot be assessed at a global level, because only specific studies exist.
	Quantities of species and change process:							

n°	indicators	H	M	A	T	NFI	RGFI	observations:
32	number of forest species	H	M	A		4		NFI: This is a necessary variable in the calculation of indicators, which are expressed in the form of proportions (cf. § 34 et 35). This knowledge cannot be derived from forest inventories. However, NFI's represent a unique opportunity to widen this knowledge. The quantities of species are generally known with a great margin of doubt. The amount of known species is also a result of the amount of work carried out in this field, and it can vary from country to country. The concept of forest species is not absolutely evident. These can be exclusively, frequently or occasionally present in the forests. Specify that it refers to plant and animal species. Helsinki suggests to refer to existing lists: IUCN, Habitat guideline (Europe), etc.
							4	RGFI: Idem.
33	number of endangered forests, and change process	H	M	A		4		NFI: Cf. previous comments (§32). An absolute value can sometimes be an indicator of our personal knowledge; should a ratio be preferred (cf. § 34)? It is necessary to define the parameters and the thresholds enabling to assess the « danger of extinction » risk? Refer to specific national, regional or global studies. For instance: – IUCN; – Habitat guideline (Europe); – OECD (the forest aspect of the species is not indicated); – etc.
								RGFI: Idem.
34	proportion of endangered species/number of forest species, and change process	H	M			4		NFI: Idem § 33. In effect the following proportion is measured: (known endangered forest species / known forest species), and probably, this ratio is a good estimation of: (endangered forest species / forest species). However, statistics will present species categories which vary greatly from one country to another.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
								For instance, 2/3 of the countries which replied to the Helsinki survey gave an estimate of this indicator for 1990 (data were missing in most cases for 1980). The species categories vary greatly from country to country: fauna: mammals and /or birds and /or reptiles and /or amphibians, etc., and the same for flora.
							4	RGFI: Idem.
35	proportion of threatened, rare, vulnerable, endangered and extinct specie.s		M			4		NFI: Same indicator as the previous one (§34), with more detailed categories. Definitions must be specified in the most objective way; otherwise estimates and more specially their change over time will be questionable. Normally, the same species can belong to several of these categories.
							4	RGFI: Idem.
36	number of forest species which have a reduced distribution area compared to their area of origin.		M	A		4		NFI: Probably this is a particular case of the previous categories (cf. § 33 à 35). Try, as in previous cases, to avoid subjectivity as much as possible (otherwise results and comparisons over time will become questionable). Which "origin" is referred to (1000, 10 000, 100 000 years ago)? Which are the species considered? Are any area reductions due to changes of climate or human intervention taken into consideration? In the circumstances, an assessment of this indicator seems quite difficult in the light of our actual knowledge (which varies according to species and countries). This indicator, if retained, would not always be part of a NFI.
							5	RGFI: Idem.
	HEALTH AND VITALITY OF THE FOREST: Areas affected during a given time:							
37	areas (and % of forest) affected by insect attacks or diseases, divided	H	M	A	T			NFI: Indicator listed in the 4 documents, with various formulations about ways to evaluate the level of

n°	indicators	H	M	A	T	NFI	RGFI	observations:
	according to seriousness (measured by growth loss or death rate)							seriousness of attacks. We have selected again Helsinki. Other formulations: – Montreal: " area affected at a level of seriousness which is superior to the range of previous variations " ; – Africa: " area affected with the indication of seriousness of impact "; – Tarapoto: " area affected " Specify (if that is what is meant) that it refers to the average area which is affected annually in a given reference period (1, 5 or 10 years for example).
						4		This indicator corresponds to often annual events (such as insect attacks). Therefore, it is difficult for an NFI to estimate it since it is usually not carried out in such a short time. Considering the poor areas concerned, an observation system based on permanent plots might not be the solution either. Therefore, there will often be an expert estimation based on information held by administrators. The thresholds of seriousness must be clearly indicated and quantified in an objective manner. Otherwise comparisons over time will be inaccurate. In many cases, these death attacks will not be detected because of drought (cf. § 44) (the two can also be combined). Helsinki survey: 2/3 of the countries which replied gave an estimate of this indicator with great differences in interpretation (great difference of values).
						1 or 2		A possibility which should be considered and was suggested by the Helsinki formulation is to assess these attacks by their impact on the health conditions of the stands: dead, decaying or healthy trees. This approach could then be taken into account in a NFI. Two types of indicators are possible: – estimate of total standing volume corresponding to different health conditions; – estimate of areas affected through counting of inventory sampling plots where the proportion in volume of dead trees is above a certain threshold. Measuring of growth loss, by isolating the share that would be due to the attacks, is much too complex.
							5 and 6	RGFI: This indicator would not have much meaning at this scale.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
38	forest area and other wooded land (and % of forest) burnt annually	H	M	A	T			NFI: The concept of seriousness of damage is also taken into account in dry Africa (in fact, it is necessary to know if fires did or did not destroy the forest). An estimate of this indicator is not done in a NFI, which is not suited to estimate annual variables.
						4 or 5		The use of remote sensing observation should be considered, while keeping in mind certain points: – how long does the passing of a fire remain detectable on satellite imagery (depends on the season), and therefore at which intervals must images be filmed? – the necessary images must be available at the right moments (problems of clouds, particularly in tropical areas). Remote sensing should enable to find the endangered areas rather than to estimate burnt areas. Helsinki: out of 31 countries which replied, 25 gave an estimate of this indicator.
							3 (reg.) and 5	RGFI: The significance of this indicator varies from one region to another (for example, it is very important in the Mediterranean area). The timber bulletin provides regular data on Europe; but how reliable can it be? (seems to vary from one country to another). Only a few specific studies have been made over time.
39	annual area of windthrow due to storms and % of forest concerned ...	H	M	A		4 or 5		NFI: The concept of seriousness of damage is also taken into consideration for dry Africa. An estimate of this indicator is not part of an NFI, which is not suited to estimate annual vaiables (same problem as in the assessment or forest fires, cf. § 38). Helsinki survey: out of 31 countries which replied, 19 gave an estimate on this indicator.
							5	The reliability of estimating such an indicator is questionable (measuring difficulty, small- scale windthrow not taken into consideration, threshold area can vary). RGFI: Idem. This indicator was not retained at this scale.
40	... and volumes extracted from these windthrow	H				4		NFI: This indicator is not part of a NFI; it belongs to production statistics.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
								It is possible to estimate it for exceptional and large windthrow by comparing the production of the year concerned with the average annual production.
							5	RGFI: Idem. This indicator was not retained at this scale.
41	forest area .(and % of forest) affected by: – clearing.		M			1 or 2		NFI: This is a particular case of the indicator « forest areas converted to other uses » (see § 9). A period of time must be determined.
							1 or 2	RGFI: Same remarks.
42	– permanent flooding		M	A	T	1 or 2	2	NFI et RGFI: Same remarks as above (cf. § 41 et § 9).
43	– salinization		M			2		NFI: Is there the need of such a detailed indicator (to be justified on a case-by-case basis)? Same remarks as above (cf. § 41 et § 9). There is a significant difference between the areas entirely affected and the healthy ones. This poses a problem in the estimate.
							5	RGFI: Too detailed at this scale.
44	– drought			A		1 or 2		NFI: Same observations as for the indicator No. 37 concerning insect attacks and diseases. Besides, the meaning of « drought affected » forest (a rate of dead standing trees does, for instance go beyond a certain threshold) must be specified. Distinction during inventories between dead, decaying and healthy trees can provide a global indication on these phenomena.
							5	RGFI: Too detailed at this scale; it is only necessary to keep significant classes of forest area changes for which: – compilations can be considered based on national data (accurate definitions, simple and reliable measures, little missing information); – estimations by remote sensing can be made directly.
45	– wind erosion			A		5		NFI:

n°	indicators	H	M	A	T	NFI	RGFI	observations:
								The definition is much too vague (and difficult to specify and measure). See § 69.
							5	RGFI: Too detailed for this level.
46	– competition of exotic species		M	A		3		NFI: Measuring method similar to inventory for assessing (in volume or in area) seriousness of dead standing trees and /or decaying trees. See § 37, last part.
							5	RGFI: Too detailed for this level.
47	– encroachment of shrub species			A		2		NFI: The importance of such an indicator at a national level must be confirmed. In the framework of an inventory, it would be a question of taking note of the proportion of the area affected within each inventory sampling plot.
							5	RGFI: Not relevant at this level.
48	– concentrations of specific air pollutants (sulphates, nitrates, ozone) or ultraviolet B radiation beyond a certain threshol		M			4 2?		NFI: According to complexity of measures, and frequency at which they must be taken (weekly in certain cases), an appropriate device must be set up (permanent plots). Collection of such data should not be part of a NFI. If there are data which can be collected in the field which do not require recurring measurements, they could be taken into account in a NFI (for example, measurement of concentration of heavy metals in foam samples).
							3(reg.) and 5	RGFI: Same remarks. It would be impossible to monitor this indicator at a global level.
49	change in defoliation (measured by % of defoliated trees) during the last 5 years (distinguishing between different levels of seriousness)	H				4		NFI: This indicator, proposed by Helsinki, refers to a European measuring protocole (permanent plots every 16 x 16 km, measured every year). A NFI is not the best way to assess this indicator. Certainly, it is possible during land surveys to observe defoliation levels of trees, but the following difficulties will arise:

n°	**indicators**	**H**	**M**	**A**	**T**	**NFI**	**RGFI**	**observations:**
								– in deciduous forests, measures cannot be taken during a certain period of the year; – The 5 year period is inferior to the cycle of most NFI's.
							3(reg.) and 5	RGFI: This indicator is not as significant in every region and should not be retained at a global level.
50	area of « forest lands » (and %) biologically impoverished		M			5	5 and 6	NFI and RGFI: The definition of this indicator is far too vague. It cannot be assessed as such.
51	% of regeneration area with serious damage caused by wildlife or grazing (H); area affected by grazing (A)	H		A		5	5 and 6	NFI and RGFI: Dry Africa: the regeneration is not explicitly referred to; in fact, damage can also occur in adult stands (trimming) This indicator is already difficult to measure at the level of management unit; in its actual formulation it would be impossible to try assessing it at a national level.
52	% of forest ecosystems withn and without regeneratio			A		5	5 and 6	NFI and RGFI: The indicator is not measurable. It can be interpreted in many different ways.
	Quantities of chemical elements:							
53	total quantity, and change during last 5 years, of deposits of air pollutants	H				4 (or 2?)		NFI: This indicator, proposed by Helsinki, refers to a European measuring protocol (permanent plots). Same remarks as for § 48. Besides, the size of a sample might be too limited in the light of cost, to extrapolate data and assess total quantities. It would be more relevant to consider the n-uplet of values (or a combination of these values, or a median value, or the proportion of values which have gone beyond a certain threshold - cf. § 48), and to consider its change over time.
							3(reg.) and5	RGFI: No analysis possible at a global level.
54	change in the balance of nutritional elements and soil acidity (CEC et pH) in the course of the last 10 years	H		A		4 (or 2?)		NFI: This indicator, proposed by Helsinki, refers to a European measuring protocol (permanent plots). Same remarks as for § 48. The pH is is easily measurable, specially in the framework of a NFI (protocol to be specified). A mean value would have no meaning; a median

n°	indicators	H	M	A	T	NFI	RGFI	observations:
								value or the proportion of values inferior to a given pH should be assessed.
							3(reg.) and 5	RGFI: No analysis possible at a global level.
	PRODUCTION OF WOOD AND OTHER FOREST PRODUCTS: **Areas (or area ratios):**							
55	% of managed forests (and other wooded land) according to a management plan or management guidelines	H		A		4		NFI: See comments made in § 26. Remark: not all forests are managed with a production objective. It could also be possible to try to determine the area managed for this purpose.
							1 or 2	RGFI: Idem.
56	area and % of forests with a « sustained » production objective, in comparison with forest area under « permanent » production				T	5	5	NFI and RGFI: Which is the difference between a « sustained » production forest and a « permanent » production forest? This indicator should be replaced by the previous one (§ 55), which is more demanding (managing is stronger a concept than setting a goal)
57	area (and « net area ») of forest land available for wood production		M			3		NFI: This indicator synthesizes information of different kind and origin: legal, economic, technical (see FAO definition of « exploitable forests », FAO Forestry Paper No. 124).
							1 or 2	RGFI: In the global forest resources assessment of 1990, this indicator was assessed for the developed countries (synthesis of questionnaires); this was not the case for developing countries. There is a great demand for this indicator to be considered in the next global forest resources assessment.
58	forest plantations area, with differentiation between native and exotic species		M		T	4	1 or 2	Simple reminder here. See § 4. Montreal classifies this indicator in the production field, and Tarapoto in that of forest resources.
59	areas of production forests under sustainable management, divided by classes of unit areas and				T	5	5	NFI and RGFI: This indicator is not measurable: the quality of management cannot be evaluated directly and completely.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
	comparison with total forest area							Is it to be intended (translation problem): forest areas managed with a production goal, divided by class of unitareas? In this case, see § 55.
	Wood volumes (or volume ratios of):							
60	relation between increase in wood volume and harvests during the past 10 years	H	M	A		3		NFI: Montreal compares the average annual harvest with an estimated sustainable production (a possibility) but the reference period is not specified. Reminders (FAO definitions): – gross growth = average growth in a given period of all trees over a certain diameter + recruitement (volume of trees which reach minimal diameter); – net growth = gross growth - natural losses of standing timber (mortality due to diseases, insect attacks, fires, windthrow, etc.) – felling = volume, measured according to the same criteria as standing volume, of living or dead trees felled during a given period, whether they are or are not taken out of the forest, also includes pre-trade cutting. The definition of harvest must be specified : does it include felled volume and /or volume actually taken out of the forest? This indicator should be limited to exploitable forests (cf. § 57). The parameters which contribute to the definition of exploitable forest should therefore be taken into account in NFI's, so that the results can be published at this level. Net growth should be taken as an element of comparison of harvest. Gross and net growth of standing wood volumes can be obtained in a continuous NFI. Gross growth can be assessed in a non-continuous NFI, if it is possible to measure the rings. Growth is not measurable in the case of a non-continuous NFI. Generally in most cases, only standing volumes are estimated in NFI's. Growth is assessed by comparing the differences of total volumes observed in the course of two NFI's on one hand with the (more or less known) data on growth, mortality, harvest (production statistics) on the other hand. Such operation will enable to make an approximate assessment of felled volumes for own consumption and /or undeclared felled volumes. Amounts of wood taken from forests can be established on the basis of production statistics.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
								Nevertheless, the reliability of these statistics can vary very much: uncertainties about volumes used for domestic consumption (and in particular fuelwood which represents the greatest part of wood collected in developing countries), cutting of timber not mentioned in the statistics, etc.
							4 or 5	RGFI: Idem. Compilation at a global level depends on the quality of national data (cf. above). This estimatioon should pose no problem for developed countries (see FRA90). This will be difficult to achieve for developing countries due to lack of statistics.
61	volume (and%) of estimated sustainable forest production compared to total production				T	5	5	NFI and RGFI: This indicator is not measurable, for the same reasons as mentioned in §59.
62	total standing volume, within production forests (M and A); differentiating (A): – merchantable species – non-merchantable species – and plantations (native or exotic species)		M	A		3		NFI: Would it not be better to prefer an indicator relating to growth (see § 60)? Production forests: for the results of an NFI to be published at this level, the parameters which contribute to the definition of exploitable forests (cf. § 57) must be taken into account from the very moment the inventory is conceived. No great problem to extract from inventories total volumes by species categories (commercial or not, definition to be specified). Plantations: see § 4.
							5	RGFI: Idem. See § 14 (total volumes) and § 57 (production forests). It is not possible to make a compilation at a global level, as definitions vary too much from country to country.
63	average consumption of fuelwood per caput and per year			A		3		NFI: This type of statistics is the object of specific surveys. The results of an NFI can be used, as indicated in § 60, to assess domestic consumption of wood.
							4	RGFI: Idem.
	Quantities of other forest products (or quantity ratios):							
64	ratio between annual collection of non-wood		M			5		NFI: This is the information sought, but this indicator is

n°	indicators	H	M	A	T	NFI	RGFI	observations:
	forest products and their estimated sustainable production							far from being measurable in its present form. Which are the products considered (for instance, animal species classified as game)? How are samples measured (collection for domestic consumption is naturally difficult to estimate)? How are existing quantities and increases assessed (something already difficult to do for a cluster and for only one animal species)? It will be necessary to see national statistics which might exist (on hunting and specially on species classified as game) and could serve as indicator at a national level. Essentially they will be trade statistics.
							5	RGFI Each country should be considered on a case-by-case basis, according to the possibility of obtaining reliable information, and to the importance of certain products recorded at a local level. A global synthesis is impossible. Regional syntheses on the trade of the more important products such as rattan and bamboo can possibly be considered.
65	quantity and/or total value (and change) of harvest of non-wood forest products: fodder, game, mushrooms, honey, gum, fruit, roots and leaves, medicinal substances, products for handicrafts, etc.	H	M	A		4 or 5		NFI: These are statistics that are not part of a NFI. See comments above (§ 64).
							5	RGFI: Idem.
	SOIL AND WATER PROTECTION: Areas (or area ratios) and soils: *managed areas:*							
66	forest area (and other wooded land), and % of area managed primarily for soil soil protection	H	M	A	T	4		NFI: See comments made in § 26. Helsinki survey: out of 31 countries which replied, 24 gave an estimation of this indicator with obviously different interpretations (data vary greatly from country to country). In this case, it is possible to observe the change of areas from country to country; however the data of several countries cannot be added up.
							3	RGFI: Idem. Definitions must be very accurate and not too detailed, so as to make an aggregation on

n°	indicators	H	M	A	T	NFI	RGFI	observations:
								various countries possible. In the actual case, all the areas managed for soil or water protection as the main objectivie could be taken into account. FRA90 for temperate countries: the survey recorded forests where soil protection had « great meaning » (subjective), rather than forests managed with this objective (more objective).
67	forest area (and other wooded land), and % of area, managed primarily for water protection, against floods, avalanches, etc.	H	M	A	T	4		NFI: Same remarks as above (§ 66) and as those made in § 26. Helsinki survey: out of 31 countries which replied, 19 gave an estimation of this indicator, with differences in interpretation (data varies greatly from country to country).
							3	RGFI: Idem.
	Soil area:							
68	forest land area (and %) with a « considerable » soil erosion		M			3 or 4 or 5		NFI: It is necessary to give an objective definition (which can be measured and observed with no ambiguity) of what a « considerable » erosion is. Then it will be possible to decide on the possibility of taking such observation into account during NFI's. This indicator is yet too subjective to allow comparisons over time.
							4 or 5	RGFI: Idem.
69	forest land area (and %) with very poor organic content, and /or whose chemical properties have been altered		M			4 (or 2?)		NFI: The definition of this indicator is too vague; it cannot be assessed as such. See remarks made in § 48 and 54. If certain data are measurable in a simple manner in the field, then consideration could be given to taking it into account in a NFI.
							5 and 6	RGFI: A compilation at regional or global level is not possible.
70	forest land area with compacted soils (and %) and /or whose physical properties have been altered		M			5	5 and 6	NFI and RGFI: This indicator is not measurable.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
71	forest land area (and %) with an accumulation of persistent toxic substances		M			4 (or 2?)		NFI: See observations made in § 48 and 53.
							5 and 6	RGFI: A compilation at regional or global level is not possible.
	Quantities of water (lengths of water streams, areas of water bodies):							
72	% of the length of water streams located in the forest basins, with abnormal flows (compared to previous variations);		M		T	5		NFI: This indicator is not part of a NFI. A few observations: – it is necessary to define what a forest basin is; – does it refer to high and low water flows over a 10, 100 year period.? This information is only known about the rivers of a certain importance; – it is necessary to have measuring points downhill from the water catchments, with measurements taken very regularly; – rather than measuring lengths of water streams (which are the ones to be considered ? Where do we stop?), the area of affected water catchments could be selected.
							5 and 6	RGFI: Of no interest on a global scale.
73	% of the length of water streams or of the area of water bodies with abnormally impoverished biological diversity (with reference to previous variations)		M			4		NFI: This is part of a special study, and not at all of a NFI.
							5 and 6	RGFI: Not possible to consider at a global level.
74	% of the length of water streams or of the area of water bodies with abnormal values (with reference to previous variations) in pH, quantity of dissolved oxygen, chemical components (electrical conductivity), sedimentation and temperature		M			4		NFI: This is not part of a NFI. To which area should the measurement points correspond?
							5 and 6	RGFI: Parameters are too small to be observed at a global level.
	SOCIO-ECONOMIC FUNCTIONS **Areas (or area ratios):**							
75	area (and % of total forest area) managed with primary objective: – leisure and tourism		M	A	T	4		NFI: See observations made in § 26.

n°	indicators	H	M	A	T	NFI	RGFI	observations:
							3	RGFI: Idem. The problem of a common definition for all countries is still there.
76	– maintenance of cultural, social and spiritual values		M		T	4		NFI: See observations made in § 26. In most cases, there will be a combined objective. The more detailed and distinct are the management objectives, the more varied will the interpretations be, and the less possible are comparisons and aggregations. Must be grouped with indicator 75.
							5	RGFI: Idem.
77	– management of landscape			A		4		NFI: See observations made in § 26 and 76.
							5 and 6	RGFI: Of no interest at this scale.
78	per caput area of freely accessible forest and % of total forest area	H				3		NFI: The Helsinki scientific council suggests a reformulation: forest area legallly accessible to the people. Should be brought closer to indicator No. 6 (forest area by ownership type). The FRA90 study for temperate countries identifies forests in which recreational fonctions have great importance (subjective).
							4	RGFI: This indicator was not considered at a global level. Certain regions can be especially interested in considering this indicator.
	Other quantities:							
79	volume of wood production; (also: value and added value)		M			4		NFI: See § 60. It is not part of a NFI.
							4	RGFI: World statistics on timber market compiled annually by FAO.
80	production of non-wood forest products		M			4 or 5		NFI: See § 64 and 65. It is not part of a NFI.
							5	RGFI: It is obviously impossible to keep statistics at a global level, except possibly for certain products such as rattan or bamboo.

UNEP and the Global Forest Assessment

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Introduction

Forests occupy roughly 40 percent of the global land area. The significance of forests for man and the human environment is universally known and was discussed at great length during the UNCED process and numerous fora. In fact, forests occupy a prominent place in two conventions; i.e., on biodiversity and climate, signed during the Conference and an agreement was also reached on a declaration of "Forest Principles." In addition, Agenda 21 covers a wide variety of forestry related issues.

In Chapter 11: "*Combating Deforestation*" of Agenda 21, following four programme areas have been identified:

A. Sustaining the multiple roles and functions of all types of forests, forest land, and woodlands.
B. Enhancing the protection, sustainable management, and conservation of all forests, and the greening of degraded areas, through forest rehabilitation, afforestation, reforestation, and other rehabilitative means.
C. Promoting efficient utilization and assessment to recover the full valuation of the goods and services provided by forests, forest lands, and woodlands.
D. Establishing and/or strengthening capacities for the planning, assessment, and systematic observations of forests and related programmes, projects and activities, including commercial trade and processes.

The objectives of the Programme Area D related to forest assessment and monitoring are:

1. "To strengthen or establish systems for the assessments and systematic observations of forests and forest lands."
2. "To provide economists, planners, decision-makers, and local communities with sound and adequate updated information on forests and forest land resources."

Principles 2© of “NON-LEGALLY BINDING AUTHORITATIVE STATEMENT OF PRINCIPLES FOR A GLOBAL CONSENSUS ON THE MANAGEMENT, CONSERVATION, AND SUSTAINABLE DEVELOPMENT OF ALL TYPES OF FORESTS” also envisages:

> “The provision of timely, reliable and accurate information on forests and forest ecosystems is essential for public understanding and informed decision-making and should be ensured.”

Undoubtedly, assessment and monitoring are fundamental to the management, conservation and sustainable development of all forest types of the world at all levels. Timely and reliable information about status and condition of world’s forests is being increasingly demanded for various purposes by the international community. It is generally recognized that information on forest resources is high in demand but short in supply. There are numerous national and international agencies involved in forest resources assessment. However, all these activities are uncoordinated and are based on using different methodologies, definitions, and measurement standards.

The rationale for UNEP’s Involvement

Some of the past activities in the forest assessment and related fields, which justify UNEP’s involvement in the future, are summarized below:

- During the beginning of the last decade, UNEP/GEMS (in cooperation with FAO)carried out the first *“Tropical Forest Resources Assessment”* project1980.The results of which attracted unprecedented attention towards the problem of tropical deforestation. FAO/UNEP 1980 forest assessment served as a benchmark of international efforts and might have been one of the contributory factors leading to UNCED.

- UNEP/GRID has supported forest monitoring methodology development efforts using remote sensing data. GRID offers its system capabilities to collate, analyze, archive, and disseminate forest cover data for scientists and agencies involved with forest assessment.

- UNEP/GEMS provided in-kind support to FAO’s Forest Resources Assessment 1990 project and participated in the In-depth review of the project held in the FAO Headquarters, Rome.

- UNEP and FAO jointly organized an expert consultation *on “Environmental Parameters in Future Global Forest Assessment”*, December 1992, in Nairobi.The consultation was organized to identify various environmental parameters and develop suitable methodology for future global forest assessment. The report of the expert consultation was distributed widely.

- UNEP cooperated with FAO/ECE in organizing meeting of experts on global forest resources' assessment at Kotka (Finland), May 1993 and June 1996. The meeting generated technical recommendations for the future global forest resources assessment incorporating environmental components.

- UNEP is providing archiving and distribution facility for IUFRO's permanentsample plots' data.

- UNEP and IUFRO, in cooperation with FAO, organized an international workshop on *"Developing Large Environmental Data Bases for Sustainable Development"*, July 14–16, 1993, in Nairobi. The workshop was attended by over 80 participants both from developed and developing countries.

- UNEP in partnership with scientific agencies around the world is involved in the development of globally consistent core data sets for environmental assessment and sustainable development strategies.

- UNEP in cooperation with FAO is working on standardisation of land cover classifications.

In recent past, UNEP has been receiving strong endorsements from governments and expert groups for commitment in the future forest resources assessment and monitoring activities:

> "Within UNEP's existing mandate and the priorities of Agenda 21, Chapter 38, UNEP must continue to emphasize what may be called its "environmental sensing" responsibilities, commonly referred to as UNEP's monitoring and assessment role. These include Earthwatch's gathering and evaluating of the best environmental scientific information and data and making it available to policy makers in usable form."

(UNEP/GC.17/28, April 21, 1993)

> "...it will (UNEP), when requested, also take part in the coordination of global and regional forest assessment and in the development and dissemination of forest data."

(Report of the GC of the UNEP on the plans to implement Agenda 21 of the UNEP, 17 Session, May 1993)

> "The Committee recommended that FAO strengthen its cooperation in this field (Forest Resources Assessment) with national institutions concerned and international organizations such as UNEP (for the integration of environmental parameters) and ITTO (in relation to national forest resources accounting.)"

(Report of the 11th Session of the Committee of the Forestry, FAO, March 1993, Rome)

> "The expert group endorses the concepts that the global forest assessment in the future include more parameters to support environmental activities."
>
> "FAO, in cooperation with UNEP, should review future forest assessments with respect to their objectives, the methods to be applied, and the balance of efforts by the agencies in various components of the work, including its role in remote sensing."

(UNEP/FAO Expert Consultation on Environmental Parameters in Future Global Forest Assessments, December 1992, Nairobi)

UNEP Forest Policy

Earth's forests are deteriorating at an alarming rate.International concern has never been greater. An Intergovernmental Panel on Forests (IPF) was created at the third session of the Commission of Sustainable Development last year to address the issue. As one of the agencies working in support of the IPF and called upon to support and facilitate the implementation of UNCED's Forest Principles, UNEP is faced with a major responsibility.

In response to these increasing demands placed upon UNEP, the organization has taken a more proactive role by developing a comprehensive forest policy and proposed action programme for 1996–2000 which will be submitted to the next session of the Governing Council. Approved last March, the forest policy paper will guide UNEP in addressing the environmental aspects of the deterioration of forests all over the world. UNEP's activities will be "issue driven" and will take into account its comparative advantages in resource assessment, environmental policy and management support. Our main role will be one of agenda setter and catalyst in convening policy dialogue on forest related environmental matters.

Equipped with an integrated policy on forests, UNEP is in the position to provide valuable guidance to the IPF. Among other issues, the organization will be able to increase its contribution to the work of the Panel on trade and environment as requested by the second meeting of the IPF held in Geneva, on 11–22 March. UNEP will also continue to work on the needs of countries with low forest cover and develop legal mechanisms for the sustainable management of forests.

Resource Assessment and monitoring of forest change

UNEP will facilitate the assessment, promotion and development of indicators and dissemination of information on the state of the World's forests. It will collaborate with FAO and other agencies in developing improved methodologies for assessing changes in forest biomass. It will monitor commitments made by national governments under Regional Forest Agreements and under the Climate change, Biodiversity and desertification Conventions that relate to the influence of forests on carbon budgets, climate change, preservation of biodiversity and sustainable land use.

Through its ongoing Global Biodiversity Assessment project UNEP will pay attention to forests. This Assessment project will serve as basis for decision making to meet the objectives of the Convention on Biodiversity as well as Agenda 21.

Information for decision making

Since Stockholm and the UN Conference on the Human Environment in 1972, informing has been a major task of UNEP. After UNCED in 1992, Agenda 21 called for improved access to environmental data and information and enhanced capacity of countries to use information for decision making. UNEP is playing a lead role in providing access to environmental data and information for decision making.

UNEP has the opportunity to influence the future course of global forest conservation and development. But the organization can not succeed without additional financial resources and the collaboration of all stakeholders. In implementing the action programme 1996–2000 on forests, UNEP will continue to work closely with the FAO and other UN bodies. UNEP will also enhance cooperation with Governments, scientific networks, conservation groups, private sector foundations, industrial associations and environmental policy research institutions. Only with strong commitment on the part of all stakeholders can we hope to secure the global cooperation needed to safeguard our forests into the 21st century and beyond.

Item 4

FAO Forest Resources Assessment 2000: Lessons Learnt from FRA 1990

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1. Problem formulation

The on-going international debate on forests and forest related issues, originating mostly from UNCED and its follow-up including Intergovernmental Panel on Forests (IPF), Framework Convention on Climate Change, Convention on Biological Diversity, Convention to combat Drought and Desertification, more or less set the Agenda for FAO FRA 2000 .

UNCED Agenda 21, Chapter 11, contains international obligations with special reference to country capacity building in forest resources assessment.

Questions related to sustainabe management of forest resources, to meet the present and future needs of society, are as old as the foundation of FAO FRA in 1946.

The above issues need global information. Some information are common and others are specific to a problem. However, a common feature in all of them is the emphasis on systematic observation (in other words monitoring of changes) and on the understanding of change process (see Box 1).

The studies on global climate change and biological diversity loss require that forest area changes must be presented in the form of transition matrices as each type of area transition is associated with different amounts of impact. In climate change studies, assessment of total biomass associated with forest trees and soil is further required.

Furthermore, reliability of change assessment in the developing and developed countries must be comparable as the two data sets have to be added to obtain a global c-balance.

The total forest cover change needs to be broken-up separately into deforestation of natural forests and afforestation (i.e. raising plantations in non-forest areas), as the two types of changes have different implications in climate as well as biological diversity.

Results are further required to be aggregated by ecological zones for the purposes of implication for global change studies.

Data is required in the form of time-series to match with time-series of meteorological observations.

Last, but not the least, objectivity and transparency of assessment is of paramount importance due to political sensitivity associated with deforestation numbers.

Box 1. Forest cover monitoring requirements of the post-Rio conventions.

Framework Convention on Climate Change

Article 4, All Parties..... shall:

(a) Develop, periodically update, publish and make available to the conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases... using comparable methodologies to be agreed upon by the Conference of the parties;

(g) Promote and cooperate in scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives related to the climate system and intended to further the understanding and to reduce or eliminate the remaining uncertainties regarding the causes, effects, magnitude and timing of climate change and the economic and social consequences of various response strategies.

Convention to Combat Drought and Desertification

Article 16. The Parties agree, according to their respective capabilities, to integrate and coordinate the collection, analysis and exchange of short term and long term data and information to ensure systematic observation of land degradation in affected areas and to understand better and assess the processes and effects of drought and desertification... To this end, they shall, as appropriate:

(a) facilitate and strengthen the functioning of the global network of institutions and facilities for the collection, analysis and exchanges of information, as well as for the systematic observation, at all levels, which shall, inter alia:

(i) aim to use compatible standards and systems

(ii) encompass relevant data and stations, including in remote areas

(iii) use and disseminate modern technology for data collection, transmission and assessment on land degradation; and

(iv) link national, subregional and regional data and information centres more closely with global information sources;

(c) support and further develop bilateral and multilateral programmes and projects aimed at defining, conducting, assessing and financing the collection, analysis and exchange of data and information, including, interalia, integrated sets of physical, biological, social and economic indicators.

Convention on biological diversity

Article 7. Each Contracting Party shall:

(b) monitor, through sampling and other techniques, the components of biological diversity identified pursuant to subparagraph

(a) above, paying particular attention to those requiring urgent conservation measures and those which offer the greatest potential for sustainable use;

(c) identify processes and categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, and monitor their effects through sampling and other techniques; and

(d) maintain and organize, by any mechanism, data derived from identification and monitoring activities pursuant to subparagraphs (b) and (c) above.

2. Information need assessment

2.1. Main parameters

The relation between these parameters and some major forest-related issues is presented in the following table:

	Issues :	Land /environment degradation				Sustainable development		
		Deforestation	Forest Degradation	Carbon cycle/ climatic change	Biodiversity loss	sustainable forest management	Cause-effect studies	
Parameters	Information content			Relevance scoring				
<u>Forest cover</u>								
State	forest/ non forest classification	**	#	**	*	**	*	
Change	deforestation/ afforestation	***	#	**	**	**	**	
<u>Land cover</u>								
State	detailed forest and non-forest classes	**	**	***	***	***	**	
Change	change matrices, change processes, flux diagrams	***	***	***	***	***	***	
<u>Volume/Biomass</u>								
State	by forest/ land cover classes	*	**	***	*	***	*	
change	Carbon release/ sequestration	**	***	***	**	***	***	
<u>Biodiversity</u>								
State	of ecosystems; species richness		*	*	#	***	*	*
change	ecosystem degradation, species loss	*	*	*	***	**	***	

*** essential, indispensable
** desirable
* optional
# non relevant

The relevance scoring in the above table indicates the estimated contribution of a given parameter (or set of parameters) to understanding of the issues under consideration.

While considering the spatial resolution of estimates, or minimum reporting level, the global perspective and consistency should be kept in mind and cost/time implication seen with a practical angle. Some parameters imply the use of high resolution data or field level observations, which strongly influence the survey approach, in view of the obvious cost and time limitations.

The question is: what is the most detailed data baseline for reliable estimates achievable by year 2000? and what survey approach is most suitable to develop such baseline data set?

Reporting units:

The scope of FRA 2000 will have to be on a truly global basis i.e. covering the total geographic land area at all reporting levels. From an administrative/geographic view point, the reporting levels for the parameters listed above and their data sources can be summrized as follows:

	Administrative/geographic units	Relevant data sources
Level I	Global and/or by broad economic/climatic groups (Tropical Developing Countries, Non-tropical Developing Countries, Developed Countries)	– State and change estimates from FRA2000 remote sensing survey Aggregation of regional data
Level II	Region	– State and change estimates from FRA2000 remote sensing survey Aggregation of sub-regional data
Level III	Sub-region	– State and change estimates from FRA2000 remote sensing survey – Integration with country-level data **In view of the different data sources, minor discrepancies with country-level data are expected**
Level IV	Country	– National surveys, inventories, land cover/use maps – State and change estimates from FRA2000 remote sensing survey; – Multi-variate change models – Integration of the above three elements to define the parameters at standard reporting years
Level V	Sub-national Unit	– National surveys, inventories, land cover/use maps – State and change estimates from FRA2000 remote sensing survey Not a reporting level but an essential spatial/statistical database level to develop multi-variate analyses for modelling and adjustment purposes

An additional reporting level is represented by *ecological zone*. This is considered essential since it allows to visualize the environmental context and the forest formations for the study of the change processes. The following ecological zones have been used, with various levels of aggregation, to report tropical forests conditions at year 1990:

Lowland Wet
Lowland Very Moist
Lowland Moist With Short Dry Season
Lowland Moist With Long Dry Season
Lowland Sub-Dry
Lowland Very Dry/Sub-Arid
Lowland Arid/Desertic
Premontane Moist
Premontane Dry
Montane Moist
Montane Dry
Alpine

3. Lessons from FRA 1990

3.1 Regional assessments

Developing countries: In the FRA 1990, as will be the case *in FRA 2000, the lack of reliable data in developing countries will be, no doubt, the most important limiting factor.* This will require that all relevant data are collected, as much as available, and techniques developed to obtain an unbiased and reliable estimate of other parameters of main concern. *FORIS, GIS and modelling activities of FRA 1990, will continue to play an important role in FRA2000 too.*

The assessment must be linked with capacity building to meet obligations of Agenda 21, mentioned earlier.

Due to reasons of lack of adequate and comparable data to build a time-series of forest cover changes for forests in developing countries, remote sensing sampling survey using multi-date high resolution satellite data should remain an important part of the assessment.

Developed countries: In the FRA 1990 assessment for developed countries it was possible to compile detailed data for most countries with accuracy which generally exceeds by far that achieved for developing countries. Data on growing stock, woody biomass, growth rates and harvest yields were included. However, *the quality and quantity of the data vary considerably between the countries, and there are many gaps in the information supplied. Therefore, regional totals could not be made for all variables studied. Moreover, core definitions have been interpreted and applied quite differently in the various country groups due to differences in basic concepts and schools of thought.*

3.2 Global synthesis

Global synthesis was, no doubt, the most problematic for FRA 1990, compounded by problems of the two economic regions but also due to *lack of initial planning to integrate data.*

Results obtained regarding forest area change were incomplete and not conclusive. In estimating area changes, there were two problems. The first concerned the concept of "gross" and "net" change. The positive and negative changes in the forest cover of a country may cancel each other out and produce a net change in forest cover close to zero. Purely for forest area accounting this does not matter; however for the assessment of the "environmental functions" of the forest, it is preferable to have separate estimations for both positive and negative changes in forest cover.

The second question concerned changes in the definitions and mensurational standards used in a country over time. This may result in estimates which include "real change" as well as "spurious change" due to improvements in measurement techniques. In such a case, it is necessary to reappraise the baseline results according to the improved definitions and only then compare values at two different points in time. Only in this way can valid estimates of change be obtained.

On a global scale further complications arose *because definitions and/or measurement techniques differed among countries. These may produce estimates at global level of unknown reliability.* In the 1990 assessment, harmonization of country data on a global basis was undertaken for the developing countries, but not for the developed ones. This, however, should not distort the results as the magnitude of change in the developed countries is rather small.

In the context of change assessment, the pan-tropical survey based on remote sensing implemented as a part of Forest Resources Assessment 1990 Project, deserves a special mention. It provides statistically reliable and consistent estimates of forest cover over space and time. Of particular interest are the "change matrices" which show the extent as well as direction of land cover changes and can thus help to explain the process of deforestation and forest degradation and, in particular, the transfer of forest land to agriculture and other purposes (see the following Matrix and Bar-chart).

3.3 Some conclusions

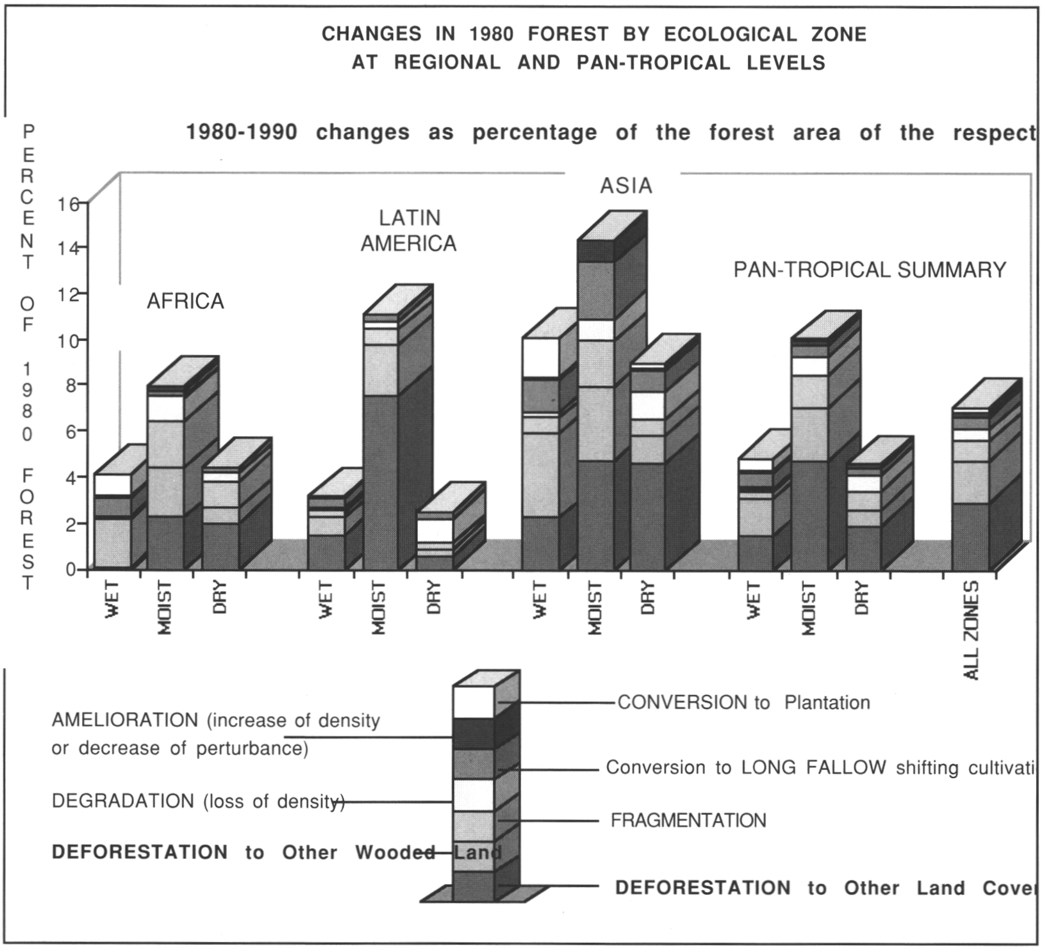
FORIS and GIS could contribute to better harmonization of databases and, in particular, in building reliable and harmonized time-series data at global level. However, FORIS/GIS cannot solve all the problems, the error arising from the use of varying definitions could obscure real changes in a significant manner which are expected to be smaller than the error itself.

A global sampling survey, using multi-date high resolution satellite data for the period 1980–1990–2000 could provide a reliable estimate of mean forest cover and of changes during 1980–2000 and serve as a basis of systematic observation of global changes.

Pan-tropical area transition matrix for the period 1980–1990

Land Cover Classes in 1990 (Million hectares)

Land Cover Classes in 1980	Closed Forest	Open Forest	Long Fallow	Frag-mented Forest	Shrubs	Short Fallow	Other Land Cover	Waterr	Planta-tions	TOTAL 1980 Million ha	%
Closed Forest	**1275.91**	8.97	9.27	9.17	2.53	21.57	34.79	1.78	3.95	**1367.96**	*44.6*
Open Forest	0.86	**283.31**	1.30	5.18	1.46	2.40	10.18	0.05	0.21	**304.94**	*9.9*
Long Fallow	1.10	0.26	**48.61**	1.08	0.79	2.35	2.27	0.05	0.01	**56.54**	*1.8*
Fragment. Forest	0.58	0.63	0.63	**159.33**	0.45	1.41	11.40	0.25	0.39	**175.06**	*5.7*
Shrubs	0.15	0.20	0.26	0.14	**152.69**	0.34	19.17	0.19	0.15	**173.30**	*5.6*
Short Fallow	0.56	0.29	0.46	0.39	0.16	**119.79**	7.30	0.19	0.17	**129.31**	*4.2*
Other Land Cov.	0.71	0.70	0.26	1.35	1.94	2.03	**834.23**	1.58	0.44	**843.26**	*27.5*
Water	0.14	0.02	0.01	0.05	0.01	0.07	1.46	**stable**	0.02	**1.78**	*0.1*
Plantation	0.05	0.03	0.00	0.00	0.00	0.01	0.11	0.00	**15.68**	**15.88**	*0.5*
TOTAL Million ha	1280.06	294.41	60.81	176.69	160.03	149.97	920.91	4.09	21.03	3068.01	
1990 %	*41.7*	*9.6*	*2.0*	*5.8*	*5.2*	*4.9*	*30.0*	*0.1*	*0.7*		*100.0*



Pan-tropical woody biomass flux diagram

Experiences of the TBFRA-1990

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The forest resource assessment is a major source of information on the world's forests on global and regional levels for a wide range of users from academic researchers to government bodies. Its role and importance was recognised and stressed by many international fora. Recently the forest resource assessment is considered as a unique tool assisting the implementation of many of UNCED's recommendations, and which could also contribute to monitoring the Helsinki process. Being aware of these facts member countries of COFO urged FAO to attach the highest priority possible to this task and make it a continuous programme in close co-operation with all competent and concerned national and international organisations.

The temperate forest resource assessment was carried out by UN-ECE/FAO in accord with the program of work of the Joint FAO/ECE Working Party on Forest Economics and Statistics. The preparations were initiated by "Kotka I", the FAO/ECE/FINNIDA ad hoc expert meeting generously hosted by Finland in October 1987. The meeting agreed that the inventory had to be carried out by means of an enquiry for which a draft layout was developed. The Joint Working Party considered the recommendations of the ad hoc expert meeting in its session in February 1988 and invited the national correspondents to comment on the draft enquiry. The second ad hoc meeting held in September 1989 in conjunction with the IUFRO conference on natural resources monitoring proposed further modifications.

The final version of the enquiry together with the terms and definitions for the temperate forest resources assessment was approved by the 17th meeting of the Joint Working Party in December 1989 and circulated to the ECE member countries as well as to Australia, Japan and New Zealand in spring 1990. The countries sent their replies to the ECE secretariat in the period of 1990–1991. Based on these replies the secretariat prepared a report on the preliminary results which was considered by the third ad hoc expert meeting and the 18th meeting of the Joint Working Party, both held in August 1991. These fora invited countries to check their data and provide final version of the replies. As a result of these efforts "The Forest Resources of the Temperate Zones: Main Findings of the UN-ECE/FAO

1990 Forest Resources Assessment" was published in 1992, prior to the publication of the two volumes of the final version in 1993.

The enquiry developed through the above steps was very ambitious in terms of requesting quantitative and descriptive data on a wide variety of forest resource's indicators. Besides the large number of parameters describing the state of the forests and their wood production function, obviously the special enquiry on the non-wood goods and services was the greatest step forward in developing a real multifunctional forestry approach in the forest inventory. The experiences of the previous forest inventory published in 1985 showed that despite the methodological difficulties there was a potential for collecting internationally comparable data on the non-wood functions which were of increasing importance even at that time. The development taken place since then, especially UNCED and the Strasbourg and Helsinki ministerial conferences justified the efforts made in this field.

The 1990 forest resources assessment could address a wider range of problems and in a more complex way than any other assessments before, and has become an extremely useful source of information for policy makers, government bodies, international organisations governmental or not, the general public, all who concerned with environmental and forestry issues. *This paper however focuses only on some of the problems and experiences of FRA 1990, without mentioning most of its strong points.*

Despite the indisputable achievements of the assessment which made it a "professional best-seller" with two reprint series, there were several concerns expressed in as early as 1991 during the third ad hoc expert meeting.

In some cases the enquiry proved to be too ambitious and some countries were not able to complete the enquiry in full. It was agreed that at least the table on essential data had to be filled in by each country even if some of the parameters were not readily available. In these cases national correspondents were invited to provide their own estimates instead of leaving this job for the secretariat. The need for a well established system of national correspondents capable to provide replies reflecting the official views of their countries was underlined by those cases where contradicting replies arrived from different sources of the same country. Reservations were made regarding some terms and definitions. Especially the "exploitable" and "unexploitable" forest and other wooded land were subject to criticism, and a need for more widely acceptable definitions was expressed.

When preparation for FRA 2000 started in 1993 the Kotka II meeting, generously hosted again by Finland, provided a unique opportunity for the experts to summarise the lessons of the previous assessment. The results of these discussions, later considered also by the first meeting of the Team of Specialists on the Temperate and

Boreal Forest Resources Assessment in March 1995 could be summarised as follows:

Not only the whole enquiry proved to be too complex in some cases, sometimes there were difficulties in providing the "essential" data set. There was a wide range of replies both in terms of quality and quantity of the data supplied. The information gaps made it impossible to calculate regional totals for many parameters.

The fact that only few parameters were comparable with the ones in the previous assessments stressed the need for a set of terms and definitions unchanged on the long run. In addition to this, problems arising from the different interpretation of some of the definitions due to the differences in the methods applied by the different countries also called for definitions ensuring comparability over time and geographical regions. It became evident that information from certain countries like Canada, Japan, USA, ex-USSR, especially in case of non-wood goods and services was not directly comparable with those of Europe, due to the large differences in size, population, culture and history. The problems of comparability were triggered by the lack of a common reference year or period. (In addition to this the 1990 temperate forest resources assessment is not fully compatible with that of the tropical countries.)

Change data were missing in several countries, and serious concerns were expressed regarding reliability in case of some other countries. These problems together with the ones described above did not allow to draw a complete picture on the development and change of the forest resources of the temperate zone over time.

In spite of the excessive complexity of the enquiry there were indicators considered to be relevant but missing from the assessment, such as parameters describing the status of forest ecosystems, their naturalness and biological diversity. The increasing importance of the criteria and indicators of sustainable forest management (the Helsinki and the Montreal processes) urged the forest resource assessment community to focus on parameters like forest health in terms of defoliation, forest damages, forest fires, forests' contribution to the global carbon cycle etc.

A special way of using the forest assessment's data was largely limited by the lack of georeference. Given the country as the only georeferenced unit the potential for any spatial analysis was restricted if possible at all.

The data collected in the course of the assessment represent an enormous value. It was emphasised several times that the best use of this information could only be achieved if resources were available to carry out detailed comparison, evaluation and analysis. It was and still is a general feeling that the potentials in FRA 1990 are far from being fully exploited. Although the two-volume publication undoubtedly fulfilled its aim and was widely used, electronic media providing more sophisticated ways of retrieving information were felt necessary. This gap was partly bridged by EFI's initiative in developing a relational database for FRA 1990. It is obvious however, that the compilation of FRA 2000 should be a computer aided procedure from error-checking to editing the publication itself. It is very likely that many users will require computer files rather then hard copies, so the new media could be diskettes and CDs. Dissemination of the information through the world wide web should also be considered.

The FRA 1990 was prepared between 1989–1993, a unique period of the twentieth century's history. As a result of the overall economic and social changes in Eastern Europe and large parts of Asia the number of the ECE member countries increased from 34 to 44 during this period without significant changes in ECE's geographical coverage. Although these changes did not affect FRA 1990 itself, it became evident that particular attention would have to be paid to the problems of the new member – often newly constituted – countries.

This period was also characterised by a fast development of the international environmental and forestry policy. The increasing public awareness of environmental issues, together with the efforts of professional circles resulted in considerable achievements in the policy fields. Strasbourg, Rio de Janeiro, Helsinki, Montreal, some of the important stages of this process increased the role and responsibility of the forest resources assessment. Although FRA 1990 was excellent in addressing the non-wood forestry issues it was understood already in 1993 that the next assessment would have to meet new demands especially in these fields.

Knowledge Obtained from the Global Forest Resources Assessment 1990

Viewpoint of Developing Countries

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1. Institutional aspects

In developing countries the main problems for national assessment are:

- Few resources and lack of specialized personnel.
- Very often there is no continuity in the necessity of the national forest inventories, they have usually another urgent problems to solve.

These are the principal reasons because it is very difficult to obtain the information needed, based on existing data.

2. General aspects

The main observations regarding the 1990 assessment are:

- The governments and other institutions involved in natural resources evaluation, do not understand well the terms and definitions for the global assessment.
- This complicates the quality of the data collected.
- In some developing countries, they don't understand well the objectives, terms, definitions and necessities of the global assessment, because they believe that the main purpose is to use the results for planning at a national level.
- For this reason it is convenient that FAO improves the explanation to the countries, regarding the differences between objectives, characteristics and use of the information, for global and national levels.
- It is a priority that the countries agree with the basic terms and definitions for the global assessment, and to work on how these basic terms and definitions can be used in more detail for each country in

their national inventories. This can help to maintain comparable and compatible the information.

- It is necessary to develop basic classifications, terms, definitions and how to obtain information about non-wood functions of the forest.
- In many developing countries: There isn't a forest evaluation for the whole country, only case studies of for specific regions. The evaluation of changes over time is very difficult, because of the lack of periodic comparable inventories and the same references year of the information.

3. Specific aspects

- It's necessary to have a universal agreement on terms and definitions for forest and other wooden land. In some countries like Mexico, some forests (millions of hectares) were considered in the first national inventory, as an other wooden land.
- It's convenient to evaluate change data, not only for forest coverage categories, also it is necessary to widely consider the local knowledge in order to calculate, the changes in the land use. Information regarding forest degradation is very poor. It is necessary also to work in concepts, definitions, and methodologies, in order to have this information with more quality that can be comparable.
- The biomass information should be standardized

In general, it is necessary to put an extra effort to clarify which is the role and responsibilities of the countries in the global assessment. This aspect is very important in the process of data collection and in the interpretation and use of the results.

NGO Perspectives on the 1990 Forest Resource Assessment

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The following paper has been derived mainly from discussions within WWF. However, the author has worked with several conservation NGOs – including IUCN, Friends of the Earth and Greenpeace – and therefore the conclusions hopefully reflect a wider NGO perspective.

Introduction

Over the past few years, the FAO/ECE Forest Resource Assessment has proved to be a key source of information for WWF. The volumes covering tropical and temperate and boreal forests have been used repeatedly, both in policy development and the identification of priority areas for field programmes. We remain surprised that many governments apparently still do not to give it the status that it deserves, and fail to provide either adequate resources or information.

However, it is also worth noting that a fair proportion of NGOs barely know that the assessment is carried out at all. Publication of the 1990 FRA attracted virtually no media coverage in many countries, and copies are hard to find in libraries or bookshops. To some extent, government disinterest may be exacerbated by a perception that the process is distant and rather academic, and a higher profile for the FRA might well increase enthusiasm amongst respondents. This issue is returned to below.

Following a workshop within WWF and discussions with the ECE secretariat, a series of proposals have been made for further development of the FRA from an NGO perspective. These are presented below.

Further development of the FRA

Seven main developments are suggested:

- *Standardisation*: the usefulness and comparability of current data are limited by confusion about definitions and reference dates. This has been repeatedly referred to by NGOs as evidence of lack of coordination within UN agencies. Particular problems are caused by:

- different definitions of "forest" – ie the use of different minimum levels of tree cover to constitute a forest in the tropical and temperate assessments;
- lack of agreement about definition of some key terms, such as boreal", amongst participating countries;
- lack of an agreed reference time for measurements.

We recognise that reaching such standardisation is both time consuming and costly. However, the relevance of FRA-2000 will be greatly improved if agreement can be reached wherever possible, and remaining discrepancies clearly identified and explained.

- *Widening of issues*: the usefulness of the FRA will also be increased if the scope of issues considered is widened, to include various aspects of the quality of the forest as well as the area covered by trees. Additional elements could include reference to the authenticity or naturalness of forests and non wood goods and services.

  Such a development will in practice mean that some elements will have to be measured on a non-quantitative basis, and that new approaches to measurement may be required, including use of data from other sources, specialised consultant reports etc.

- *Relevance of incomplete data*: in many cases, good partial information is better than none. Although some key data must of necessity be collected for all countries, partial coverage of other issues is better than omitting them altogether, or publishing inaccurate information from those countries where such data are not collected systematically.

- *A framework for future assessments:* implicit in this is that a proportion of the questions asked should be aiming not only to collect information that is already available, but also to help shape national monitoring programmes for future assessments – ie part of the aim of the FRA-2000 should be to provide a vision of the type of assessments required in the future, even if only a minority of countries will be able to supply all this information in the next couple of years.

- *Improved quality of information:* we believe that quality of information could be improved by three developments:
  - a collaborative effort within countries, so that NGOs, industry and academics become involved in the resource assessment (perhaps through a working group) in addition to the designated government officials;
  - additional resources being made available to the secretariats, to analyze additional information, outside data sources etc;
  - and perhaps also provision of specialised training for some or all of those involved in the information gathering within countries.

- *A bibliographical role:* the FRA could also be an ideal opportunity to request additional published information relevant to forest resource assessment, including for example national statistics, reports to international initiatives such as Helsinki and Montreal, reports to the CSD and IPF, etc. An annotated bibliography of information available around the world would be a valuable addition to the main report.

- *Raising the profile*: as mentioned above, the impact of previous FRAs have been limited by lack of publicity. Options for increasing the profile of FRA-2000 include:
  - publicising this through the Intergovernmental Panel on Forests and seeking assurances from governments that the issue will be taken seriously;
  - collaborating with a professional publisher on the final report; production of a summary leaflet and/or pamphlet;
  - hiring professionals to help with the promotion of the document.

Agenda Item 5

Results of Kotka II Meeting 1993

Aarne Nyyssönen

FAO/ECE Meeting of Experts on Global Forest Resources Assessment in Cooperation with UNEP and with the support of FINNIDA (Kotka II) took place from 3 to 7 May 1993. About one third of the participants of the present consultation attended also that meeting. The report as approved by the meeting is included in the proceedings published as Research Paper 469 of the Finnish Forest Research Institute. A number of essential items of the report are included in the following review.

Mr. J.P. Lanly, Director of the FAO Forest Resources Division, defined the objectives of the meeting as follows:

– a revision of the top level definitions and classifications for a better consistency of the information at regional and global levels;
– the incorporation of additional environmental parameters in global assessments, on the basis of the work achieved and of the conclusions of the UNEP/FAO expert consultation held in December 1992 in Nairobi;
– the technical modalities for building the capabilities of national institutions of developing countries in order for them to contribute increasingly to the building up of knowledge at world level and to strengthen the ”bottom-up” component of the global exercise.

He hoped the meeting would generate clear technical recommendations on how the assessment should proceed.

The meeting was informed of the status of FRA 90. By that time an overview had been presented to the FAO Committee on Forestry, and the country reports for the tropical countries were to be issued shortly. The temperate zone assessment had been issued in two volumes. Work with the non-tropical developing countries was in hand. Today, all the relevant reports on FRA 90 are available.

The results of an enquiry into future forest resource information needs and the possibility of supplying them were discussed. The meeting was also informed of plans to collect and store remote sensing data in a standardised and cost effective way in a system called RESPAS (Remote Sensing Processing and Archiving System) as well as of some other activities.

Under the item of Review of parameters and classifications the meeting split into four working groups:

Group 1: General forest inventory parameters (developing and industrialised countries)
Group 2: Parameters related to biomass
Group 3: Parameters related to biodiversity
Group 4: Parameters related to land cover change and vegetation degradation.

The reports of the groups, which take into account also comments made by the plenary session, were reproduced in the annexes of the meeting report.

In order to summarise the recommendations of the meeting, the following references will be made:

It is essential that national and international organisations engaged in forest resource assessment coordinate their activities and cooperate with each other to avoid any duplication of efforts.

FAO and UNEP were encouraged to prepare jointly a project proposal for global forest biomass monitoring as part of the FRA process. The relevant working group felt that FAO should initiate the production of a guide for local biomass studies, including change assessment. Such a guide should be designed so that it can be applied in a wide range of inventory situations.

FAO and FAO/ECE should increase their efforts to compile at regional and global levels forest-related biodiversity data collected by national institutions.

Particular attention should be paid, at all stages, to national capacity building in developing countries, notably as regards construction of national data bases, training of staff and the necessary equipment.

It was pointed out that countries in transition had specific problems, which needed urgent resolution. FAO/ECE and FAO should continue to attach priority to their programmes to assist these countries.

Because the UNCED preparatory process had demonstrated that problems of a political nature arose from the lack of consistency and comparability of data on the status of forests in the North and the South, it was considered essential that in the future the core information be entirely comparable and that the format of the enquiry and the methods of work be agreed in advance at the intergovernmental level. The meeting suggested that FAO, FAO/ECE and UNEP study the feasibility of establishing an intergovernmental panel of experts in forest resource assessment and monitoring to advise these organisations in carrying out the work. Furthermore, since the system of national correspondents had proved useful for the FRA 90 (temperate zone), the meeting invited the Joint FAO/ECE Working Party on Forest Economics and Statistics to consider re-establishing the correspondent network, and FAO might consider using this system, with appropriate modifications in developing countries.

As regards the continual updating of the forest resource data base, the meeting felt it was desirable to have a unique global data base to incorporate data from tropical, industrialised and non-tropical developing countries, to provide a single world-wide source of data on the forest resource, which could be regularly updated. Before this recommendation could be implemented, it was necessary to explore a number of questions.

Finally it was recommended that the relevant UN organisations should make sure that all land cover types, including grassland, shrubland, wetlands and arid land are adequately covered in international reporting on natural resources.

Progress on Formulation of GFRA 2000

Klaus Janz

1. Our view on FAO's role and on working principles

At national and sub-national level.

Forest inventories are national matters – they are executed by countries to serve purposes at national (or sub-national) levels.

FAO's role:
Capacity building to enhance countries' capacity to carry out forest inventories in a cost-effective manner and to make use of them for own planning & monitoring & decision making. The primary aim is to serve the needs of the countries. Secondary aims are to facilitate for countries to fulfil reporting obligations to international initiatives and organizations and to facilitate global assessment through more and better standardized country data.

Tools:
- workshops, guidelines, specially designed projects, training;
- technical assistance through FAO's field programme

At regional and global level.

FAO's role:
Analyze information needs at these levels regarding forest and related resources. Identify user groups. Provide objective information as needed, covering all countries. Disseminate to users.

Questions to clarify:
- processes of data acquisition
- cooperation of FAO with countries, with other players
- specify need for scientific support, operational support

Guiding principles regarding parameters to be included:
Information to be collected must have an identifiable use. Important for relevance.

Only such parameters should be included in the assessment that can be collected with the available tools and mechanisms at reasonable cost. Important for possibility to collect data.

Parameters to be included in the assessment must be measurable in a scientifically sound manner and it must be possible to compile the information with a level of accuracy that makes reporting meaningful. Important for acceptance, credibility and usefulness.

Guiding principles regarding definitions and classifications:
The core definitions must be applicable throughout the region in which they are to be used (regionally or globally).

Compatibility with common understanding. – The information produced should be in line with common understanding in countries concerned. Examples: "forests" versus "woodlands"; forests versus cropland with trees; temporarily unstocked forest.

Operationality. – It must be possible to use the set of definitions and classifications in FRA. For developed countries this means use in a questionnaire and for developing countries that existing country information as well as centrally acquired remote sensing data have to be formatted according to this set.

2. Available tools and mechanisms

Basis to start from:

- **proven methods of FRA90**
- **identified strong and weak points**
- **identified new information requirements**
- **commitment form RS community to assist**

For developing countries there is a FRA programme supported by FAO's governing bodies that consists of four components: (1) assessment based on existing reliable country data (the "FORIS" approach), (2) sampling based remote sensing using high resolution satellite data in the tropical zone, (3) country capacity building, and (4) further efforts to include more environmental parameters.

A situation in the UNCED follow-up with many initiatives and many actors in the field of forestry. From them we get requests for new information, qualitative information, more accurate information, better comparability between countries and regions.

The lessons learned from FRA90 suggest that we should concentrate on core variables that are measurable, available in countries and useful at the international level. The Working Parties and experts consulted so far when preparing FRA2000 for industrialized countries all agree on this.

Funding situation and basic approach quite differing between the assessments for developing and for industrialized countries. For developing countries the funding sources for development assistance are available. There is a secretariat that consists of some 6–8 professional staff and has therefore a certain administrative and technical power. On the other hand even essential information is often lacking in the countries concerned. Data collection has been done in a double approach using active retrieval and analysis of source data and –in the tropics – a sampling of high resolution satellite data. Enquiries have proved to be unsuccessful. Capacity building is an integral part of the assessment.

The assessment for industrialized countries has traditionally been carried out by ECE/FAO in a cooperative approach in which member countries and certain organisations have provided major contributions, mostly in kind, and a very small secretariat team has played a coordinating and assembling role with a limited amount of analytical and validation work; this is a natural and justified approach in a region where most countries have rather well developed forest inventory capacity. Data collection has relied on a questionnaire enquiry supported by country correspondents.

Progress in Formulation of Approaches for TBFRA-2000 (Conceptual Framework)

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Introduction

The overall awareness of the role which forests, their resources and the forest management play on the Earth has increased dramatically in the recent years. Since the UNCED Conference, the issue of the forest resources assessment (FRA) has been given a high priority at the top political levels, notably through CSD (Commission for Sustainable Development) and subsequently IPF (Intergovernmental Panel on Forests) processes. High expectations have been raised for the FAO's work in this area at the global level, and for that of ECE/FAO with regard to temperate and boreal forests.

The up-dated information on forest resources is an essential prerequisite, for example, for the land use planning, natural conservation and development activities, sustainable forest management (multiple-use forestry practice) and the rational utilization of forests. It is not by chance that the world forestry sector faces increased demands for expanded accountability of the environmental attributes of forests. The Pan-European (Helsinki), Montreal (Santiago) and other post-UNCED processes and initiatives have proved that the reliable information on forest resources is necessary for making right policy decisions.

The Global Forest Resource Assessment 2000 is expected to be a historical forest resources assessment on the threshold of the third millennium. It will highlight and evaluate the situation and trends of the forest resources on our planet at the sunset of the 21st century, and will pave the ground for many future forestry-related debates, decisions, actions, as well as practical activities at dawn of the new times. The Global FRA-2000 should facilitate understanding of the true value of forests for all benefits it provides, especially among politicians, decision makers and leaders of public opinion.

The international forest resources assessments are *far not* a new area of the FAO and ECE/FAO activities. Actually, the Assessment

2000 will be the seventh in the row of such kind of assessments since the mid-century. The UN-ECE/FAO forest resources assessments have steadily been developing over the period as regards objectives, coverage, contents, classifications, terms and definitions applied, but none of them was geo-referenced: the only geographic unit was the country. The geographical reference: this is the expected turning point in the forthcoming assessment.

The Assessment 2000 will be built on the experience gained in previous forest resources evaluation and monitoring projects. The list of difficulties, weak points and missed opportunities of the FRA-1990, prepared by the secretariat in the process of the

formulating the TBFRA-2000 approaches, could be recommended (and has already been used) as a reference document for the Global FRA-2000 (at national and international levels, including this "Kotka-III" meeting). It should help (along with others background papers) to propose improvements for the implementation of the project.

The "Kotka-III" expert consultation should be an operational meeting aimed at general consensus on the structure of the Global Framework for the Assessment 2000, scope of the assessment (common parameters), background terms and definitions, methods to be used for FRA-2000. We have to reach an agreement on the conceptual and practical aspects of the Global Framework.

All participants of this "Kotka-III" meeting are involved (directly or indirectly) in the preparation of the Global FRA-2000. This large-scale exercise consists of different components which should be reconciled in the final outcome of the project. The TBFRA-2000 is one of the components of the Global Assessment 2000.

Starting Preparation for the Temperate/Boreal FRA-2000

Reviewing the preparation of the Temperate and Boreal Forest Resources Assessment 2000 since the *ad hoc* "Venice 1989" meeting (through "Kotka-II" meeting, May 1993) to the "Expert Consultation 1996", we should note and state that the first practical steps have already been done. The work on the Helsinki and Montreal criteria and indicators for sustainable forest management during the period 1993–1995 provided (an indirect but important) contribution in the process of preparation for the Global FRA-2000. The Team of Specialists (ToS) on the Temperate and Boreal Forest Resources Assessment 2000 was established under the auspices of the Joint FAO/ECE Working Party on Forest Economics and Statistics and held its inaugural meeting in March 1995.

The 20th session of the Joint Working Party (Geneva, 20–22 June 1995) approved the mandate the Team of Specialists on the TBFRA-

2000, reviewed its activities and proposals of the first meeting of the team. The Working Party requested the team to prepare proposals for the Assessment 2000 by its next session (preliminary June 1997), taking full account of the global context, the likely availability of resources and possible partnership with other organizations.

The 53rd session of the UN/ECE Timber Committee (13–16 November 1995), attaching high priority to this project, emphasized the importance of having high quality and comparable information on the forest resources for decision making process. The Committee stressed the importance of developing common (standard) classifications, terms and definitions at the global level, and welcomed the planned Expert Consultation on the Global Forest Resources Assessment 2000 ("Kotka-III" meeting). It also noted that the quality of the Assessment would depend on the availability of financial and manpower resources, and urged countries to consider contributing resources to the central team.

The Joint FAO/ECE Working Party considered the network of national correspondents as a "vital component of the whole project". The official request to nominate national correspondents for the TBFRA-2000 was sent by the secretariat to the ministerial level of countries at the end-1995, and the network of national correspondents was established by spring 1996. Their first contribution to the work will be the up-dated information on forest resources for the "State of the World Forests Report 1997" and replies to the EU EFICS enquiry on the information users' needs.

Following the proposals of the first meeting of the Team of Specialists, the workshop on Remote Sensing (RS) Support for the Global Forest Resources Assessment 2000 was organized by IUFRO in cooperation with FAO, ECE/FAO, UNEP and the Joint Research Centre of the Commission of the European Communities from 12 to 14 March 1996 in Washington, DC, USA. The remote sensing community expressed its interest to contribute to the Global FRA-2000. It supported the idea that FRA-2000 data should be presented by ecofloristic zones with the global, not just the tropical coverage.

The cooperation could be mutually beneficial for both parties: Global Assessment 2000 and the remote sensing community. Sharing data would strengthen all programmes involved, although the implementation of the cooperation would require from FAO a specific programme, which should include needs for assistance, the coordination plan, additional time and resources.

The second meeting of the Team of Specialists on TBFRA-2000, held in April 1996 in Geneva, reviewed the work done since its first meeting and prepared, in particular, the forthcoming "Kotka-III" expert consultation. The main outcome of the meeting was the formulation of proposals for the draft framework of the global and temperate/boreal Forest Resource Assessment 2000. This draft framework, finalized after the meeting, is one of the background documents for the elaboration of proposals here, in Kotka.

Generally, the FAO and ECE/FAO project on the Global Forest Resources Assessment 2000, including its temperate and boreal zone part (TBFRA-2000), is now in an advanced planning and preparation stage. The temperate and boreal forest resources assessment is one of the most important, visible and of high priority programme elements, which are in the ECE/FAO programme of work. The results of the Assessment should be published just before the year 2000. Three years only are left for the implementation of this very important and ambitious task.

Forest Resources Information Needs

The data (information) to be collected by the temperate/boreal FRA-2000 should address those items which were identified by governments as being of importance, notably through the Helsinki/Montreal criteria and indicators. TBFRA-2000 should collect (at least) the minimum amount of data which could satisfy real needs of the information, but at the same time, these data should be the best possible, checked, analyzed and well presented.

The survey of users and users' needs is of primary importance for the proper definition of the scope and coverage of the international FRAs. The content and design of the TBFRA-2000 should be tailored to meet the requirements of different users' (readers) categories. Who are they ? It was noted earlier that FRAs are an important source of information and reference material for policy-makers, managers, researchers, foresters, consumers of forest products and services, and all others concerned with forestry, timber and woodworking industries, ecology, environmental and natural conservation and socio-economic development.

The information needs (requirements) assessment, as it is agreed with our colleagues from DGVI of the European Commission (Brussels) and EFI (Joensuu), will be implemented on the basis of the EFICS study questionnaire. The network of the national correspondents for TBFRA-2000 should be involved in the needs assessment (replies to the questionnaire). Analysis of the replies could be implemented by the WSL (Switzerland) personnel, as kindly proposed by Mr. M. Köhl, the leader of the team.

Scope and Coverage of the Temperate/Boreal FmRA-2000

Reviewing the progress in formulation of approaches for TBFRA-2000, first of all we should note that it is one of the numerous components of the Global FRA, which are contributing at different layers (temperate / boreal / tropical; developing / industrialized (developed); statistical (FORIS) / RS components; UNEP/IPCC/ other actors; etc). This paper considers and highlights the progress made in the preparation of the temperate and boreal part (component) FRA-2000, some of its organizational, structural and logistics aspects.

Another point is that the ToS on TBFRA-2000, ECE/FAO secretariat and parent bodies (ECE Timber Committee and FAO European Forestry Commission) have deliberately slowed work on the temperate/boreal part of the assessment, so that it should be an integral part of the Global effort, based on a common platform (Global Framework).

Scope and coverage, as well as challenges of the Global FRA (and subsequently the Temperate and Boreal Forest Resources Assessment 2000) are defined by the UNCED-Rio Conference and its follow-up activities. Actually, the present assessment is facing a number of challenges which are sometime contradictory and self-exclusive: e.g. how to deal with the necessity to address ”new” parameters requested by the Helsinki/Montreal processes, to minimize ”data gaps” and the demand to ”simplify and streamline” the assessment; or how to reconcile the conflicting views that ”partial information is better than no information at all” and the need to provide regional ”totals” of data included into the assessment ???

The ToS at its second meeting noted once again that a balance between the feasibility of collecting and providing data for the next round of the assessment and the ”pressure” of new parameters (variables) was needed. When considering parameters (attributes) to be included into the enquiry, data sources and the feasibility to obtain this data should be taken into full consideration. The introduction of new elements into the enquiry (e.g. ”forest health”, ”Biodiversity”, etc) should also be considered taking into account the mandate of the Global FRA.

The presentation of data by ”ecofloristic zones” would require an ”ecofloristic zone” map. A possibility to use one of the existing ”ecofloristic zones” maps should be taken into consideration. The proposals of the above mentioned Washington RS workshop should help in this work. The eco-referenced data could also be produced on the basis of countries’ replies (if they would be provided at the lower, ”provinces” level), but in that case the GIS work would be needed. Among other restrictions: relevant definitions should be agreed at the international level (e.g. the definition of "sustainability" has yet to be formulated and widely accepted).

It is important that every participating country make an effort to provide the requested information (although this may not be possible in every case, but the attempt should be made). At the same time, the enquiry should be aimed at obtaining the information which is really needed for the Global Assessment – not just trying to "pick up" only common data that countries can currently provide. Long range goals should also be the focus of attention during the preparation and running the TBFRA-2000 project.

The following principles (among others) underlying the choice of data to be included into the Assessment 2000:

- the data should be relevant and of value to users at the international, and not just at the national level; it should be based on internationally acceptable terms and definitions;
- the large majority of countries should be willing and able to supply the data; FRA attributes must fulfil the conditions of being measurable and available in most countries;
- there should be a positive benefit/cost ratio, i.e. the value of the collected information should be greater (or at least not more) than the costs involved in its collection; or by other words: the requested information could be obtained with the available data acquisition tools at acceptable cost;
- the introduction of new parameters should provide statistical continuity with previous assessments or, at least, does not result in a break of it; the framework for the Assessment 2000 to be agreed, should not require major alternations for subsequent assessments (look into the future).

For the evaluation of the importance of different attributes (parameters), and as a basis for the further consideration on what countries would provide for the temperate and boreal forest resources assessment, the team of specialists identified six main issues to be addressed in TBFRA-2000, namely: Wood production; Carbon cycle; Biodiversity; NWGS (including "Protection function"); Land use; Forest condition.

Based on the input from the ToS, the ECE/FAO consultants assistance and voluntary contributions (expertise and knowledge) from some countries and individual experts, the secretariat is now on the way of designing the enquiry for the temperate/boreal forest resource assessment 2000. The first draft proposal of this enquiry, concentrating mainly on the "traditional" forest resources' parameters (prepared by the ECE/FAO consultant, Mr. Tim J. Peck), is proposed for your attention at the "Kotka-III" meeting.

Enquiry for TBFRA-2000, Terms and Definitions

The scope and contents of TBFRA-2000 should be agreed by nations from the outset and expressed in the enquiry. The enquiry for the TBFRA-2000 should be organized in such a way that it could directly (or indirectly) respond to the Pan-European (Helsinki) criteria and indicators. In this connection the problem of the application of the same "language" (terms and definitions) was noted. The problem of the comparability of countries' data on the Helsinki indicators and the FRA data should be considered carefully. The FRA should therefore design its data collection (enquiry) not only towards indicators as already specified, but in such a way that they could contribute to the overall issues.

If we assume that the TBFRA-2000 has to help in finding answers not only to such questions as, for example : "Do we have sufficient forest areas and volumes?" "Are they decreasing or growing?", but also to the questions like "Could the recreation, landscape, wildlife diversity and timber production happily co-exist?", it seems unavoidable to apply ambitious and voluminous enquiry (questionnaire). Of course, it contradicts to the task to simplify the enquiry, but if we want to collect a comprehensive information on the temperate/boreal forest resources, the simplification would be a problem..

The design of the enquiry will be based on the findings and outcome of many other recent events, including global ones (UNCED, CSD, IPF), regional (Montreal and other initiatives), as well as on specific (specialized) meetings (workshops), like "Kotka-II" or "Kotka-III" meetings, the Washington RS workshop for FRA-2000, etc.

The ToS proposed the following variables for the top terms and definitions to be applied in the Assessment 2000:

	Height	Width	Canopy	Size	Use
Forest Land	> 5m	> 20 m	> 10 %	> 0.5 ha	Not agr.
Other Wooded Land	< 5 m	..	Tree 5–10 % Bush > 20 %	Same as for F.L., but < 0.5 ha	Not agr.
Trees outside FOWL	..	..	..	..	..

(Everything but "Forest and OWL")

The Temperate/Boreal Forest Resources Assessment 2000 enquiry will be built on the Global Framework to be proposed by the present "Kotka-III" meeting, taking into account possible comments and improvements from the Joint UN/ECE Timber Committee and the FAO European Forestry Commission session to be held in September this year. The final version of the enquiry has to be approved by the 21st session of the Working Party (June 1997) and sent out to national correspondents in the 2nd half of 1997.

Resources for the Implementation of the Assessment

The traditional approach to funding ECE/FAO work on temperate and boreal forest resource assessments has been a cooperative approach in which member countries and certain organizations had provided major contributions, mostly in kind, and a very small secretariat team had played a coordinating and assembling role with a limited amount of analytical and validation work; this was considered as a natural and justified approach in a region where most countries have rather well developed forest inventory capacity.

The network of national correspondents (experts and institutions) was established in the first half of 1996. More than 40 national correspondents (experts and institutions) were officially nominated by countries to this network by now. The first action (tests) of the network is undergoing in replying the questions to be included in the "State of The World Forests' Report 1997", as well as to the EFICS enquiry on the forestry information needs.

Generally, the four driving forces are being used now in the preparation of the TBFRA-2000, and all of them are vital for the success of the project:

- Team of Specialists on the Temperate and Boreal Forest Resources Assessment 2000;
- Network of National Correspondents;
- Consultants' Assistance; and
- ECE/FAO and FAO Secretariat Work on the TBFRA-2000.

Nevertheless, the ToS at its last meeting stated that there was a danger that only a part of the significant potential of the FRA-2000 would be realized because of lack of a sufficient, relatively small amount of additional financial and secretariat resources to coordinate activities and to analyze, validate and integrate the replies received, and thus to ensure that the much larger resources being contributed in kind by countries were used to the full.

The Team of Specialists considered that the following staffing would be needed to implement the assessment the proper way:

Possible staff needs for TBFRA-2000

Task	1996 [person months]	1997 [person months]	1998 [person months]	1999 [person months]
UN/ FAO-ECE secretariat:	6	12	12	9
Information needs assessment (design of enquiry, validation, distribution, analysis);	12	3	–	–
TBFRA-enquiry (design, validation, distribution, plausibility checks, analysis);	6	24	24	6
Result publication	–	–	6	12
Dissemination (CD, Internet, ...)	–	–	6	12
Total	24	39	48	39

Plan of Action and Future Activities

The "Plan of Action for the preparation TBFRA-2000" (see *Annex I*) for 1996–1998 was reviewed and adopted by the ToS in April 1996. The activities of the team, included in the Plan of Action, will be coordinated with the process of the Global Forest Resources Assessment. The third meeting of the team was provisionally scheduled for the first half of 1997. At the same time it was proposed to hold the ToS meeting in conjunction with the *ad hoc* meeting of experts and national correspondents (to consider the definite draft enquiry and to brief national correspondents on its application).

The preparation of the *ad hoc* meeting of the experts and national correspondents to consider the draft enquiry on TBFRA-2000 and to explain its application is an essential part of the ToS activity. This should be the subject for consideration and approval by the Joint session of the UN/ECE Timber Committee and the FAO European Forestry Commission in September this year.

The enquiry, as already presented above, will be prepared on the basis of the Global Framework to be agreed this week in Kotka. The final draft enquiry on the TBFRA-2000 should be available in spring 1997, before the third meeting of the team and COFO meeting. The national correspondents should start working on the enquiry in the second half of 1997, so that they would (as foresters) start harvesting figures (relevant forest resources data), not decreasing at that time the harvest of the timber or non-wood goods and services.

The issue of the capacity building of national forest inventory systems in CITs through FAO (TREES, etc), EU projects (PHARE, TACIS, etc) and others should be the focus of attention in the process of the preparation and implementation of the FRA-2000. The countries should be encouraged to build and develop their national inventory systems in the direction of the conformity with the internationally proposed (agreed) standards.

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Annex I Plan of Action for the preparation TBFRA-2000

	Activities	Date (time frame)	Action	Status (notes)
1.	Second meeting of the ToS (groups' work on draft proposals to the enquiry; discussions on the *draft enquiry; recommendations)*	15–17 April 1996	ToS Secretariat	Done
2.	Follow-up to the 2nd meeting of the ToS *(draft enquiry according to 2nd meeting proposals; documents for "Kotka-III" meeting)*	May 1996–June 1996t	Secretaria ToS	Done
3.	Circulate the information users' needs enquiry to the network of National Corresp.s for TBFRA-2000	June 1996	Secretariat	Done
4.	Expert Consultation on the Global Forest Resource Assessment 2000, "Kotka-III" meeting	10–14 June1996	Secretariat ToS Leader	Done
5.	Finish setting up the Network of National Corresp.s for TBFRA-2000	July–August 1996t	Secretariat	
6.	Follow-up to the "Kotka-III" meeting; documents for the Joint UN/ECE Timber Committee and the FAO Forestry Commission session	June–Sept. 1996	Secretariat ToS	
7.	Replies from countries' (national) correspondents on the concise enquiry "State of the World's Forests 1997"	June–July 1996	Secretariat	
8.	Replies from countries' (national) correspondents on the information users' needs enquiry; anal ysis and the information needs assessment	July–Sept. 1996	Secretariat ToS	
9.	Compilation and analysis of the information for SOFO 1997 (temperate/boreal); send it to FAO	Sept.–Oct. 1996	Secretariat National Corresp's	
10.	Joint UN/ECE Timber Committee and FAO European Forestry Commission session *(information; endorsement of proposals to the draft enquiry; countries' support)*	September 1996	Secretariat ToS Leader	
11.	Involve other FAO Regional Commissions *(information; invitation to the cooperation)*	October 1996	FAO Secretariat	
12.	Common Framework for the Global Forest Resources Assessment 2000 is available	end-1996	FAO Secretariat ToS	

Activities	Date (time frame)	Action	Status (notes)
13. Finalize draft enquiry, including terms and definitions for TBFRA-2000	January 1997	Secretariat ToS	
14. Circulate the draft enquiry (including terms and definitions) for review by interested organizations and experts; their reaction (by March 1997)	January 1997	Secretariat	
15. Preparation for the 3rd meeting of the ToS *(draft enquiry be finalized and prepared for approval by the Joint Working Party; final comments and proposals to the enquiry)*	February 1997–March 1997	ToS Secretariat	
16. COFO meeting in Rome	March 1997	FAO Secretariat	
17. Assistance to selected countries through secretariat visits and/or regional workshops for capacity building/strengthening	1997–1998	FAO Secretariat ToS	
18. *Ad hoc* meeting of experts and all national correspondents to consider the definite draft enquiry and to brief on its application *(capacity strengthening be also discussed)*	Summer 1997	Secretariat ToS	
19. The 3rd meeting of the ToS (possibly in conjunction with the above *ad hoc* meeting)	Summer 1997	ToS Secretariat	
20. 21st session of the Joint ECE/FAO Working Party on Forest Economics and Statistics *(approval of the draft enquiry for TBFRA; urged countries to provide support)*	June 1997	Secretariat	
21. Circulation of the enquiry to the network of national correspondents *(deadline for replies: March 1998)*	Sept.–October 1997	Secretariat	
22. Preparation for the 4th meeting of the ToS *(entering the stage of the implementation of the Assessment)*	February 1998–March 1998	ToS Secretariat	

The above activities should be coordinated with the Global Forest Resource Assessment 2000

Agenda Item 7

EFICS – Towards Improved Forestry Information for Europe

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1. Background

Until recently, the interest in forestry issues in Europe has been overshadowed by the attention paid to agricultural policies. However, since the beginning of the 1990s the manifold functions of the available resources (economic and social) and environmental values have become increasingly important in forestry planning in all European countries, due to sectoral policies (agriculture, environment, regional, etc.). Not only the European Union but also the decision-makers at national or regional level are more than before aware of the important role that forests can play as an economic and environmental factor. Consequently, there is a need for more information on temperate and boreal forests.

At the moment, there is no accurate, self-consistent and up-to-date information available about forested areas at the European level. Forestry information available at the Community level is incomplete and covers only part of the needed information.

The European Union aims to collect the information that exists in many Member States and make it comparable. To reduce the heterogeneity, or even lack of reliability of the current data sources, an appropriate system to collect, process, analyse and disseminate the information is required. To accomplish this task, the Council Regulation (EEC) No. 1615/89 of 29 May 1989 established a *European Forest Information and Communication System (EFICS)*. The objective of EFICS is to collect, co-ordinate, standardize and process data concerning the forestry sector and its development. According to the Council Regulation EFICS "should facilitate the implementation of decisions taken at national and regional level concerning the forestry sector, and thereby improve knowledge of that sector at all levels" and "must be set up taking into account existing information systems". In particular, information collected in National Forest Inventories and in any existing and accessible data bases should be utilised.

2. The problem

Forest resource assessments have been developed by individual countries according to their information needs. Today different inventory systems can be found in Europe, which were developed and optimised towards national objectives, but do not necessarily follow common, international guidelines. Due to the national focus the list of criteria covered by national surveys differs substantially: some countries assess mainly the productive function of forests while others provide additional data on non wood goods and services such as the protective function or biodiversity issues. The current situation is characterised by essential differences in inventory, sampling and assessment procedures, data sources utilised, nomenclature (e.g. measurement rules, definitions), models (e.g. volume estimation, estimation of growth components, forest structure, etc.), analysis techniques, inventory organisations and responsible bodies, and inventory cycles.

Some of the major problems in combining national results to international statistics arise due to the following factors:

- incompatible nomenclature even for attributes of prior importance, such as forest cover
- differences in periodicity; no common points in time are available to which the inventory results could be related
- statistical inconsistencies regarding sampling designs, analysis procedures, error calculation, sampling frame
- reliability of data, especially attributes assessed due to definitions
- data sources utilised
- differences in techniques to aggregate tree or plot data for a unit of reference
- the units of reference for which national data are provided do not match
- data formats, availability of raw data, degree of aggregation of available data

However, national forest resource assessments have some major advantages. They are often based on sound statistical techniques, they provide representative data for an entire region or nation, and the costs of the assessments have already been covered by the individual countries. As forest surveys have a long tradition in Europe and give a coverage up to 70 years they are a valuable tool to describe current values and changes in forest resources. A high degree of expertise is allocated to this in the national bodies. The results are used by national and regional bodies and have proved to be valuable for management planning and/or forest policy. These advantages encourage to seek for methods to integrate differing techniques and to harmonise procedures and nomenclature, with the objective of compiling national forest resource information and establishing a reliable and consistent data base at the European level.

The European Forest Institute has been contracted by the Commission to clarify the national basis and possibilities for harmonised information collection for EU member states and Norway, Switzerland, Lichtenstein and Iceland. The one-year project started in January 1996. The main goal of the work is to provide options (including the cost estimates) for further decision-making for improving the forest statistics and developing the EFICS.

3. Tasks to be carried out within the EFICS-study

3.1. Analysis of the existing forest inventory and survey systems in the member states

The first phase of the project will mainly be a compilation of existing systems at the national and regional (e.g. federal states) level. Forest resource assessments that will be investigated for the project include national forest inventories, regional inventories, and forest surveys for monitoring forest condition. Assessments below the regional level will not be included in the analysis, as they are often created for specific purposes and thus increase the problems of inconsistency without improving the quality of the obtained information. The analysis will cover EU and EFTA countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and UK A brief analysis of the situation in other countries of Europe, especially in Central Eastern Europe, will be included. A modular approach will be applied in the survey, the modules covering data sources, nomenclature, assessment techniques, reliability of the data, data storage and analysis, models, inventory reports, forest statistics of the country and other forestry data. The survey and inventory systems of each country are analysed according to the flow chart presented in Figure 1.

In addition to these modules, the following information will be analysed:

a) institutions and organisations involved in the assessments, including their tasks and resources, and the legal status of the assessment
b) the cost of the forest survey, separated in costs for assessment, administration, data analysis and infrastructure, financing bodies
c) the users of the information provided and the users needs
d) availability of data

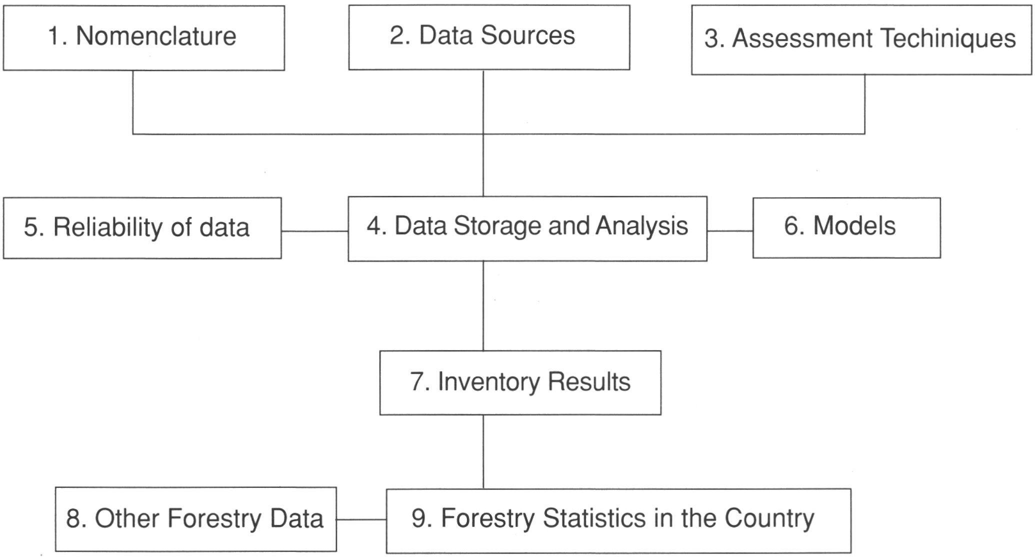

Fig. 1 Flow chart for deriving the inventory results and forestry statistics of each country

3.2 Comparative analysis of existing systems and the results obtained

The comparative analysis will be carried out for each module presented in the previous section. This comparative analysis will show the basic problems in the compilation of national data at the international level with a special reference to data sources, nomenclature, assessment techniques, reliability of the data, data storage and analysis, models, inventory reports, forest statistics of the country and other forestry data.

Special emphasis will be put on the attributes assessed and their nomenclature, especially the categorical variables used to form subgroups on which data are presented (e.g. development stages, forest structures, ownership classes). The effect of differences in the nomenclature on the reliability and accuracy of output results will be studied.

Besides differences in nomenclature, assessment and analysis methods, the reliability of results is affected by different error sources. Different error components (sampling errors, representation errors, grouping errors, measurement errors etc.) will be combined together with the analysis of the applied nomenclature.

According to the comparative analysis, the variables will be grouped as follows:

- attributes that already have a comparative format or do not need any

further modification,
- attributes that need to be harmonised and can hardly be utilised for aggregation at the moment,
- attributes that cannot be used in their current format but can be converted to meet the required standard (the standard will be defined during the work),
- attributes that have to be collected in addition to the current set of available attributes.

3.3. Information needs assessment

The attributes prioritised by the recipients of the questionnaire (altogether appr. 300) will be summarised. An analysis will be carried out on whether are found regional i.e. country groups where the order of importance of the attributes differ from each other. The user requirements and information needs at the international level will be evaluated by approaching organisations such as DGVI, Eurostat, FAO/ECE, European Parliament, EEA, environmental organisations and forest industries (e.g., WWF, CEPI).

This classification will be carried out separately for each country and summarised at the European level. Attributes not available in all countries and key attributes with high priority will be listed.

3.4. Proposals for improvement

Proposals for the harmonisation of nationally assessed variables to fulfill information needs at the European level will be based on two major features:

1) the importance of the attributes, and
2) the efforts needed to meet an appropriate standard of harmonisation.

For each attribute, technical solutions will be studied that make it possible to modify, convert or transform the attributes into a form which allows comparative analyses at the European or regional level. The proposals will be based as much as possible on existing definitions, assessment schemes and methods applied in the countries. The tasks involved in this phase will be presented.

It will be investigated how much activities are required and what kind of costs are involved, if different targets are set at the European level. Three or four hypothetical target levels will be defined regarding the harmonization efforts, for instance:

1) up to 5 most important attributes should be harmonized
2) up to 10 most important attributes should be harmonized
3) more than 10 attributes should be harmonized

To come up with a sound analysis method which is based on the national analysis procedures and available results and data, an analysis procedure for the European level will be developed. The procedure will cover both the data preparation (extraction from national data bases or building up a European database with redundant but unique and available information) and the analysis and statistical estimation procedures. Statistical methods to obtain information on the precision of the results will be included.

One of the major problems in merging national forest resource figures is due to the periodicity of the assessments. No common point in time is available to which the results could be aggregated. Thus, one project module will concentrate on updating techniques which will then allow to relate multi-national inventory results to one common point in time.

In the context of EFICS, remote sensing data would be a potential input for harmonizing the existing nomenclatures, and also for contributing the European forest information system by new harmonized information. The JRC/EMAP FIRS project (Forest Information by Remote Sensing) will study the regionalization of European ecosystems, and the European forest nomenclature. The anticipated development of various remote sensing methods in the 5-10 year time period will be reported, and their expected impact on the collection of harmonized forest information at the European level will be analysed.

A similar analysis will be carried out on the possibilities of geographical information systems (GIS). Special attention will be paid to the potentials to combine relevant data sources for analysis and to the presentation of the forestry statistics in an attractive and user-friendly way.

Modern information technologies will create new possibilities both for the collection of the information, and for its dissemination. Internet is the most used ‘network of networks’, enabling computers in different locations to communicate with each other. Today, the estimated number of computers connected to Internet is approximately 3 million. These kinds of networks (and protocols like World Wide Web facilitating the use) will improve the possibilities to collect forest information in Europe more efficiently, check and evaluate it quickly, and update it more often than using conventional methods. This would enable the building of forest information systems in a decentralised way, which have certain benefits compared to centralised ‘databanks’.

Report on the Workshop on Remote Sensing Support for the Global Forest Resources Assessment

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Introduction

The year 2000 Forest Resource Assessment will be a landmark in the history of forestry. It will be a milepost against which our accomplishments will be measured and it will be the benchmark from which future activities will be planned (Lund 1993).

The Food and Agriculture Organization (FAO) of the United Nations, the United Nations Environment Programme (UNEP), and the United Nations Economic Commission for Europe (UN/ECE) share the responsibility of producing periodic global forest resource assessments. The next one will be for the Year 2000. Currently, the Temperate/Boreal Forest (TBF) Assessment is based upon input from individual countries. The Tropical Zone (TZ) assessment is based upon country participation, stratification a vegetation map of the tropical regions, and a sub-sample using satellite imagery. Information sought for the assessments include estimates of the status and changes in forest extent, condition, biomass and biodiversity.

Experts at the 1995 UN/ECE/FAO meeting on Temperate and Boreal Forest Resource Assessment (TBFRA) for the Year 2000, recommended that the developers of FRA 2000 (FAO, UNEP, UN/ECE) make use of the wealth of information and knowledge that are available or will be available from remote sensing institutes and organizations. Use of remote sensing can overcome some problems inherent with the use of country-level questionnaires – most notably differences in national definitions and inventory techniques and the timeliness of national estimates. In addition, there is need for spatial information that the national statistics do not currently provide.

The 1995 TBFRA suggestion echoes recommendations from past international workshops and conferences (Lund and Preto 1989, Justice 1992, Malingreau, da Cunha, Justice 1992, and UNEP 1993). The International Union of Forestry Research Organization's (IUFRO) XX World Congress Panel on Global Resource Assessments Beyond 2001 held in Tampere, Finland in August 1995 reinforced this need (Singh 1996).

Remote sensing workshop

To decide what could be done for the FRA 2000 from remote sensing, the IUFRO Subject Groups S 4.02, 4.11, and 4.12 organized the FRA 2000 Remote Sensing Workshop in cooperation with the Forestry Division, FAO, the Timber Section of the UN/ECE, UNEP, and the European Commission Joint Research Centre (JRC). The USDA Forest Service (USFS) hosted the meeting. More than 30 invited people attended – primarily from the remote sensing community and representing the United Nations, Non-government organizations (NGOs), Universities, and Research Institutes.

Methods used in the workshop included a review of UN/FAO/ECE needs, a survey of participants on the current extent of their work, general discussions, work group sessions (vegetation map, sample designs, and strategic planning), followed by reporting, recommendations and conclusions.

Output and recommendations

The following is the outcome and recommendations from the remote sensing meeting (Paivinen, Koehl, Lund, and Blue 1996). The participants identified potential remote sensing support in the following areas:

- a world land cover map to be used by FRA for stratification purposes and for analysis of available country data
- acquisition and enhancement of high resolution satellite data. This task is now much more complex than in the 1990 assessment
- cooperation in the development and critical review of methods

The remote sensing community considers the global forest resources assessment 2000 (FRA 2000) an activity of high significance in which FAO should have a lead role and to which it wants to contribute. There is a readiness to cooperate with FAO in suitable ways. Participants identified a need for the following:

a. Goals/users/product specifications for FRA 2000 from the remote sensing side
b. A global map for stratification (and ancillary data needs)
c. A sampling approach to provide high resolution data needs for change detection

d. Remote sensing research needs and national capacity building
e. Approaches for collaboration

The workshop participants recommended 10 actions to take in developing and implementing FRA 2000.

1. The FRA 2000 developers need to state more precisely what is the goal of the assessment, who the report is to serve, and what is the specification for their product. FAO should tighten this process.
2. FAO, UN/ECE, and UNEP should develop a strategic plan for developing and carrying out the FRA 2000 and subsequent assessments. The developers need to commit to this activity as a priority and staff it accordingly with senior staff
3. In developing the plan, FAO, UN/ECE, and UNEP should:
   a. Compile an independent synthesis of "lessons learned" from the 1990 and 1980 assessments (perhaps based on already completed reviews)
   b. Conduct a user need's assessment including who are the users, what information they need, what products do they want (how should the information be packaged) . . . etc.
   c. Establish a decentralized approach in carrying out the assessment. While quality control should be standardized, the actual work should be distributed.

4. In carrying out the plan, FAO, UN/ECE, and UNEP should work with other partners. They need to engage the community to help in meeting mutually agreed to goals in a mutually beneficial way. This is a unique role of the developer of FRA 2000 which FAO needs to realize.
5. Letters of invitation to participate in FRA 2000 should be sent from the lead developer of the FRA 2000 to the heads of these organizations.
6. The FRA 2000 should make use of existing multinational remote sensing efforts.
7. Use existing remote sensing data bases to create a vegetation cover map/database to do a global synthesis. This would be updated and improved using data from local initiatives as they are completed.
   a. This map and database should be derived from the Global Land Cover Characteristics Database (GLCCD) being developed by UNEP, USGS EDC, NASA, EPA and IGBP.
   b. The map and database should include a range of vegetation cover types, not just closed forest, and include both temperate and tropical regions.
   c. Use the GLCCD for both stratification and the final vegetation map/data base.
   d. The map/database should be a dynamic product, with preliminary data available in 1997, and a product suitable for wide distribution by the year 2000. Post 1997 work would consist of:
      1) Validating and correcting the preliminary forest cover data
      2) Building in ancillary data sets. Ancillary data sets might

include land use data, (productive and protective forests), data on forest condition and quality (e.g., plantation forest, degraded forest) and land ownership (e.g., forest concessions) etc., where available.

8. Use multi-dated, high resolution imagery for change detection wall-to-wall where such coverage is available or in a sampling mode where it is not.
9. Classification of the imagery should be carried out with the participation of individual countries, provided they have the tools.
   a. Country capacity building should be increased.
   b. Imagery used for FRA 2000 should be made available to participating countries at cost of reproduction.

10. Continue research in new sensors and remote sensing methodologies emphasizing ways of improving global and national assessments.

The participants recommended that the findings of this workshop be presented for consideration at the UN/ECE and FAO Team of Specialists (ToS) meeting on TBFRA 2000 in April in Geneva, and at the UN/ECE/FAO and UNEP FRA 2000 Expert Consultation ("Kotka-III" meeting) in Finland, in June 1996. By adoption and implementation of these recommendations, the FRA 2000 and the activities of potential partners will be significantly enhanced. It should also provide cooperators with increased regional and local contacts in the world.

Follow-up actions

The recommendations from the Remote Sensing meeting were discussed at the Second Meeting of the Team of Specialists (ToS) for the Temperate and Boreal Forest Resources Assessment (TBFRA-2000) held this past April. There was general acceptance of the remote sensing recommendations for discussion at Kotka III (UN/ECE and FAO 1996).

Since holding the workshop, the International Union of Forestry Research Organizations (IUFRO) Subject Group S 4.02, the U.S. Geological Survey and the U.S.D.A. Forest Service have promised support for FRA 2000 in carrying out these recommendations. Speaking for the participants of the remote sensing workshop, we request that you, the experts at Kotka III, second our recommendations and urge FAO, UN/ECE, and UNEP to move forward accordingly.

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Assessing Tropical Forest Distribution and Conditions using Remote Sensing at a Pantropical Scale

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1. Introduction

The debate surrounding the definition and implementation of appropriate tropical forest policies has clearly shown that the political will to "save" the forests must be supported by better informed perspectives on the role those resources play in the global environment. Such improved knowledge can help in the decision, propose neutral assessment and assist in the evaluation of certain courses of action.

Of major concern is the issue of forest distribution and its rate of change. While the question can be expressed in simple terms (how much forest is there, and how fast is it changing ?), the answer has been very elusive. For many years attention has focused upon global figures. The FAO has thus established that for the period of 1981–1990, 15.4 million hectares of forest have been transformed (FAO, 1993). this represents a deforestation rate of 0.8% per annum. Most of the deforested area passed to agriculture in a land conversion process with a much smaller proportion to logging. Such statistics are weakened by the impossibility to generalise the retained definition of "forest" or "deforestation" from one area to another.

Current requirements for knowledge about forest transformation and new information technologies made imperative the development of more advanced systems of data gathering and analysis which can accurately and regularly inform a variety of users of ongoing changes in the forests of the world. The large- scale TREES Project (1992–1995) was dedicated to the development of global forest cover assessment techniques at the level of the tropical belt.

2. Results obtained during the first phase of TREES

A joint project between the Joint Research Centre and the European Space Agency was initiated in 1991 entitled the TREES Project : Tropical Ecosystem Environment observation by Satellite.

Its three main objectives are:
- the development of techniques for a global tropical forest inventory using AVHRR and ERS-1 as the main sources of data supplemented by high resolution optical data;
- the development of techniques for the detection and monitoring of the active deforestation areas;
- the development of a comprehensive Tropical Forest Information System to support the modelling of tropical deforestation dynamics.

The TREES project had succeded to provide during its first phase an extensive data base on tropical rainforest distribution and condition around the tropics. The content and achievements of this first phase are summarised hereafter.

The first task of the project relates to the base line inventory of tropical forests. It concerns in priority the rainforest biome and adjacent semi-seasonal formations. The TREES concept was to make a wall to wall coverage using highly repetitive observations at medium to low resolution. A multi-annual set of AVHRR data was acquired over the whole tropical belt during the period 1991–1994. Those data, collected from a series of local stations, have been assembled, screened and analysed with the purpose of deriving a first global tropical forest base map at 1 km resolution. A series of analytical tools for AVHRR low resolution data analysis have been developped (Malingreau et al, 1995a). The results of the first activity of the TREES Project consist of the global assessment of tropical forest cover at 1 km resolution (Achard et Estreguil, 1995 ; D'Souza et al. 1995, Mayaux et al. 1996).

The TREES Project has demonstrated that optical remote sensing data can provide the material for assembling a base line map of tropical forest cover and for producing a global assessment of those ecosystems. Comparison with reliable conventional forest cover maps or more detailed forest inventories on selected sites has shown that a good level of agreement is obtained for most of the forested regions. The validation method develop by the TREES Project has called for using Landsat TM data and the design of unique statistical techniques for the calibration of the AVHRR analysis using results from high resolution instrument (Mayaux and Lambin, 1995) Ecologically important parameters such as fragmentation and seasonality have also been characterized using the same data set (Jeanjean et al. 1995).

The TREES Project has also heavely invested in the analysis of data provided by the satellite ERS-1. The SAR (Synthetic Aperture Radar) microwave data have been analysed using a scheme which has foreseen the selection of 18 sites around the tropics and the compilation of a large scale mosaic over Central African Region (JRC, 1996).

A mobile receiving station installed and operated at Libreville (Gabon) by the German Aerospace Agency (DLR) has acquired the ERS-1 SAR data set. About 3,000,000 km2 have been covered during a short 1994 acquisition campaign. The mosaic was obtained by assembling 477 individual images of the SAR sensor, acquired between July 20 and August 28, 1994. This product presents a synoptic view of the vegetation and geology of Central Africa in a display never achieved before (Malingreau et al., 1995b). Because of permanent cloud cover the acquisition of earth observation satellite data over this tropical region has notoriously been difficult before the advent of satellite radar remote sensing. All the full resolution images (52 gigabytes) are kept in a data base at the JRC and are used in more detailed analyses.

The information contained in this data set is highly valuable for the study of the forest cover of Africa. The limits between the rainforest domain and the savanna in the northern and in the southern part of the Congo basin are particularly well marked by a clear contrast between the radar signal over the two biomes.

Openings in the forest itself are visible when occupied by savanna. Large areas of secondary forest regrowth can be discerned along roads and old settlement areas.

3. TREES II: Towards an operational tropical forest monitoring system

The activities of the TREES Project 1992–1995 were conducted in view of the preparation of an operational tropical forest monitoring system. In such a perspective it is useful to recall a series of premises:

- The pressure upon tropical forest ecosystems is still very actual. Unexpected scenarios of deforestation must still be considered : this requires permanent detection capabilities.
- Changes in tropical forest areas are highly diverse. Analysis must be tuned to specific situations.
- Lack of consistent methods to monitor forest areas, differences in definitions of forest types make comparison of deforestation rates between regions and in time difficult : standardisation of approaches can be fostered by global projects.
- An improved knowledge of the causes of deforestation is a

precondition to any successful remedial actions : modelling work must come in support to the analysis.
- The data provided by Earth observation will contribute to the scientific analysis of the nature of forest ecosystems : progresses in measurement techniques are still to be made in order to put to rest some of the contentions issues about current rates of deforestation.

The TREES personnel has established, during that first period, a scientific and technical know-how which is now at a stage where it can be organised into a semi operational set-up leading to a "prototype" for operational tropical forest monitoring. The general objective of the second phase of TREES is to develop such a prototype which can on a regular basis :

- produce relevant and accurate information on the state of the tropical forest ecosystems ;
- analyse such information in terms of deforestation trends and possible impacts ;
- make the information available under the adequate format to a well identified community of users.

TREES II Project outline

The development of the Prototype of an operational tropical forest monitoring system will focus on the setting-up of the following set of activities:

- A core of experts specialised in various tropical forest environments will continuously analyse a set of relevant data collected through a variety of means in order to derive a permanent assessment of the conditions in the tropical forest areas at the pantropical level. The analysis will concentrate upon the identification around the world of the "hot spot" areas where deforestation is the most active. Those hot spot areas will be intensively analysed for characterising and measuring changes occurring in their midst.
- The information provided by the analysis will be fed in a structured Tropical Forest Information System (TFIS) which will be at the same time the logical repository for the project derived information and a tool for organising data in view of its further analysis.

The TREES methodology foresees the identification of those hot spots using a range of remote sensing and ground reference data. A sampling scheme will address the measurement of those changes using an extensive set of high resolution satellite data. The system will be oriented towards the detection and measurement of deforestation rates by focusing upon the hot spot areas where forest changes are the most important and rapid.

Recent developments in spatial modelling into a analytical framework leading to an improved understanding of the drivers behind tropical deforestation will be implemented. Change models have been elaborated which incorporate a series of socio-economic determinants of deforestation and remote sensing data. These models which have shown to help in the current understanding of forest dynamics have to be tested and applied to a wide variety of situations.

Historical data in the analysis of changes in tropical forest canopies will also be incorporated. More than ten years of satellite data exist which can be exploited to assess various patterns of change in the forests ; those patterns can be linked to seasonal, inter-annual and long term dynamics.

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Agenda Item 8

Suggestion for Standardization of National Statistics for Use in Global Assessment

K.D. Singh

Background

Following UNCED conventions, countries are providing statistics for use in global studies like climate change, biodiversity loss, deforestation, land degradation (including desertification) etc. However, in aggregating the country statistics at a global level a number of problems are being encountered among others related to *a common definition and reference date.*

As country's source data are collected at varying periods of time to satisfy country specific needs, heterogeneity in *reference date* and *definition*, among countries, is very much expected. Standardization or adjustment is, therefore, necessary to conform to a common global definition. Adoption of a common global definition by all the countries for their national inventories, is not possible in the near future, nor it is advisable in the context of specific country needs. It is more practical to develop a methodology (or an adjustment function) to bring the country statistics to a common global standard. The method has to be revised each time, when a country will change its own standard in the course of time. The question arises as to who should develop the methodology?

The following model is proposed to bring the country data to a standard classification and reference date:

$$y_{ij} = x_{ij} + a_{ij} + b_{ij}$$

where x_{ij} = source value of a variable x referring to the i-th country and the j-th forest assessment

a_{ij} = adjustment factor for the difference in classification between the country and global assessments

b_{ij} = adjustment for the difference in time between the country and global assessments

y_{ij} = adjusted value (syn. standard estimate) referring to the i-th country and j-th assessment derived from the source variable x for the purposes of the global assessment

The adjustment factor “a” (for classification) is estimated through a review of the country classification system, the factor “b” (for time difference between country and global assessments) is estimated through an adjustment function (syn. model) based a time-series analysis of a large number of forest cover observations for the same survey area.

An important limitation of the modelling approach lies in the fact that it does not provide the value of associated confidence interval. In contrast, a statistically designed survey provides estimates of mean as well as the standard error (or confidence interval). Only with the help of such surveys, the FAO estimates quoted above could be declared as acceptable if they would fall within the specified error limits of a statistically planned survey.

The second question is equally important as to who should carry out the adjustment? The countries or a global level institution who may have been given such a mandate by countries? For example, FAO, in the particular case of food and agriculture statistics under Article 1 of its constitution, or UNEP for environmental data. Both ways, the need for complete transparency and quality control in collection and adjusting of data is obvious.

The third problem in the present context, arises from the fact that many developing countries have no up-to-date country level statistics or no statistics at all due to lack of funds or trained man-power or both. To give an example, on parameters like biomass change, only few countries have got data collected from statistically sound surveys. How to fill in the large data gap or reliability gaps due to out-of-date data?

Finally, there is the need for validating the overall global values obtained from the aggregation of diverse country sources with varying definitions, timeliness, reliability and in some cases no response. Is it correct to accept what ever values we get or carry out a validation. These are some fundamental questions in the minds of all investigators involved in global level studies, whether it is climate change, deforestation or land degradation.

To solve the above problems, it is proposed to develop a mechanism which would be responsible for integrating global and national information as a continuing process. A conceptual framework of cooperation is proposed in Figure 1.

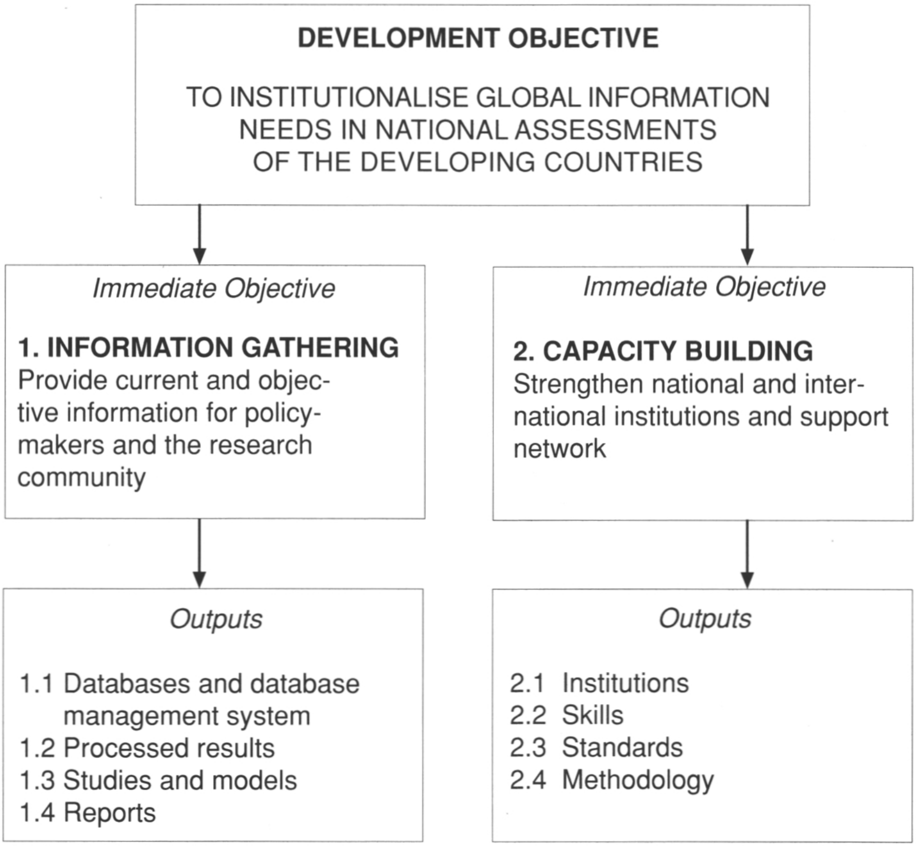

Fig. 1 Conceptual framework of an integrated national/global programme to support conventions in the framework of UNCED Agenda 21

Summaries of Voluntary Papers

Plan for Second National Forest Resource Assessment in Nigeria

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Twenty years after the Indicative High Forest Inventory of 1973–1977, Nigeria's first national forest inventory, arrangements have been finalised to undertake a second national forest inventory. This exercise is being executed with a grant from the African Development Bank, and it embraces forest resource survey with forestry databank development and institutional development. A contract has been awarded to Beak Consultants Limited, Canada to undertake the forest resource survey in collaboration with counterparts, technical and field staff of the Nigerian State Forestry Departments. Tropical high forests in 14 southern states will be inventoried together with forest plantations larger than 50 hectares in various parts of the country. The systematic cluster sampling technique will be used for the natural forests and stratified random sampling for the forest plantations. The natural forest sample plots will measure 50 metres square, while those in forest plantations may vary in size depending on age and stand density, with a minimum of 20 metres square.

The forest resource assessment study is to be in two phases, the first phase lasting 16 months and the second phase eight months. Phase 1 is to involve the collection and analysis of forest productivity and socio-economic data, while phase 2 is aimed at preparing management plans and project proposals based on the analysis of information and data generated from questionnaires. To provide necessary support to the forest resource study, the Environmental Management Project took off with World Bank assistance in March 1993 to revise the 1978

vegetation and landuse maps, monitor forest and vegetation degradation and strengthen the Federal Department of Forestry with a view to establishing the forestry node of the National Environmental Network. The Compact Airborne Spectrographic Imager is to be used in conjunction with ground checks for the interpretation of the newly acquired satellite imageries of forests at high resolution. This technique is expected to facilitate the determination of bio-physical variables and the physical locations of forest reserves.

Japan – Forest Inventory System; Current Situation and Future Directions

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The forest inventory systems at the national and regional level are defined by the Forest Law and enforced periodically every five years. The systems are divided into two types. One is called "ordinary inventory" and the other is called "simultaneous inventory". The purpose of ordinary inventory is to grasp accurately the state of an individual forest. To determine the quantity of a whole stand or a partial stand, a sample plot method is applied. The forests which were cut and renewed in last five years or prearranged to cut within next planning period are examined in detail and if necessary the boundary line and the name of the sub-compartment are changed. The results of the survey added to the forest register and the map.

The purpose of simultaneous inventory is to grasp the total volume of a whole forest. A stochastic method is applied. The out line of the sampling plot method established in 1958 is explained briefly as follows:

1. The unit of inventory is a regional planning area which has been defined so by being a watershed.
2. A stratified sampling method is applied to the national forest and expected to obtain accuracy within 10% in a managed forest and 15% to 20% in an unmanaged forest. A simple sampling method is applied to ,private forests and expected to obtain accuracy with 15%.
3. A plot's size is 0.1 hectare and the shape is rectangular.
4. Location of a plot is selected at random from the grid and drawn on a map. To identify that point on the ground, aerophotograph is referred to.
5. Permanent plots are also designated and a periodic inventory is continued.
6. The data of the sample plots is processed statistically and the total volume is calculated by an interval estimation method. The confidence coefficient is 95%.

Recently, this sampling survey has not been conducted and the Japanese forestry statistics has been depended on the database established from ordinary inventory, because the data accuracy of the ordinary inventory has been getting better.

In view of the inherent complexity of the forest use, comprising both timber and non-timber sectors, planning for their efficient use and effective management has become an increasingly difficult task. Especially, in order to decide on the appropriate non-timber use of forest land the planner must assess the human needs for goods and services as well as the productivity of the forest land. Therefore, the decision maker has to collect a broad range of information covering not only the nature of the forest resources but also human activities which relate to the non-timber uses of the forest. But there is, as yet, no experience in the forest sector of including such social-environmental information in the forest resources database. Moreover, some forest uses are frequently in conflict and there is no common measure that can be used to evaluate all of them satisfactorily. Economic value can be attached to timber outputs, but there is presently no sound way of evaluating economic costs of the social welfare effects of the forest.

New Zealand Forestry – a Forest Resource Inventory Dichotomy?

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New Zealand does not have a formal national forestry inventory as understood in terms of the systems which many developed countries operate. Reasons for this need to be appreciated in terms of the history of the establishment of the planted production forests (currently 1.5 million hectares and comprised entirely of species exotic to New Zealand) and the strong movement for protection of the 6.4 million hectares of natural forests for non-wood production values. General statistical information on the development of forestry in New Zealand may be found in *Ministry of Forestry 1996a*.

The National Exotic Forest Description (NEFD) is an aggregated high level inventory system based on the detailed stand records which forestry owners and managers keep about their planted areas. Its purpose is to provide and maintain an authoritative, high quality database of the New Zealand planted production forest resource capable of being used for wood supply forecasting and for monitoring changes to the resource through time. Other uses include central government policy making; planning and investment analysis by the forestry industry; planning and policy making by local government and other agencies; and for providing some information relevant to New Zealand's international reporting obligations.

NEFD data is collected annually on area by age for species groups (radiata pine; Douglas-fir; other softwoods; all hardwoods); tending regime; area clearfelled; volume harvested through clearfelling and production thinning; planting levels (new planting and restocking) and at the local authority level. Aggregated yield table information is collected periodically from forestry companies. The yield information together with the area-age database provides the essential information needed for wood supply forecasting. Further details are in *Ministry of Forestry 1993; 1996b; and 1996c*.

Reporting on the natural forests is more complex and less developed. This is because New Zealand lacks an up-to-date, accurate description of its national landcover. The New Zealand Land Cover Database Project (NZLCDB) will provide the foundation for filling a recognized reporting information gap with the natural forests.

The NZLCDB builds upon successful pilot classification work undertaken in 1993/94 for two districts with substantial forest cover. This lead to a national initiative to complete the database for the whole country. Successful remote sensing data capture (using SPOT images) in the summer of 1995/96 will ensure that by June 1998 New Zealand will have an up-to-date map in high resolution digital form of its land cover capable of being used for many forestry and other land cover needs.

Developments based on this – possibly by the establishment of sample plots in the natural forest and scrub areas and reviving data collection from previously established plots – should ensure New Zealand is able to report fully and comprehensively on the state and condition of both the natural forests and the planted production forests. An important prospect is that by so doing it will lead to a more holistic understanding of what forestry is based upon in New Zealand.

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WWF's Criteria of Forest Quality

Nigel Dudley

WWF's research on temperate and boreal forests concluded that, although the area of forest was stable or even expanding in many cases, the quality of these forests was often declining from an environmental and sometimes also a social standpoint. In particular, old-growth forests, and multi-purpose forests, are being replaced by intensively managed forests and plantations. Whilst these may be efficient at producing timber, other values risk getting undervalued or ignored.

In order to better identify the elements that are important in high quality forests, WWF has defined a series of criteria that contribute to forest quality:

authenticity:

- natural composition of trees etc;
- natural spatial variation of trees with respect to age,
- size, proportion of dead timber; continuity;
- accommodation of natural disturbance patterns within forest management;
- integration of forest into the landscape;

forest health:

- tree health;
- health of other flora and fauna;
- robustness in the face of global climate change.

environmental benefits:

- biodiversity conservation;
- soil and watershed protection;
- local climatic effects; carbon sequestration.

other social and economic benefits:

- timber products;
- non-timber products;
- support for local industries;
- recreational value;
- forest as homeland for people;
- aesthetic and spiritual values;
- historical and cultural values;
- educational values; local distinctiveness.

A forest cannot be expected to include all these values within single stand. However, within a landscape or region, forest planning should be able to allow representation of all the above.

Land Classification – a Test

H. Gyde Lund

Successful global resource assessments, based upon individual country inputs, depend on the nations being able to provide data following some internationally acceptable standards and definitions. Meaningful global forest resource assessments are heavily dependent upon the international definition of forest land and other key terms. The following definitions are being proposed for the Forest Resource Assessment 2000.

Forest land – Land under natural or planted stands of trees with tree crown cover (or equivalent stocking level) of more than 10 percent and areas of more than 0.5 ha, whose primary use is forestry. The trees should be able to reach a minimum height of 5 m at maturity in situ. The definition further states that areas which are temporality unstocked but are expected to revert to stocked forest are also considered forest land.

Tree – A woody perennial with a single main stem, or in the case of coppice with several stems, having a more or less definite crown. Includes bamboos, palms and other plants meeting the above criterion.

Forestry – Activities related to the management of forest and other wooded land for the production and supply of wood and-or other goods and services of forest and other wooded land.

If one looks closely at this somewhat circular definition of forest land, one can see it has components of combination of land cover, land use, and land potential. For example if a piece of land has had the tree cover removed, in order to classify it as forest land, one has to know that it will be used for forestry purposes, and that the trees will reach 5 m at maturity. Similarly if a piece of ground has young trees on it one has to ascertain if the trees will reach 5 m and, I assume, 10 percent crown cover at maturity.

To see how well participants were able to consistently use the definition of forest land, I gave a non-scientific test using 26 slides of various vegetation conditions. For each slide, I asked three questions:

1) how would you classify the scene (forest, other wooded, trees outside forest land, other), 2) why did you classify the lands that way, and 3) in situations where the land is not classes as forest, and considering the need for data on carbon storage, biodiversity, etc, should we include these land and the resources they contain in the next assessment?

As to ability to agree on forest land, the bottom line was that most people could agree on what areas were covered by trees, but not necessarily on if the land were going to be used for forestry purposes. There was some confusion about if the 10 percent canopy cover applied to the current situation or to some point in the future. There was also confusion about how to classify plantations of rubber, palm oil, and orchards or if these lands should be included in the assessment. They did 100 percent agree on the classification of a sand dune and parking lot!

The test showed that participants could not consistently classify forest land according to the definition. There was less agreement as to whether or not the lands should be included in the Assessment. If we are to rely on data from the countries to construct the Assessment, then we have to have definitions and standards that can be easily followed and that make sense. To correct this situation, we need to either provide more instructions on its use or limit the definition to one for either land cover, land use, or land potential. An alternative is for one entity to do the global classification and provide the information to the countries. Since most classification of forest land will be done using remote sensing, then the definition should be one dealing with land cover rather than land use or land potential.

The United Sates Forest Inventory Program

H. Gyde Lund and W. Brad Smith

Background

The United States of America is the fourth largest country in the world. It accounts for approximately 7 percent of the Earth's land area and 6 percent of the world's forest land. Not only is the U.S. large, it is also one of the most, if not the most, diverse countries in the world as far as land distribution and vegetation types are concerned. Our vegetation and lands range from the tundra and boreal forests in the Alaska, to the tropical forests in Puerto Rico, Hawaii, Guam, and America Samoa, to the deserts of our Southwest, and the hardwood forests of the Northeast.

Responsibility for periodically inventorying the forest resources of the United States falls to the U.S. Department of Agriculture, Forest Service. We have about 737 million acres of forested land (by our definition). Because of the size of the United States and the wide distribution of our forest lands, we survey the forest resources on a State by State basis. We have been conducting our inventories since 1930.

Our State-wide inventories use a double sample of photo points and field plots. In a typical year, we inventory some 50 million acres of forest land, using 200,000 photo points, 13,000 field plots, and 1,300 quality assurance plots. Each State is re-inventoried roughly every ten years. Beyond the usual timber information, we collect data on understory vegetation as well. As such, our surveys are multiple resource inventories.

State statistics are aggregated approximately every five years to produce a national assessment. We use the data from our national assessments to provide input to the Global Forest Resource Assessments. Since we are on a 10-year State cycle, at any point in time, some of our national data may be nine years old. The same may be said of the data we provide for the FRA. On the average, our current national data are consistently about five years old. If we are to provide new data for Global Assessments, then we need at least a nine year advanced notice using current methods and schedules.

Changes in the wind

Several changes are taking place that will affect our inventories. They include changes in resource and information management policies, our organization, our design strategies, and technology.

Resource Management and Informational changes include shifts from:

Resource management to ecosystem management
Emphasis on resource production to ecological functions
Interest on activities at the local level to the global level
Movement from specific direction to general direction
Single use to multiple use

Organizational changes include the movement from:

Top down management to bottom up management
Centralization to decentralization
Corporate strategies to self empowered task groups
Ample funding to reduced budgets and "rightsizing"
Staff work to committee work
Agency orientation to partnerships

Design strategies include movement from:

Scientific to artistic
Quality to quantity
Probablistic to opportunistic sampling
Single resource inventories to integrated inventories

Technology changes

1. We recently entered a partnership with other federal agencies to purchase nationwide coverage of Landsat TM imagery.
2. The Forest Service will be getting an agency-wide Geographic information system. All of our nearly 900 field offices will have access to the GIS. Given the large investment in GIS and Landsat imagery, we will be making more use of satellite imagery and computer technology to inventory and monitor our lands. This will enable us to do spatial analyses and modeling that we could not do before.
3. To cope with these changes, we have been working toward developing an annual forest inventory technology. This technology would provide current inventory estimates annually through integration of current data base techniques, remote sensing imagery and analysis, annual field sampling, and model predictions. Quality remote sensing imagery and analysis will be critical for determining forest area and detecting major change in land use characteristics. Field plots are updated annually, some based on a remeasurement sample and the rest based on predictions by new growth and survival models.

Derived data bases will be available for analytical uses such as identifying cause and effect relationships, monitoring forest health, biodiversity studies, and addressing non-timber issues.

Inventory and Monitoring Institute

All these changes mean that we should change the way that we do our inventories. This will call for more coordination and use of existing data. To help meet future information needs and to build on the changes taking place, the Forest Service is working toward developing an Inventory and Monitoring Institute. The mission will be to help and support the collection and management of consistent, scientifically reliable resource information at all levels to support ecosystem management. The focus is on strategic planning and agency consistency.

The functions are to:

- Standardize protocols, eliminate redundancy and inconsistency, and promote quality assurance procedures for inventory, monitoring, and evaluation activities.

  Develop procedures to assess and certify the scientific quality of Agency resource data. Highlight areas where weaknesses exist, and develop strategies for improvement.
- Advise the National Headquarters on actions, priorities, and budget allocations necessary to address strategic inventory and monitoring issues.
- Provide technical assistance and serve as a clearinghouse of inventory, monitoring and evaluation information relating to techniques, procedures, protocols, and methods.
- Coordinate, set priorities, and promote research and development of inventory, monitoring and evaluation techniques.
- Ease sharing of information, methods, and protocols with external organizations.

Staffing will consist of an Institute Director, Deputy Directors (Protocol and Quality Assurance, Information Management, Technology Transfer, Interagency Coordination, and Administrative Support.

If the Institute comes into being, it probably will have the lead in providing U.S. data for FRA2000. Hopefully with the new Institute and increased use of new technology we will better serve our public.

Criteria and Indicators and the Evolving Concept of Sustainable Forest Management

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The issue of C&I for SFM is a challenge both politically and technically. During last few years, criteria and indicators for sustainable forest management have promoted the international, regional and national dialogue on forest in an open and transparent way and remarkable achievements have been reached in various international and regional initiatives.

Under the umbrella of the Ministerial Conference on the Protection of Forest in Europe, all European countries have committed themselves to the stewardship and use of forests and forest lands in a way of sustainability, recognising that the conservation and appropriate enhancement of biological diversity in all types of forests is an essential element for their sustainable management. To this end, the signatory states have committed themselves and undertaken to prepare, without delay, specific national and regional guidelines and to incorporating them into their forestry plans and programmes for the implementation of the General Guidelines.

In the Helsinki-Process signatory countries and the EU have developed of a set of 27 most suitable quantitative indicators and a number of descriptive indicators for sustainable forest management. At the moment, European countries are in process to implement those criteria and indicators at national level. The list of Pan-European criteria and most suitable quantitative indicators is the toolbox for gathering and assessing information on how the signatory states have succeeded in implementing the general guidelines for sustainable forest management as described in the Helsinki Resolution H1 and H2. A summary presentation of Pan-European experiences will be provided for the Third Session of the IPF.

In Finland, a list of 160 national level indicators has been developed in an broadly based project. Also a pilot project has been launched to study the feasibility to formulate and to use criteria and indicators at sub-national level. These sets of criteria and indicators are based on the pan-European list.

As being a forest policy instrument, criteria and indicators are interlinked with several elements of the work of the Intergovernmental Panel on Forests. The timely monitoring of the state of sustainability in forests depends on the quality and quantity of data available, and thus criteria and indicators are, as a cross-cutting element, closely related to forest resources assessment and forest information systems, and linked with national forest and land-use plans, with the work on underlying causes of forest degradation and deforestation, with international cooperation, trade and environment etc. In this respect, further examination of links between international, national, subnational and local levels is needed.

There are many common denominators in the criteria and indicators presently under development and testing by the ITTO and within the Helsinki, Montreal, Tarapoto and Dry Zone Africa processes. All these processes have their specific regional and eco-regional features.

In order to take stock on potentials of criteria and indicators, all countries should be encouraged, through necessary capacity building, to further expand and intensify activities in the identification and use of economically, socially, environmentally and culturally relevant criteria and indicators at national level. Also tests should be carried out how to improve the applicability and measurability of the indicators, keeping in mind that all indicators can not be quantified.

Indicators are ways of measuring and describing achievements built in criteria, and translate the criteria into more direct operational tools, thus supporting the reporting process, and making the reporting internationally credible. The quantitative and descriptive indicators should be interdependent and jointly provide a full picture of the state of forests and forest management in a country.

It is clear that increased and better understanding of the comparability and of possible compatibility of different criteria and indicators would be important in order to advance global consensus on concept of sustainable forest management, on terms and definitions and on improved conditions for forest resources assessment and forest statistics. Particular emphasis should be put on the specific economic, social, cultural and environmental conditions.

Finland has been carrying out National Forest Inventories since 1921. Our experience is that regular forest resources assessments are prerequisite to monitor the condition of forests and other wooded lands and they form an information basis for the sustainable forest management. In the forest resources assessment, the linkages between international and national levels and between different sectors must be further developed. Forest related data information systems should take

place primarily at the national level. Capacities of national organisations in collecting, handling and synthesising of data as well as access to data should be guaranteed in all countries.

At the international level, there is need for a greater comparability of data from different countries. The work of FRA 2000 and other related international activities on forest inventory, monitoring and statistics should be encouraged. We should also support efforts to harmonise the key concepts, terms, definitions and classifications.

Special national needs and conditions should be respected in the search for internationally comparable information for forest policy formulation and capacity building at national and sub national levels. In this respect special attention should be paid to the assessment of some key criteria and both quantitative and qualitative indicators for sustainable forest management, which form a good basis for the prioritisation of information needs.

We should put emphasis on the coordination between the forest and other related information systems. Overlapping work should be avoided at all levels and special consideration should be put on identifying the users of information and dissemination of information, as well as how non forest information could be included and further developed in conjunction with forest information.

As part of the intersessional activities of the IPF, Finland will host an Intergovernmental Seminar on Criteria and Indicators for Sustainable Forest Management on August 19–22, 1996 in Helsinki. The scope of the Seminar is based on the Programme of Work of the Panel:

- Exchange and share knowledge and experiences for a wider understanding of regional processes and national initiatives and their relationship.
- Examine progress made in the implementation of criteria and indicators in diverse social, economic and environmental conditions.
- Facilitate the engagement of regions and countries not yet involved in the development of criteria and indicators for sustainable forest management.
- Examine the possibilities for developing greater comparability of criteria and indicators and for their international compatibility.

Victoria: An Example of How the Processes for Nature Conservation and Sustainable Forest Management Reporting, and Forest Resource Inventories Can Be Integrated

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Australia

Australia is an island continent of approximately 750 million hectares of which about 5 % is forested and about 15 % is other wooded land.

Australia's National Forest Policy Statement (1992) identifies the goals of promoting nature conservation and the sustainable use of its forests, and provides a framework to ensure that Australia fulfills its obligations under relevant international agreements.

In general terms the Montreal Process provides criteria and indicators which can be applied by Australia to report on progress towards nature conservation and sustainable forest management.

At the regional level the Australian and State governments have negotiated Regional Forest Agreements which outline the studies to be undertaken, and the processes by which achievement of nature conservation and sustainable forest management can be recognised.

Within my state, Victoria, the Statewide Forest Resource Inventory is being conducted concurrently with the flora, fauna and forest disturbance studies required as part of the Regional Forest Agreement Process. Together, this information is used to calculate sustainable yield forecasts and develop Forest Management Plans as well as provide the necessary source data for other Regional Forest Agreement reports.

Towards the 21st Century Sustainable Forest Management through the Establishment of National Forest Inventory in Indonesia

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Indonesia harbors the third largest tropical forest in the world. The present area of public forest land is 140.4 million ha consisting of 30.7 million ha protection forests, 18.8. million ha conservation forests (nature reserve, wildlife sanctuaries, national parks, grand forest parks and nature recreational parks), 31.3 million ha limited production forests, 33 million ha permanently production forests and 26.6 million ha convertible forests for agriculture settlement, transmigration etc.

Indonesian ecological concept and sustainable forest management principles are reflected in the Indonesian Constitution of 1945 (article – 33, para – 3), the Basic Forestry Act No 5 of 1967, the Basic Law on Environmental Management Act No 4 of 1982, the Conservation of Living Resources and their Ecosystem Act No 5 of 1990, the Spatial Use Management Act No 24 of 1992, the Ratification of the UN Framework Convention Climate Change Act No 6 of 1994, the Ratification of the UN Convention on Biological Diversity Act No 5 of 1994 and some other government regulations.

In order to identify forest condition and standing stock as well as forest mapping as a basis for forest management, it has been conducted a National Forest Inventory (NFI) Project through survey and non-terrestrial inventory by interpretation of satellite imagery and aerial photography.

NFI component has four main components: forest resources (change) monitoring (FRM), forest resources (status) assessment (FRA), geographic information system (GIS) and digital image analysis system (DIAS). There are also the technical assistance (TA) and the training components, both of which cut across the main components.

The major activity in FRA is to make 3000 cluster plots throughout Indonesia. The progress up to April 1996 there are 2794 clusters have been enumerated, and 2788 clusters of them have been entered to database, 2735 clusters have been analyzed, and 1706 clusters were used to make Statistic of Forest Resources in Indonesia. Based on the compiled data of Landsat MSS interpretation (1986 and 1991), there is 120.6 million ha covered by forest consisting of 92.4 million ha permanent forest areas (protection forest, conservation forest, limited/permanently production forest) and 21.6 million ha convertible forest and 6.6 million ha non-forest areas.

The distribution of forest cover in the major islands are: Sumatera 23.63 million ha, Kalimantan 38.94 million ha, Sulawesi 11.38 million ha, Maluku 6.41 million ha, Irian Jaya 34.97 million ha, Nusa Tenggara – Timor Timur 2.22 million ha, and Java-Bali 3.03 million ha. The temporary result of the distribution of forest potential in five major islands for all species with diameter of more than 20 cm are: Sumatera 1.37 billion m^3, Kalimantan 3.13 billion m^3, Sulawesi 0.55 billion m^3, Maluku 0.66 billion m^3 and Irian Jaya 2.17 billion m^3.

After finishing the first round wall to wall of Forest Vegetation and Land Use Map (scale 1:250,000), NFI proceeded by digitizing them in several layers: base map (coastal line), river (water bodies), road, vegetation, forest land use, province, scene boundary. Then, updated them by second round mapping results and added some optimal layer: forest concessionaires, forest plantation, estate, transmigration etc. The GIS database is also handle data from sample plots (temporary and permanent plots) in form of grid numbers of cluster, and major information of the cluster: land system, land category, forest type, stand condition and species dominant.

Forest Resource Assessment in Malaysia

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The forest resource of Malaysia is an important renewable asset which has contributed significantly to the socio-economic development of the country. Of the total land area of 33 million hectares, approximately 19.2 million hectares or 58 % percent is forested. Out of this a total of 14.04 million hectares has been designated as Permanent Reserved Forest.

The implementation of a sound and effective forest management requires quantitative and qualitative information pertaining to the resource. The information could only be collected by quantifying the forest resource base through some form of forest assessment or inventory.

In Peninsular Malaysia forest inventories are carried out at three levels of forest management which are namely; macro, management and operational level. At macro level, the first national forest inventory (NFI 1) was carried out in 1970–1972 with the assistance of UNDP/FAO. Subsequently in 1981–1983, the second national forest inventory was carried out to collect and update the forest resource information obtained during the NFI I and this was conducted by the staff of the Forestry Department. The third national forest inventory was recently completed in 1992.

The third national forest inventory was undertaken in collaboration with FAO/UNDP and was implemented under a programme called Continuous Forest Resource Monitoring System (CONFORMS). This monitoring system paved way for continuously monitoring of forest resource and change detection through the integration of remote sensing, geographic information system (GIS) and field data. CONFORMS is implemented in three phases. Phase 1 involved collection of information on all types of natural forest and plantations from monitoring points based on satellite imageries mainly LANDSAT TM. Phase 2 involved the establishment of a geographic information system (GIS) to describe in detail the forest situation past, present as well as to monitor changes to the forest cover. While phase 3 entails field sampling on a continuous basis from randomly selected grid points according to pre-determined standards. This sampling will keep the stand and stock table data of the various forest types updated regularly.

The future challenges of forest resource assessment is the ability to integrate collection of information pertaining to biological diversity and other environmental parameters. With declining budgets and increased concerns for the environment there is urgent need for integrated or multiple resource inventories be undertaken. This will provide sufficient information regarding forest resource base to enable the policy makers and forest managers plan and manage the forest resources sustainably.

Remote Sensing Based Sample Survey of Forest Cover State and Changes in the Temperate and Boreal Zone

K.D. Singh

1. New information needs

The global forest resources statistics published by FAO in the Forestry Paper 124 serve the general needs of the international community. Specific information needs have arisen, following the UNCED, which must be taken into consideration while deciding on the content of future State of Forest Reports. These new needs relate to conventions on climate change, biodiversity and forestry principles. With respect to the latter, the expressed needs relate to sustainability indicators.

A common denominator to all of the above information needs is concern about: r*eliable assessment of changes in forest resources at national, regional and global levels following political and ecological sub-divisions.*

The FAO/ECE 1990 assessment experienced serious problems in the very issue stated above. The report has no change estimates even of forest area, not to speak of growing stock. Further complexity was non-additivity of country figures of changes because of varying definitions and standards of measurements among countries.

Finally, there is an expressed demand on countries, as part of global conventions, to provide a globally consistent information on the process of changes in area and growing stock in the context of global c-budget.

2. Options to be considered

Two options for data gathering come into consideration:

(i) organization of existing data in a special manner as done for the tropics in the 1990 assessment. This would involve reporting of source data and an adjustment process;

(ii) use of a remote sensing based sample survey, using globally consistent

> definition and measurement techniques. These techniques have been found most satisfactory and acceptable for the tropical forest resources assessment 1990.

Some Scandinavian countries have also conducted large-scale studies on the use of high resolution satellite data in the context of national level forest inventory. This experience will be most useful.

The IUFRO meeting in Washington, 11–14 March 1996, has recommended that the sample survey implemented in the tropics should be extended worldwide.

The FAO/ECE secretariat may consider both options and advise what is most feasible for FRA 2000.

Mexico's National Forest Inventory

Victor Sosa Cedillo

In Mexico, three National Forest Inventories have been carried out. The first National Forest Inventory began in 1961 and it finished in 1985. The second one from 1991 to 1992, was a Wide Vision Forest Inventory.

The last National Forest Inventory (1992–1994) has the following objectives:

- To update the statistics and cartographic information of the forest surface by vegetation types, topography and types of use.
- To determine timber sustainable production for rural consumption and forest industry supply.
- To classify and delimit the conservation, restoration and production zones in forest terrains, agreed with the forest resources, characteristics and functions.
- To establish a permanent system of an updated information that permits to develop the capability in order to carry out periodical assessment and the monitoring of the forest ecosystems so as to support the policies, programs and projects to be performed.

TM high resolution Landsat satellite images scale 1:250,000 were used. The main characteristics of these images are:

Characteristics	Description
Scale	1:250,000
Collecting date	1991–1993
Space resolution	900m^2
Image coverage	185 x 185 km
Satellite	Landsat
Sensors	TM
Presentation	Cinta Exabyte 8 mm
Format	Digital
Band	TM4, TM3, TM2

The images were visually interpreted and adjusted with field information. Field data were obtained through a systematic sampling design. Observations inside and outside of the sampling units were made. Were obtained 122 Forest Maps and 122 Zoning Maps at the scale 1:250,000. Also a National report and one for each state of the country (32).

The general uses of this inventory are:

- To assess the current situation, to estimate changes in the past and to predict trends about forest resources of the country.
- To formulate specific and global forestry policies, likewise sectorial plans in short, medium and long term.
- To improve the knowledge of forest ecosystems and to have a permanent assessment and monitoring system of them.
- To define ecological and forestry guidelines, and restrictions to avoid negative impacts on forest resources.
- To plan and to give priority to other kinds of forest inventories in specific areas and different objectives.

The information of Mexico's national forest inventory will be integrated easier with FAO's assessment, because the concepts and classifications of periodic inventory were taken from FAO manual for this purpose.

It is clear that cooperation of FAO with Mexico in forestry issues must be maintained and increased for a mutual benefit, specially focused on year 2000 when world forest assessment and a new forest inventory in Mexico will be made simultaneously.

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The National Forest Inventory of Norway

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The National Forest Inventory (NFI) is a sample plot inventory with the aim of providing data on natural resources and environment for forest land in Norway. The NFI was established because of the fear of over-exploitation of the forests and shortage of timber in the future. Today, we do not consider that as a real threat to the forests. Standing volume and increment have showed constantly increasing trends since the first inventory. During the past few years, more attention has been directed towards the ecological and environmental aspects of the forests, and this has led to some expansion of the inventory.

The first assessment of the NFI was carried out during the years 1919–1930, while the ongoing inventory cycle (the 7th) was started in 1994 and is expected to be completed in 1998. Yearly assessments of forest condition were started in 1988.

The sampling design has changed considerably over the years. A grid net of permanent sample plots was established during the period 1986–93. Permanent sample plots have a circular fixed area of 250 m^2 and are systematically distributed in a 3.0*3.0 km grid. These are remeasured over a 5-year period. Temporary sample plots (concentric fixed area) are applied to ensure reliability for individual counties. Each third permanent plot in each direction (9.0x9.0 km grid) is also a sample plot in the survey of forest condition.

Assessment of forest condition is carried out on sample plots representing forests over the entire country, while ordinary NFI recordings are not made above the coniferous forest limit nor in Finnmark county. Parameters which characterize level of development and species composition of the vegetation, utilization and yield capacity of the land, forest treatment, relations concerning forest operations, etc., are being measured or estimated. One of the main tasks of the NFI has been an assessment of timber resources. Data are being collected so that the volume can be computed for different tree species, diameter and quality classes, etc. Number of trees and annual increment are also calculated.

The inventory is completely based on terrestrial recordings (and maps), and at present, no interpretation of aerial photographs or other remote sensing methods are being utilized. However, the institute has started experimental work on satellite image processing, but it is expected to take some years until remote sensing is an integrated part of the NFI.

The survey results are primarily a tool for strategic planning by central authorities. One of the most important users is the Ministry of Agriculture. Even since the first inventory, laws and regulations are formulated partly as a result of information from the NFI. Forest authorities at the county level will mainly use survey results as guidelines for control and coordination of activities within their field of responsibility. A reasonable management of forest resources is the aim of the forest owners' associations, and survey results are of substantial value for their work. Other groups of users are forest industries, researchers, educational institutions and also organizations and authorities dealing with environmental issues.

Results from the Test Enquiry on Pan-European Criteria and Quantitative Indicators for Sustainable Forest Management

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In the follow-up of the Second Ministerial Conference on the Protection of Forests in Europe a set of criteria and 27 quantitative indicators for sustainable forest management have been developed. In order to test the suitability of the developed criteria and quantitative indicators as well as to gather information on how the European countries are progressing in implementing the general guidelines for sustainable forest management as described in the Helsinki Resolutions H1 and H2, a questionnaire was prepared. The questionnaire, together with guidelines for its completion was sent out to 38 countries in September 1994. In response to the enquiry, the questionnaire was returned from 31 countries.

In general the countries were able to provide more data on the situation in the 1990's than in the 1980's, and consequently it is not possible to present changes over time for all indicators. Data for the years 1984, or the nearest year, and 1994 or the nearest year were requested. The intention was to quantify the changes that have taken place over the last decade. However, the reference years used by the countries vary, and that the time interval for the data provided is not always ten years, but can be shorter or in some cases even longer. Also the definitions used in national inventories and statistics of different countries may vary a lot from the definitions given in the explanatory notes for filling in the questionnaire. Moreover, classifications for some indicators may differ considerably between countries. Consequently, the results from different countries are not easily comparable, but they indicate only trends in individual countries. For these reasons, and as data were not available from all European countries, it is not feasible at this point to present total results for all of Europe based on the data from the enquiry. In order to complement the information from the enquiry and to illustrate the development of forest resources and health in Europe, results based on the ECE/FAO and ICP Forests statistics are also presented.

The results have been chosen so that there are at least some results for each criterion. In the selection, the answer rates and the comparability of answers have been considered (*i.e.* definitions and classifications used in each question are as homogeneous as possible in different countries). Hence, results concerning 18 indicators are presented.

The exercise showed that there is a strong need to broaden the scope of data collections e.g. national forest inventories should be adapted to monitor the whole forest ecosystem, and to integrate environmental aspects and socio-economic data into forest statistics. Further development is needed in the definition of terms and in the harmonisation of classifications, if data from different countries are to be comparable. Research needs are greatest for measuring and monitoring biodiversity. In the future it should also be considered how indicators describing forest policy instruments could be used for the assessment of sustainable forest management. There may be a need for basic research in this respect.

It has to be emphasised that these results represent the first effort to use quantitative data for describing the state of the sustainable forest management in the Signatory States of the Helsinki Resolutions H1 and H2. As information was not yet available for all quantitative indicators, caution has to be taken when observing developments in individual countries. In order to get a holistic view how each individual country is progressing towards sustainable forest management, it is essential that a general overview describing the national forestry sector, as well as forestry policy instruments is included in the assessment.

Forestry Commission – National Inventory of Woodlands and Trees

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United Kingdom

The Forestry Commission have historically carried out national woodland surveys of Great Britain every 10–15 years. The first survey was in 1924 and consisted of a questionnaire to owners. Subsequent surveys were in 1938, 1947, 1965 and 1980. The earlier surveys were complete inventories of all woodlands with sample surveys in 1965 and 1980. Hedgerows and park tree surveys were first introduced in 1951 and were carried out along with the 1965 and 1980 woodland surveys. The surveys have been crucial in providing data for production forecasts and the development of the wood processing industries. They also give important information to formulate government forest policy.

A New Woodland Survey started in 1994 and is now the 6th Inventory the Forestry Commission has carried out. A combination of the latest in digital mapping technology together with a broad field assessment of woodlands will give a very accurate picture of the size, structure and condition of our woodlands in Britain. Both private and state woodlands are being surveyed.

The survey is divided into two parts – the main woodland survey and the survey of small woods and trees. The aim is to complete both parts by 2001 and for the survey then to be conducted on a continuous cycle. Results will be published on a county basis.

The first stage in the main woodland survey is producing a computerised map showing all woodland over 2 hectares. This is created from 1:25,000 aerial photographs with surveyors interpretating woodland into broad categories such as conifer, broadleaved, mixed, coppice, young plantation, new planting and felled. The next stage is the selection of a 1% sample of woodland area. Woodlands are stratified by size into 3 categories (2–100 ha, 100–500 ha and over 500 ha) and a sampling grid provides a random cluster of 1 ha sample plots. These sample plots are then visited by our surveyors after obtaining owner access permission. A wide range of crop data is collected such as species, planting year, top height, stocking, area, timber potential, thinning history and accessibility.

Important new features from previous surveys are

- a questionnaire to private owners on ownership type and management context,
- a woodland structure assessment that will give data on the diversity of our woodlands,
- dead wood, natural regeneration, mammal damage and forest health assessments.

The small woods and trees survey will assess woodlands of less than 2 hectares together with groups and single trees and hedgerow trees. A random sample of 1km squares is selected and interpretation from air photographs is carried out. A field check gives ground truthing of this interpretation.

In summary, the Forestry Commission has started it's 6th Woodland Inventory. New types of data are being collected that will make us much better informed about our important woodland resource. With the use of computerised mapping we will also have an accurate picture of the extent of woodlands in Great Britain. This will provide vital tools to assist in the Global Forest Resource Assessment and respond to the increase of importance in areas such as biodiversity and criteria and indicators.

Study Tour on Forest Inventory and Management Practices

Halla-Sippola Estate, UPM-Kymmene Forest
13 June 1996

12.30 Leave by bus from Kotka to Sippola

13.30 UPM-Kymmene Concern
Forest Management Planning System
by *Mr. Fred Kalland,* Forest Manager

Coffee break

Forest tour, guided by *Mr. Kalland*

Biodiversity Monitoring in National Forest
Inventory of Finland
by *Dr. Erkki Tomppo*

Discussion of forest regeneration methods, key habitats and other biodiversity aspects, and nature protection.

17.30 Buffet dinner

By 20.00 Arrival at Kotka

Biodiversity Monitoring in National Forest Inventory of Finland

Erkki Tomppo and Tiina Tonteri
The Finnish Forest Research Institute
Helsinki, Finland

1. National Forest Inventory Traditions

The traditional role of the Finnish National Forest Inventory has been to provide unbiased, reliable large area information on forest resources. The information has been utilised in large area forest management planning, such as determining the level of cuttings and other treatments needed, as the information basis of the official forest policy, and in the strategic planning of the forest industries.

The first NFI was carried out 1921–1924. The inventories have been based on sampling and the measurement of sample plots. Aerial photographs have been applied in addition to ground measurements from the 5th inventory (1967–1970) in the north of Finland. The Finnish Forest Research Institute (Metla) has been responsible for all the inventories. During the eighth rotation (1986–1994), the Metla started to apply a multi-source inventory system which utilises satellite images and digital map data in addition to ground measurements. The ninth inventory started in the spring of 1996. A new feature is measurements taken purely for forest biodiversity assessment.

2. Biodiversity in National Forest Inventory

Sustainability or, rather, the increase in cutting potentials, from the outset, has been a central principle in Finnish forestry legislation and silvicultural instructions. This means sustainability in forest areas, growing stock and growth, carbon and nitrogen balance, for instance. The Rio de Janeiro environmental program and the resolutions of Strasbourg and Helsinki Ministerial Conferences and their follow up procedure imply that sustainability with respect to biological diversity must also be taken into account. New practices and biodiversity measurements have been very rapidly introduced into practical forestry in Finland, in spite of the lack of research information. For instance, living trees are left in cutting areas in order to increase the amount of decaying wood and diversity of forests. Some ecological research has been carried out in timber production forests, but this information has not been combined with forestry and forest inventories before.

Recent inventories have already produced some information about biological diversity, but definitions of concepts, new measurements and even research are needed to do this properly. Especially information on environmental factors and ecological processes influencing the structures of animal, plant and fungi communities is needed, since the choice of measuring the right parameters has a vital importance.

The National Forest Inventory will be a part of the national biodiversity monitoring system. The measurements and information produced by the current and recent Finnish forest inventories, especially from the point of view of biodiversity, are described here. The biodiversity measurements are still under development.

The National Forest Inventory today has two grids of field plots, that intended for forest resource and condition monitoring, about 70 000 sample plots in the entire country, and that intended mainly for monitoring changes in understorey vegetation and forest health, amounting to 3000 plots.

Field data collected in the National Forest Inventories have traditionally involved characteristics which describe some environmental factors having an influence on biodiversity, or in some cases, which describe the biodiversity itself. Examples include site fertility, soil type, tree species composition by crown layer and, in some inventories, understorey vegetation. In 1995 and 1996, some new biodiversity measurements were added. The most important of these is the assessment of key biotopes and amount of decaying wood.

The key biotopes usually have rare kinds of vegetation, since they are located on distinctive sites. They maintain an important part of the biodiversity at local and landscape levels, because these sites often have diverse flora and fauna, which strongly differ from that of the surrounding areas. Many of the key biotopes are potential habitats for rare and threatened species.

In the natural old-growth forests of the boreal zone there usually is a large amount of dead wood at different stages of decay. Dead wood is an important habitat for many specialised insect, polypore, moss and liverwort species. The composition of these communities depends on, for instance, tree species, degree of decay and trunk diameter. Some species are even restricted to a certain kind of dead wood: aspen, large coniferous trees or burned wood. The amount of dead wood in Finnish forests has rapidly declined since the introduction of effective forest management practices, yet the exact amount of dead wood is unknown. At the moment, however, the dead wood is increasing again due to underutilisation of forests, especially in South Finland.

3. Field Measurements for Biodiversity Assessment in National Forest Inventory

In the National Forest Inventory, a total of over 150 variables is measured or assessed in the forest. These include general data of field plot cluster and plot identification data, as well as specific data on forest stand or a single sample tree. In the following, the variables applicable in forest biodiversity assessment are briefly listed. The variables are divided into stand level data and tree level data. A part of stand level data is given by crown layer classes.

1. Stand level data:

- site data (e.g. land class and its changes, direction and distance to the closest stand boundary, site fertility, mire type, soil type, quality and thickness of organic layer, drainage accomplished and proposed, forest income taxation class, etc.);
- information by crown layer (e.g. species in the layer, development class, stand establishment, dominant tree species, species mixture, number of stems, quality, mean diameter, mean height, age, syndrome, originating time, cause and seriousness of damages);
- Other stand level information (e.g. damages, lichen survey, stand quality, accomplished measures and time, proposed measures and time, basal area).
- key biotopes within a circular sample plot with a radius of 30 m. Key biotopes include rare habitats with a characteristic species composition (rare or endangered species often included; for instance, springs, streams and their watersides; rare fens and swamps and bogs; habitats surrounding lakes, rivers or ponds; gorges, ravines, etc.). The variables assessed on these keyhabitats include: biotope type, area, strength of anthropogenic influence, management practices and value as a keybiotope.
- number of tree species (on permanent plots only).

2. Tree level data are measured for tally trees include co-ordinates (on permanent plots), tree species, diameter, timber assortment class and crown layer.

3. The additional variables measured for sample trees (every 7th tallied tree) include

- origin of tree, upper diameter (at the height of 6 m, on every 9th cluster), bark thickness (only on every 9th cluster), height of dead branches, height of green branches, height and length of broken part of the trunk, height increment, diameter increment, at the height of 1.3 m, age at 1.3 m and age,
- information on damages as damage syndrome and time of origin, cause of damage and length of rotten part, seriousness, defoliation, length and timber quality class of each part of stem, timber assortments class, reasons for possible quality lowering.

4. Rare tree species and exceptionally large trees are measured on a sample plot with a radius of 12.52 m. From these trees, tree species, diameter at 1.3 m, timber assortment class and crown layer are assessed.

5. Dead or decaying wood are measured on a sample plot with a radius of 12.52 m. These plots are measured only on every second tally tree plot. The parameters assessed are tree species, appearance class, bark cover percentage, position to the ground (lying trees), stage of decay, diameter at 1.3 m (standing trees), diameter at both ends (lying trees), and length.

In the 3rd national Forest Inventory in 1951–1953, understorey vegetation sampling was carried out in order to analyse the geographic distributions of the species. Old and recent inventory data can, to some extent, be utilised for analysing both past and present biodiversity. The oldest linewise survey data are already stored and the rest will be stored in computers for this purpose.

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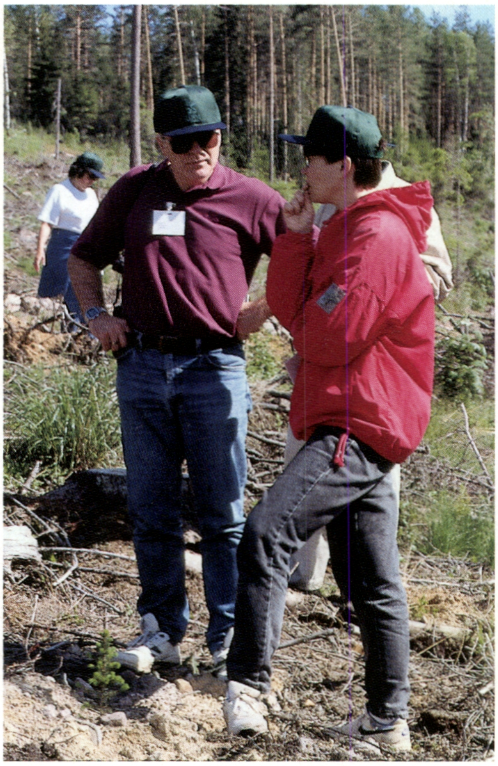
Abbreviations

ECE (or UN/ECE)	United Nations Economic Commission for Europe
EFICS	European Forest Information and Communication System
EROS	Earth Resources Observation System
EU	European Union
EU TREES	European Space Agency Tropical Ecosystem Environment Observation System
FAO	Food and Agriculture Organization
FCCC	Framework Convention on Climate Change
FORIS	FAO's Forest Resource Information System
FRA	Forest Resources Assessment
FRA 80	Tropical Resources Assessment Project 1980
FRA 90	Forest Resources Assessment Project 1990
FRA (TZ) 90	Forest Resources Assessment (Temperate Zone) 1990
GFRA-90	Global Forest Resources Assessment 1990
GFRA-2000	Global Forest Resources Assessment 2000
GIS	Geographic Information System
IPCC	Intergovernmental Panel on Climate Change
IPF	Intergovernmental Panel on Forests
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
IUFRO	International Union of Forestry Research Organizations
NFI	National Forest Inventory
OECD	Organisation for Economic Co-operation and Development
SAG	Scientific Advisory Group
TBFRA	Temperate and Boreal Forest Resurces Assessment
UNCED	United Nations Conference on Environment and Development, Rio de Janeiro 1992
UNEP	United Nations Environmental Programme
WCMC	World Conservation Monitoring Centre
WWF	World Wide Fund for Nature

FOWL	Forest and other wooded land
NAI	Net annual increment
NWGS	Non-wood goods and services
OWL	Other wooded land
SFM	Sustainable Forest Management

Photographs



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The cover shows the arms of the city of Kotka. "Kotka" is the Finnish for "eagle".

Metsäntutkimuslaitoksen tiedonantoja 620
The Finnish Forest Research Institute. Research Papers 620

ISBN 951-40-1541-X
ISSN 0358-4283