METSÄNTUTKIMUSLAITOKSEN TIEDONANTOJA 889
THE FINNISH FOREST RESEARCH INSTITUTE, RESEARCH PAPERS 889



Proceedings of FAO Expert Consultation on Global Forest Resources Assessment 2002

Kotka, Finland, 1–5 July 2002

Edited by Anne Luhtala & Jari Varjo

METLA

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Preface

The Finnish town Kotka has become well known for forest inventory specialists as the venue of expert meetings on global forest inventories. The first Kotka meeting was arranged in 1987, and the following two meetings took place in 1993 and 1996. The fourth meeting was held from 1 to 5 July 2002. The official name of this latest expert consultation was "Global Forest Resources Assessments – Linking National and International Efforts", but the participants called it simply "Kotka IV".

The consultation took place at the same venue as in the previous times: Kymenlaakso Polytechnics. This venue, earlier known as Kotka College of Forestry and Wood Technology, offered excellent facilities for intensive and effective consultations. Good cooperation with the staff of the college made arrangements smooth and pleasant. The City of Kotka hosted a memorable get-together evening on its museum icebreaker "Tarmo". The study tour organized by StoraEnso offered the participants an excellent opportunity to get acquainted with the Finnish family forestry and modern harvesting technology.

The consultation was attended by 58 (with organizers 66) participants from 32 countries. FAO in collaboration with UN-ECE took care of the preparations of the meeting. The Government of Finland supported financially the participation of 23 persons from developing countries and countries in economic transition. The Finnish Forest Research Institute, Metla, was responsible for the technical arrangements of the meeting.

The Chairman of the consultation was Mr. Risto Seppälä (Metla and also President of IUFRO). Mr. Adrian Newton (UNEP), Mr. Christopher Prins (UNECE), Ms. Susan Braatz (UNFF Secretariat) and Mr. Kari Korhonen (Metla) were elected co-chairs. Mr. Peter Holmgren (FAO) and his team deserve a major credit for the success of the meeting. A number of other participants also functioned as chairmen and rapporteurs in various sessions and working groups.

Compared with the previous Kotka meeting the emphasis was now more in conceptual and strategic issues. Findings and recommendations were grouped into three major categories: national forest assessments, global forest resources assessment and linkages between national and global assessments.

This Kotka IV Proceedings contains papers presented in plenary sessions, reports of working groups, minutes of

different sessions, summaries of voluntary papers, the final report as well as list of participants, description of the study tour and photographs taken during the meeting week.

The printing of this Proceedings and costs of all technical arrangements were financed by the Government of Finland.

Opening Statement by the Goverment of Finland

Aarne Reunala
Director General, Dr. Sc. (Agric. & For.)
Ministry of Agriculture and Forestry, Finland

Distinguished experts, Ladies and Gentlemen,

It is a pleasure for me to welcome you all to Finland and to Kotka. It is already the fourth time that the UN-ECE/FAO Expert Consultation on Global Forest Resources Assessment is being held in this beautiful city on the coast of the Gulf of Finland.

The city of Kotka has strong forestry roots. It was founded in 1878 as a growing centre for forest industries and exports. It was a perfect location for a sawmill, since its proximity to the mouth of the river Kymijoki meant that logs from far inland could be floated downstream and processed. The sawn timber was subsequently exported. The company Stora-Enso, nowadays a world leader in papermaking, has one of its oldest roots in Kotka, dating back to 1872, when the Norwegian businessman Hans Gutzeit established here Finland's first steam-powered sawmill there. In 1908 the company built a sulfate pulp mill to make use of sawdust and waste wood.

Even today you can see and feel Finland's forest history here in Kotka. There are several pulp-, paper- and sawmills in Kotka and its neighbourhood, and Kotka is still Finland's largest export port. In the central port of Kotka you can visit the museum icebreaker "Tarmo", which is the world's oldest functioning icebreaker. It was built in 1907 in Newcastle-upon-Tyne, England, and is equipped with a steam engine. Tarmo has helped Finland's forest industry exports for many decades.

The Kymenlaakso Polytechnic, where we are now, is also closely linked to the forests. It has special degree programmes in forestry and forest products marketing, as well as technology and business administration programmes that also serve companies in the forest sector. The Polytechnic has 3500 full-time students and a staff of around 400. There is even a forestry study programme in English for exchange students. Annually

the Polytechnic sends over 100 -students abroad, and receives about the same number of foreign students to study here in Finland.

The three previous Kotka meetings were all hardworking and successful. I am sure that the tradition and the surroundings will create the same spirit, and that all of you distinguished experts from around the world will make this meeting an important contribution to increasing our knowledge of the world's forests.

The agenda of the meeting is challenging. The first topic consists of the lessons learnt from the previous assessments, and especially from the Global Forest Resources Assessment 2000. The second topic consists of national forest inventories and their links to global forest information needs. The final discussions should conclude with recommendations for future global assessments.

The name of this fourth Kotka meeting is "Linking National and International Efforts". It is natural to take national experiences as a basis for international cooperation. But it also works the other way round: internationally agreed principles and criteria are needed in order to harmonise national assessments since, without common concepts and methods, global assessments cannot be produced in a reliable and economically efficient way.

The demand for global forest information is increasing as a result of several on-going international forest-related processes. The United Nations Forum of Forests had its second session in New York in March 2002 and next autumn there will be, under the umbrella of the UNFF, the second International Conference on Criteria and Indicators of Sustainable Forestry. More accurate data are also needed within the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biodiversity (CBD) and its thematic work programme on forest biodiversity. For example, the commerce of carbon sinks cannot really start to develop without improved data on forest resources. If the UNFF succeeds reaching agreement on a legal framework on all types of forests, as we hope, the Global Forest Resources Assessment would be the cornerstone of the new forest convention.

Finland's forest history is one example of the value of forest resource information. On hundred years ago Finland's national economy and rural population were heavily dependent on the forests. In order to evaluate possibilities of developing the

forest sector, the first national forest inventory was carried out in 1921–1924. The results were convincing and since then altogether eight national forest inventories have been carried out by the Forest Research Institute Metla. We carry out the inventory continuously, region by region, and the ninth inventory has been going on since 1995.

The national forest inventories have provided a solid basis for Finland's forest policy for 80 years. They have given us reliable information about the volume and annual growth of the timber resources, on which the estimates of allowable annual cut have been based. This information has been crucial for the investment decisions of forest industry companies as well as for the government's forest strategies.

Just two examples. In the Second World War Finland lost 10 per cent of her territory, and reconstruction of the national economy was largely based on forests and forest industries. The total drain, which was 40 million m^3 in the 1940's increased to 60 million m^3 in the 1960's. For the national economy this development was extremely important, but for the forests it was a threat, since for the first time in Finland's history annual cuttings exceeded the growth of the forests. The growth was 50 million m^3 according to the 1960–1963 forest inventory.

The political answer was new forest improvement programmes. As a result of several national programmes carried out during 1965–1975, annual investments in silviculture and forest improvement increased three-fold from 85 to 250 million e/year (in 2000 monetary value). This effort brought good results: the annual growth of the forests increased and is today 80 million m^3, which is more than 50 per cent higher than in the 1960's.

In 1999 the Government approved Finland's National Forest Programme 2010 (NFP 2010). The background of the programme was the economic recession of the 1990's and the need to secure economic and other benefits from the forests. The NFP 2010 aims at increasing the use of domestic industrial wood to 63–68 million m^3/year (total drain of about 73–78 million m^3/year) by the year 2010, which means an increase of 5–10 million m^3 compared to the situation at the end of 1990's.

On the basis of the forest inventory data and the Government's and forest owners' commitment to maintaining an adequate level of silvicultural and forest improvement investments, we can be sure that the cutting target is sustainable.

NFP 2010 also includes many other important aspects, such as safeguarding the ecological sustainability of our forests, increasing the value added of the mechanical wood industries, improving forestry and forest industry know-how, and active participation in international forest policy. Concerning ecological sustainability, this week a national committee will deliver its report suggesting, among other things, that we should have the same kind of inventories for biodiversity as we have for the timber resources. It is a good suggestion – in fact we know already quite a lot about the changes in our forest vegetation, since the occurrence of major forest plants was included in the forest inventories already in the 1950's. However, further development is needed in order to measure the whole range of forest biodiversity.

The majority of Finland's forests are owned by private non-industrial forest owners and the average size of a forest holding is about 30 hectares. Therefore we have, besides the national forest inventory, also a separate system of local forest inventories, that produce data for individual forest plans. These local inventories are carried out by 13 Regional Forest Centres, which are responsible for the promotion of private forestry in their regions. In the future, it is conceivable that the national inventory and the regional inventories could be merged, but we still need methodological development before this can become a reality.

Lastly, I would like to mention that Finland's national forest inventory has since the very beginning, been the responsibility of the Forest Research Institute, Metla, whereas in many countries it is the task of the forest administration. Both models are certainly good, but we feel that our close relationship with research has given us the advantage of continuous and strong development of inventory methods. We are very proud of the work of our National Forest Inventory team at Metla.

Ladies and gentlemen, distinguished experts. Based on our experience I would like to emphasize that a good national forest inventory is a necessary basis for forest policy and a national forest programme. It also seems evident that there is a need to widen the scope of forest inventories to cover fields other than timber resources, especially biodiversity. As all global forest conventions and processes emphasize the importance of national forest programmes as the main tool for sustainable forestry, it is inevitable that the value of forest inventories and Global Forest Resources Assessment will increase in the

coming years.

You have some very challenging days ahead here in Kotka. On behalf of the Ministry of Agriculture and Forestry I would like to thank all the institutions and persons involved in the preparations for this meeting, and wish you most successful work and a pleasant stay in Finland.

Kotka IV Background and Objective

Background

At its fifteenth session in March 2001, the FAO Committee on Forestry (COFO)[1] was informed about the main findings of FRA 2000 as well as proposals for future assessments. COFO made a number of recommendations, highlighted also in the FRA 2000 Main report. Excerpts of the COFO 2001 report (FAO 2001) relating to FRA are found in Appendix 1 of this paper.

In particular, COFO recommended that the FRA programme continue to be a priority for the FAO Forestry Department. FAO was requested to provide continued technical and financial assistance to build national capacities for carrying out forest assessments.

Of particular relevance to the Kotka IV meeting is the following para in the COFO 2001 report (FAO 2001):

> "47. The Committee noted the inclusion of a wider range of forest-related variables in FRA 2000 than in past assessments. It *recommended* that FAO continue its efforts to carry out broad assessments that included various aspects of forest resources, such as biological diversity, forest health, and resource use. While acknowledging the importance of the studies on forest cover and cover change, the Committee recognized that the monitoring of indicators of sustainable forest management would require assessment of qualitative forest and ecosystem parameters, as well as variables related to social and economic features of forest use."

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[1] The Committee on Forestry (COFO) is the most important of the FAO Forestry Statutory Bodies. The biennial sessions of COFO (held at FAO headquarters in Rome) bring together heads of forest services and other senior government officials, usually representing more than 100 countries, to identify emerging policy and technical issues, to seek solutions and to advise FAO and others on appropriate action. Other international organizations and, increasingly, non-governmental groups participate in COFO.

To follow up some of the COFO 2001 recommendations, FAO is arranging the "Kotka IV" expert consultation on

> "Global Forest Resources Assessments – linking national and international efforts".

This meeting will be an opportunity to evaluate the FRA 2000, to highlight the alarming gaps in forest information in many countries and make proposals on suitable strategies for FAO to address this issue. The focus of this meeting is to identify strategies, methods and mechanisms for future global forest resources assessments, and particularly how national forest inventories can contribute to global assessments, while at the same time meeting national requirements for information.

Objective of Kotka IV

The meeting aims at developing recommendations on strategies, scope, methods and mechanisms for future global forest assessments. It is based on the assumption that good and reliable national data will contribute to develop a better global forest assessment. Therefore it is the linkage between national and global information that is highlighted.

New technology may also contribute to develop more accurate and relaible information. The meeting will then be oriented to define new approaches to the development of national forest assessments, that could be later used on global forest assessment. Above all, improved national information is of course valuable for the country in question.

Kotka IV is primarily addressing future global assessments from a conceptual viewpoint. By comparison, Kotka III, in 1996, was aimed to elaborate more on the details (definitions and variables) for producing FRA 2000. Following the delivery of FRA 2000, we now have the opportunity to further develop the framework for future global assessments. It has therefore been considered less urgent to elaborate on definitions and variables, and more important to lay down overall principles and approaches for the future.

The Objective of Kotka IV is therefore to make recommendations to FAO and its partners regarding:

- The overall scope of global forest assessments – should all forest benefits be covered?
- The level and mechanisms for participation of countries,

- The relationships between FAO/FRA and other international bodies,
- Organization of secretariats and supporting groups, particularly the establishment of a global advisory group,
- The scope and technical approach of country capacity building related to national forest assessments,
- The role of independent remote sensing surveys in future global assessments.

Reference

FAO. 2001. Report of the Fifteenth Session of the Committee On Forestry. Rome, Italy 12–16 March 2001. http://www.fao.org/DOCREP/MEETING/003/Y0703E.HTM

Appendix 1. Excerpts from the COFO 2001 report

"RESULTS OF THE FOREST RESOURCES ASSESSMENT 2000 (ITEM 8B)

45. The Committee commended FAO for carrying out the Forest Resources Assessment 2000 (FRA 2000) and for presenting the findings in a comprehensive and transparent way. It acknowledged the difficulties posed by the limited availability of timely and accurate national inventory reports, and by the lack of adequate financial resources to ensure the elaboration of these inventories. It recognized the considerable efforts involved in harmonizing national inventory information in a global synthesis. While recognizing that the rate of global deforestation may have slowed in the 1990–2000 period, the Committee nonetheless noted with concern the continued high level of deforestation. It urged countries to consider the FRA 2000 findings when carrying out policy development and planning.

46. The Committee recognized FAO's leading role in global forest resources assessment and *recommended* that the global FRA programme continue to be a priority for the Forestry Department. It also emphasized the importance of seeking harmonized definitions of forest terms.

47. The Committee noted the inclusion of a wider range of forest-related variables in FRA 2000 than in past assessments. It *recommended* that FAO continue its efforts to carry out broad assessments that included various aspects of forest resources, such as biological diversity, forest health, and resource use.

While acknowledging the importance of the studies on forest cover and cover change, the Committee recognized that the monitoring of indicators of sustainable forest management would require assessment of qualitative forest and ecosystem parameters, as well as variables related to social and economic features of forest use.

48. The Committee *recommended* that FAO continue to analyse the findings of FRA 2000, including the causes underlying the positive and negative long-term trends in forest resources. Such conclusions should be included in the main report of FRA 2000, scheduled to be released later in 2001. The Committee *recommended* that FAO investigate additional opportunities to publicize the findings of FRA and bring it to the attention to the wider public audience.

49. The Committee supported the participatory validation process employed in FRA 2000, whereby a comprehensive brief containing the preliminary findings was submitted to each country for comment and validation. Members expressed the importance of being able to review the figures before finalization and release of the results, and indicated their willingness to participate in this process. Members noted that they had until 31 March 2001 to validate the data.

50. The Committee *recommended* that FAO continue to work with regional partners and processes, including the UN Economic Commission for Europe, in global forest resources assessment, and it emphasized the benefits of carrying out assessments and analyzing results at the regional level.

51. The Committee *requested* FAO to provide continued technical and financial assistance especially to developing countries and countries with economies in transition, for country capacity building in carrying out national-level assessments and monitoring, in order to improve the timely availability and quality of data."

"PROPOSALS FOR GLOBAL FOREST RESOURCES ASSESSMENT (ITEM 8D)

59. The Committee was informed of FAO's plans regarding future work on forest resources assessment, including a proposed Global Forest Survey (GFS) framework; on information standards; and on continuous global reporting. Conclusions of the informal technical session, which was held on the topic the previous day, were presented.

60. The Committee supported, in principle, the idea of a

Global Forest Survey, recognizing its potential as a mechanism to improve the availability and quality of national level data and information and as a useful complement to FAO's periodic global forest resources assessments. The Committee *recommended* that FAO further develop the concept of the GFS and elaborate its scope, methodology, objectives, activities, outputs, institutional arrangements and financial requirements, taking into account the need to clarify the relationship with FRA. The Committee noted the potential links between the GFS framework and the criteria found in many criteria and indicators processes. FAO was also asked to consider whether the name adequately reflected the proposed activities. The Committee *requested* FAO to elaborate the GFS proposal in collaboration with countries and to take into account related international initiatives. The Committee *recommended* that FAO present a more detailed proposal to the next sessions of the Regional Forestry Commissions and to the Sixteenth Session of COFO.

61. The Committee *recommended* that the GFS give special attention to country capacity building, using on-going national efforts in forest resources assessment, linkages with other regional and international initiatives, continued work on forest-related definitions, and qualitative forest parameters.

62. The Committee also took note of the proposal to include an interim five-year effort of reduced scale between each ten-year Global Forest Resources Assessment. "

Annotated Agenda for Kotka IV

1 Opening of the meeting

(Monday 9.00–9.30)

Representatives of

- FAO (Peter Holmgren, Senior Forestry Officer, Global Forest Assessments)
- Government of Finland (Aarne Reunala, Ministry of Agriculture and Forestry)
- UNECE (Christopher Prins, Chief, Timber Section) welcome participants and the press.

2. Open hearing and press conference

(Monday 9.30–11.00)

The public has been invited to make short presentations of relevance for the Kotka IV meeting.

After the presentations, the press is invited to ask questions.

3 Objectives of the expert consultation

(Monday 11.00–12.00)

Election of chair and co–chairs for the meeting. (Chairs and rapporteurs for working groups will be elected later)

Adoption of the meeting agenda

Practical information (Daily schedule, group work arrangements, voluntary papers)

Background papers:

3.1 Objectives of Kotka IV (covered also in opening remarks)

3.2 Provisional Agenda for Kotka IV

4 Reports from on–going activities

(Monday 13.30–14.15)

Background papers (presentations):

4.1 Priorities of the FRA Programme (P. Holmgren)

4.2 Report from FAO expert consultation on forest definitions (D. Schoene)

4.3 Analyses based on FRA 2000 results – deforestation and agriculture K. Govil

5 Review of the Global Forest Resources Assessment 2000

(Monday 14.15–16.00)

This agenda item will briefly revisit the Global Forest Resources Assessment 2000 (FRA 2000), in relation also to previous global assessments and the delegates are asked for their views on FRA 2000 approach, methodology and findings.

Background papers (presentations):

5.1 Comparison between Kotka III recommendations and FRA 2000 output (P. Holmgren)

5.2 User perspectives on the FRA 2000 process, results and implications (E. Matthews)

5.3 Why did we end up here? The evolution of global forest assessments (R. Persson)

Issues for discussion and consideration:

- Whether it was an effective approach to rely mainly on national information and reports in FRA 2000;
- To what extent FRA 2000 met expectations from different users.

6 National forest assessments and their links to global assessments

(Monday 16.00–16.45, Tuesday 9.00–10.30)

Background papers:

6.1 Country views on linkages between national information needs/situation and international reporting requirements

6.2 *Information gaps at national level – situation and cases*

(M. Saket)

6.3 *Review of technological and methodological options to meet national information needs (C. Kleinn)*

6.4 *Biodiversity indices in national forest inventories (A. Newton)*

6.5 *Feasibility of low intensity sampling approach for national inventories, including cases (T. Thuresso)*

6.6 *FAO's approach to support national forest inventories and assessments (M. Saket)*

Issues for discussion and consideration (noting that workgroups will also address these points):

- The reporting burden on countries and relevance of international requirements at the national level;
- Recommendations and observation on the development of national forest inventories and the use of information in national policies;
- Reasons for and consequences of current information gaps at national level;
- Ways forward for biodiversity monitoring at national level;
- Relevance of FAO's approach to support national forest assessments;
- Recommendations related to the technical design of FAO's inventory model for supporting national forest assessments.

7 Recommendations for future global assessments and reporting

(Tuesday 10.30–12.00, 13.30–15.00)

Background papers (presentations):

7.1 *Current international reporting requirements – mandates, mechanisms, overlaps and potential synergies (S. Braatz)*

7.2 *Forest resource assessment and indicators of sustainable forest management: the European experience (C.Prins)*

7.6 *Assessing and reporting carbon stock changes in forests for FRA, UNFCCC and Kyoto Protocol: conflict or opportunity? (D.Schoene)*

7.3 *Proposed scope of global forest assessments. (P. Holmgren)*

7.4 *Role of independent remote sensing studies in global forest assessments (E. Tomppo)*

7.5 *Future options for global assessment: methods, mechanisms, contents, format and frequency (M. Saket)*

Issues for discussion and consideration (noting that workgroups will also address these points):

- Should global forest assessments continue to rely on national data and reporting?
- Is the "all benefits – all beneficiaries" an appropriate scope for global forest assessments?
- How should C&I be incorporated in global forest assessments?
- Recommendations for scope and frequency of global reporting, including linkages between FRA and conventions;
- Recommendations for regional level reporting, including links to global level;
- Recommendations on harmonization of international reporting;
- Which variables can be provided to global assessments through independent remote sensing surveys?
- Recommendations on scope and approach for independent remote sensing surveys;
- Recommendations on the organization of global assessments, including the establishment of a Global Advisory Group.

8 Working groups dealing with agenda items 6 and 7

(Tuesday 15.00–17.00, Wednesday 9.00–12.00, Thursday)

Four working groups are identified. A fifth on conclusions related to FRA 2000 is considered, depending on the progress under agenda item 5.

The expectation on all groups is to focus on and formulate draft recommendations for the Meeting Report within the theme given to the group. The groups may also want to draw and draft conclusions for the Meeting Report, but the main focus should be on recommendations. Recommendations should clearly indicate *to whom* (FAO, Governments, others).

The working group process and drafting of meeting report shall be as follows:

1. Delegates sign up for preferred groups (see below) by Tuesday morning. Secretariat makes final assignments of groups.
2. Group elects chairperson (NOTE! Chairperson will be requested to join drafting committee meetings for the Meeting Report after the group works) (Rapporteurs will be assigned by secretariat);
3. Group discusses, structures and formulates draft recommendations;
4. On Thursday morning a short review of progress will be made in plenary;
5. On Thursday afternoon, groups present their findings to plenary, including discussion;
6. Group reports will be joined into a first draft Meeting Report by the meeting secretariat;
7. A drafting committee consisting of chair persons will review the first draft Meeting Report in light of their respective group work findings;
8. The consolidated first draft will be presented to plenary on Friday.

Two following groups have been identified:
Group 1: National assessments – focus on FAO's support

Group 1 will address agenda item 6 as a whole and make recommendations related to all topics.

Group 1 shall in its work emphasize the proposed FAO approach to support national forest assessments in their discussions, conclusions and recommendations.

Rapporteur: Mohamed Saket

Group 2: National assessments – focus on scope and links to international reporting

Group 2 will address agenda item 6 as a whole and make recommendations related to all topics.

Group 2 shall in its work emphasize the overall scope and future role of national forest assessments in international reporting in their discussions, conclusions and recommendations.

Rapporteur: Kailash Govil

Group 3: Global assessments –focus on overall scope and role

Group 3 will address agenda item 7 as a whole and make recommendations related to all topics.

Group 3 shall in its work emphasize the scope and role of the FRA process in international processes and reporting related to forest resources – an in particular include the role of national reporting in global forest assessments – in their discussions, conclusions and recommendations.

Rapporteur: Hivy Ortiz-Chour

Group 4: Global assessments – focus on independent remote sensing surveys

Group 4 will address agenda item 7 as a whole and make recommendations related to all topics.

Group 4 shall in its work emphasize the scope and role of independent remote sensing surveys in future global forest assessments in their discussions, conclusions and recommendations.

Rapporteur: Soren Dalsgaard

9 Study tour Organized by StoraEnso

(Wednesday 13.00–)

10 Working groups continues, preparation of reports

(Thursday 9.00–12.00)

11 Presentation of working groups reports

(Thursday 13.00–17.00)

Presentation of group reports and discussions.

12 Formulation and adoption of meeting report

(Friday 9.00–14.30)

Draft report will be presented by drafting committee.

Tentative organization of recommendations

- Related to national forest assessments
- Related to the overall scope and role of FAO's global forest assessments
- Related to the contents and structure of future global forest assessments
- Related to the respective roles of countries and independent surveys in global forest assessments
- Related to the interactions and synergies between FAO/FRA and other international bodies
- Related to the organization and work plan for global forest assessments

13 Any other matters, Closing

(Friday 14.30–15.00)

Agenda Item 4

Reports from on-going Activities

Priorities of the FRA Programme

Peter Holmgren
FAO Forestry Department, Rome.

Introduction

The Forest Resources Assessment (FRA) Programme has a long history in FAO and is placed squarely at the center of the mandate of the FAO Forestry Department. Based on relevant guiding documents[1] the Programme can be described as having two main components – one related to global assessment and reporting, and one related to support to countries to develop their forest information base.

This document was developed following the delivery of FRA 2000 in October 2001 to outline future directions for the FRA Programme.

The two major components of the FRA Programme will here be related to as follows:

1. Global assessment and reporting
2. Support to National forest assessments

FRA programme components and priorities

Global assessments and reporting

Objectives[2]

1. Compile, analyze and report forest information covering all countries

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[1] such as: FAO Strategic Framework 2000–2015, FAO Medium term plan 2002–2006, PWB 2002–2003, FAO Strategic Plan for Forestry, Report from COFO 2001

[2] The FAO Medium Term Plan 2002–2007 Objectives call for "systematically analysing, documenting and reporting on the status and trends in forest resources; developing and updating methods for forest inventory, analysis, assessment and monitoring based on common and agreed concepts and terms; and strengthening capabilities to assess forest resources and the underlying causes of deforestation and forest degradation"

This includes periodic (major) global assessments, contributions to other publications and efforts such as the biennial State of the World's Forests (SOFO) and outlook studies, continuous maintenance of core information, working with information partners, and providing information to external users. It also entails a coordinating role within the Department for involvement of and close collaboration with other technical units in assessment and reporting of forest resources.

2. Maintain mechanisms and arrangements for global reporting
This includes to maintain a global network of expertise that can contribute to the development, implementation and evaluation underpinning global assessmessments and reporting on forest resources. The network consists of national experts serving as focal points in their countries, teams of specialists that meet about annually to give recommendations on global assessments, international agencies that serve as partners in global assessments, as well as supporting regional/sub-regional bodies and mechanisms. Also included here is the task to ensure that FAO governing bodies and other relevant fora are kept closely informed and are given the opportunity to guide the development of the Programme. Finally, it includes to ensure that technological solutions (e.g. supporting information systems, notably the FAO Forestry Information System – FORIS) are available to make global assessments and reporting efficient and accountable and that adequate capacity is supported and developed at all in particular national, levels. Global reporting also entails the development, use and sharing of common and agreed concepts and terminology.

Interactions

- With other technical units in the Forestry Department, particularly to help ensure timely availability and compatibilty of data developed and maintained by these units in the range of technical subjects to be reported upon in the by global forest resources assessments;
- with other relevant technical units in other Departments in FAO;
- with all member countries;
- with international expertise, in particular the global team of specialists mentioned above, which will support the FRA

Programme through providing scientific and technical advice and guidance;

- with international partners, in particular other UN agencies and major intergovernmental mechanisms such as IPCC and CBD. There is a special link and strong collaboration with UNECE whose specialists of the timber section co-ordinate the assessment in industrialized countries.

Support to National Forest Assessments

Mission statement

FRA 2000 identified considerable gaps in national forest resources information in most countries. This component of FRA will adress this issue by promoting approaches and methodologies towards development of systematic, nation-wide information on the forest resources and their uses, with empasis on information collected through field sampling. Work will be focussed on pilot survey implementation or summary assessments in selected countries, and will be coordinated with other country-oriented work by FAO – notably the national forest programmes.

Objectives

1. Support countries in the development, packaging and use of national information related to forest resources.

Forest resources information, as used here, refers to information on existing forest resources and their development over time; and information related to the management and use of these resources. "National" implies that the focus is on systematic, national level information. The activity includes support and in-depth work with selected countries to specify information requirements, survey design and support to implementation, information storage, analyses and reporting, and to interact with policy and planning processes. It also includes support to countries in the development of relevant projects on forest resources information, in support of seeking financial support for these activities.

2. Establish an international framework for forest resources information reporting

This includes working with countries on the development of appropriate technical approaches to fulfill their information

requirements. FRA in collaboration with partners, will work towards a framework model for national forest surveys and reporting standards that will help countries meet their obligations to report forest information to various international fora. Such a "model" (or alternative "models") will also make FAO's support to countries more effective.

Interaction

- project countries and countries requesting assistance;
- donors;
- nfp activities.

What about the "Global Forest Survey"?

During COFO 2001, and following the presentation of results from FRA 2000, proposals for future global forest resources assessments were presented. In particular, the serious and remaining information gaps – also on basic forest parameters – in most countries were highlighted and given as a rationale to develop more effective approaches to national forest assessments.

Furthermore, the requirements for broad and reliable information not only on the forest resources as such, but also the management and uses of these resources, including indicators of sustainable forest management, call for a survey approach based on systematic field sampling where these variables can be observed simultaneously and in the appropriate scale.

Finally, the national provisions of core forest infomation to international processes and conventions, including future global forest resources assessments, need to be strengthened and harmonized.

A conceptual approach[1] was presented to COFO 2001 under the tentative name "Global Forest Survey" (GFS). These were the comments received:

> "The Committee supported, in principle, the idea of a Global Forest Survey, recognizing its potential as a mechanism to improve the availability and quality of national level data and information and as a useful complement to FAO's periodic

[1] See FRA Working Paper 28 (Global forest survey – Concept paper)

> global forest resources assessments. The Committee *recommended* that FAO further develop the concept of the GFS and elaborate its scope, methodology, objectives, activities, outputs, institutional arrangements and financial requirements, taking into account the need to clarify the relationship with FRA. The Committee noted the potential links between the GFS framework and the criteria found in many criteria and indicators processes. FAO was also asked to consider whether the name adequately reflected the proposed activities. The Committee *requested* FAO to elaborate the GFS proposal in collaboration with countries and to take into account related international initiatives. The Committee *recommended* that FAO present a more detailed proposal to the next sessions of the Regional Forestry Commissions and to the Sixteenth Session of COFO.
>
> The Committee *recommended* that the GFS give special attention to country capacity building, using on-going national efforts in forest resources assessment, linkages with other regional and international initiatives, continued work on forest-related definitions, and qualitative forest parameters."
>
> Source: COFO 2001 Report.

The concepts presented in the "Global Forest Survey" approach are entirely covered by the FRA component "Support to National forest assessments" as presented in this paper. This takes care of the COFO request to reconsider the GFS name. The links to global assessments and the FRA Programme as a whole are also made clear.

In short the FRA approach to support national forest assessments would be characterized by:

- a systematic approach to national forest assessments – to create a solid base for planning processes;
- collection of data through field sampling, assisted by remote sensing to make the field sample efficient;
- survey parameters based on internationally accepted standards and definitions, but expanded to cater for national (or regional) specific needs;
- survey parameters that cover forest resources as well as the management and uses of the resources (including indicators of sustainable forest management);
- an FAO involvement that builds on requests and committments of countries;
- an FAO involvement that goes as far as implementation of systematic national pilot surveys, which will (a) generate new

knowledge and build capacity in the countries, (b) generate information that can be used in global assessments;
Note: The outer line indicates the activities of forest resources assessments.

- a long term approach to forest knowledge management (see figure below) where the initial national assessment round does not need to be very ambitious, but can be well covered by a systematic pilot survey. Feedback generated can then guide further assessments;

The coming year – as outlined in this paper – will include continued development of the FRA support to national assessments and their linkages to national and international processes. For COFO 2003, a more detailed proposal will be made, building on these experiences.



Forestry knowledge management at the local, national or international level. Source: FRA 2000 Main report.

Expert Meeting on Harmonizing Forest-related Definitions for Use by Various Stakeholders

Rome, 22–25 January 2002
(Extracted from: Proceedings of Expert Meeting on Harmonizing forest-related definitions for use by various stakeholders Rome, 22–25 January 2002. pp 36–49)

Introduction

The Expert Meeting on Harmonizing Forest-related Definitions for Use by Various Stakeholders was jointly organized by the Food and Agriculture Organization of the United Nations (FAO) and the Intergovernmental Panel on Climate Change (IPCC), in collaboration with the Centre for International Forestry Research (CIFOR) and the International Union of Forest Research Organizations (IUFRO), at FAO Headquarters, in Rome, from 23 to 25 January 2002.

The objective of the meeting was to start a process to review, improve, where feasible, and interrelate forest-related definitions, in particular *biome-specific forest definitions,* and definitions for the terms *forest degradation* and *devegetation.*

The meeting was not intended to question decisions taken by Parties to the Conventions, neither did it intend to interfere with ongoing processes. The purpose of this meeting and its follow-up process was rather to look at the subject matter from a purely technical point of view and to complement work done by other bodies and processes.

Much global or regional information on forest resources is derived from national data. FAO has, therefore, developed forest-related definitions for national inputs to globally aggregated forest assessments and outlook studies. The Parties to the United Nations Framework Convention on Climate Change (UNFCCC) have developed forest-related definitions for use in climate change issues involving land use, land-use change and forestry. Other organizations have developed such definitions

for other purposes, such as assessing forest resources or monitoring biological diversity in forests. There is a need to improve the compatibility and consistency of definitions in order to permit comparability and thus improve the quality and usefulness of forest information; increase the synergy among conventions and international processes; and use more effectively the scarce available resources for assessment, monitoring, reporting and verification.

There is a need for globally and regionally aggregated information on forest resources and forest ecosystems to:

- Define the concept of, and monitor progress toward, sustainable forest management;
- Assess the role of forests in climate change;
- Assess the attributes of forest ecosystems and their changes which affect biological diversity, conservation and other functions;
- Analyse the social, economic and other environmental roles of forests.

The information required differs between users but, with consistent, comparable or even convertible definitions, it could be possible to exchange it.

Harmonized forest-related definitions might further help to reduce the reporting burden on countries, thus reducing costs and, in some cases, also improving the quality of the information. Ambiguities and misunderstandings could be avoided.

It is thus expected that the harmonization of definitions will prove to be of great importance to the forestry and agriculture sectors, as well as to the implementation of the UNFCCC, the Convention on Biological Diversity (CBD) and the United Nations Convention to Combat Desertification (UNCCD). The need for harmonization was elaborated by the Resumed Sixth Session of the Conference of Parties to the UNFCCC (Bonn, 16–27 June 2001), the Twentieth Session of the FAO Council (Rome, 19–23 June 2001), the FAO Committee on Forestry at its fifteenth session (Rome, 12–16 March 2001), the

FAO Committee on Agriculture at its sixteenth session (Rome, 26–30 March 2001) and the first session of the United Nations Forum on Forests (New York, 11–12 June 2001).

A discussion Paper was prepared and shared with the participants before the meeting (its final version is included as Annex I).

The Meeting agenda is shown as Annex II.

The participants (Annex III) included a total of 52 experts,

resource persons and observers invited by the Director-General of FAO. They were selected on the basis of their specialized knowledge and familiarity with the ongoing work on forest-related definitions in various international fora, including UNFCCC, CBD, UNCCD and UNFF. Participants served in their personal capacity and not as representatives of their governments or organizations. In addition, resource persons from each of the co-sponsoring and collaborating agencies attended the meeting.

Opening seremony

The meeting was opened by Mr M. Hosny El-Lakany,Assistant Director-General of the FAO Forestry Department; Mr Ian Noble, of IPCC; Ms R. Prüller, of IUFRO; and Mr Ken MacDicken, Assistant Director-General of CIFOR.

Messages were received from the Secretariats of the CBD and the UNFCCC, represented by Mr J. Plesnik, Chairman of the Subsidiary Body on Scientific, Technological and Technical Advice to the CBD; and by Mr Dennis Tirpak, Coordinator Science and Technology, respectively.

Organization of the work

The meeting was chaired by Mr Wulf Killmann, Director of the FAO Forest Products Division, and moderated by Mr Markku Simula, Indufor. Part of the meeting was conducted in the form of group sessions. Each of the five groups dealt with different issues: The first group, focusing on the issues related to afforestation, reforestation and deforestation, was chaired by Mr Jean-Paul Lanly, and its rapporteur was Mr Robert Scholes. The second group dealt with forest degradation, revegetation and devegetation; it was chaired by Mr Ian Noble, with Mr Masahiro Amano acting as rapporteur.The third group worked on tropical biome-related forest definitions, with Ms Thelma Krug as Chairperson and Mr Ken MacDicken as rapporteur. The fourth group worked on temperate and subtropical biome-related forest definitions, with Mr Gyde Lund III as Chairman and Mr Jürgen Pretzsch as rapporteur. The fifth group dealt with boreal biome-related forest definitions, with Mr Anatoly

Shvidenko as Chairman and Mr Brian Haddon as rapporteur.

Of the four plenary sessions, the first one focused on the concepts and information requirements of the relevant international conventions and fora. The second session was aimed at identifying forest-related terms for which definitions are still needed. The third session explored biome-specific definitions; and the fourth session identified ways and means on how the process of harmonizing forest-related definitions could be continued.

The presentations made in the workshop are reproduced in Annex IVand the reports of group work in Annex V.

Conclusions

Need for harmonization and reporting requirements

Forest-related definitions are used internationally or are being developed under various international conventions and fora. These encompass, *inter alia,* UNFCCC, CBD, UNCCD, UNFF and various other bodies to which countries have reporting obligations, including FAO and International Tropical Timber Organization (ITTO). Different reporting requirements represent a considerable burden for the countries, and particularly developing countries have difficulties to meet them. Differing definitions aggravate this burden.

Various conventions and stakeholders have their own objectives and therefore different information needs. For example, the definitions agreed upon after extensive negotiation for Articles 3.3 and 3.4 of the Kyoto Protocol (KP) are highly context-specific and, to a large extent, related to the role of forests in climate change and, particularly, to carbon accounting, reporting and verification. Thus clear definitions were required for terms such as 'forest', 'afforestation', 'reforestation', 'deforestation' and 'forest management' to specify the land areas and activities affecting carbon accounting.

The CBD has not included the term 'forest' in its Art. 2 (use of terms). The Ad Hoc Technical Expert Group on Forest Biological Diversity (AHTEG) considers the FAO (FAO 2000) definition of 'forest' useful, but notes that many other useful definitions also exist. The fact that 'forest' has been defined in many ways is in itself an indication of the diversity of forests and forest ecosystems in the world and of the diversity of

human approaches to manage and conserve them.

According to AHTEG, a forest is a land area of more than 0.5 ha, with a tree canopy cover of more than 10 percent, which is not primarily under agricultural or other land use. In the case of young forests, or regions where tree growth is climatically suppressed, the trees should be capable of reaching a height of 5 m *in situ* and of meeting the canopy cover requirement. The CBD treats forests as a functional ecosystem unit which should be conserved, used sustainably, and the benefits derived from it should be shared equitably. In this sense, CBD's view of forests is function and ecosystem oriented.

The UNCCD views forest and wooded land as a land component within the integrated management of natural resources. Forest definitions should help to understand better causes, factors, state and impact of land cover degradation and the effectiveness of remedial measures, which are taken at various levels, to combat desertification.

The objectives of the UNFF's programme of work related to Monitoring, Assessment and Reporting include

(a) common understanding of concepts, terms and definitions;
(b) streamlining of reporting requirements; and
(c) reducing reporting burden on countries and providing meaningful, reliable and cost-effective information on forests.

The reporting needs under the UNFF focus on progress in the implementation of the IPF/IFF Proposals for Action, progress towards sustainable management of all types of forests, and the review of the effectiveness of the UNFF process.

FAO has a fundamental long-established task to compile and produce global baseline statistics on the forest sector, including forest resources assessments. Global assessments are made in participation with countries, applying harmonized terms and definitions. The Global Forest Resources Assessment 2000 (FRA 2000) was published in 2001 and was the first to have consistent definitions of forest and forest-change processes, applied by all countries. Agreement on terminology illustrates the commitment of participating countries to achieve comparable global information.

Countries will continue to develop and use their own definitions for their forests. These can be made compatible and consistent - also over time – with the international definitions. The experience with FRA 2000, where national classifications and definitions were mapped into globally homogenous classes

for all countries, shows that harmonized definitions are feasible.

ITTO recognizes the need for harmonization of definitions in the following three areas:

a) for the criteria and indicator processes;
b) for country reporting on progress towards sustainable forest management, taking into account the reporting requirements of different organizations; and
c) for the ongoing development of guidelines for the restoration of degraded high forests, the management of secondary forests and the rehabilitation of degraded forest lands in tropical regions, especially as regards the definitions of degradation, restoration, rehabilitation and with regard to different forest types such as primary forest, modified forest, disturbed forest, degraded forest and secondary forest.

Coordination between the various international bodies in developing definitions and reporting requirements has been inadequate. This has resulted in inconsistent and sometimes conflicting definitions. The FRA definitions are not fully consistent with other international processes. Varying interpretations of 'reforestation' in the Kyoto Protocol have burdened negotiations about the role of forest carbon sinks. Conflicts also arise because of differing views of forests and forest management between geographic regions, or because various interest groups focus on alternative functions of forests.

The Meeting concluded that there is a need to harmonize definitions which could help reduce the burden of reporting on countries and even improve the quality of information.

Desirable characteristics of forest-related definitions

To be useful, internationally applicable forest-related definitions should be:

- clear, concise, objective and unambiguous in the context used;
- information-rich (predictive, useful and effective for the intended use) and not driven by exceptions;
- practical and easily applicable in all countries so that data collection, meaningful reporting and verification are possible and cost-efficient;
- easily adaptable to national systems;
- consistent over time and harmonized over space (and international process);
- seamless with related non-forest definitions to allow their consistent use in various international fora;

- constructed or harmonized in such a way that the current reporting requirements from countries are reduced.

The purpose of harmonizing-forest related definitions would be to reduce the costs of data collection, reporting and verification; avoid ambiguities and misunderstandings; and improve functional coordination between international conventions and other arrangements. As a general rule, existing definitions should be adopted. Whenever necessary, they should be adapted, improved and related to each other.

State and change processes

The forest-related definitions dealt with in detail at the Meeting formed part of an overall classification of land (state) and of change processes occurring within and between land classes. There is a fundamental necessity to consider the complete set of generic land classes that include all lands. Such a generic classification would provide a consistent framework for developing and applying more specific definitions under various conventions and for various uses of information, while providing a common baseline for general land classes.

These classes may be based on land cover, land use, their combination, or additional attributes and functions. The relevant terms related to forest state include forest, non-forest, other wooded land and trees outside of forests. Terms related to change over time include afforestation, reforestation, natural expansion of forest, revegetation, deforestation, devegetation, natural regeneration of forests, forest improvement and forest degradation. Further, the terms related to the agent or mode of change (such as natural events, directly or indirectly human-induced activities, as well as forest management) also need to be addressed.

One approach in setting up a framework for forest-related definitions could be to create a system of entities with continuously varying attributes (e.g., crown cover, height, naturalness, etc.), from which any number of objective-oriented classifications can be derived and adapted for application within a specific context. Such a system could also encompass change processes and the various functions affected by them (climate change mitigation, maintenance of biological diversity, provision of wood and non-wood products, soil and water conservation and other services). Each function to be considered could

be characterized by using appropriate criteria, indicators, reference points or proxies, if indicators cannot be measured directly. Developing definitions for forest functions is a particular challenge, as functions are not necessarily related to a specified area.

Reference points may be needed for such concepts as "sustainably managed forests" or "healthy forests". The former may be derived from the Criteria and Indicators for sustainable forest management that have been developed under various international and regional processes.

Forest as a land-use class

Although land cover is an important feature in defining land classes and changes between them, the Meeting recognized that forest definitions should distinguish tree-covered land that is primarily used for agriculture or urban environments. In this context, it was noted that the FAO-UNEP Land Cover Classification System (LCCS) is a comprehensive methodology for description, characterization, classification and comparison of most land cover anywhere in the world at any scale and at different levels of detail. It is a useful tool to allow rational use and easy exchange of land cover information between different countries, institutions and end users. Land-cover classes rely on the combination of a set of independent diagnostic attributes allowing the user to define a wide variety of different land-cover features within a standardized but flexible framework.

The Meeting discussed the following classes related to the state of the land: forest, other wooded land and other land, including trees outside forest. The following change processes between these land classes were discussed: deforestation, afforestation, natural expansion of forests, reforestation, natural regeneration, forest degradation, forest improvement, devegetation and revegetation.

There is a need to adapt threshold values for forest definitions to improve their relevance and applicability in different local conditions or forest types. There is also a need to develop guidance for countries on how to select those threshold values to ensure comparability and consistency, if the definitions themselves cannot be harmonized. Threshold values are particularly important for forest area and carbon accounting, and they should consider the resilience of the forest under different situations and for different functions.

Comparative framework

A comparative framework for harmonizing forest-related definitions could be a matrix where the definitions of a number of concepts and terms can be listed, described, compared and related to different uses (international conventions, FRA, etc.) and stakeholders.

The IPCC Special Report on Land Use, Land-Use Change and Forestry provides a useful starting point, and some of its elements were further elaborated upon by the Expert Meeting. It was also suggested that a set of functions should be developed to relate and, if possible, convert definitions.

The Meeting identified a number of core terms for which internationally used definitions are already largely compatible. They could, however, be improved to make them more consistent and directly comparable. These core terms include, *inter alia*, forest, forest land (as land use), land-use change and degradation.

Definitions of forest, afforestation, reforestation and deforestation

Definition of forest is fundamental to how afforestation, reforestation and deforestation are defined by various parties. FRA 2000 and the Marrakech Accord of the UNFCCC (COP-7) have slightly different interpretations of what is forest even though they share common elements (a threshold value for tree cover, tree height and minimum area of land). However, there are key differences:

(i) The FAO definition sets a single threshold for canopy cover (10%), height (5 m) and minimum area (0.5 ha), whereas the KP definition provides for a range in these values within which a country may choose an appropriate threshold to suit to its own circumstances. However, Parties are required to justify in their reporting that such values are consistent with the information that has been reported historically to FAO or other international bodies and, if they differ, to explain why and how such values were chosen.

(ii) The FAO definition specifically excludes orchards, agroforestry and urban forests, whereas these are not explicitly excluded in the forest definition of the Marrakech Accord. However, the latter definition assigns any system of practices on land on which agricultural crops are grown to the activity "cropland management". If trees form part of such a system, they are thus excluded from forest.

Afforestation, as applied by FRA 2000, is the conversion of non-forest into forest as the result of direct human action through planting or seeding. Afforestation explicitly excludes natural expansion of forest to non-forest land, whereas deforestation does not distinguish natural loss of forest from that caused by human action. Therefore, the FRA definition of afforestation is not truly symmetric with that of deforestation. Taken together, afforestation and natural expansion of forests represent all changes from non-forest to forest according to the FRA definition.

For Article 3.3 of the Kyoto Protocol, afforestation is defined in the Marrakech Accord as "the conversion of land that has not been forested for at least 50 years to forested land through planting, seeding and/or human-induced promotion of natural seed sources". The term 'forested land' is not defined, and it is unclear whether young forests which are not yet firmly established are included or not. Similarly, the expression "promotion of natural seed sources" would exclude other forms of regeneration, such as vegetative propagation, which may not have been the intent of the negotiators. FRA does not make any qualification regarding the means of afforestation (through seeds or vegetative propagation).

Both definitions of afforestation are compatible in the sense that they require human action and crossing of the forest/non-forest threshold. They differ in that the Kyoto Protocol requires that the land has not been forested within the previous 50 years, whereas the FRA definition does not. The FRA thresholds are fixed, whereas the Kyoto Protocol allows them to be chosen by the Annex I countries from within a range.

The treatment of young forests is compatible in the two cases. However, the KP definition explicitly includes young forests, whereas FRA 2000 considers as afforested only young forest stands that have been successfully established, but may not yet have crossed the applicable thresholds.

The FRA definition of *reforestation* implies active establishment (through seeding or planting) of forest on land previously forested but temporarily below the forest threshold due to harvesting or disturbances. Natural regeneration on forest lands is defined and accounted separately. Lands undergoing reforestation or natural regeneration (according to FRA) continue to be forest throughout. Neither of these transition processes involves a change in land-use class.

The KP definition (Article 3.3) defines reforestation as con-

version of land that was forested but had been converted to non-forested land. For the first commitment period, reforestation is restricted to land that did not contain forest on 31 December 1989. The definition uses three undefined terms: non-forested land, forested land and land that did not contain forests. Reforestation, as defined by the Kyoto Protocol, is accounted as afforestation under FRA 2000 since the land was not previously forested. The current definitions of reforestation by FRA and the KP are therefore incompatible from a land-use point of view.

The terms afforestation and reforestation have not yet been defined under Article 12 of the KP referring to the Clean Development Mechanism (CDM). If different thresholds are used from those under Article 3.3, this could have major implications for land area reported as afforested or deforested. The requirement of meeting sustainable development objectives is also likely to introduce additional conditions. The KP may exclude credits for afforestation and reforestation activities that do not meet sustainable development objectives, as defined by the Party.

The Kyoto Protocol defines *deforestation* as "direct human-induced conversion of forested land to non-forested land". Parties must report how they differentiate deforestation from harvesting or natural disturbance that is followed by re-establishment of a forest. In FRA, deforestation is "the conversion of forest to another land-use class or the long-term reduction of the tree cover below the minimum 10 percent threshold". Both definitions refer to non-temporary (long-term or permanent) change from forest to non-forest. The definitions differ in the sense that deforestation under FRA can also be a change in land use/forest use to other use, and it includes both human-induced and natural causes.

Both definitions leave the time period for a "temporary" unstocked state undefined. Another source of inconsistency is that the KP definition of deforestation excludes natural permanent forest loss. This could be significant due to landslides, flooding, volcanic eruptions or other natural disasters, and even climate change.

It is important to note that, in a given country, minimum areas defined for forest (and non-forest), afforestation and deforestation should be consistent and preferably equal. If a forest patch falls below the minimum area chosen, it needs to be reported as deforested. The minimum area requirement is also

important as it influences possibilities and costs of monitoring by remote sensing.

Definitions of forest degradation

Forest degradation is a change process which FAO defines as "changes within the forest which negatively affect the structure or function of the stand and site, and thereby lower the capacity to supply products and/or services". The CBD defines a degraded forest as a state which delivers a reduced supply of goods and services from the given site and maintains only limited biological diversity. Such a forest may have lost its structure, species composition or productivity normally associated with the natural forest type expected at that site. ITTO (in preparation) applies the state concept to degradation referring to all those forests or forest lands that have been altered beyond the normal effects of natural processes through human activities or natural disasters, such as fire, landslides, etc.

All these existing definitions of degradation are largely compatible, and a generic common definition could be developed without greatly disrupting the existing use of the term. However, the available definitions may be inadequate because they do not take into account the relative levels of resilience in different forest types. Neither are structural changes related to biological diversity considered. Natural forest and plantations might require differentiated criteria. Indicators would be needed for resilience of forest types and such changed structures of forest which indicate degradation. It was noted that degradation is not always human-induced, as it can also take place for natural reasons (e.g., nutrient leaching).

Forest improvement describes the reverse process of forest degradation. Other terms for this purpose may, however, be preferred, such as aggradation.

The various definitions of degradation (and improvement) leave several open issues related to the reference point (initial state, definition of the appropriate set of goods and services, time frame of the change, etc.). Further considerations include whether the process is human-induced or natural, and whether it should cover both discrete events and slow, chronic degradation.

A core definition of forest degradation should preferably provide

(i) the reference point;

(ii) an agreed set of variables; and
(iii) indicators (and their proxies if necessary) to measure the change of a forest (ecosystem).

A negative change in any indicator (beyond a certain threshold value) would represent an element of degradation. Both process and state definitions may be applied. A generic, composite index for degradation, based on a weighted combination of indicators and/or their changes over time, could be a template for international application.

Weighting would be justified, as various negative changes would not have an equal impact on forest functions. Additional elements could be added or singled out, depending on the particular interests related to the forest (e.g., carbon density even though it may already form part of the composite index). The use of proxies (e.g., crown cover percentage) will continue, but more work is needed in validating their appropriateness and translating them into relevant information on the specific aspects of degradation.

There is a need to review all existing definitions and seek for stakeholder views on the generic definition of forest degradation and its application. Any composite measures or additional sustainability or context-specific measures should be checked in practice to ensure that they can be assessed at reasonable cost and used for national reporting. In addition, such measures should not lead to pervert situations where e.g. unsustainably managed forests exhibit increased carbon density.

Biome-specific definitions

Due to the difficulties of applying global definitions to the highly variable biophysical and socioeconomic conditions prevailing in the world's forests, COP-7 of the UNFCCC has asked its Subsidiary Body for Scientific and Technical Advice (SBSTA) to explore the possible application of biome-specific definitions that could capture important aspects which are not identified when using globally applicable definitions. Were a biome-based approach adopted, the participants of the Meeting felt that 'biomes' should be defined 'bottom-up' (i.e., as a specified set of vegetation types) rather than on a climatic basis.

The Meeting also concluded that biomes are probably less useful as a basis for different definitional thresholds than forest or vegetation types. The concept of biocentric biome is not necessarily compatible with the actual land use and the way

forests are managed and utilized. As many countries include several biomes, using biome-specific definitions would increase, rather than decrease, the reporting burden. Socio-economic parameters and land-use systems cross-cut the limits of biomes, which is another complicating factor. A tiered approach, based on a common definition of forest at the top level (e.g., an ecosystem-based definition) and biome or forest type-specific definitions at the next level, could address the problem. Another option is classification of forest categories according to the degree of anthropogenic influence (protected natural forest, managed natural forest, plantation, agroforestry, etc.).

COP-7 left open the possibility of applying biome-specific forest definitions for the second and subsequent commitment periods. However, a choice may have to be made earlier, when applicable definitions are agreed upon in the context of the CDM (Art. 12).

Other initiatives

The Meeting took note of the following related activities:

- SBSTA of the UNFCCC is to consider applying biome-specific forest definitions;
- SBSTA of the UNFCCC must also develop forest-related definitions for the CDM (Article 12 of the KP);
- PCC has been requested to develop definitions for degradation and devegetation;
- ITTO is working on defining degraded and secondary forests;
- The World Conservation Union (IUCN), the World Wildlife Fund (WWF) and CIFOR are developing a typology of plantations;
- IUFRO is working on terminology;
- UNEP and IUFRO are working on how low-forest cover should be defined.

Recommendations

Definitions

1.1 The current definitions related to the Kyoto Protocol and the FRA are largely compatible with each other in spite of some inconsistencies. In order to improve the comparability between the two sets of definitions, the Meeting recommended the following:

- Parties to the Protocol may wish to consider, in the second or subsequent commitment period, dropping the requirement for a 50-year non-unforest condition for afforestation. This would eliminate the need for a separate definition of reforestation and bring the KP afforestation figures into closer agreement with the FRA results;
- FAO should take action to ensure that all the relevant bodies are aware of the final version of forest-related definitions of FRA 2000;
- FAO may wish to consider expanding the FRA definition of afforestation (i) to include assisted regeneration not involving direct seeding or planting, and (ii) to differentiate direct human-induced deforestation and permanent forest loss due to other causes. This would make the FRA data compatible with the needs of the Kyoto Protocol.

1.2 In deciding about adopting the AHTEG definition of forests, the CBD may wish to verify that it is using the FRA 2000 definitions of afforestation and reforestation correctly.

Follow-up action

The Expert Meeting made the following recommendations for follow-up action:

- i) The process of harmonizing forest-related definitions should be continued and urgently completed under the umbrella of the Collaborative Partnership on Forests (CPF), with FAO acting as the Secretariat, in cooperation with IPCC, IUFRO, CIFOR and the Secretariats of the CBD and UNFCCC.
- ii) Other stakeholders should be invited to participate in the process, including those who have not yet been part of the process (e.g., International Labor Organization).
- iii) The results of the Meeting (the Meeting Report and the Discussion Paper) should be conveyed by FAO to the interested parties, including the international and regional C&I processes. In particular the following meetings should be informed: COP-6 of CBD, IPCC meetings on Good Practice Guidance and the Kotka IV meeting on FRA.
- iv) A Task Force of knowledgeable experts should be formed without delay to plan and implement identified follow-up work.
- v) FAO, in cooperation with the Task Force, should prepare a comprehensive analytical framework, including compilation and analysis of similarities and differences between different definitions and their relationships, in order to facilitate the follow-up process.
- vi) The draft report on the framework should be submitted to

the participants of the Meeting and other experts for review and comment. Based on the comments received, the final version would be prepared.

- vii) A second Expert Meeting should be arranged, preferably in June 2002. The Meeting should review the report on the framework and decide on further action that may be required to harmonize forest-related definitions

Agenda Item 5

Review of the Global Forest Resources Assessment 2000

Comparison between Kotka III Recommendations and FRA 2000 Output

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Abstract

The Global Forest Resources Assessment 2000 (FRA 2000) was designed at the Kotka III expert consultation in 1996. Kotka III provided a detailed specification of subjects and variables to be included, as well as proposed methods and procedures. In the subsequent implementation of FRA 2000 the Kotka III report was the single most important reference. This paper compares the actual output from FRA 2000 with the Kotka III specifications to evaluate the goal fulfilment. It is concluded that FRA 2000 output corresponds well with both the subject coverage and the data content recommended at Kotka III. Furthermore, the methods and procedures proposed by Kotka III were closely followed. From a project implementation perspective, FRA 2000 seem therefore to have delivered the expected output. FRA 2000 may not, however, have delivered the evaluation of global forest status and trends expected by some users.

Introduction

Did the Global Forest Resources Assessment 2000 (FRA 2000) deliver the expected output? This paper evaluates the degree of goal fulfilment by FRA 2000 in relation to the Kotka III report.

The Kotka III expert consultation on the Global Forest Resources Assessment 2000 (Nyyssönen & Ahti 1996) was held to develop the framework for FRA 2000. Its recommendations were later endorsed by the Committee on Forestry in 1997 and the Intergovernmental Panel of Forestry. In the subsequent implementation of FRA 2000, the Kotka III report was used as

a "bible" and general reference point.

Kotka III was production oriented in the sense that the meeting aimed for a specification of methods, tables and variables for FRA 2000. By comparison, the Kotka IV meeting is planned to be more related to the scope and role of the FRA process in relation to other national and international processes and initiatives. The Kotka III report specifies tables and variables for FRA 2000, and makes clear statements on methods and procedures to be followed. It is therefore straightforward to make a direct comparison with the FRA 2000 output. This paper refers to pages 36–49 of the Kotka III proceedings, constituting the Final Report of the meeting.

FRA 2000 publications

FRA 2000 delivered a range of publications in different formats. All publications are available to the general public, for example on the FAO website (FAO 2002a). It is important to note that the FRA 2000 Main report (FAO 2001) represents only a fraction of the published material. Table 1 summarizes the FRA 2000 publications.

Comparison related to subject coverage and data

Kotka III lists 10 global tables that also constitute the proposed subject coverage for FRA 2000. FRA 2000 output cover all these subjects, and practically all specified variables (Table 2). In addition to the Kotka III specification, the global output of FRA 2000 also included data on the forest management plan status, including forest certification.

Comparison related to methods and procedures

The Kotka III report provided extensive guidance of methods and procedures of FRA 2000. These recommendations were followed in the implementation of FRA 2000 (Table 3).

Table 1. Publications related to the Global Forest Resources Assessment 2000

Publication	Format	Comment
FRA 2000 Main report	FAO Forestry Paper 140	Summarizes the entire FRA 2000 project. Includes data for all countries, methods and results by subject, and recommendations.
UNECE/FAO report on Europe, North America, Australia, New Zealand and Japan	UNECE report (Geneva Forest and Timber Study Paper 17) and database (available on CD)	This report includes the wider range of variables and data collected for the industrial ized countries and constitutes a major input to the global report.
FRA Working Papers	Informal series of working papers published by the FRA Programme. 60 papers published between 1998 and 2002.	The working papers include a range of topics including special country and region reports, proceedings from expert consultation on methods, and full documentation of project components such as the pan-tropical remote sensing survey.
FAO Forestry country profiles	Country profiles covering topics for the entire forest sector and published on the FAO Forestry website.	The country profiles constitute the major data repository for FRA 2000 and includes several thousands of web pages for more than 200 countries in up to four languages. The national data, conversion methods and harmonized international results are available here. In addition, narratives for the main subjects are included. The country profiles are stored in the Forestry Information System (FORIS) which is a direct descendant of the databases used in previous global assessments. The FORIS system is maintained centrally at the FAO Forestry Department, but data ownership is decentralized.
Global maps	Digital format and posters	Global maps of forest cover and ecological zones were produced by FRA 2000. These outputs are available for free.
FRA 2000 CD	FAO CD-Rom	The CD includes all the above outputs (except the UNECE/FAO report) in three languages.
FAO reports external to FRA	FAO reports in different formats.	FRA 2000 included a wide range of subjects and engaged several technical units outside the FRA Programme. These units have produced output to FRA, for example on wood supply, non-wood forest products, forest management, forest plantations, and forest fires. These outputs are further elaborated in publications produced by the respective units.

Table 2. Subject and data coverage proposed by Kotka III and corresponding FRA 2000 output

Kotka III table	Corresponding FRA 2000 output
1. Area of forest and other wooded land	Chapters 1 and 2 and global tables 2–6 in FRA 2000 Main report. Further details in web country profiles. At the global level, subdivision into "natural" and "semi-natural" forest was not made because of lack of data and/or difficulties to apply the definition on national data.
2. Protection status	Chapter 7 and global table 15 in Main report. FRA 2000 drew both from national reporting and the global database maintained by UNEP-WCMC.
3. Ownership	Data for industrialized countries in UNECE/FAO report. Data for developing countries only available for plantations (in web country profiles).
4. Main ecofloristic zones	National data produced by overlaying global maps of forest cover and ecological zones. Data presented in relative mesaures in table 14 in FRA 2000 Main report. Extensive narratives by region and country also produced.
5. Wood supply potential, and 8. Fellings and removals	Chapter 9 and global table 15 in the Main report combine these topics. Industrialized countries reported areas available for wood supply and details related to fellings and removals. For developing countries a comprehensive study on the removal of timber and corresponding concession arrangements was made. The relative area available for wood supply was estimated using global maps of forest cover, terrain, protected areas roads and major rivers.
6. Changes over time	Chapters 1,3 and 6 and global tables 4 and 9 of the Main report. Further details in web country profiles. Global data produced for changes in total forest and forest plantations. Industrialized countries also provide changes of other wooded land. Global data projected to year 2000 and changes to the period 1990–2000. Remote sensing survey provide change matrices for the pan-tropical region. Change in volume of growing stock available only for a subset of industrialized countries.
7. Growing stock and biomass	Chapter 2 and Table 7 in FRA 2000 Main report. Global data reported for total forest, but details by forest type included in calculations for developing coutnries. These details will be published in the web country profiles. Further details provided by industrialized countries, see UNECE/FAO report.
9. Fires	Chapter 8 and table 8 in FRA 2000 Main report. Also, an extensive Working Paper (number 55) and country briefs for the web coutnry profiles were developed.
10.Non-wood goods and services	Non-wood forest products covered in chapter 10 and global table 12 in FRA 2000 Main report, based on an extensive project that produced a number of FRA-external publications. Country briefs developed for the majority of countries and presented in the web country profiles. Quantitaive data largely lacking, but indicative data on major product groups identified. Forest services covered partly by chapter 5 and global table 13 (biological diversity) and partly by the UNECE/FAO report on industrialized coutnries. Major conceptual and data problems prevented comprehensive reporting.

Table 3. Major recommendations from Kotka III related to methods and procedures, and how these were implemented in FRA 2000

Kotka III recommendation (paragraph in Final Report):	Corresponding FRA 2000 implementation:
The importance of partnerships with all interested parties (4. and 18c.)	Partnership with countries and national correspondents (global table 16 in FRA 2000 Main report) strengthened. Partnership at the intergovernmental level, particularly with UNEP, strengthened. Wide range of professionals representing many international bodies and organizations involved in the project. (The joint work arrangement between UNECE and FAO continues to be an institutional backbone for the implementation)
Concern that FRA 90 did not have the expected influence. Call for more attractive and user-friendly publication, as well as improved public relations (5.)	Easy access to results (through the world wide web), transparency and traceability were priorities when assembling the FRA 2000 output. FORIS has been established as the Forestry Department system for forest information, giving it a higher profile and longer-term perspective. FRA 2000 output fed directly into the State of the World's forests 2001 report together with an extensive presentation of findings. Press conferences and wide dissemination of reports have generated considerable media attention.
Closer relationship with criteria and indicator processes, including further harmonization (6.)	FRA 2000 did not address this explicitely in its output , but the increased interest to use FRA 2000 data in these processes is notable, particularly for the next Ministerial Conference for the Protection of Forests in Europe in 2003. Considerable input was also given to the previous ministerial conference in Lisbon 1998. Kotka IV is asked to provide further guidance in this field.
Use of remote sensing to complement national reporting (15. and 18b)	FRA 2000 followed this recommendation and extended the FRA 90 remote sensing survey of forest cover changes in the tropics to cover the twenty year period 1980–2000. The survey provided important additional understanding of land use change processes and was useful to verify and calibrate forest area findings at the regional level. It was not possible, however, to extend the survey to all countries.
Provision of national source data (17b,c)	FRA 2000 has documented and/or included the source data for its estimates. For forest area, the source data themselves are published in the country profiles. For industrialized countries, the reference to source data is limited to comments in the UNECE/FAO report.
Adjusting national data to common definitions and common reference year, including to develop methods for this. (16., 17. and 18a)	Definitions are further elaborated below. On adjusting to a common reference year, this was done in FRA 2000. An expert consultation on the topic was held in 2000. Adjustments were made by the secretariat and validated by countries. Some imple mentational problems were initially encountered for industrialized countries who adopted an approach were only data at the latest reference year would be reported. This led to a need for further adjustment of some countries quite late in the process.
Use of spatial information for all countries (18d)	Global maps were developed and data and country maps derived from these for all countries.

Comparison related to definitions

Kotka III included extensive discussions related to terms and definitions, and several of the background papers elaborated further on this topic. It is also stated (Para 16) that FRA 2000 should include the adjustment of national data into common, global definitions. It is, however, important to note that no final set of definitions were agreed on at Kotka III. Para 19 of the Final reports explicitely says "definitions to be added later".

Nevertheless, Kotka III provided important and comprehensive input to the terms and definitions to be used. Although no formal agreement was reached, the implementation of FRA 2000 has consistently referred to the "Kotka definitions" for the core variables of the assessment. The lack of a formal agreement has, however, led to some discussions throughout the implementation.

Following Kotka III, the Geneva secretariat produced guidelines and questionnaries for the industrialized countries, building on the Kotka III report. The FAO secretariat produced FRA working papers 1 and 2 only in 1998 (FAO 1998a,b) to guide the implementation in developing coutnries. Although some minor mismatches between these sets of definitions remained, it is fair to say that the Kotka recommendations were followed and that overall, a common, global set of definitions was established for FRA 2000.

In 2001, when the FRA 2000 main report was compiled, the need was identified to harmonize definitions also across international processes, notably between FRA and the Kyoto protocol. This led to a careful editorial review of some of the definitions used in FRA 2000 to make them clearer. This refers to the definitions of forest, the area change processes related to forests (deforestation, afforestation, natural expansion of forests) and changes within the forest (reforestation, natural regeneration, degradation and improvement). The edited version of these definitions is included in the FRA 2000 Main report. These formulations have also been used at the expert consultation on forest-related definitions that was held in January 2002 in Rome (FAO 2002b). From this meeting it is clear that basic definitions will continue to evolve, but also that the current FRA definitions constitute a well established standard.

Discussion

On the whole, the FRA 2000 output show an almost surprisingly high correspondence with the specifications made at Kotka III. This is satisfying from a project implementation perspective, and an important feedback to the contributors to FRA 2000.

However, there are also views that FRA 2000 did not answer the important questions on global forests and their development. Para 1 of the Kotka III report states that FRA 2000 should "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". It is arguable whether FRA 2000 did this, despite the high goal fulfilment in relation to the Kotka III specification. The key word is "evaluation". To many users and to policy processes this probably means more than providing data tables.

As stated initially, Kotka III was production oriented and produced considerable output related to the details of the FRA 2000. Obviously, this is an important and unavoidable step in the process, but perhaps the strong focus on the details of the answers led to less discussion about what the question was? In the planning of Kotka IV, the emphasis has become the opposite. Less emphasis will be put on the details in future global assessments. Instead alternative options as to the scope and role of the FRA process will be presented to the participants and recommendations on this conceptual level is asked for by the FRA secretariat.

References

FAO. 1998a FRA 2000 Terms and Definitions. FRA Working Paper 1. www.fao.org/forestry/fo/fra/index.jsp

FAO. 1998b FRA 2000 Guidelines for assessments in tropical and subtropical countries. FRA Working Paper 2. www.fao.org/forestry/fo/fra/index.jsp

FAO. 2001. Global Forest Resources Assessment 2000 – Main report. FAO Forestry Paper 140. ISSN 0258-6150. www.fao.org/forestry/fo/fra/main/index.jsp

FAO. 2002a. FAO Forestry website. www.fao.org/forestry

FAO. 2002b. Expert meeting on harmonizing forest-related definitions for use by various stakeholders, Rome 23–25 January 2002, Proceedings. FAO Forestry Department, Rome.

Nyyssönen, A. & Ahti, A. (editors). 1996. Expert Consultation on Global Forest Resources Assessment 2000. The Finnish Forest Research Institute.

Research Papers 620. ISBN 951-40-1541-X.
UNECE/FAO. 2000. Forest Resources of Europe, CIS, North America, Australia, Japan and New Zealand. Geneva Timber and Forest Study Papers 17. United Nations, Geneva.

User Perspectives of the FRA 2000

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Abstract

This paper presents the findings of a survey, carried out at the request of the Food and Agriculture Organization of the United Nations (FAO), of selected organizations and individuals with a strong professional interest in global forest data. Respondents commented on the methodology and findings of the Global Forest Resources Assessment 2000 (FRA 2000), on earlier reports, and on the possible design of future global forest assessments. Users commended FAO for striving to produce a high quality product in spite of technical difficulties, and resource and institutional constraints. The issue of greatest interest to them is obtaining accurate data on forest area and forest area change, and they generally feel that "FAO should concentrate on getting the basics right." There is considerable frustration over the perceived continuing inaccuracy of forest area and change data, especially, but not exclusively, in the tropics. Although users welcome FAO's increasing emphasis on qualitative aspects of forest monitoring and assessments, they also express concern that this emphasis may be spreading FAO's resources too thinly. This implies that new institutional arrangements may be needed for the next FRA, probably involving more "contracting out" of certain elements of the global forest assessment. Users are sensitive to the political and cultural issues surrounding any global monitoring exercise involving the collection and analysis of data on national resources. However, many respondents doubt that FAO's current approach, based primarily on national data sources, can adequately serve the needs of global scientific research and policy making. Users strongly endorse FAO's call, in a technical paper prepared for the FRA 2000, for a "new vision and approach" in preparing the next Global Forest Resources Assessment. The paper closes with a set of options for achieving this goal.

Introduction

Publication by FAO of its decadal global forest resources assessment (FRA) is always a major event. However, the release in 2001 of the FRA 2000 stirred an unusual level of interest and controversy in both specialist and lay audiences. Accordingly, FAO requested the World Resources Institute to carry out a survey of organizations and individuals who have a strong professional interest in global forest data. (Organizations contacted are listed at the end of the paper.) We encouraged respondents to share their thoughts on the methodology and findings of the FRA 2000, and its predecessors in 1980 and 1990. We also solicited their ideas on the objectives and design of future global forest assessments. The survey was limited, involving some 20 telephone interviews and e-mail exchanges. While this is not a statistically significant sample of the user community, we believe it constitutes an important sample of organizations with particular expertise and influence in global forest data collection, analysis and policy development. This paper reports the findings of the survey and includes a set of response options for FAO to consider as it prepares for future global forest assessments.

Part 1: Looking back

The FRA reports are of critical importance

FAO has reported on the world's forest resources for more than half a century. Since 1980, reports have taken the forms of the Global Forest Resources Assessment (FRA), published at 10-year intervals. These reports are complemented by the biennial State of the Forest Reports, which summarize FRA findings and also cover institutional and socio-economic aspects of forests and forest use. FAO has stated, rightly, that "reliable information on forest change . . . and its trends has been widely recognized as indispensable for ensuring the sustainable management of the world's forests."[1] The FRA reports are current-

[1] Paivinen, R., A.J.R. Gillespie, R. Davis, and P. Holmgren. "Assessing State and Change in Global Forest Cover: 2000 and Beyond." XXI IUFRO World Congress. Full papers of Subplenary sessions: 251–257.

ly the prime (indeed the only) source of globally consistent data and information on forest area, condition and management. The importance of their reliability cannot be overstated.

FAO names countries as the primary users of its forest assessments and highlights the FRA's importance in "supporting the development of policies and programmes aimed at the management, conservation, and sustainable development of their [countries] forest resources." (FRA 2000:XXI.)

There are other important end users, however, including the international scientific community, conservation planners, forestry professionals, environmental nongovernment organizations (NGOs), bilateral and multilateral lending agencies, the forest products industries, and intergovernmental policy bodies. This paper presents a synthesis of the views expressed by individuals drawn from these communities. Although the FRA 2000 contains a wealth of material, this short paper focuses primarily on forest area and forest area change over time, because these issues proved to be of greatest concern to the end users we surveyed.

A brief summary of the FRA 2000

The new FRA 2000 is an integrated survey of all forests in the world. Based for the first time on a common definition of forests for all countries, it reports that global forest area in 2000 was 3.869 billion hectares (ha), of which slightly more than half is found in the developing countries. Forest area in 1990 is reported as 3.963 billion ha, indicating a net decadal loss of 93.9 million ha, equivalent to a net forest area change rate of -0.22 percent per year. The FRA 2000 extends the previous, descriptive coverage of the environmental dimensions of forests, by retaining sections on biodiversity, biomass, and protected areas, and adding new sections on nontimber forest products and the sustainability of forest management. Quantitative indicators of biodiversity, biomass and protected areas are improved and extended. Common national indicators of sustainable forest management and the volume of nontimber forest products are still at an early stage of development, both being limited in scope by lack of data.

The FRA 2000 introduces a new category of Total Forest to describe forest area, comprising natural forests and plantations; these two categories were disaggregated in the FRA 1990.[2] The report also introduces a spatial component for the first

time, in the form of global maps of forest area and ecological zones. The ecological zones replace the ecofloristic zones of the FRA 1990.

A significant methodological change since 1990 is evident in FAO's decision to drop its modeling approach to estimating deforestation rates in the absence of reliable data. The mathematical model used in the FRA 1990 correlated deforestation with economic and demographic factors, particularly population growth, and proved controversial among forestry experts. In the FRA 2000, FAO has reverted to a greater reliance on expert opinion to compensate for poor data, the approach used in the FRA 1980. There has been no change, however, in FAO's use of high resolution satellite imagery to sample changes in forest area. These images complement the information derived from national forest inventories. As in the FRA 1990, the new report uses a satellite survey of 117 sites located throughout the tropical zone; the total sampled area covers approximately 10 percent of tropical forests.

User opinions: Positive aspects of the FRA 2000

Scope

The FRA 2000 is appreciated for its comprehensive coverage of forest inventory, environmental and management issues. This broad scope provides strong endorsement for the view – once controversial – that an integrated approach, going beyond traditional parameters relevant to timber production, should be the goal of forest monitoring and assessment.

The report is more substantial than that produced in 1990 and, if FRA 2000 Working Papers are included, equal to the monumental 1,500 page FRA 1980. It provides in one volume considerable detail on forest cover and characteristics at the national and regional levels. The data harmonization methods used by FAO aim to synthesize this information into a global "big picture" that is unavailable from any other organization. The extensive data tables enable comparisons among countries, and the 10-year timespan of the report provides trend data for changes in forest area.

Transparency and participation

Much of the data and supporting documentation were made available by FAO on the FRA 2000 website well in advance of

publication of the final report. Visitors to the website were invited to comment and, while this process resulted in some criticisms of preliminary findings, FAO is to be praised for pursuing such openness. The openness has been widely commented on and welcomed.

Collaborative approach

The FRA 2000 has been compiled in a more collaborative manner than its predecessors. FAO developed the methodology through a process of consultation with experts outside the organization. Significant elements of work were undertaken by other institutions. For example, the UNEP-World Conservation Monitoring Centre (UNEP-WCMC) provided analysis based on its protected area database, Rutgers University in the United States conducted a literature review of scientific publications on tropical deforestation, and the new global maps were put together with help from the U.S. Eros Data Center (EDC), UNEP-WCMC, the International Institute for Applied Systems Analysis (IIASA), and other institutes and government agencies around the world. Users commented that more collaboration of this kind will be essential to the success of future forest resources assessments, as the range and depth of issues to be covered continues to increase.

Simpler adjustment methods

Users of the report welcomed FAO's reversion to the use of linear projections and expert opinion, rather than modeling, in adjusting forest area estimates to a common reference year of 2000 and estimating deforestation rates for countries with inadequate data sources. This approach is believed to provide a more honest reflection of the uncertainty surrounding inventory data on forest cover and change rates in much of the tropics.

Inclusion of primary data

In comparison with earlier reports, the FRA 2000 displays notably more transparency regarding the collection and analysis of its underlying data. For the first time, users have ready

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[2] The term Total Forest was retrospectively applied to FRA 1990 data in the *State of the World's Forests 1997* and *State of the World's Forests 1999*. However, it was not used in the FRA 1990 itself

access to statistics on forest cover provided by countries, allowing some insight into the process by which these national data are reclassified to conform to the global classification system used by FAO. Detailed technical papers available on the World-WideWeb provide supplemental explanations of the FRA 2000 process and methodologies.

Improved spatial data

The FRA 2000 is the first FAO assessment to present global maps of forest cover, ecological zones and protected areas. According to one expert, they are not adequate to develop national-level estimates of forest cover but the map of ecological zones is an improvement on the Ecofloristic Zone map used in FRA 1990. This map gave rise to questionable estimates for the main types of tropical forest, particularly those in Africa.[3] The new map is based on the Köppen climatic zone system used by Bailey[4] to delineate the boundaries of major biomes, and represents tropical biomes better than before. For example, the boundary between tropical rain forest and tropical moist deciduous forest is more realistic, although the boundary between tropical moist deciduous forest and tropical dry forest in Africa is still set in such a way as to include a lot of open savanna woodland within the tropical moist deciduous category.

User opinions: areas of concern regarding FRA 2000

A number of issues emerged from our survey as being of concern to users. They relate to the FRA 2000's accuracy, its comparability with earlier reports, and definitional issues.

Accuracy and reliability

Although there has been a slight improvement over the past decade in the availability of recent survey data, the accuracy of estimates for many developing countries is judged to be still relatively poor.

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[3] Grainger, A. 1996. "An Evaluation of FAO's Tropical Forest Resource Assessment 1990." *Geographical Journal*. 162: 73-79.

[4] Bailey, R.G. 1989. Explanatory Supplement to Ecoregions of the Continents. *Environmental Conservation*. 16 (4).

Tropical countries

Users reported their frustration over the inaccuracy of estimates of the extent of tropical forests and the rate at which they are declining in area (deforestation) and quality (degradation). It is widely appreciated, not least by FAO, that the quality of primary data on tropical forest resources at its disposal remains very poor. The accuracy of national estimates supplied to FAO is affected by two major sources of error. Both of them are outside FAO's control if it chooses to rely primarily on data provided by national governments, and if funding for capacity building in poor countries remains at its current low level.

- Forests are not monitored comprehensively or frequently enough in most tropical countries to map their extent accurately or to track their rate of change. In the absence of inventory data for specific dates (e.g. 1990 and 2000), FAO's new estimates of forest area and change over time are often the product of expert opinion processes that, however scrupulously conducted, remain no more than educated guesses. Satellite imagery is acknowledged as a useful supplement to inventory information but the FAO has limited resources and has relied on a 10 percent sample of tropical forests to track deforestation since 1980. The statistical validity of this level of sampling has been strongly challenged[5] but, even if the sample results may legitimately be extrapolated to the tropical region as a whole, they cannot be used as the basis for country estimates. In some countries with very poor inventory data, however, just one or two satellite scenes appear to have been the prime source of new information.
- Many tropical countries encompass multiple biome types, and estimates of open woodland areas are far more inaccurate than those of closed forest (which are poor enough) because it is difficult to monitor woodlands by remote sensing techniques and government forestry agencies tend not to survey them as part of normal forest inventories. Definitional differences among countries further complicate this issue (see below). Because, according to an earlier FAO estimate in FRA 1980, open woodlands account for about 40 percent of all tropical forests, the error attached to their area makes a significant contribution to the error for the area of tropical forests as a whole. This is likely to be a major problem for many years to come.

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[5] See, for example, Tucker, C.J. and J.R.G. Townshend. 2000. "Strategies for Monitoring Tropical Deforestation using Satellite Data." *International Journal of Remote Sensing*. 21 (6): 1461–1472.

Countries in the temperate and boreal regions

The quality of data from developed countries is generally better than from developing countries but problems still arise with estimates because of differences in national forestry definitions and systems of measurement, and the use of different reference periods. More seriously, there are major inconsistencies in the methodologies used to define and measure natural forest area and change in Russia and Canada.

- Complex national definitions of Russian forest land have long obscured actual forest cover in that country. Furthermore, the boundary between northern forest and tundra is vague, and the additional forest that should be counted under the new (globally harmonized) 10 percent canopy cover threshold proved hard to quantify.
- Data from Canada are highly aggregated from provincial sources, and the Canadian government reports only on production forest land. Nonproduction forests are classified as "other wooded land" in FRA 2000, even though many of them appear to meet the FAO definition of forests. This results in underreporting of more than 170 million hectares, or 40 percent of Canadian forest land. FAO relied on the Canadian Forest Service's 1994 National Forest Inventory for both its 1990 and 2000 data, reporting a net change in forest area of zero over the decade.

Because Canada and Russia account for at least 65 percent of all forests in the developed country survey, methodological inconsistencies in their reporting skew the results for the entire temperate and boreal forest region.

Forest carbon stores and biodiversity

Two other areas of scientific investigation are adversely affected by the limitations of national forest area data: climate change and biodiversity. FAO has an active and expanding program of activities related to climate change and has stated that "FAO's Forest Information System with its Forest Resources Assessments provides the most comprehensive global data set on the world's forests and may thus become an important basis for carbon accounting under the Kyoto Protocol." [6] However, the

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[6] Committee on Forestry (COFO). 2000. "Climate Change and the Kyoto Protocol: Key Forestry-Related Issues". Secretariat Note. Item 9 of the Provisional Agenda. COFO Fifteenth Session. Rome, Italy, 12–16 March 2001.

FRA 2000 is frank in acknowledging that volume and biomass data were not widely available for the developing countries and that such data as did exist used widely differing standards, terms and definitions (FRA 2000:17–18). Volume and biomass data were derived by multiplying an estimated volume and biomass per hectare for various forest types with the estimated area of each forest type. Given the data available to FAO, this was the best that could be done, but a more systematic and accurate effort to measure global carbon stores is essential. The tropical countries with the greatest carbon stores are generally those without adequate capacity to measure them. These are also the countries that stand to benefit most from the Clean Development Mechanism (CDM). Our respondents noted the risk that carbon credits and trading systems will develop based on sometimes errroneous data, which could discredit the entire carbon sinks side of climate change mitigation efforts. It is worth noting that trading in a variety of ecosystem goods and services is likely to become more widespread in future. This represents a major opportunity to press the case for improved monitoring.

The number and size of protected areas in forests are critically important proxy indicators of biodiversity. The FRA 1990 provided a simple listing of the number and area of sites protected under IUCN categories I–II and III–V.[7] The FRA 2000 introduces a more sophisticated methodology but the results are open to misinterpretation. The protected forest areas in developed countries, reported by the countries themselves, aggregate areas within IUCN categories I through VI. Categories V and VI represent very low levels of protection and, as FAO acknowledges, may include areas under general forest management, so the failure to list these two categories separately is unfortunate.

No information on protected areas was provided by the developing countries. FAO therefore overlaid the UNEP-WCMC protected areas (PA) database with the new FRA 2000 global forest map to determine protected forest areas and disag-

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[7] Food and Agriculture Organization of the United Nations. 1995. *Forest Resources Assessment 1990: Global Synthesis.* FAO Forestry Paper 124: 12. The Forest Resources Assessment Paper 112, which focused on the Tropical countries, provided supplementary country data on forest classified by function for protection or conservation.

gregate them by forest type. This approach enabled estimates to be made of the area of protected forests at the regional level but disaggregated data at the national level are not provided, presumably because the global forest map is at too coarse a scale to allow forest area estimates by country.[8] The availability of good mapped data on PAs to use for the overlay is limited; boundary data are either unavailable or of dubious accuracy for many of the world's protected areas. FAO cites the technical difficulties involved in generating area data from point reference data, which were all that were available for some tropical countries (FRA 2000:61).

The FRA 2000 does not contain any information on the status of protected areas, or on the status of biodiversity in forests outside protected areas. Reporting on forest biodiversity status is a critical but immense task which some of our respondents believe should not be undertaken by FAO. They argue that FAO does not have the resources or capacity to cover all the environmental and management issues relevant to global forest resource assessments, and that the current attempt to do so spreads its limited resources too thinly. Environmental issues such as biodiversity should not be neglected but they are increasingly well covered by other organizations. FAO is already calling on these organizations for input to the FRA. The process of "contracting out" could be taken further, if FAO were to concentrate on basic forest statistics (monitoring) and a larger number of collaborative partners were to take greater responsibility for specific areas of analysis (assessment) (See Part 2).

Lack of consistency and comparability among successive FRAs

FAO is obliged to publish the best estimates it has, even if they show some discontinuity with earlier ones. The problem, as expressed by many end users, is that successive FRA reports differ so much in their methodologies and presentation that clear comparisons among them become impossible. Consistent data time series do not exist beyond the decade spanned by each report. This seriously undermines the ability to use FRA data to

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[8] National forest protected areas for the developing countries can be found in the Global Tables (Appendix 3, Table 15). They are expressed as a percentage of total forest cover, where total forest cover has apparently been derived from the global forest map.

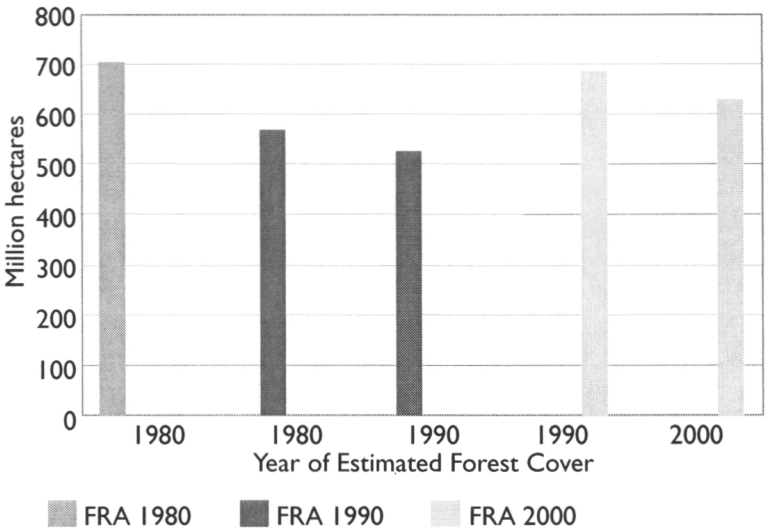


Figure 1. Successive Estimates of Natural Forest Cover in Tropical Africa

track long-term trends in forest area, which is one of the main concerns of respondents in our survey.

Changing baselines

The FRA 2000 adopts a globally consistent definition of forests, using a 10 percent canopy cover threshold for all countries. A 20 per cent threshold was formerly used for the developed countries. In addition, new methodologies are introduced to estimate forest area in the developing countries. These adjustments have been projected retrospectively to develop a revised estimate of global forest area in 1990, the baseline year from which changes in forest area are calculated. The new baseline is 15 percent higher than was estimated in 1990. The new baseline may or may not be more accurate than the original estimate but the methodology-induced increase of 15 percent in global forest area is actually greater than the actual decrease in global forest area estimated to have occurred during the 1990s. In the tropics, baseline estimates have not been affected by major definitional changes but the variation among reports is still striking. As an example, successive estimates of natural forest area and forest loss in tropical Africa since 1980 are shown in Figure 1. Even specialists find such shifts frustrating, and they are likely to be impenetrable to lay readers. This will

spread more confusion as different interpretations are made in various publications derived from the FRA data.

Aggregating natural forests and plantations

Further confusion may be caused by the FRA 2000's aggregation of natural forest area and plantation area to form the category of Total Forest. The FRA 1990 listed natural forests and plantations separately. To compare natural forest area at the country level in FRA 2000 with previous estimates, readers must first disaggregate natural forest area and plantation area, using the global tables appended to the report.[9] However, any attempt to compare natural forest area in 2000 with natural forest area in 1990 will be confounded by two problems. (1) Because of the revised baseline, readers must use the new, higher estimates of natural forest area in 1990 that can be calculated from FRA 2000; this is a self-referential comparison. Comparisons with natural forest area in 1980 cannot be made at all. (2) Revised estimates of country-level plantation area in 1990 are not provided in FRA 2000, so the only option is to use the original estimates of plantation area given in the FRA 1990. Unfortunately, FAO's methodology for estimating plantation area has changed over the 1990s, so the two sets of plantation area data should not be compared in this way.

Many FRA users we spoke to disagree in principle with the aggregation of natural forest and plantation area. Although it might be interesting in some respects to monitor the change over time in Total Forest, the two types of forest differ greatly in biodiversity, wood production (plantations are heavily biased toward timber, pulpwood and woodfuel production), and exploitation (clearfelling is common in plantations and rare in closed tropical forests). The current practice of aggregating natural forest and plantation area further encourages the perception that a rise in plantation area can offset an equivalent fall in natural forest area.

Aggregating forest area losses and gains

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[9] The FRA 2000 provides disaggregated data for natural forest area and plantation area at the global, regional and subregional levels but readers interested in country level disaggregation must perform the calculations themselves, using the plantation area and Total Forest area data listed separately in the Appendix of Global Tables.

Deforestation rates and forest expansion rates are also aggregated in FRA 2000 to give a Net Forest Area Change Rate. Natural forest losses (through conversion to other land uses) and gains (through reforestation and afforestation) are disaggregated at the global, and tropical/nontropical levels, but not at the regional or country levels. This prevents any meaningful country-level comparisons with natural forest loss rates provided in earlier FRA reports. The problem here is that deforestation and reforestation/afforestion are distinct processes; deforestation is largely caused by agricultural clearance in response to the need for more food and cash crops, while reforestation and afforestation are usually responses to demand for wood fiber or tree crops. To understand what is happening in the world's forests we must monitor both trends independently. Since deforestation is now spatially concentrated in the tropics, publishing a global mean net change rate can be misleading. Our respondents indicated that they would have preferred a greater emphasis on the disaggregated regional trends, rather than on the global rate of change. The FRA 2000's estimated global net area change rate of -9.4 million ha per annum over the 1990s has been widely quoted in the media, and mistakenly compared with previously published higher estimates of natural (i.e. tropical) forest loss.

Changing ecological zones

Other comparability problems will hamper more specialized end-users interested in charting trends in particular forest types, for example, tropical moist forest or open savanna woodlands. FAO has published only global figures for the areas of each forest type. The percentages of Total Forest within each ecological zone are listed for each country, but not the areas, presumably because the ecological zone map is too coarse in scale to allow such differentiation.[10] Although the new ecological zone map used in FRA 2000 is an improvement over the ecofloristic zone map used in FRA 1990, its estimates for different types of both tropical and temperate forests are incompatible with those in FRA 1990.

To sum up, the changes introduced in FRA 2000 might all be

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[10] This is curious, given that the area of forest within each ecological zone must have been determined by FAO, in order to calculate the percentage. Presumably, the intention is to avoid uncertain area data being cited without qualification.

acceptable in the long term if they were to solidify as the basis of future reporting. More fundamental comparability problems remain in the use of expert judgment to estimate tropical forest area and deforestation rates when adequate inventory data are not available. While techniques such as the Delphi Technique and Convergence of Evidence Technique, used in the FRA 2000, produce defensible results in the context of a single study, they are not replicable over time. There can be no guarantee of consistency as subsequent FRA reports are prepared drawing on the expertise of different individuals. The margins of error cannot be quantified with any degree of reliability.

Definitional issues

Common, agreed definitions of "forest," "deforestation", and other terms are critical to consistent, replicable global forest assessments. Yet definitions that are satisfactory to all potential users of the FRA reports remain elusive.

FAO's current definition of forest is "land with tree crown cover of more than 10 percent and area of more than 0.5 ha, which is not used primarily for agricultural or urban purposes." The definition thus encompasses both land cover and land use elements. The definition of deforestation used during the preparation of FRA 2000 (after some modifications) is "the conversion of forest to another land use *or* [sic] the long-term reduction of the tree canopy cover below the minimum 10 percent threshold." As with forests, this is a definition based on both land cover and land use criteria. A note appended to the definition explains that it specifically excludes areas where trees have been removed as a result of harvesting or logging, and where the forest is expected to regenerate naturally or following silvicultural intervention.

FAO maintains that this dual definition is necessary to "be of optimal use to policy-makers" (FRA 2000:2). This begs the question: what kind of policy? A land use definition of forest that includes land currently bare of trees is compatible with forest management for timber production and meets with no objection from traditional foresters. But forest land that has been cleared of trees, or thinned in the course of selective felling, displays very different ecological characteristics from a closed forest. Ecologists, climate change scientists, conservationists and others interested in aspects of forest quality (for

example, degree of fragmentation) have argued strongly in favor of a land cover definition, and preferably one that distinguishes several different canopy cover thresholds. The FRA 2000 provides potentially useful supplementary information in the form of data showing harvested area (FRA 2000:Appendix 3, Table 10) but few of the developing countries have any data listed.

A practical problem with the land use definition concerns the difficulty of anticipating whether forest "expected to regenerate naturally" will actually do so, or whether planned replanting will actually occur. Land uses in the tropics tend to be unpredictable, because of volatile economics and insecure land tenure. Forest is constantly being harvested, cleared for cultivation, and abandoned to possible regrowth or replanting. Yet, FAO's definition of deforestation depends crucially on trying to distinguish between "temporary" and "permanent" removal of tree cover, a distinction that is probably impossible to achieve in many cases. The pace of change in much of the tropical zone is rapid and it is important to monitor the timing and spatial distribution of such change, so far as possible, as it occurs.

Equally serious difficulties arise when FAO attempts to reconcile differing national definitions of various types of forest – montane forest, swamp forest, wooded grassland, wooded savanna, and so on. The harmonization process involves reclassifying numerous categories of forest land into the broad categories of closed forest, open forest, plantations, shrubs, forest fallow and other land. These categories are further adjusted to the single category of Total Forest. Our respondents commented that the harmonization process appears to be particularly inconsistent in Central Africa, where wooded savanna is classified as closed forest in some cases, and as open forest in others. Researchers have pointed repeatedly to major discrepancies between FAO forest area data for Gabon, Cameroon and the Central African Republic, for example, and other estimates based on maps or remote sensing images of vegetation cover that record "where the trees are" but do not attempt to reconcile national definitions of forest.[11]

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[11] See, for example, Mayaux, P., F. Achard, and J-P. Malingreau. 1998. "Global tropical forest area measurements derived from coarse resolution satellite imagery: a comparison with other approaches." *Environmental Conservation*. 25.

Summary

Users to whom we spoke in our survey concur that, despite the great effort expended on compiling the FRA 2000, the state of knowledge today is far poorer than the report implies. The unreliability of forest area data, particularly in a few large, forest-rich countries, means that overall conclusions about forest area and change cannot be relied on.

Changes in forest area baselines mean that trend data are not available for periods of more than one decade. Changes in estimation methodologies further limit comparability between reports. Such discontinuities between decadal reports prevent the development of long-term time series.

FAO's increasing transparency in both process and methodology is widely welcomed. However, major questions surround the organization's continued reliance on national inventory data as the primary source of information for future global forest resources assessments.

Part 2: Looking forward

In the light of these responses to FRA 2000 what is the best way to move forward to provide the next comprehensive global forest dataset and analysis of that dataset? FAO itself, in a technical paper prepared for the FRA 2000, has already called for a "new vision and approach" for the next global forest resources assessment. This part of the paper presents a set of options to assist FAO in defining what that new vision and approach should be.

Identifying key stakeholders

The first imperative for FAO is to identify the major stakeholders in its FRA programme and determine their needs. The United Nations and its specialist agencies such as FAO have performed an outstanding service over the last 40 years or more in building up global compendia of data on many subjects. The world, therefore, has looked to the United Nations to monitor the global environment. FAO represents a competent and reliable intergovernmental body to whom countries can entrust national forest inventory information in the knowledge that it will become part of an internationally accepted document. Countries also have the assurance that they can scrutinize and if

necessary challenge FAO's analysis before the final report is published. FAO's good standing represents a substantial asset of value to everyone interested in monitoring and managing the world's forests.

However, governments are not the only stakeholders in the FRA. Scientific, environmental, and public interest in forests has grown dramatically in recent years, bringing new demands for more extensive, more accurate and more timely information. Demand is also rising for information at multiple scales, including the subnational scale. The most vocal demands for change in current forest monitoring processes have come from the research and environmental advocacy communities, who are impatient for the best possible forest statistics, as well as information on an ever-broadening range of ecological issues. Their needs came through strongly in the responses to our survey. But many national governments, too, are anxious for more frequent updates on forest area and condition. Governments are increasingly interested in the role of forests in national economic and social development and of their own responsibilities as stewards of global biodiversity. Still another community of interest exists in the private sector. Industries want to know the extent and condition of timber and other forest-based resources, and they need to understand in detail the institutional and regulatory context in which they must operate.

Options for future forest resource assessments

Enhance the present organizational design

FAO has steadily refined the design of the FRA since 1980 and, in the absence of any radical policy shift, it is likely that incremental improvement will continue. In this scenario, the next FRA would differ in some respects from FRA 2000, but national forest statistics would continue to be the main source of data. This approach has the advantage of continuity and it maintains FAO's key partnership with national governments. On the other hand, it is likely that the same constraints that affected FRA 2000 will still be in evidence ten years from now and that they will restrict the accuracy and usefulness of the FRA 2010.

Seek funding for dedicated Research Centres in member states

A second option, which is entirely consistent with FAO's partnership with national governments and its policy of strengthening the capabilities of developing countries, would be to stimulate funding for the establishment and staffing of dedicated research centres in key states that contain a large proportion of the world's tropical forests and are in proximity to other heavily forested states. FAO has already launched a pilot programme to improve forest monitoring in a limited number of countries, and Option 2 would expand on this programme, should it prove successful. This would help to improve the quality and frequency of forest monitoring in the tropics through a genuine partnership approach. A drawback to this approach would be the probable delays in raising funds, training, and construction of facilities.

Adopt a consortium design for data collection

Another strategy would be for FAO to establish and coordinate a consortium to collect data. The consortium would consist of a small number of remote sensing centres with expertise in forest monitoring. Each member of the consortium would be responsible for one or more regions or sub-regions. This approach would have the advantage of being able to produce results in time for the next FRA but, on the other hand, it could be criticized for being over-centralized. However, in time, each member could form its own consortium with other centres in its region of interest to arrive at a more decentralized mode of operation.

If a consortium approach were adopted, the processes already developed under the FRA programme would provide the means to link global data and information sets produced by the consortium with national-level data gathering and field validation of results. A top-down approach enabled by advanced technologies and the bottom-up approach already embedded in FRA could be combined in a regular monitoring process that would exceed the current performance of either approach alone. If such a consortium were established and the burden of data acquisition reduced, FAO would be free to focus on regular collection and analysis of a limited set of core data variables, which would provide the foundation for integration of additional information, modeling and analysis by other groups.

Adopt a consortium design for data processing

A number of respondents to our survey felt that FAO has spread itself too thinly in trying to provide substantive information on trends in forest quality in addition to basic data on forest area and rates of change. Another consortium option (which could be pursued in parallel with or in place of Option 3) would be for FAO to "contract out" to other bodies the analysis of the implications of changes in forest area. Relevant issues for analysis would include biomass and carbon stocks, biodiversity, sustainability of forest management, and timber reserves and production. Many universities, research institutes and other groups around the world are already collecting and analyzing such information at the national, regional and global levels. However, their contribution could be greatly strengthened if their efforts were harmonized around a commonly agreed global forest information agenda. Such an agenda, with the mandate of FAO behind it, would identify priority monitoring and assessment needs for the coming decade (and beyond), based on an analysis of user needs and the degree to which those needs are being filled by existing efforts.

Another important component of forest monitoring and assessment that has been accorded a lower priority in recent FRAs concerns forest use and management, production and trade of forest products, and the socio-economic role of forests as sources of employment. As part of the reorientation of the FRA process in the mid-1990s, FAO's office in Rome formed a new partnership with the UN Commission for Europe (ECE) in Geneva, which specializes not only in European forestry issues but in assessing the state of the global forest sector. It would be a logical development for FAO to include UN/ECE in Geneva in any data processing consortium to add value to the basic FRA data on forest area and change rates. The International Tropical Timber Organization and CIFOR might be other logical partners.

Propose the establishment of a Global Forest Monitoring organization

The alternative to relying on outside bodies to collect and process satellite and other forest data would be for FAO to work toward the formation of a dedicated Global Forest Monitoring Organization. In fact, FAO has already proposed a World Forest Survey, which bears some similarities to such an idea.

Unfortunately, this ambitious proposal has not so far attracted the necessary financial support. If a Forest Convention were to come into force that specified FAO as the agency responsible for monitoring the sustainability of forest management worldwide, then FAO would have a mandate to establish a comprehensive global forest monitoring program. However, this is not yet the case. FAO could either try to proceed with its World Forest Survey idea in the absence of such a mandate, or choose to wait until a Forest Convention is eventually agreed.

Another strategy would be for FAO to capitalize on the fact that forest monitoring is becoming increasingly central to implementing the Climate Change and Biodiversity Conventions. FAO could propose that the United Nations establish a new UN Global Environmental Monitoring Organization (GEMO). FAO and other UN agencies, possibly together with public and private sector organizations outside the UN system, would collaborate with GEMO. The new body would then supply FAO with much of the basic data on forest areas and rates of change necessary for the FRA reports. This would allow FAO to continue with its present practice of collating estimates of forest resources submitted to it by its member states, and to work with a consortium to add value to its basic data, as described in Option 4.

Is doing nothing an option?

FAO, like any producer of information, cannot fail to recognize the demands of its end users or the possibility that other bodies will compete to supply these demands if there is a perceived "gap in the market." The increasing availability and quality of satellite imagery is already leading to the emergence of competing forest surveys from outside the UN system. In the 1990s, bodies such as the TREES Program of the European Commission Joint Research Centre and IUCN's World Conservation Monitoring Centre (WCMC) produced their own estimates of world forest cover. Most recently, UNEP, a sister UN agency, working with the U.S. Geological Survey, produced an estimate of the world's remaining closed forest area and highlighted differences with FAO findings.[12] WCMC has also recently

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[12] UNEP. 2001. *An Assessment of the Status of the World's Remaining Closed Forests*. UNEP/DEWA/TR 01-2.

become part of UNEP, further enhancing its capabilities. None of these surveys yet rivals the FRA reports in terms of global coverage, and their differing methodologies mean that regional results cannot be combined to produce a global whole. Nor do they have the political mandate to report national information to an international audience. However, these deficiencies can in principle be overcome if the will to develop a consistent global dataset exists.

This raises an interesting challenge for FAO as it contemplates the next global forest resources assessment. Does it seize the initiative itself and become an active participant in trying to shape the global forest monitoring community of the future, or does it try to maintain its current approach while alternative systems of global forest monitoring become increasingly effective competitors that undermine FAO's primacy and create confusion among users seeking authoritative forest data? FAO appears to believe that maintaining the status quo is not an option, and that other strategies need to be considered. The options listed above are not mutually exclusive, nor do they exhaust the options available to FAO, but they do chart the main highways toward improved global forest monitoring and assessment in the future.

Taking a fresh look at reporting the results of FRAs

FAO and others are all too aware that repeated efforts to develop new institutions or projects to address current forest monitoring deficiencies have failed for lack of resources and inability to win the cooperation of key players in these efforts. This fact reinforces the need to raise the profile of forest information in the wider economic and social policy context and appeal to the broadest possible political audience. However, forest area, deforestation rates, biomass volumes, and carbon storage are somewhat abstract concepts in isolation. Their impact in the policy world is proportional to their perceived impacts on economic development, social wellbeing, and environmental quality.

Would it not be constructive to tie the process of forest monitoring and environmental assessment more closely to the process of reporting on forest-related economic and social issues? Such issues include forest products industry outputs and trade, employment, aid and investment flows, and the implications, perhaps via scenarios, of good and bad forest

management for development.

FAO's flagship publication in the agriculture world is the State of Food and Agriculture, published annually since 1957. The report combines statistical information with special studies of issues of long-term interest. Links between a thriving agricultural sector and a sound, sustainable economy are made abundantly clear. The impact of this report would surely be diminished if it reported only on cropland area, soil depths, biomass volumes, and farmland in conservation programs. While these data provide the critical underpinning of the report, they are incorporated into an analysis directly targeted to policy makers. By analogy, the FRA might gain immeasurably in political weight and financial support if it were seen as the critical input to a regular publication on "The State of Forest Products and Services." FAO's role could be to focus its efforts on accurate forest monitoring, while partner organizations contribute more substantially to the assessment. There may be merit in an ambitious merger between the current FRA and State of the Forest reports that creates something greater than either publication alone. Socio-economic and environmental issues should be placed at the centre rather than the periphery of such a merged forest report.

Conclusion

This paper has summarized current views about the perceived merits and drawbacks of FRA 2000 and outlined some options for making progress in the future. In the opinion of most of our respondents, current monitoring efforts are not adequately meeting the needs of policy-makers or scientists for information on the global extent and quality of forest resources. These needs are daily becoming more imperative. The global forest estate is diminishing in quantity and – in some respects – quality, even as our understanding of the importance of forest market and nonmarket products and services grows. New international environmental agreements will stand or fall on the trustworthiness of data underpinning national goals and commitments to meet them.

FAO, its member states, and other interested organizations together can develop new information gathering and communication tools that will capitalize on the existing strengths of FAO and its networks, and on the tremendous technological capacity

of remote sensing technologies. The problems summarized in this paper are likely to persist if the present organization of the FAO Forest Resources Assessment continues unchanged. The next FRA represents an unprecedented opportunity to experiment.

List of Organizations Contacted

- Centre for International Forestry Research (CIFOR), Indonesia
- UNEP World Conservation Monitoring Centre (UNEP-WCMC), United Kingdom
- Joint Research Centre (JRC) of the European Union, Italy
- University of Maryland, United States
- University of Leeds, United Kingdom
- Association pour le Developpement de l'Information Environnementale – Programme Regional de Gestion de l'Information Environnementale, Gabon
- World Bank, United States
- The Nature Conservancy (TNC)
- Conservation International (CI)
- Worldwatch Institute
- Worldwide Fund for Nature (WWF)
- International Institute for Advanced Systems Analysis (IIASA), Austria
- European Forest Institute (EFI)

Why Did We End Up Here? The Evolution of Global Forest Assessments

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The stage

When FAO delivered the Global Forest Resources Assessment 2000, or FRA 2000, (FAO 2001), several well-known organisations stated that FAO's results could not be trusted, or needed to be interpreted in a certain way (e.g. Stokstad 2001). In addition, several countries expressed concerns that their national information was presented in an inappropriate way. Similar comments have been conveyed after earlier global assessments.

FAO is by its constitution a neutral forum for the world's countries and has as a major task to provide global baseline information on forests and forestry (FAO 2000). Consider then that FAO, as a leading UN agency in its field, is openly challenged when presenting basic and supposedly neutral statistics, after several years of work in collaboration with countries and partners. Something then seems to be wrong. Either the confidence in FAO's work is low, or there are political or financial advantages in questioning the results, or reliable source data are missing which opens for speculations. There may be some truth in all three points. This paper argues that the last point is most important and analyses the global forest information situation in the light of past experiences and current requirements.

The future of the world's forests and trees are at the centre of several major environmental and development issues. The convention on biological diversity highlights forests as a key concern. The convention on climate change acknowledge forests as a moderator of athmospheric carbon. Food security increases and livelihoods are made more sustainable with better forest and tree management. Life quality is enhanced by the promo-

tion of outdoor recreation and other forest services. At the same time forests continue to provide a wide range of goods including timber, energy and non-wood forest products. Forests also provide opportunities for agricultural expansion in many parts of the world. We have therefore developed an awareness of resource conflicts and shortage. So, how can we best develop and benefit from these multiple functions of forests now and in the future?

We don't know how. We lack the most basic facts to do the analysis because few countries have forest inventories that give the information required. This is not limited to the developing world. The situation in several industrial countries is less than satisfactory for national and international forest policy development and implementation. In developing countries there are many limitations. Only 22 countries (of 137) have repeated inventories, 28 countries have no inventory, 33 have partial forest inventory. Very few developing countries in the world have up-to date information on their forest resources and fewer have national capacity for generating such information.

Most of the world's forests are subject to national policies that aim at sustainable management. Numerous ngo's are engaged to influence forestry according to their agendas. Several conventions, typically signed by the majority of countries, establish political commitments to preserve the environmental functions of forests. They also establish requirements to report national progress towards the conventions' objectives. In short, the forest issue is in everybody's mind and there is in words a monumental political will to progress towards good and sustainable use of the forests. And the political will has expressed the need to monitor the progress, for example in country reports to conventions.

But has the commitment to carry out assessments been equally elevated? Is there sufficient interest to seriously monitor and assess forest developments, or does the political will end after signing the conventions? Or is it so that the scope and methods of global and national forest assessments are still evolving? This paper argues the latter point and attempts to define a conceptual platform for future global forest assessments.

Forest information and politics

Forest information presented directly by countries is often political. Furthermore, ngo's present information that suits their purposes. It is therefore necessary that international statistics are summarized by an organization that do not have an agenda of its own. There is then no realistic alternative to a UN-organization, such as FAO. UN organizations are, however, also often under pressure to hide information that are considered embarrassing for a country. This problem can be reduced somewhat by making the statistics easily available to all. The process is likely to benefit from a transparent approach.

Global forest assessments are largely made by aggregating and standardizing national information. This is both a necessity and a desired approach. It is necessary because practically all forest information is compiled at national level (or lower) through within-country led initiatives. There are some exceptions, mainly land-cover surveys, that are done over larger expanses, but a global forest assessment relies heavily on reports and input from countries. Global assessments are made on request from FAO member countries, which make them natural partners in the work. This is also a desired approach because the involvement of countries leads to a higher acceptance of findings, helps build capacity in countries and provides a bridge from the global level to the national where policies are implemented. The reliance on country information in global assessments has been criticized as countries may cheat. So far, however, the advantages of country participation are believed to vastly exceed eventual data quality problems (FAO 2001).

Some environmental ngo's collect quite a lot of forest information (e.g. Global Forest Watch). They do , however, often have a narrow interest, such as conservation according to Western norms. They may also want to influence the provision of information from other sources – e.g. by stating that information about reduced deforestation in a country is not trusted. Ngo's have rarely an interest in many issues related to forest products (especially timber). In theory NGOs could play an important role in improving knowledge about the forests. But then they must be more directed towards development than advocacy.

Lately much interest has been attached to changes in forest area as this is the hottest and most easily understood indicator of forest development. But also this information is political.

Some countries may want to hide their high deforestation rates. Others may want to have as high figures as possible as they believe this will give more assistance to forestry. The Kyoto protocol may trigger further manipulation of figures. Several ngo's seem not to accept the slow-down of deforestation as reported by FRA 2000. Thus, even the simplified case of deforestation as a development indicator is not an undisputed measure. Depending on how the term is chosen to be interpreted, the global area of deforestation can be between close to 0 (if only true virgin forests are counted) to over 50 million ha per year (if all temporary forest clearings are counted).

Also the reported forest condition depends highly on the national policy context. For example, some countries downplay the proportion of forest plantations as they want to promote the existence of natural forests, whereas other choose to exaggerate them to point at the wood production potential. Some countries claim that all their forests are under protection schemes, whereas others report only those areas under strict conservation.

For many of the "new" questions , such as biological diversity, air pollution and its effect on forest ecosystems, the carbon cycle, the social functions of forests, and the type and intensity of forest management, there are still serious problems in finding relevant relationships and agreed concepts. As a result national reporting often becomes ad hoc and highly subjective.

In the abscence of neutral and systematic facts, forest information has been politicised, meaning that it is sometimes being released or interpreted to fit a policy purpose. This erodes the confidence in forest information.

History of national assessments – why did we end up not knowing?

When national inventories started the aim was to find out how much wood was available. Wood was the only benefit, or utility, from the forest that was considered. A National Forest Inventory (NFI) was e.g. started in Sweden in 1923 because there was a fear that Sweden should be facing a wood-shortage. After 10 years the first information was ready and the NFI has continued to deliver information since. The inventory showed that there was no shortage of wood but instead a continuous increase in both area and volume. The scope of the inventory has been widened step by step as the scope of forestry issues

widened at the national level.

In Sweden, and about a dozen more countries, the National Forest Inventory is based on a sampling design. In many other countries national figures instead come from a summary of management plan inventories. These are the two principal approaches to an NFI. A major disadvantage with summing up management plans is that the sums can contain considerable systematic errors, as shown for Armenia (Thuresson 2002) where the real volume growth was twice the estimates in management plans. Several countries are currently establishing sampling based nfi's.

Support to national inventories became a popular form of forestry assistance in the 1960s. The forest resources were normally described in the same way as in Europe, and the inventories therefore often gave correct answers to wrong questions. The typical objective was to find out how much wood of commercial sizes and species were available for exploitation. This meant, for example, that general land use issues such as the expansion of agriculture into forest areas and the role of forests in poverty alleviation were not well studied, although these were and are major issues.

Support to national forest inventories have at some stage been given to most developing countries. Despite this, few have good knowledge about their forest resources. This is because most inventories were one time undertakings. The support normally failed to build sustainable inventory organizations. The result from the inventories were seldom used for much meaningful planning (except to identify areas suitable for exploitation). Both Governments and donors eventually seem to have lost interest in support to inventories.

From the 1970s and onwards a belief was spreading that field inventories were no longer required. Remote sensing would give all the information needed. Large sums of money have been used to produce glossy maps and test ideas about what remote sensing can produce. But in, e.g., Africa the knowledge about the forests seem often to have decreased compared to the era of field-inventories in the 1960-s to 1980s. There is a potential in remote sensing for certain area measurements, but a land cover map is not a forest assessment. Thus, the strong focus on remote sensing in forest assessments may have side-tracked the discipline. This awareness is currently growing and a return to field inventories to supply policy-relevant national information seems to be appearing.

History of global assessments

Global forest assessments (FRAs) primarily serve the international community by monitoring and assessing development, changes or progress, of forests and forestry. Although international fora do not have a mandate to implement decisions, the information can be used in negotiations and as reference information for countries. This section describes how global assessments, requested by the international community, have evolved.

The first attempts in the 1920s and 1930s were partly geographic studies – as part of the exercise to describe the surface of the World (even if "timber shortages" are discussed in some). At the first FAO conference in 1945 a recommendation was made that a World Forest Inventory (WFI) should be undertaken as soon as possible. The first World Forest Inventory was carried out in 1947/48. It was later decided that World Forest Inventories should be undertaken every fifth year. WFI s were done for the years 1953, 1958 and 1963.

The objective of the WFI can be summarized by quoting the first words of the WFI 1948: " The whole world is suffering from shortages of forest products". This was very much the idea behind the first WFIs, following the contemporary approaches at the national level. In order to know the balance between supply and demand one needed to know the resources. Regional and global Timber Trends Studies were made in the 1960s. It was no doubt also a hope that one should be able to show changes by doing the inventories every five year.

The reports by Persson (1974, 1975 and 1977) also put an emphasis on the forests as a resource but also discussed deforestation. This issue became increasingly hot and the Forest Resources Assessment made in 1980 put a great emphasis on this, with funds coming from UNEP. The Forest Resources Assessment made in 1990 also had deforestation as a main theme. But new themes like biological diversity started to turn up.

In FRA 2000 a number of new requests were raised. Deforestation was important but issues like biodiversity and protected areas were also included. The conservation issues had grown in importance. But FRA was also expected to give information about productive aspects, e.g overall wood supply, forest plantations and trees outside of forests. Information was also requested about non- wood forest products. Clearly, the design of FRA 2000 (Nyyssönen & Ahti 1996) was farsighted and in-

cluded a much wider range of forest benefits than earlier assessments. Two observation can be made after the completion of FRA 2000, (a) the information to decribe several of these benefits does not exist, and (b) the main interest from users and media is still on forest area and area change, and not on the new subjects.

The global FRAs have changed method and definitions continuously. This is because of the experiences gained and new demands from users. If a definition proves to give unsatisfying results it has to be changed. If a method proves to have limitations it must be changed. The changes made over the years can easily be explained. This state of affairs means, of course, that it is difficult to make comparisons between consecutive assessments.

The WFI from 1948 to 1963 used a questionnaire approach. Countries supplied FAO with information. When this method was tried again in the late 1960s it failed. The capacity of many countries had been reduced. What was then tried was an "expert method". As much as possible information about the forests in countries was collected. An "expert" tried to summarize this and give a consistent picture. This was probably the best method to use in the 1970s and 1980s. But it meant that the dialogue with countries was greatly reduced.

The "expert method" was subjective. There was no clear method except common sense (and definitions). In FRA 1990 a more "scientific method" was wanted. A data base (FORIS) was built up which used information from the countries. The idea was to step by step built up this data base. The work with FORIS meant that the dialogue with the countries were strengthened. The information had to be adjusted to fit FAO's definitions. A remote sensing method was also introduced. This gave information about forests and deforestation at global and regional level and could be used to check if regional figures coming from FORIS was in the right order of magnitude.

FRA 2000 have further developed the methods from FRA 1990. The relationship with countries has been further strengthened and the relationship between global figures and national reports presented in a transparent way. Providing a possibility to trace all estimates to source documents is believed to improve the quality also of future assessments. The pan-tropical remote sensing survey was continued as an independent instrument to study land cover changes and compare them with national estmates at a regional level.

Suggested scope of global forest assessments

Following FRA 2000, the process to define the next global assessment of forests has begun, involving stakeholders at national and international levels. Given the complexity and large number of participants, it may be useful to define a generic scope for the global assessment, that can serve as a starting point for technical design, setting priorities and project implementation.

It is assumed that FRAs are primarily made to monitor and assess the overall progress of forestry towards defined political goals at the international level. In addition, important analyses are facilitated, for example related to trends in trade and forest industry. The word assessment means "to determine value" and FRA therefore includes (a) to produce data from forest inventories, and (b) to put together inventory data to meaningful results that describe and evaluate forest benefits, or at least indicators of such benefits. We may also include the forward projection (scenarios) of forest benefits in the assessment concept.

"Progress" means that the overall situation is perceived as an improvement compared to an earlier point in time. This comparison must be done to evaluate the political and economical actions towards sustainable forest management or other policy objectives, and to put the effect of these efforts in a broader development perspective. Is it, for example, better to invest in more forest plantations than in improved infrastructure? Is it better to use some land for agriculture than to keep it under forest?

We therefore need a measuring stick, an assessment, that tells us whether the goal fulfilment of a certain political process is higher or lower than before, and how other benefits from forests (or other sectors) have been affected by the process. Preferrably, the measuring stick should be subject to quality control, so that the progress can be confirmed in terms of statistical significance and proven objectivity in the assessment process. We want to have stable measurements and observation so that comparable time series can be established. Furthermore, we want to be able to project the development into the future, using alternative scenarios, to help us make new or adjusted decisions.

In the above we have seen how forest assessments have become gradually more complex and incorporate more benefits

(utilities). In fact, it is difficult to exclude any benefit from forests from an ideal assessment. From a conceptual viewpoint, a global FRA should therefore address all benefits from the forests, ranging from biological diversity to pulpwood. In addition, it seems relevant to include the full range of beneficiares, ranging from local land users to the global population. There is otherwise a risk that the big global issues (climate change, biological diversity) dominate the information and that local produce and rural development aspects are marginalized We therefore define global FRA as the process that monitor the values of all forest benefits for all beneficiares, including past trends of these benefits and projections into the future.

Put in another way, a global FRA should not only study the biophysical forest and tree resources, but also the management and uses of these resources, with an emphasize on long-term trends. It then becomes obvious that the current focus on forest area and area change is irrelevant. This measure provides a very poor evaluation of forest resources as most benefits depend on other parameters.

Simplifications – the indicator game

In the above we have established a conceptual formula for global FRA's. They are to study all benefits from the forests over time. Obviously, this is very complicated, so we have to live with simplifications and good-enough approximations. But we need to keep an eye on these simplifications because the connection to the conceptual base is easily lost. The simplified information set may then become a goal in itself. We have seen this in the extraordinary focus on one number – the rate of global deforestation. The mantra that deforestation is bad has been repeated so many times that it has become a goal in itself to reduce this single global figure.

Fortunately, there are international processes that help us simplify the task, and yet stay on the holistic track. Let us now have a look at Criteria and Indicators of Sustainable Forest Management. The Criteria are straightforward. They express the objectives of forestry, as negotiated in political processes. Being political, they are vaguely formulated, see example in Table 1, but Criteria in essence also express a multi-purpose goal function, including the full range of benefits from forests. They have evolved from historical timber oriented national

policies into todays international agreements that address the multiple functions of forest. Criteria are therefore a good starting point for designing global forest assessments.

Table 1. The Ministerial Conference for the Protection of Forests in Europe has defined six criteria for sustainable forestry

1.	Maintenance and appropriate enhancement of Forest resources and their contribution to global carbon cycles
2.	Maintenance of forest ecosystem health and vitality
3.	Maintenance and encouragement of productive functions of forests (wood and non-wood)
4.	Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems
5.	Maintenance and appropriate enhancement of protective functions in forest management (notably soil and water)
6.	Maintenance of other socio-economic functions and conditions

However, when the Criteria are broken down into Indicators we run into problems. Indicators are selected to make an assessment of how well, say, a country meets the Criteria and provides a mechanism to monitor progress over time. But the process of identifying indicators has, so far, leaned very much on the data that is available, because fast progress is wanted. Therefore we end up with indicators that are not optimal.

The other major issue is that we can not take for granted that indicators are equally valid, or that they are equally weighted, in different countries. Therefore, although the Criteria may be a good starting point, we have not solved how to generate systematic and valid information for all countries related to the Criteria. This will be a major challenge for the next global assessment. We may end up with a set of Criteria that can be generally agreed, but methods for assessing the progress towards these Criteria that vary between countries and regions.

Collecting the information and using it

In the above, an approximate picture of the contents and structure of a global assessment has been drawn. In this section we

will look at how the information can be generated and how this activity fits in the policy process. As before, we assume that information generation and policies are mainly dealt with at the national level.

Global assessments would continue to piggy-back on national efforts by extracting information relevant at the international level. An international organization can not on its own collect detailed information about countries. Expert methods and remote sensing can give the rather rough information that so far has been requested at the international level, but if better information is wanted, countries must be more involved. It is then necessary that the capacity is developed in countries so that they can improve their information.

Some current problems at the national level are related to poor links between supply and demand of information. Thus the situation cannot be remedied e.g by just introducing or improving national forest inventories and related data gathering. It is necessary to consider the role of information in the policy process. This can be illustrated in the following way (Janz & Persson 2002):

- Public debate (or "political" or "scientific"),
- Identifying problems and potentials,
- Designing options for (political) action,
- Analysing the consequences of such action,
- Decision-making (which option to chose),
- Implementation,
- Monitoring.

The process can be seen as a circle. Implementation and monitoring generate new public political and/or scientific debate and new problem identification. In the above we have argued that the Criteria and Indicator processes provide this input and may serve as a specification for forest resources assessments. So what is the next step?

It has long been known how to implement national inventories but this knowledge is not used too a great extent in many countries. Instead, it seems as forest information has been supply driven in recent decades, partly through the promotion of remote sensing. The policy process will thus be guided with what can be collected with remote sensing not by the information needed. But without field work the knowledge gaps, particularly related to local management and land use, will remain.

Some decades back forest inventories where popular among

professionals. This interest seems to have declined. During some time after 1960 a number of inventory organizations were established in all tropical regions. Outside Asia there are really no longer much capacity. The donor programs dealt with collecting information, not to use it. Few organizations got a strength so that they could be of value in the policy process. That work remains or has to start from new.

We therefore conclude that the information and knowledge generation is best made at the national level, and integrated with national policy processes. The knowledge to collect information, mainly through national forest inventories, exist but the implementation capacity in many developing countries is very low. If better international information about forests is wanted, national capacities must be improved.

What is required at the international level?

Current international reporting requirements to forest-related fora are outlined in Braatz (2002). At present information is requested by many international organizations in a quite uncoordinated way. Countries are irritated by this. As questionnaires often are answered by different organizations in the countries the information coming from countries can also be conflicting. It would be a great advantage if FRA/FAO, CBD, IPCC, etc. co-operated and assisted countries to produce country reports which gave the information needed by most international processes.

There is a need to find forms of working so that the information requested at the international level – and which is realistic to give – can be supplied. In this context it is also necessary to strengthen the capacity at the national level. To do what is needed at international level wouldn't require a lot of money. If donors and international organizations joined in a CGIAR system for this we could get what we need. In 10–15 years time the situation would look much better.

International processes emphasize some, but not all benefits from forests, with some variation also over time. Currently, carbon sequestration and biological diversity dominate the debate and also the information demand. Thirty years ago it was the supply of wood. Likely, new topics will be rising in the future, perhaps related to water balances or energy. Global forest assessments should highlight currently important topics,

but also need to take a longer-term view – backwards as well as into the future.

Conclusion

We conclude that global forest assessments have been under a continuous development. We can be sure that the information needed and the methods available will look different ten years from now. This development will continue, driven largely by the international reporting requirements. It seems important that the global FRA process adopt the generic platform to address all benefits from forests and tree resources, for all beneficiaries. In this way, global FRA's can maintain a neutral and independent status visavi explicit agendas expressed in international processes and by various organizations.

Improvement of global FRA's requires a good co-operation with countries and professionals in countries. This is most easily achieved if the countries see that they can benefit from co-operating with FRA. This can mean that the countries get assistance to produce the information needed by the country itself, for example through multi-purpose field inventories supported by the global FRA process.

The political processes to establish Criteria and Indicator to monitor progress towards Sustainable Forest Management is an opportunity for global FRA's. Using the Criteria as a starting point for designing assessments may tie the inventory and assessment work closer to policy implementation and monitoring.

On the other hand, Indicators that have been selected for the Criteria is a mixed bag. On one hand they represent an effort to use existing or reachable data to monitor the Criteria. On the other, they may often be oversimplifications and are not applicable in different scales. Global FRA's should relate to indicators, but at the same time be a strong actor in developing and refining indicators, as well as how they are applied.

The scope of global FRA conceptually encompass international processes that deal with a partial set of benefits from the forests, eg climate change or biological diversity. It is therefore essential that synergies are found to make good use of financial resources and competence. Lack of resources may in reality not be the main problem. A lot of resources have been used for producing, e.g., land cover maps based on remote sensing with

the rationale to produce policy-relevant information. If such available reources were used to strengthen capacity in developing countries and generate the policy-relevant information in the field much could be achieved – also at the international level. One option would be a CGIAR-system for policy processes and improvement of statistics.

References

Braatz, S. 2002. International reporting requirements. *Kotka IV Background paper*

FAO. 2000. FAO Strategic plan for Forestry. FAO, Rome. www.fao.org/forestry

FAO. 2001. Global Forest Resources Assessment 2000 – Main report. FAO Forestry Paper 140. ISSN 0258-6150. www.fao.org/forestry/fo/fra/main/index.jsp

Janz,K. & Persson, R. 2002. How to get to know more about the forests? Supply and use of information for forest policy? CIFOR

Nyyssönen, A. & Ahti, A. (editors). 1996. Expert Consultation on Global Forest Resources Assessment 2000. The Finnish Forest Research Institute. Research Papers 620. ISBN 951-40-1541-X.

Persson, R. 1974, 1975, 1977. Reports about the forest resources of the World and Africa. Research Noters 17, 18 & 22. Department of Forest Survey. Royal College of Forestry, Stockholm

Stokstad, E. 2001. UN report suggests slowed forest losses. *Science*, 291(5512):2294

Thuresson, T. 2002. Feasability of low-intensity sample in national forest inventories. *Kotka IV Background paper*

Agenda Item 6

National Fores Assessment and their Links to Global Assessments

Country (India) View on Linkages between National Forest Information Needs and International Reporting Requirements

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Abstract

The national and international needs of forestry related information is similar, although at local level (forest division or district) only a limited set of data collected at a greater intensity may be adequate. Forestry data are generally both spatial and non-spatial in nature and these databases have to be made available in GIS environment. The power and speed of Internet and WWW have to be utilized in exchange and dissemination of such databases. For convenience, each country should have a nodal agency and/or server with vertical and lateral network linkages for collection, compilation, storage and dissemination of information. There is need to establish uniform standards for forestry terms and definitions. Similarly, some uniformity must be adopted in approach and methodology for collection of data, subject to objective and purpose of data collection. Each State Forest Department or agency may create databases pertaining to their local domain. All these can be linked to the server of the central/nodal agency where national and international level data are stored. It should be an endeavour of nodal agency to maintain the databases and metadata as per agreed international formats and standards. Since India and many other countries are yet to develop these standards, international coordinating organisations such as FAO and IUFRO may provide all necessary assistance in developing uniform formats and standards for creation of electronically linked databases.

Introduction

Forest-influences transgress international boundaries and, from the perspective of forest as land use, the whole earth becomes a global village. Certain global phenomena where forests play crucial role, such as climate change, environment and biodiversity, have been drawing attention of the whole world. Today no single country can remain unaffected by what happens to the forestlands in other regions. In such a scenario, there cannot be any difference between national and international information needs with respect to forests. However, besides being a global resource, forest is also a local resource and a few limited aspects of forest may get prominence at local level. For instance, production of wood, fodder, medicines and creation of employment and income are considered more important at the local level. Consequently, planners and managers at divisional or district levels may need data only on these aspects of forest resources. However, at national and international levels, in addition to basic data on forest resources, quantitative information on role of forest in biodiversity conservation, carbon sequestration and environmental amelioration is equally important.

Till recent past, most of the forest related information generated by different countries pertained to their local and national perspectives on forestry. National and regional plans were largely based on the quantifiable tangible products coming from the forests. The information needs were largely confined to finding out availability of forest resources and means to utilise them for maximum economic growth. However, the last few decades have witnessed a change in the perception of values of forests and their management. It was during the 1970s and 1980s that global awareness about conservation role of forests got momentum and information needs at national and international levels began converging. This paper describes national and international information needs and linkages from India's perspective.

Country background and information needs

India is a vast country with geographical area of 3.3 million sq km. Variety of its climate and agro-ecological zones has made India one of the 12 mega-biodiversity regions in the world. Its

forest resources, covering about 19.4 percent of the country's geographical area (FSI, 2000), have been classified into 16 major and 221 minor forest types (Champion & Seth, 1968). After independence in 1947, the initial thrust had been on exploitation of natural forest resources for economic growth. It is reflected from its forest management practices during those decades and also from five-year plans formulated for country's economic development. Forests were largely treated as resource for generating revenue and supporting wood-based industries. Though information on forest areas, legal status, growing stock and wood production were available at local level in scattered form, not much information existed on availability of forest resources in the country or a region as a whole and as such it was difficult to plan growth of forestry sector. Such information was essential for national as well as state level planning. It was mainly due to this reason that the Government of India in 1965, in collaboration with FAO and UNDP, established an organization called Pre-investment Survey of Forest Resources (PISFR) for taking up assessment of forest resources in selected areas of the country so that feasibility of supporting wood-based industries could be ascertained. PISFR took up survey of forest resources through ground inventory (to assess growing stock of different species) and also employed aerial photography (to prepare thematic maps of forest areas at 1:50,000 scale). Later on, in 1981 on recommendation of National Commission on Agriculture PISFR was renamed as Forest Survey of India (FSI) and it was mandated to monitor changes in forest cover, forest structure, species composition, etc., periodically and also to provide data on forest resources to support national level planning. It is not easy to estimate at any one point in time the growing stock of a resource of such vastness and variability by traditional field inventory methods or even by aerial photography. From 1986, FSI, an organisation under the Ministry of Environment & Forests (Govt. of India), started monitoring forest cover and changes therein on a two years cycle using satellite data.

FSI is only one of the sources, although a premier one at the national level, of information on forest resources. There are several other institutions and organisations that are also engaged in collecting and compiling one or the other forestry-related information. These include Ministry of Environment & Forests (Govt. of India), Forest Departments in the States and Union Territories, Indian Council of Forestry & Education

(ICFRE), Indian Institute of Forest Management (IIFM), Wildlife Institute of India (WII), Tata Energy Research Institute (TERI), National Remote Sensing Agency (NRSA), Central Statistical Organisation (CSO), Botanical Survey of India (BSI), Zoological Survey of India (ZSI), Central Institute of Medicinal and Aromatic Plants (CIMAP), Ministry of Commerce (Govt. of India), etc.

The information needs at local and national levels for planning purposes and for sustainable forest management include information on:

- Area and forest cover (natural and man-made forests)
- Tree cover outside forests (with species and diameter classes)
- Area under dense and open forest cover
- Area of protected ecosystems
- Growing stock of different species of wood
- Increment in volumes of different species of wood
- Availability of medicinal plants and other non-wood forest produce
- Volumes of production of wood and non-wood forest produce
- Demand, supply and trade (including international trade) of wood and non-wood forest produce with price trends
- Forest area diverted to non-forestry use
- Extent of community managed forest areas
- Number and names of endangered, rare, threatened and endemic species
- Status of natural regeneration
- Area under watershed treatment and status of soil erosion
- Location, extent and frequency of forest fires, pests and disease incidences
- Extent of forest area under working plans
- Employment generated in forestry and forest based industries
- Level of investment in forestry sector
- Number of personnel (government,, non-government, community, individuals) working in forestry sector
- Number of forestry training, education and research institutions and their capacity
- Biodiversity indices and gene pool
- Stock of carbon in forests, plantations and forest soils

Most of these data get collected at local level and compiled at state and national levels while some information is generated only at macro level. However, for each of these types of information, there may not be an appropriate mechanism for their periodic collection, compilation and dissemination. Also, the periodicity necessary for these information may be different. For instance, information on afforestation, rehabilitation of

degraded areas, encroachments, forest fires etc. is usually required annually, a periodicity of five years would be adequate for information on the extent and changes in forest cover, land use pattern, growing stock, etc. Data on production, trade and prices of forest produce may be needed on monthly or quarterly basis. Currently, Food and Agriculture Organisation of the United Nations (FAO) conducts global assessment of forest resources at an interval of ten years.

There are a number of users and stakeholders of forest related information. Besides Central and State Governments, these include research organisations, Universities and other educational institutions, industry and commercial organisations, training institutes, statistical organisations, NGOs, various international organizations, donor agencies, journalists and other individuals.

Information dissemination

It is not enough to collect and compile information; it has to be accessible to the users in a convenient and efficient manner. The owners of forest related information are mostly government controlled organisations or departments for whom transparency has never been a tradition. Only recently have they been waking up to the need for sharing information with the stakeholders. Thanks to the revolution in the field of information and communication technology, several ministries in the Government of India (including Ministry of Environment & Forests) and organisations (including FSI, WII, etc.) have their own websites through which a number of forestry data and statistics are made available to the public. The National Informatics Centre (NIC) at New Delhi acts as the nodal agency in assisting the Central and State Governments. NIC has its network throughout the country with its nodes in most of the Districts. However, many State Forest Departments, the primary sources of local forestry information, are still not on the network. Moreover, information has to be in a standard format where relevant queries can be made. However, such databases for forest related information are yet to be developed.

Recently, Department of Science & Technology (Govt. of India) has taken an initiative to establish a National Spatial Data Infrastructure (NSDI) for providing access to spatial (as well as non-spatial) data being generated and managed by

various agencies. FSI is one of the members of the Task Force for developing NSDI and is the nodal agency for forestry data. NSDI is visualized as a network of databases consisting of domain specific databases (such as forestry database to be created and managed by FSI) and a central database having metadata (to be managed by NSDI secretariat). Various issues, such as evolution of database standards at various domain servers and metadata standards for providing single window access to the domain databases are being looked into. FSI has proposed to the Ministry of Environment & Forests (Govt. of India) that during the tenth 5-year plan (2002–07) a country-wide network be created to link all the forest departments in the states and union territories. Hopefully, when NSDI is fully functional, FSI domain server will be able to link information providers and the users and there will be exchange and dissemination of information in an efficient manner.

International linkage

There have also been initiatives at international level, by FAO and International Union of Forestry Research Organisations (IUFRO), to develop Internet/World Wide Web (WWW) based forestry databases (FAO, 2001; Paivinen, *et al*, 2000). FAO has taken steps towards development of an integrated electronic Forestry Information System (FORIS) while IUFRO has come out with a strategy to create a Global Forest Information Service (GFIS). FORIS provides dynamic access to forestry data by country to Web users. FORIS has partnership with a large number of member countries that will be expanded further. The GFIS is being developed as a distributed network of metadatabases, using Internet and WWW, and will link information resources of contributing partners.

These international developments are in complete conformity with NSDI proposed by Govt. of India. FSI, on behalf of the government, can be one of the contributing partners to FORIS and GFIS and can serve as a country node. The metadata standards and formats being developed for FORIS and GFIS can be used by FSI for developing databases for its own domain server (within NSDI framework) and network.

Gaps in information

Certain problems and gaps likely to be encountered while creating worldwide linkages of forestry information may be indicated here. In India, most of the forestry terms and definitions adopted are the same as defined during British period in India. Some of the terms and definitions are adopted from those used by international organisations. Sometimes there is ambiguity over definitions of certain terms e.g. forest, degraded forests, wastelands, scrub, etc. There is a definite need to establish a process of developing and accepting terms and definitions so that as far as possible a set of standard definitions gets adopted and used.

There is no well-defined process of collecting and compiling new information. Most of the organisations/agencies involved develop their own methodology. FSI is the main organisation entrusted with the task of assessing forest resources and it has a well defined and documented procedure of ground inventory, data collection, data processing, remotely-sensed data interpretation, etc. but there are other agencies which are also collecting and generating the same information, though on a smaller level. This not only results in duplication of work but also often lead to confusion and controversies mostly because of differences in classification, approach and methodology.

The data ownership usually rests with the organisation generating the data. Overall ownership belongs to the Government of India in case of Central agencies and the State Governments in case of State Forest Departments. Though most of the data is readily accessible, certain data/information are classified and have restrictions imposed on its sharing with the users. These restrictions vary from organisation to organisation and also depend on the nature of data. Certain information is classified as restricted and can be made available only after getting security clearance from the Govt. of India.

Certain information, such as extent of forest cover, changes in forest cover, land use pattern and changes therein, forest types, occurrence of forest fires, demographic information, etc. are readily available. However, information related to forest types, species composition, demand and supply of forest produce, encroachments, status of plantations, extent of trees outside forests, etc. are not readily available. Often these have to be estimated by employing survey and statistical tools that are time consuming and labour intensive.

In case of information not available readily or not compiled as a matter of routine, there may be uncertain amount of delay in reporting. In case of local data the delay may not be too long but for information needed at regional or national levels, and in absence of an established network for information exchange, the delay may become quite severe.

Conclusion

The national and international needs of forestry related information is similar, although at local level (forest division or district) only a limited set of data collected at a greater intensity may be adequate. Forestry data are generally both spatial and non-spatial in nature and these databases have to be made available in GIS environment. The power and speed of Internet and WWW have to be utilized in exchange and dissemination of such databases. For convenience, each country should have a nodal agency and/or server with vertical and lateral network linkages for collection, compilation, storage and dissemination of information. There is need to establish uniform standards for forestry terms and definitions. Similarly, some uniformity must be adopted in approach and methodology for collection of data, subject to objective and purpose of data collection. Each State Forest Department or agency may create databases pertaining to their local domain. All these can be linked to the server of the central/nodal agency where national and international level data are stored. It should be an endeavour of nodal agency to maintain the databases and metadata as per agreed international formats and standards. Since India and many other countries are yet to develop these standards, international coordinating organisations such as FAO and IUFRO may provide all necessary assistance in developing uniform formats and standards for creation of electronically linked databases.

References

Champion, H. G. and S. K. Seth. 1968. A revised forest types of India. Publication Division. Government of India, New Delhi.

FAO. 2001. Global Forest Resources Assessment: Main Report. Forest and Agriculture Organisation of the United Nations, Rome.

FSI. 2000. State of Forest Report-1999. Forest Survey of India, Dehradun.

Paivinen, R., E. Landis, R. Mills, G. Petrokofsky, D. Langor and A. Schuck. 2000. Global Forest Information Service – Improved access to information on forests. XXI IUFRO World Congress, 7–12 August 2000, Kuala Lumpur, Malaysia.

The Linkages between National Information Needs/ Situation in Poland and International Reporting Requirements

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Abstract

In the paper the general shape of Polish forestry information system was presented on the background of historical development. The main information levels (local, national, international) were analyzed with particular attention paid to local level, where the major part of national data has been generated so far. The main organizational interlinkages between the levels were charted, for which the most severe constraint, the varying of data quality, was presented. Possible recommendations to improve the present information system were proposed, which should lead to better recognition and coordination between international assessments. The increase of national/international capacities and tighten incorporation of international level into national inventory systems are main conditions for better development of international assessments.

Introduction

The general shape of Poland's forestry information system in big extent was determined by ownership structure which has been unchanged for over the last fifty years. In this period prevailing part of country forests was held by State Treasury (about 80%), the remaining part belonged to numerous (about 1 million in 2001), dispersed private owners. The second factor which highly influenced the principles of information system

was the political and economical priority given for wood and other commercial forest products. This priority was especially visible before the year 1989.

Poland is the country which managed its forests in the typical way common for Central Europe. Polish foresters decided to develop traditional forest management plans as a basic source of forest and forestry information. In consequence, in the frame of forest inventory, the ample set of data has been collected, which in some part has been expected only to supply the data for forest management at the local level. Important segment of assessment reports was designed mainly for analyzing and aggregating at the regional and national levels. The source data was collected according to the same, nationally applied methods with similar, relatively high quality, that is why mentioned system seemed to be efficient and sufficient until the end of seventies.

The ecological catastrophe which occurred in the eighties took form of permanent deforestation in the south of Poland, which made Polish foresters aware of the weakness of hitherto information system. The main disadvantage was the long period (10 years) of data collection and the limited extent of information. The lack of data about the health and sanitary state of Polish forests was especially severe. Prompt actions oriented to supply existing database were taken, which resulted in four cycles of state forest health inventories in the eighties and in the establishment of Forest Health Monitoring which has been carried out in the frame of "International Cooperative Program – Forest" since the 1989.

The ongoing increase of international political activity initiated the third stage of development of national information system. The standard created by MCPFE Criteria & Indicators of Sustainable Forest Management and conformed to the Polish conditions was applied as a reference system for existing data sets. The results of these application gave the basis for political decisions which established new tools for efficient forest information system. For many reasons those regulations have not been introduced into practice so far but an acceleration of this process is expected in the nearest future.

Background

In the result of applying the management planning inventory as a main data source, the shape of Polish forest information system was formed by so called "Forest management planning instructions" in big extent. The first one edited in 1957 (Anon., 1957) covered all issues related to a process of forest inventory and planning, including definitions, methods and standards. The instructions are under the process of development until the present time. On average, a new version was edited every ten years by special teams erected by the minister responsible for forestry. Teams were formed out of outstanding representatives of forest management planning science and practice, which should ensure the continuous transfer of new demands, knowledge and technologies into ongoing activities. Although instructions were designed for inventory of state forests districts they were also used in other forests, including national parks.

Local level

For almost forty years forest management plans had been elaborated exclusively by the state company – Office of Forest Management Planning and Forest Geodesy. This Office is still prevailing actor on inventory market but now it competes with private enterprises working in this field. In the result of the planning process every forest district receives assessment report for each stand, updated maps and a set of plans valid for next ten years. Detailed stand description was continuously supplemented by district service with the information about all operations made during 10-years period of plan validation, however there was no updating of original inventory data at a local level.

The scope of forest district database has been continuously improved in order to respond to the increasing demand for information about environmental aspects. The significant development has been noticed regarding the site assessments and evaluation of biological diversity. But the development of information technologies had even more influence on the system. Database and geographical software enabled efficient management of huge databases owned by forest districts by the data owners. The integrated database system successfully implemented in all districts covers all operations and allows continuous updating of the state of forest stands. But this

computer based system is even more valuable in terms of data availability. Information about natural resources is owned by State Forest Holding, according to law it is accessible for the public. Having data stored in electronic format provides access for the society to environmental data. The procedure of negotiating forest management plan is obligatory and includes all stakeholders in the process of management planning.

National level

Forest information at national level, due to the uniform character of property structure, had been of secondary importance for almost forty years after the II World War. Because majority of economic and ecological decisions were taken at the local level, the main purpose of data aggregating on the country level was to publish the information by the Central Statistical Office (Budna and Grzybowska, 2000)

Data at national level is a collection of information captured from different sources. The information from State Forests Holding, which has been processed by the same Office responsible for inventory and is the core of national database. The essential part of information – age class tables by dominant species in terms of area and volume are updated annually with the use of:

- new source data from districts which were inventoried in the previous year,
- harvest data delivered by forest districts and
- volume of increment drawn from yield tables.

The data which characterized other properties was of varied accuracy, value and timeliness.

In practice this solution was efficiently functioning as long as forest information was internal information for forest sector. The political breakdown in Poland in 1989, change of economic and political systems, coincided with the general decrease of natural environment, which resulted in the increase of public anxiety in this matter. The last decade of previous century was also the time of "outbreak" of global and regional initiatives aimed to protect natural environment, which resulted in the rapid increase of demand for relevant data. All those circumstances had to affect the forest information system.

The first and most important indication of this change in Poland was Forest Act (Anon., 1991), which comprises among other basic forest definitions, adopted from "Forest manage-

ment planning instructions". Except elevating the rank of definitions, new Forest Act and Forestry Policy (Anon., 1997) established the basis for information system. According to the Act the national forest inventory of all properties should be carried out and national forest data bank of all properties should be established. The Act confirmed the key role of State Forest Holding in this process, addressing mentioned activities to the general director of this holding.

Hitherto efforts to introduce new tools for collecting, storing and analyzing of national data allowed completing preparatory works. Up-to-date forest district inventory data is the base source for national system, which is supplemented by information from Forest Health Monitoring carried out by Forest Research Institute. Forestry related data are widely distributed by different means, the most important one is "The report on forest condition in Poland" (Michalak, 2000) which is elaborated annually, consulted at different authority levels and finally accepted by Parliament.

International level

Being a member of the main regional and global organizations (UN, OECD), processes (MCPFE) and conventions (FCCC, CBD, CLRTAP) Poland participates in the majority of relevant assessments. The responsible body for dealing with international statistics is Forestry Department of Ministry of Environment but professional assistance for this assessments provides Forest Research Institute, which is authorised to invite other organizations. The scope of involved bodies is varying and depends on the type of assessment. Besides Central Statistical Office, State Forest Holding and Office of Forest Management and Forest Geodesy valuable input is delivered by other institutes, universities and societies. At the same time numerous occasional data requests from abroad are answered by mentioned agencies.

Linkage and gaps

The general scheme of interlinks between national data sources and their holders was presented in the previous chapter. Despite the fact that many involved organizations are supervised by different Ministries, not every procedure has legal basis. Partic-

ularly, in case of reporting for international assessments, lack of formal regulations is visible, however the mandate given by the Minister of Environment for Forest Research Institute and efficient contacts between partners enable successful results in carrying out these assessments.

In our interpretation of participation in regional and global assessments the exhaustive preparation of country data should be only a part the assessment. Besides the cooperation in the methodological part of assessment the tasks of equal or even higher importance are the transmission of new demands into national systems and dissemination of international data. The possibility of participation (or at least assistance) in preparatory works depends on the assessment. The example of the cooperation which is the most desired one was applied during the Forest Resource Assessment 2000. Thanks to the mentioned efficient cooperation between Polish organizations the international forest data is widely spread using national reports and yearbooks. Unfortunately direct influence of global standards on the national system is rather limited for the lack of efficient adjustment processes for binding terms and definitions.

Despite numerous problems with data reporting, the most important constraint in this process is varying of the scope and data quality in national information system. The example of this is the expert assessment of data origin about above ground, woody biomass (fig.1). Similar problems occur in relation to other types of data, especially those which deal with changes of forest resources and data addressing new indicators.

The increasing interest on environmental issues at international level, observed in the last decade, resulted in a bigger amount of assessments. Largely these assessments rely on national data and use national capacity for data preparation. In Poland this increase is not followed by the increase of country capacity. The risk of data reporting, which is not of the best quality, has appeared. The lack of harmonization between international questionnaires resulted in redundancy of national data in the international reports or in discrepancies coming from different recommended methods of data preparation.

Alternative strategies

The basic action which should be applied in national inventory system is the implementation of economic analyses of data

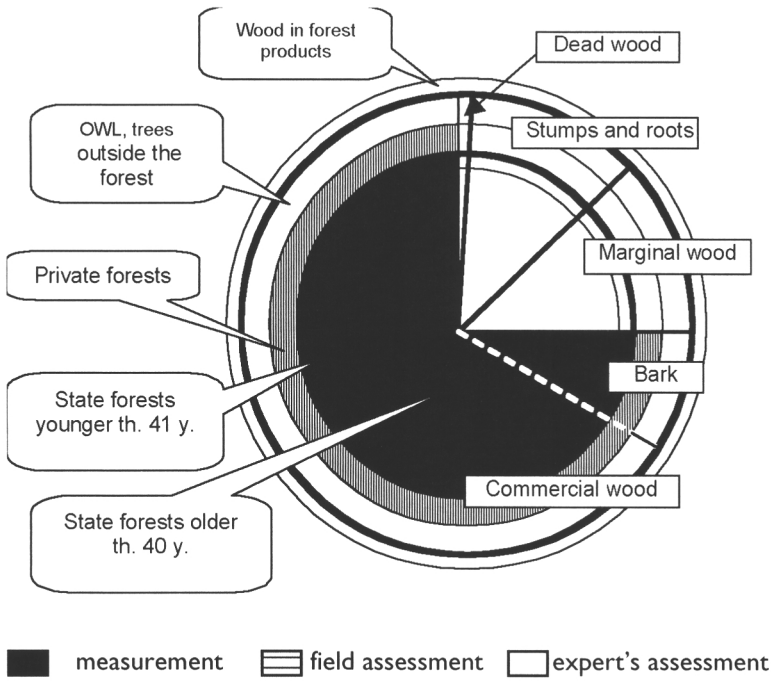


Figure 1. General scheme for data origin of wood resources in Poland. Marked areas in this scheme reflect approximate proportion of resources.

collection. The first step in such analyses is the thorough recognition of national demand for forest information, which should also include questionnaires. Such research has no long tradition in Poland. The first and only questionnaire on the needs of forest districts was carried out in 1997. Similar investigation on the national needs was conducted in the year 2001. The next step is differentiation of data depending on demand and support of the data of highest usefulness. Elaborating permanent rules for verification and updating of national information system is essential in this process. This will be empowered by integrated National Forest Inventory and stand inventory conducted for the forestdistricts.

From the national point of view, participation in international assessments should be the part of country information system. For the bilateral benefits the role of international processes in these systems should be more creative. International statistics should be regarded as inseparable, integral part of national reporting. This purpose can be mainly achieved by:

- avoiding data redundancy between international assessments,
- harmonization of definition and methods,
- stimulation of national capacities by their involvement in elaboration, interpretation and dissemination of international statistics,
- developing regional and sub-regional (internationally) processes,
- limiting the scope of assessments in order to define priorities and support the collection, interpretation and dissemination of relevant data.

Careful recognition of national/international data demand confronted with the present information system and available human, technical and financial resources should resulted in joint actions toward the development of this system. The active role of international statistics in this process could rely on the mentioned stimulation of national systems, which does not necessarily mean only the direct financing of data collection. Organizing joint workshops, trainings, exchange of specialists to carry assessment, or even language courses could become an even more important investment, which would allow better understanding, communication and cooperation.

Proposals discussed above are the means of improvement of present forest information systems. Thinking about alternative strategies for existing system, the option for establishing international data base should be regarded. It could work on regular basis and should be taken into account carefully. However the limits of this paper do not allow the explanation of this option.

Conclusion

Economic changes, increasing needs of data users, technical progress in inventory methods and techniques are the reasons for which Polish forestry is obliged to modify their information system, with a special attention paid for inventory of forest resources. Local, national and international levels should be taken into account. In the new system, the amount of features will be reduced for the benefit of data reliability. The increase of ecological features should be predicted, although the productive aspects will keep their place.

The necessity of substantial development of national system is accompanied by the increase of interest in environmental issues at international level, observed in the last decade. This

interest often burdens national systems with the significant amount of work, which is hard to foresee. At the same time, active participation in international programmes could provide access to the newest methods, technologies and techniques, especially for not highly developed countries. Possible investment in the cooperation in the field of forest assessment should benefit in many other areas, which should also bring the improvement of source data quality.

References

Anon., 1957. *Instrukcja urz_dzania lasu* (Instruction of forest management planning). Warszawa. PWRiL, 184 pp.

Anon., 1991. *Ustawa o lasach z dnia 28 wrze_nia 1991 roku* (Forest Act). Dz. U. nr. 101, poz. 444, with future amendments.

Anon., 1997. *National Policy on Forests*, Warsaw. Ministry of Environmental Protection, Natural resources and Forestry, 35 pp.

Budna, E., Grzybowska, K. 2000: *Le_nictwo 2000* (Forestry 2000). Warszawa. G_ówny Urz_d Statystyczny (Central Statistical Office). 290 pp.

Michalak R. (ed.) 2000. *Raport o stanie lasów w Polsce 1999* (Report on the condition of forests in Poland). Warszawa. Centrum Informacyjne Lasów Pa_stwowych (State Forests Information Centre). 40 pp.

South Africa's View on Linkages between National Information Needs and International Reporting Requirements

Sebueng Kelatwang

Introduction

Forest cover in South Africa comprises woodlands, indigenous forest and plantations. These resources vary significantly between provinces. Open savannah woodlands cover a large proportion of the country and vary in status, ownership and condition. Of the estimated 690 000 hectares of closed canopy forests, 69% is owned by the state and 31% by private institutions. An estimated 1.3 million hectares of industrial plantations are managed for sustainable production. Of these, 7% is owned by the state, 11% other corporate and 82% by private companies. Afforestation is occurring at a rate of around 10 000 to 12 000 hectares per year.

Time interval to collect new information

In the past forest information was collected on an ad hoc base depending on policy demand and donor funding during a particular period. Currently, the National Forests Act (1998) requires the Minister to monitor forests according to criteria and indicators and report to parliament at least every three years on facts and trends emerging from monitoring. Emphasis on the kind of information and time interval to collect and update the required information will vary depending on the national and international reporting requirements. Forest managers at forest management unit still collect relevant information regularly to monitor sustainable utilisation and conservation.

Changes in the demand of forest information over time

Demand for forest information has changed dramatically over the past eight years when forest policy changed perspective from timber production to social, economic and environmental issues. While the past forest policies focused only on annual roundwood timber statistics to promote sustainable commercial forestry development, the current forest policy endeavour to promote Sustainable Forest Management on all forest types. This change in policy perspective necessitated the need to interact policy development and implementation with information gathering process. In order to achieve this, a process to develop a Forest Resource Information Service that will pull information from different sources, identify data sources and gaps, was initiated. This system will be designed in such a way that information is presented in a useful format for policy-making, planning and reporting requirements. The proposed draft criteria and indicators framework that are currently being developed will form a basis for identifying relevant information and information gaps. It will also serve as a linkage between various information sources and different levels of government. Essentially, the type of information collected will reflect the needs of preparing the report on the state of South African forest resources.

Users of information

Users of forest information includes amongst others:

- The Department of Water Affairs and Forestry for reporting and policy review;
- The forest industry in South Africa;
- Research organisations and educational institutions;
- Other Govt.Departments like Department of Environmental Affairs and Tourism;
- Development and environmental NGOs;
- Members of the public and
- International organisations, such as the FAO.

Process to develop terms and definitions of different forest types

Terms and definitions for different types of forests are defined in the National Forests Act (NFA) No.84 of 1998. In terms of NFA, "natural forests" are defined as a group of indigenous

trees whose crowns are largely contiguous or which have declared by the Minister to be a natural forest under section 7(2). "Woodland" is a group of indigenous trees, which are not a natural forest, but whose crowns cover more than five per cent of the area bounded by the trees forming the perimeter of the group. "Plantations" are defined as a group of trees cultivated for exploitation of the wood, bark, leaves or essential oils in the trees. A definition on plantations has not aroused many debates, however for the purpose of the new classification system; natural and woodland definitions were aligned with international definitions.

Classification system for woodland resources

The Department commissioned the Council for Scientific Industrial Research to develop a classification system for woodlands. A hierarchical, nested, repeatable classification system was proposed. The new classification system seeks to address the discrepancy between the definition as defined by the National Forest Act and United Nations Food and Agricultural Organisation. It is designed to be suitably robust, yet disparate enough to allow for minimum conservation of each woodland type as required by the National Forests Act of 1998. For this purpose, woodlands include different types ranging from wooded grasslands (between 5% and 10% canopy cover) to dense thicket (area with over 75% canopy cover). Two levels of classification system were proposed namely, structural classification, which provides the extent of woodland cover, and the functional classification, which is based on ecological and physiological similarities.

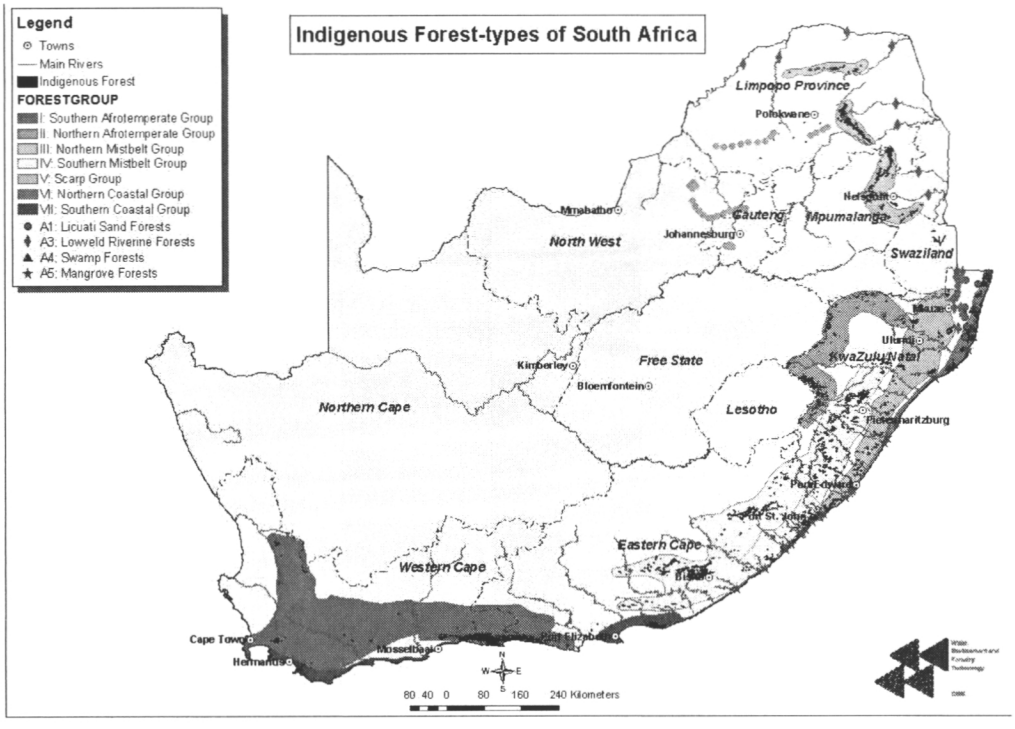
Table 1. Woodland types by extent of cover and height

Woodland type	Cover in %	Height in metres
Wooded grassland	5–10	1–20
Open woodlands	10–35	2.5–20
Low woodlands	35–75	2.5–6
Tall woodlands	35–75	6–20
High woodlands	35–75	>20
Open Bushland	10–35	1–2.5
Bushland	35–75	1–2.5
Thicket	>75	1–2.5

Source: DWAF: 2002

Natural forest classification

The new classification system for indigenous forests in South Africa, defines indigenous forest as a multilayered vegetation unit dominated by trees (largely evergreen or semi-deciduous) whose combined strata have overlapping crowns (i.e. the crown cover is greater or equal to 75%) and where graminoids in the herbaceous stratum (if present) are generally rare. This definition is based on a review of existing definitions used within South Africa and southern Africa, and elsewhere (DWAF, 2001). Previous classification systems were not derived from biological information as such could not provide government with meaningful report on the state of the forest in South Africa nor set conservation priorities. To address this shortcoming, the current classification system encompasses biographic and floristic factors. A computer-assisted numerical analysis of secondary data supported by specialist knowledge from a wide spectrum of forest ecologist was used to develop this system. Map 1 below provides the extent and distribution of indigenous forests in South Africa.



Map 1. Extent and distribution of indigenous forests in South Africa

Table 2. Distribution of indigenous forest according to ownership and province

Province	State(Hectare)	Private (Hectare)	Total (Hectare)
Limpopo	28620	8429	37050
Mpumalanga	23197	19181	42379
KwaZulu Natal	96081	43496	139578
Eastern Cape	270319	126130	396449
Western Cape	63950	12363	76313
Total	482169	209601	691771

Process of collecting, compiling the new information and agencies involved

Data categories required for Forest Resource Information Service is identified on the basis of specifications of criteria and indicators of Sustainable Forest Management. This data will come from many sources and parties, and a strategy and plan for accessing and updating such data is still to be developed. The Department of Water Affairs through the CSIR National Land Cover collects information on the extent and distribution of all forest types in South Africa. Information on non-timber forest products from state land is collected through licences and exemption at local level and aggregated at national level. The Department of statistics collects information on utilisation of forest resources (fuelwood, non-timber forest products) on communal land. Roundwood timber statistics is collected through questionnaires.

Process of reporting at local, national and international level and agencies

The National Forest Act of 1998 mandates the Department of Water Affairs and Forestry to report every three years on the "state of the forest" in South Africa. Following this, the report is submitted to the Department of Environmental Affairs and Tourism to meet the requirement of the National Environmental Management Act. The Department of Environmental Affairs submits a report on the "state of the environment" to the UN commission on sustainable development.

Key players in placing demand, collecting, processing and supplying information

Key players in placing demand, collecting, processing and supplying information are the same as in section 1.3 above.

Data ownership and access

The Department of Water Affairs and Forestry and other government agencies who collaborate in gathering information owns the data, however research and academic institutions are mostly commissioned to collect this information. There is potential to also access information on plantation cover from private companies.

Changes over the decade

There have been tremendous changes in the demand for forest information over the last decade as the government moves towards promotion of Sustainable Forest Management. Different stakeholders are also beginning to collaborate in terms of sharing costs for data gathering. There is a move towards consultation with respect to agreed terms of reference for different classification systems of all forests types. Information sharing has also improved over the past five years.

Linkages and gaps

In most cases forest inventory is seen as a technical problem meant to merely describe extent and distribution of forest in South Africa. Currently, the only linkage that exists is between data gathering and regulation. Added to this, emphasis on utilisation of criteria and indicators at national, and forest management unit is on monitoring and regulation and very little emphasis is placed on policy development and review. While the National Forests Act provides a framework for reporting, at national level, this framework is yet to be adhered to when organising and collecting data at local level.

Gaps in terms of time interval for collecting and updating various categories of information at various level of government depends on policy priorities and availability of resources. Poor linkages between national and international reporting requirements is frustrated by different categories of informa-

tion requirements, poor harmonisation of forest types definitions and different time intervals required to collect and update information.

Alternative strategies

- *Implementation of a system to pull forest information together at national level*: The problem in forestry information is not the lack of information but its partial, fragmentary nature and the lack of capacity to pull information together that is constraining its usefulness to interest groups. The Department of Water Affairs and Forestry seeks to address these problems through the development of a forest resource information system using criteria and indicators as guidelines for required data categories;
- *Presentation of information to decision-makers*: An interface that link data collection and data use is required. This interface should have the capability to organise information in a useful format for policy-making and planning;
- *Process to collect information*: Information requirements for each reporting period need to be communicated well in advance to relevant suppliers of information. A framework such as criteria and indicators as developed in South Africa can assist various collaborators to identify which information will be needed in the short, medium and long term. Formal agreements for information provision and access is needed and a network of willing collaborators would need to be established both at local, national and international level.

Conclusion

Forest policy changes places great challenges to providers and users of information in terms of seeking the most cost effective way of gathering data. Linkages between policy development, reporting requirements should form an integral component to the process of data collection and regulations. A collaborative network supported by incentives to providers of information is required for the successful implementation of this process. Often, users of information expect providers of information to supply them with information without taking into consideration constraints that these institutions are facing. In order to ensure systematic flow of information from local right up to international level, data categories for each reporting period needs to

be communicated to various spheres of government prior to the reporting period, and a collaborative network of providers and users of information is needed. Finally, a system that has the capacity to pull and co-ordinate the relevant information from different sources is required.

References

Department of Water Affairs and Forestry 2002: Draft baseline Study on Woodlands in South Africa, unpublished, Pretoria.

Department of Water Affairs and Forestry 2001: Classification System for South African Indigenous Forest, unpublished, Pretoria.

Department of Water Affairs and Forestry 1997: South Africa's National Forest Action Programme, Government printers, Pretoria.

South Africa, 1998: The National Forest Act No 84 of 1998, Department of Water Affairs and Forestry, government printers, Pretoria.

Forestry and Tree Information Gaps at National Level

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Introduction

This paper is intended to provide an overview of forest and tree information gaps compared to the actual needs at the national, regional and international levels. The first step consisted of identifying information users and the corresponding needs. Countries are the major users of information through governmental institutions and the civil society. At the global level, international processes and forums like many international agencies such as multilateral development banks, donor agencies and NGOs covering forest sector, are becoming very demanding of a wide array of diverse and complex information. The major global classes used by FRA – forest, OWL and OL (TOF) – are the main sources where information for different wood and non-wood products and services is collected.

Review of the information at the national level was done for the industrialised countries and developing countries separately. The state of forest and tree resources information in the industrialised countries was reviewed in respect to the parameters listed for assessment by FRA 2000 including forest area, area of other wooded land, growing stock of trees, total woody biomass, net annual increment, annual fellings, annual removals, average annual change. The parameters comprised also records on plantations, trees outside forest, biological diversity, forest management, forests in protected areas, fires, wood supply and non-wood forest products. Review was done in respect to responses/non-responses to questionnaires and on attributes. Some countries did not respond to the questionnaire on any item and others did not respond on some attributes. Review of the country information according to methodologies followed for data generation could not be performed for lack of sources.

Review of information from developing countries was done according to methodologies adopted to produce information on

forest and tree resources. Four methodologies were considered namely: detailed mapping, nationwide field sampling, general mapping and expert estimate. These give clarifications on the nature and extent of information produced using any of these methodologies. The review was thus done in respect to availability of information on forest and tree parameters of interest to national and international levels

Industrialised countries have information on a large scope of forest attributes but little or nothing on trees outside forests. The extent information is still variable among countries.

Information in the developing countries is very poor. Most available data is on area of forests. Other forest parameters are widely missing. Information on trees outside forest and other wooded lands are lacking all together. Reliability of country information is generally low.

Who uses forestry information?

Requirements for forest and forestry information are large and unquestionable and national and international interests on other wooded land and trees outside forest resources are also growing. On national level, quality information is required for policy development, implementation and monitoring. Without relevant base information, it is not possible to reliably outline optional courses, nor to evaluate the effects of previous decisions. On the international level, several processes, notably those dealing with carbon cycling, biodiversity, ecosystems and desertification, require quality-controlled input to models and analyses as well as to monitoring systems.

Countries are the major users of forestry and tree resources information through governmental institutions and the civil society. At the global level, international processes and forums like many international agencies such as multilateral development banks, donor agencies and NGOs covering forest sector, are becoming very demanding of a wide array of diverse and complex information. The major global classes used by FRA – forest, OWL and OL (TOF) – are the main sources where information for different wood and non-wood products and services is collected.

The extent and quality of information available in the countries depend on the country's responsibility. Information needs can be defined only by the users themselves. The role of FAO is

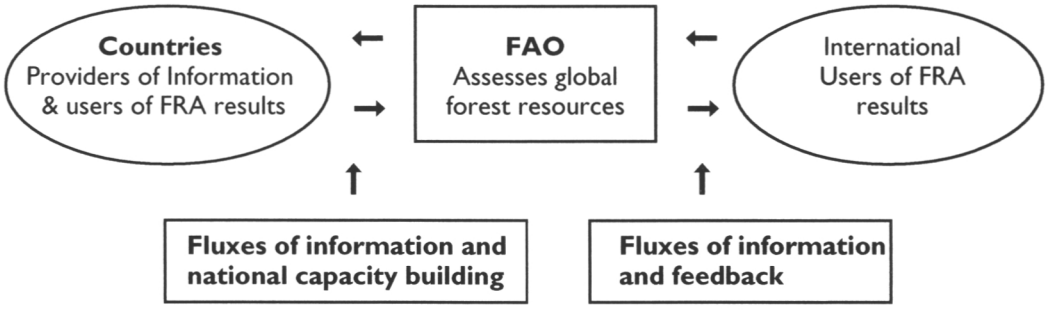


Figure 1. FRA process management and interactions with information providers and users

to identify different users of forest and tree information and work with them to define their needs, collect national data and process it according to international standards. FRA outputs are made available to users at national and international levels who feedback FAO for further FRA improvements.

What information is needed?

The world forest resources were assessed by FRA 2000 on the basis of the recommendations of the expert consultation (Kotka III) held in Finland in 1996, which provided a framework to FAO on conducting the assessment. Kotka III emphasised the need for FRA 2000 to provide basic information on traditional indicators of forest management such as *state of the world forest area, volume and biomass and changes since 1990.* It also stressed the need to include a number of non-traditional parameters in the assessment to provide a more holistic vision of forests. These include *non-wood forest products and services, protected areas, trees outside forests, biodiversity, management, fires, timber supply area, removals and others.*

The parameters recommended by Kotka III can still be extended to include a number of other environmental and production indicators from forests, OWL and TOF that are rarely contained in national reports and when reported the information is often of unknown reliability and provided into national definitions and concepts that need a great deal of work to standardise and harmonise. These parameters may include e.g. *stand structure, diameter (DBH), height, timber quality, growth, forest health, annual increment, annual felling, natural losses, management systems (traditional and formal), products and services, local populations, etc.*

The ongoing developments in the international processes and forums such as UNFCCC, CBD, CCD, UNFF, etc have increased the recognition of the role of other wooded land (OWL) and trees outside forests (TOF) in the economy of people and in the conservation of environment at local and global levels. They are thus important resources that should be included in global forest assessments. The lack of policies at the national level on TOF conservation and development was among the major reasons behind the scarcity or even total lack of information in the national level.

Where does information come from?

The identification of information gaps on woody formations in the countries was done in respect to the three major land use classes of forests, OWL and other land with TOF. While many countries have invested in inventories of forest resources little or nothing has been done to date to assess the tree resources in the non-forest lands.

In the countries, particularly those with low forest cover, utility of TOF and OWL to people is inestimable. People grow and maintain TOF for various benefits in the forms of products and services with or without help from the authorities. Governments generally recognise the multiple roles of TOF and encourage their planting outside forests without investing enough in policies and strategies to conserve and develop them on the basis of sound statistical base.

Main features of the method of the global FRA

The forest resources assessment 2000 was carried out under the auspices of the UN/ECE and FAO European Forestry Commission for the industrialised countries and by the Forestry Department of FAO for the developing countries. The FRA 2000 was prepared on the basis of the same terms and definitions used for all countries world wide. The original data have in all cases been collected at the national level on the basis of national definitions and measurements and sampling techniques which are in almost all cases different from those agreed international-

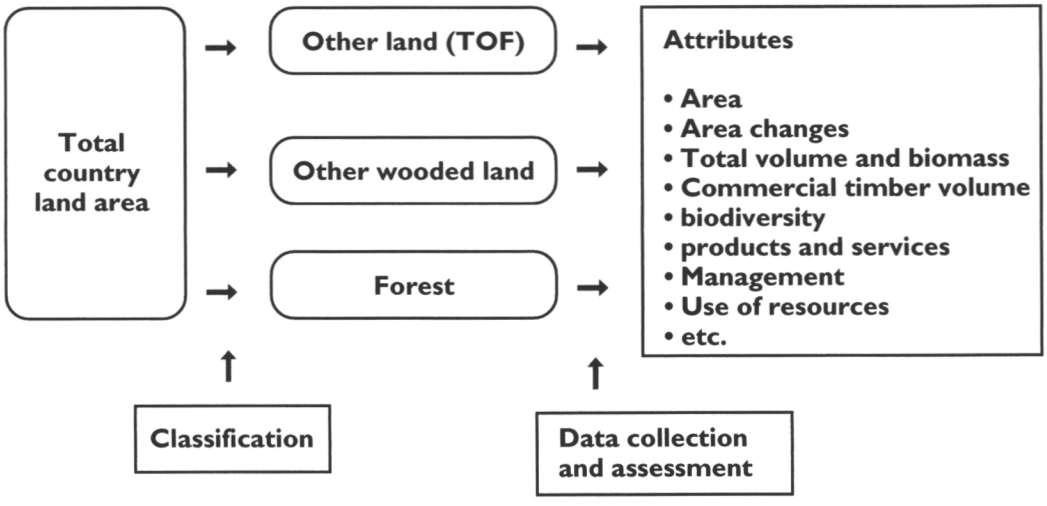


Figure 2. Global land use classes and corresponding attributes

ly for use of FRA and TBFRA[1] 2000 (UN-ECE/FAO). In the interest of comparability, they have been adjusted to fit the international definitions.

State of information in TBFRA 2000 countries

The state of forest and tree resources information in this group of countries was reviewed in respect to the parameters listed for assessment by FRA 2000. 55 countries were covered by the TBFRA 2000 including the countries that emerged due to changes in the former USSR and former Yugoslavia. Two main difficulties arisen during the process of TBFRA 2000. The first is in connection with non-responses and the second with different definitions of attributes. The non-response was recorded by nations for all attributes and by attributes.

[1] "TBFRA 2000" in this paper refers to the approximate temperate and boreal region (Europe, CIS, US, Canada, Australia, New Zealand and Japan) for which the FRA 2000 work was co-ordinated by UNECE/FAO in Geneva. However, no formal or definite assignment of regions has been made for global forest assessments.

Non-response by nations

Out of the 55 countries, five countries (9 per cent) did not reply to the questionnaire of UN-ECE/FAO. The non responding countries total land area is 1,210,810 km2 or 2.2 per cent of the land area covered by TBFRA 2000. Response and non-responses reflect the state of information in the countries and the national efforts in resources monitoring. In most industrialised countries, national information on forest resources and related attributes are obtained form national forest inventories or assessments using sampling techniques. The Nordic countries are the first ones to carry out national forest inventories. The first reported national inventories were carried out in 1919 in Norway, 1921–24 in Finland, and 1923–24 in Sweden. The central and western European countries started their national forest surveys after the Second World War during the fifties and sixties. In the USA, the first reported work was conducted in 1930 in Oregon. In these countries, the techniques of forest inventories have reached high level of perfection with introduction of sound statistical methods and use of new technologies such as remote sensing (aerial photographs, satellite imagery, radar data), computers and GPSs.

Some of the TBFRA 2000 countries including some industrialised ones did not carry out national inventories and consequently no systematic field data collection and updating on forest resources were done. They instead have assessments of their resources.

According to the TBFRA 2000, the reference year of the supplied data to TBFRA 2000 varied from 1987 to 1998. The reference period of individual nations reporting to the TBFRA 2000 inquiry ranges from 1986 (Germany) to 1998 (Iceland). Eleven countries conducted national assessments over a period of several years; for those countries the mean of the reference period is presented in Figure 3. Most countries (56 per cent) provided data assessed in 1995 and 1996. 80 per cent of the countries provided data for the reference period between 1994 and 1998. Ten countries delivered data that were assessed before 1994. Countries providing data before 1991 are Germany (1986), Azerbaijan (1988), Denmark (1990) and Spain (1990). Data from the North American region relate to 1994 (Canada) and 1992 (USA).

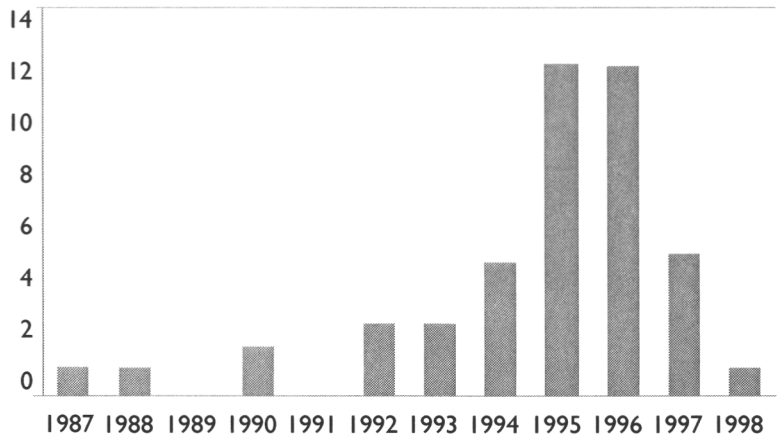


Figure 3. Number of countries per reference date
Source: TBFRA 2000

Non response by attributes

Table 1 indicates that all nations provided data for forest area and all its subsets. Only Luxembourg representing 0.005 per cent of the forest area covered by TBFRA 2000 could not provide information on the area of semi-natural forests and plantations. The area of other wooded land as well as growing stock of trees on total forest land are also attributes for which each nation could provide data. Attributes related to forest area show an excellent response rate. The same holds with some reservations in the "Other TBFRA 2000" group for changes in forest area.

The lowest response rates were recorded for annual removals. Five countries were not able to provide any information. Eight countries did not provide information on removals on other wooded land.

Poor response rates were recorded on annual fellings, removals, growing stock, annual change and net annual increment of other wooded land. In some countries assessments were carried out only on forest areas but not on other wooded land. Those countries had failed to provide information on other wooded land.

Four countries did not provide information on biomass and five countries failed to give data on biomass of stumps and roots. As biomass is strongly related to growing stock any interpretation of biomass figures can be cross-checked with information on growing stock.

Table 1. TBFRA 2000 essential data and the number of countries not responding

Parameters	Of which			Forest available for wood supply			
	Coniferous	Broad-leaved	Mixed	Total	Coniferous	Broad-leaved	Mixed
Forest area	-	-	-	-	-	-	-
Other wooded land	3	4	4				
Growing stock of trees	2	2		2	5	5	
Total woody biomass	4	4		5			
Net annual increment	3	3		3	4	4	
Annual fellings, total	6	6		5	6	6	
Annual removals, total	6	6		4	6	6	
Average annual change				1			

Source: TBFRA 2000

Information on ownership, plantations, species diversity, forest management, forests in protected areas, fires, wood supply, biomass, increment are available in many of the industrialised countries as shown in figure 4. Information on different other parameters including people, forest and tree uses, etc is generally lacking. Except for areas, no records have been given on non-wood forest products and trees outside forest.

Inventories in the Industrialized Countries

For lack on sources from all countries in the region, the methodologies followed by each country in generating information were not described for all nations. As indication and based on some reports (Proceedings of the International IUFRO S. 4.02 and S. 6.04 Symposium, May 14–16, 1990, Birmensdorf, Switzerland; Study on European Forestry Information and Communication System, Vol. 1 & 2, European Commission, 1997 and; Journal of Forestry, Vol. 97, Number 12 December 1999), the national forest inventory methodologies are given in the table below:

State of information in developing countries

FRA 2000 was planned with the ambition to cover a broad set of variables relevant to the forest sector at the international level. The intention was to broaden the global assessment

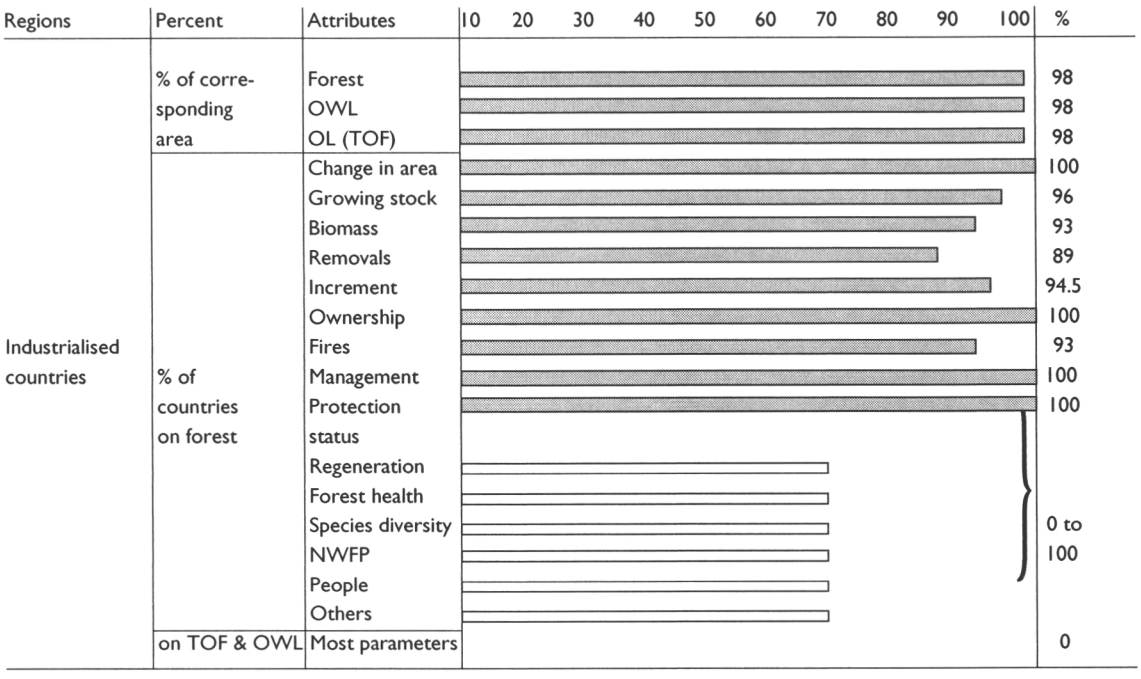


Figure 4. State of information of some selected parameters expressed in percent of land use area or of total number of countries

approach from the previous strong focus on forest area statistics to more forestry issues.

FRA 2000 used the best available and most relevant country information on forest resources. Although some countries notably improved their inventories, and although the number of reports on forest resources increased in the 1990s, many countries still lack the basic data needed to accurately assess the state and changes of their forests. A number of countries updated their forest cover estimates during the 1990s, often through remote sensing mapping, but in many cases the methodology was not directly compatible with that of previous surveys, making change estimates difficult. There is a scarcity of comparable multiple-date inventories and a need to improve both the accuracy and depth of information provided in forest inventories.

Systematic field inventories that measure volume, biomass, productivity of the forests and different other parameters were carried out in many countries, but often within limited areas. As a result, national estimates for volume and biomass had to be extrapolated from local studies. Information on biological di-

Table 2. National forest inventory methodologies in some industrialised countries

Countries	Sampling technique	Type of Sample plots
USA	Systematic	- Permanent
Sweden	Systematic	- Permanent
		- Temporary
Norway	Systematic	- Permanent
		- Temporary
Finland	Systematic	- Permanent
Switzerland	Systematic	- Permanent
Italy	Systematic	- Permanent
France	Systematic	- Temporary
Austria	Systematic	- Permanent
		- Temporary
Germany	Systematic	- Permanent

Sources:
– Proceedings of the International IUFRO S. 4.02 and S. 6.04 Symposium, May 14–16, 1990, Birmensdorf, Switzerland
– Study on European Forestry Information and Communication System, Vol. 1 & 2, European Commission., 1997
– Journal of Forestry, Vol. 97, Number 12 December 1999

versity, forest management, protection status, forest fires, forest health, trees outside forest, total biomass, non-wood forest products, growth, removals, etc is scarce, incompatible with international standards and often with low reliability. In summary, the availability of global and country information was not satisfactory for many subjects considered important for forest policy development.

The following figure shows the number of countries per reference year. Almost on third of the countries reported information for reference years of 1990 or before. Five countries did not report the reference year. The data reported in last years of 1990s are generally based on updating of historical information or on expert estimates.

Combination of mapping and remote sensing was also considered. Detailed mapping refers to construction of national maps based on remote sensing at large to medium scales (<1:50,000 to 1:250,000) and forest type classification designed for forestry purposes. General mapping means all mapping works done using remote sensing either at small to very small scale (<1:250,000) for forestry purposes or even larger

scales for non forest purposes e.g. soil, land use, land cover, etc where forestry cover is part of the legend. Nation-wide field sampling indicates conventional forest inventories based on data collected in the field from sample plots on large number of variables. It may be continuous inventory by means of permanent plots or single inventories through temporary plots. Expert estimate refers to information generated from secondary sources or from inventories carried out in limited areas of the country or even from expert guesses.

Tables 3 to 7 show the status of the countries information as per methodology applied. They show the number of countries and the corresponding total and forest areas having used one of the methodologies to generate national information on forest resources. Trees outside forests and other wooded land are not included. Percentages of number of countries and corresponding forest areas per methodology are showed in the diagrams 4a/b to 8a/b.

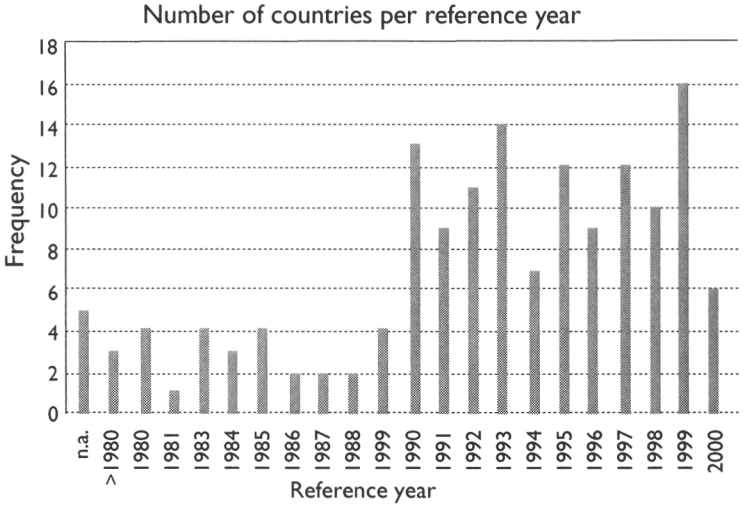


Figure 5. Frequency of countries per reference year

The state of forest and tree resources information in the developing countries was reviewed in respect to the methodologies followed by the countries in generating information and the parameters listed for assessment by FRA 2000. Four methods of data collection were considered namely:
i) detailed mapping;
ii) expert estimate;
iii) nation-wide field sampling; and
iv) general mapping.

Africa

In Africa, 43 per cent of the countries, accounting for 42% of the total land area or 20% forest area in the continent supplied to FRA information based on expert estimates. National information generated from detailed mapping and nation wide field sampling covers 22 per cent of the forest area. For 78 per cent of the forest in the region, the information is generally limited to area estimates. Data on other forest and tree resources parameters is widely lacking.

Table 3. Africa

Method of data collection	No of countries	%	Total land area	%	Forest area	%
Detailed mapping	7	13	672,896	23	238,097	37
Detailed mapping/ Nationwide field sampling	6	11	305,603	10	142,266	22
Expert estimate	24	43	1,260,583	42	127,598	20
Nationwide field sampling	13	23	609,913	20	112,608	17
General mapping	6	11	129,399	4	29,297	5

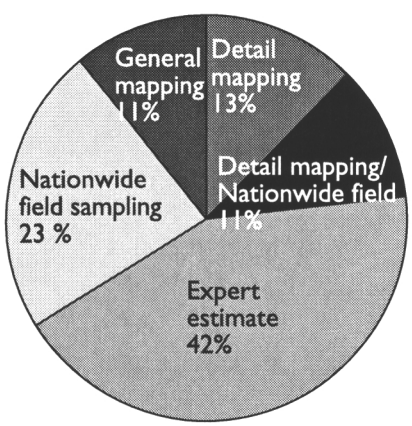


Figure 6a

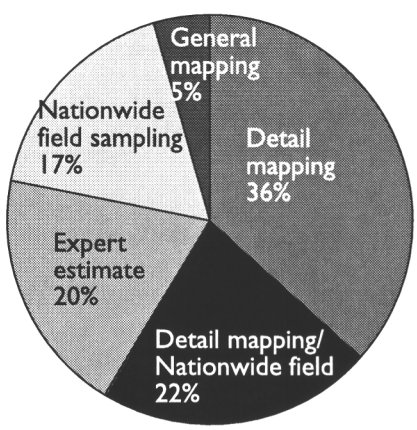


Figure 6b

Asia

54 per cent of the countries in Asia, summing up 66% of the total land area and 45% forest area in the region have information based on expert estimates. National information generated from detailed mapping and nation wide field sampling is completely lacking. Only one country has reported information based on field sampling without reference to mapping. 30 per cent of the forest cover in the continent was mapped with sufficient details for forestry purposes. For nearly 100 per cent of the forest in the region, information is generally limited to area estimates. Data on other forest and tree resources parameters is widely lacking.

Table 4. Asia

Method of data collection	No of countries	%	Total land area	%	Forest area	%
Detailed mapping	10	27	569,570	23	145,849	30
Detailed mapping/ Nationwide field sampling	0	0	0	0	0	0
Expert estimate	20	54	1,666,996	66	218,379	45
Nationwide field sampling	1	3	61	0	2	0
General mapping	6	16	291,437	12	125,245	26

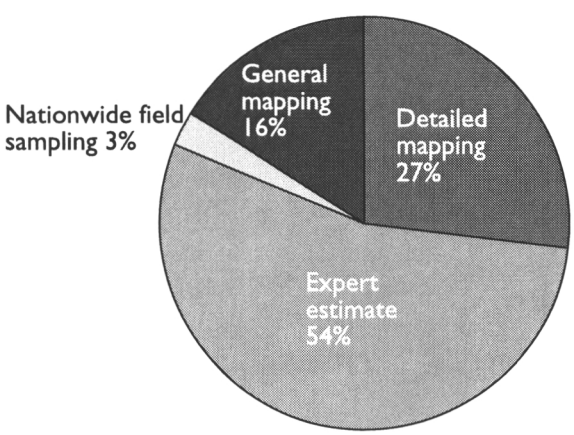


Figure 7a

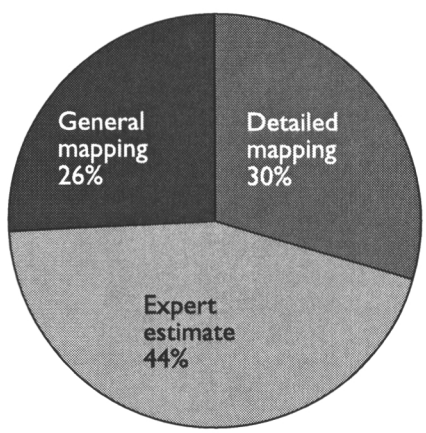


Figure 7b

Latin America

Latin America, like Asia, all countries have information produced either from remote sensing or expert estimates. Countries having produced detailed forest maps account for 44 per cent in the region. These account in terms of area for nearly 94 per cent of the total land area and 96 per cent of the forest area in the region. The rest of the countries hold information based on expert estimates. None of the country has reported information based on field sampling. Information from all countries is generally limited to area estimates. Data on other forest and tree resources parameters is widely lacking.

Table 5. Latin America

Method of data collection	No of countries	%	Total land area	%	Forest area	%
Detailed mapping	20	44	1,750,879	94	874,099	96
Detailed mapping/ Nationwide field sampling		0		0		0
Expert estimate	22	49	107,581	6	33,580	4
Nationwide field sampling		0		0		0
General mapping	3	7	4,386	0	1,474	0

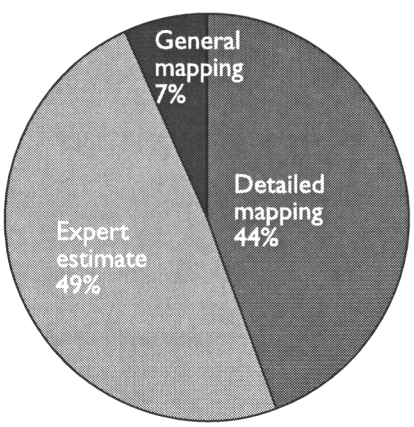


Figure 8a

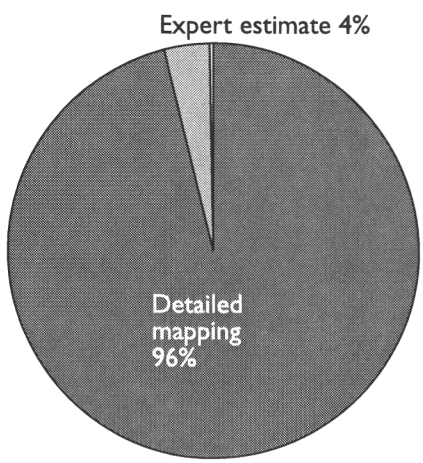


Figure 8b

Oceania

28% of the countries in Oceania which account for 94 per cent of the forest cover have information produced from remote sensing in detailed mapping works. 6 per cent of the region forest assessed through expert estimates. Information of all countries is generally limited to area estimate. Data on other forest and tree resources parameters is widely lacking

Table 6. Oceania

Method of data collection	No of countries	%	Total land area	%	Forest area	%
Detailed mapping	5	28	48,256	89	33,201	94
Detailed mapping/ Nationwide field sampling	0	0	0	0	0	0
Expert estimate	13	72	5,811	11	1,937	6
Nationwide field sampling	0	0	0	0	0	0
General mapping	0	0	0	0	0	0

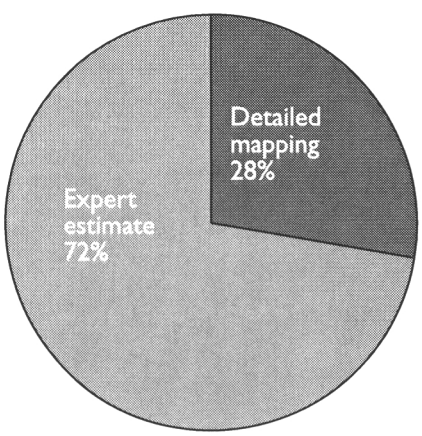


Figure 9a

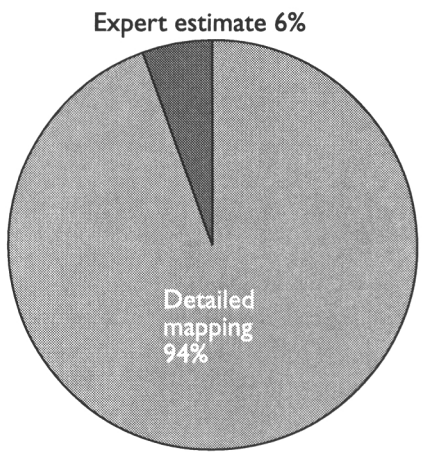


Figure 9b

All developing countries

The general tendency in developing countries for forest information generation is the use of remote sensing for detailed mapping. 31per cent of the countries which account for 70 per cent of the total forest area performed detailed forest cover maps. Forestry information generated from field nation-wide sampling is still scarce in developing countries. 13 per cent of the countries which cover about 12 per cent of the forest area have relatively detailed data sets on their forest resources.

Table 7. Developing countries

Method of data collection	No of countries	%	Total land area	%	Forest area	%
Detailed mapping	42	27	3,041,601	41	1,291,246	62
Detailed mapping/ Nationwide field sampling	6	4	305,603	4	142,266	7
Expert estimate	79	51	3,040,971	41	381,494	18
Nationwide field sampling	14	9	609,974	8	112,610	5
General mapping	15	10	425,222	6	156,016	7

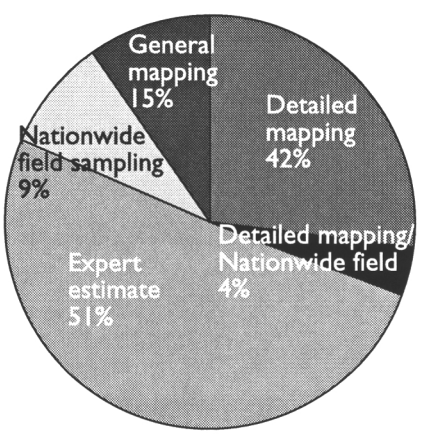


Figure 10a

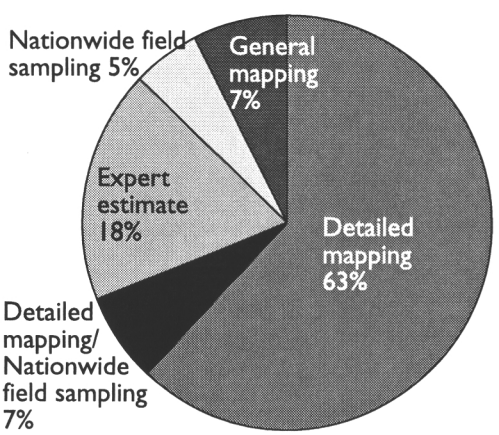


Figure 10b

On forest are, Asia has the poorest information. 70% of the forest is either dealt with expert estimates or with general mapping. The more reliable information on area is that from Latin America where 96% of the forest is covered by detailed mapping followed by Oceania with 94%.

Africa reported information forest resources on about 39% of total forest in the continent. Only one country in Asia with field collected information. The area is too small compared to the total forest in the region.

Table 8 shows that when the forest cover becomes scarcer, the countries invest less in forest information generation based on field sampling or remote sensing. 94 countries out of 156 (60%) use information produced through expert estimates or general mapping. These countries account for 47 per cent of the total area.

Table 8 shows that the number of countries, which conducted more than one national forest inventory is negligible. They are 3 out of 156 (2%). 94 countries has done nothing to survey their forest resources. National inventories based on field sampling were carried out in 17 countries (11%). 48 countries (31%) relied on mapping to produce information of the extent of the forest cover.

In developing countries information on other parameters than area remains rare. 43 countries (28%) reported information on volume, biomass, species composition and protected areas. This information included the sources of national and partial inventories.

Table 8. State of inventories and information extent in developing countries

Regions	Number of Countries	Number of countries					Forest Cover		Other Parameters		
		Without Forest Inventory	w/Partial Forest Inventory	w/National Forest Inventory							
				Repeated	Single inventory		State	Change	Volume	Biomass	Biodiversity & Environment
					After 1990	Before 1990					
Africa	56	30	10	3	10	3	13	5	30	30	30
Asia	37	26	8	0	0	1	10	5	1	1	1
Latin America	45	25	7	0	0	0	20	4	7	7	7
Oceania	18	13	5	0	0	0	5	1	5	5	5
Totals	156	94	30	3	10	4	48	15	43	43	43

Conclusions

Compared to developing countries, a number of industrialised countries have reliable information on a large number of forest attributes continuously updated. In view of the growing needs at the national and international levels, information in the industrialised countries still requires more efforts to improve to include more parameters on forest as well as TOF and OWL. In the developing countries, baseline information is still very fragmentary and of low quality. Except on forest areas, little or no information is available on all other parameters. 25% of the developing countries have forestry statistics produced from expert guesses. And the majority have information just on areas produced from detailed mapping. Three out of 156 countries only have repeated inventories and 14 have each one inventory done. 94 countries are listed without a single inventory even partial.

Except on areas, both developing and industrialised countries do not have information on trees outside forest and other wooded land including volume, biomass, biodiversity, NWFP, etc.

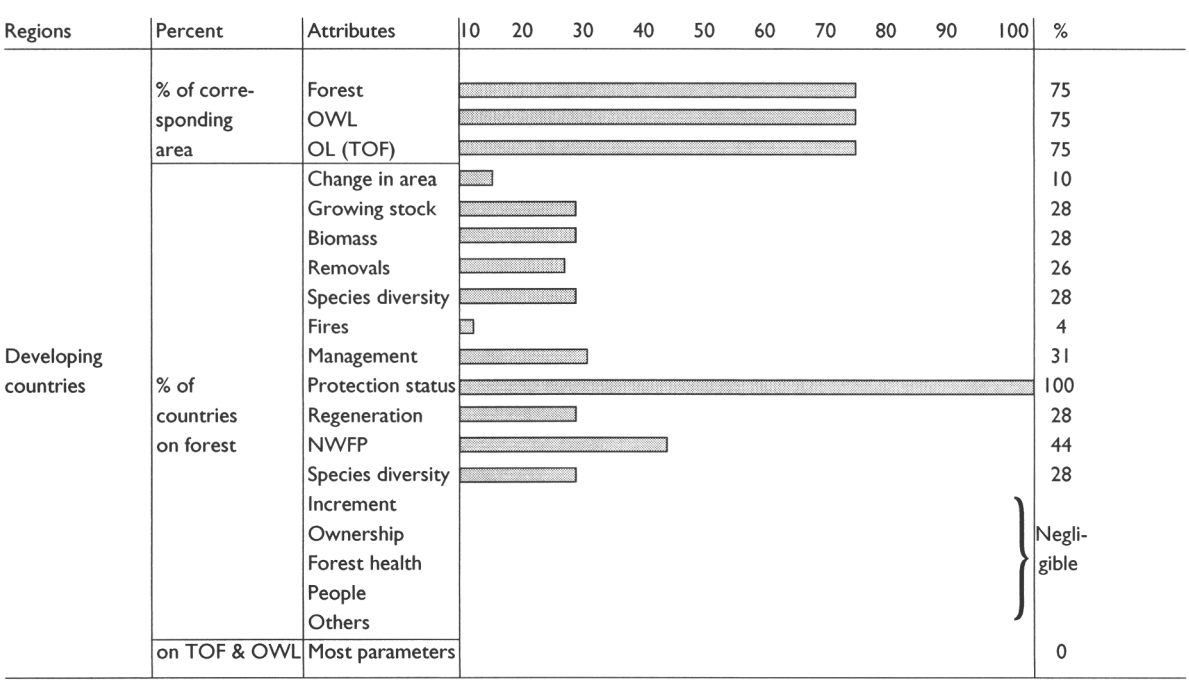


Figure 11. Conclusions

The state national capacity to design, plan and carry out national forest inventories is generally very week in the developing countries. Information is maintained in hard copies often difficult to locate and use. Very few developing countries have developed information systems on their forests.

Recommendations

a. The set of forest and tree attributes on which information is needed at all levels is far from adequately defined. It requires participatory co-operation of all parties - producers and users of information and donors - to define the entire set that can be measured in the field at reasonable cost and using the available technologies.
b. It is obvious that more efforts should be deployed to assist many developing countries in national forest inventories and assessments. National capacity to design, plan and implement national forest inventories needs to be built up or strengthened.
c. In view of the high demand on information on forests and trees, an adequate approach should be developed and implemented to assist countries in generating reliable information of woody vegetation resources. Such approach would consist of a monitoring system of forest and tree resources based on a low intensity systematic sampling that can monitor resources and their use and the dynamic of changes of these resources through deforestation, reforestation/aforestation, natural expansion, degradation and improvement. The approach should enable producing information on different parameters at acceptable reliability for national level use.
   This support should be extended to a number of countries in the TBFRA 2000 region where information on forest and tree resources and national capacities are lacking.
d. Extra-budgetary resources, mechanisms and tools should be defined to implement this approach and help countries and the international community with comprehensive and reliable information.
e. National surveys in both industrialised and developing countries should include TOF resources.
f. Forest and land use classification and nomenclature need a great deal of efforts to standardise to the extent possible.

References

FAO, 2000. FAO Forestry Paper 140. Global Forest Resources Assessment 2000. Main Report.

UNECE/FAO.2000. Forest resources of Europe, CIS, North America, Australia, Japan and New Zealand. Contribution to the global Forest Resources Assessment 2000.

Review and Discussion of New Technological and Methodological Options for National Forest Inventories

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Abstract

National Forest Inventories (NFIs) provide information relevant for formulation and monitoring of national policies for forestry and related sectors. They are important input to global forest assessments and can provide some of the information on which signatory states of the International Conventions are requested to report.

The currently implemented NFIs exhibit considerable variability in many aspects such as the technical approach, the products generated, and intensity and organization of the inventory. The variation is probably as big as the variation of the biophysical and political conditions in the countries. This paper reviews and discusses options for NFIs to raise efficiency that arise from the application of new technologies and methodologies such as developments in remote sensing, GPS, measuring devices, mobile information and communication technologies, and modeling. Both the conditions for NFIs in tropical and in industrialized countries are considered.

Introduction

The overall objective of a National Forest Inventories (NFI) is the provision of information relevant for national level decision making and monitoring for forestry and related sectors (Cunia 1978), some times referred to as forest inventories at the *strategic scale* (Schreuder 2001). NFIs also provide data for smaller

geographical or political units and are therefore of interest for those involved in forestry planning in provinces (or other sub-national units).

NFI results are an input to global forest assessments so that there is also in international interest in high quality national forest information. In this context the question arises - which is subject of this paper - whether and how NFIs can benefit from technological and methodological developments, thus facilitating the implementation of NFIs and providing improved information which would then help moving toward better management and improved policy formulation through better informed decisions. "New technologies and methodologies" refers here to those features which are not yet widely employed in NFIs; that means that they are not necessarily new, but that their application to NFIs may be extended. Structure, design and implementation of individual NFIs are as variable as the political and biophysical environment in which they take place. The potential role and impact of new technological and methodological options will vary with the general biophysical, organizational and political conditions in each particular country, and also with the national history and background of the NFIs.

Some countries have no or no reasonably up-to-date NFI; in many the overall reliability of approaches and results is low (Persson and Janz 1997). An interesting question is, why many countries do not yet have a comprehensive NFI in place. While technological and methodological considerations may also play a role in this context, and would make it therefore relevant to the topic discussed here, it is hypothesized that the major factors are of budgetary nature and the missing political priority.

The potential impact of new technologies and methodologies

New technological and methodological options may affect an NFI in all phases (inventory planning, implementation, analysis and reporting). The following criteria are being used for an evaluation:

- *Meeting information needs better*, by providing more information or by providing better information (higher precision of estimates, more accurate measurements).
- *Reducing cost*, by streamlining the NFI process at different stages. Field work with its many "cost-generating features"

(such as transport, DSA, helpers, tools, measurement devices) is a heavy cost factor in most NFIs (Guldin 2000 mentions that, for example, in the FIA program of the USFS about two thirds of the program cost arise from field plot work!) but is a central and indispensable source of information for many forestry variables; it is, therefore, natural to search options for cost reduction particularly in the context of field work.

- *Making NFIs more visible* = improving the political standing of NFIs, for example by a better and more direct availability of information to the relevant decision makers by increasing the overall credibility of results, or by integrating new sets of attributes that increases the interest in the information from a broader group of users.

Some general current trends in NFIS

National Forest Inventories have a long history, where objectives and techniques have changed over time (Hagberg 1957, METLA 1994, Guldin 2000). When technological and methodological options are to be analyzed it is also helpful to have a look on some of the observable current "trends".

Primary objective of National Forest Inventories is obviously the provision of data for national planning (e.g. Cunia 1978). However, this refers not exclusively to the data necessary for forestry planning, but to other sectors as well. The concept of Multipurpose Resource Inventories (MRI, described, for example, in detail in a IUFRO Manual edited by Lund 1998) has long been discussed and presented as the way forward; yet, it has been expressed for decades (e.g. Husch 1971) that the increasing role of other forest functions than timber and wood production would make it necessary to expand the concept of forest inventories. It was a slow process, but now the MRI concept is taken into account in many regions, where, for example, non-timber-forest products are covered (DFID 2001), or the non-forest tree resources (Kleinn 2000b) requiring the forest inventory to broaden its scope. Compliance with the commitments arisen from international conventions may play an increasing role in NFIs, as the lack of comprehensive and systematic information on status and change of the forest resources was identified as one of the major information-related problems in various chapters in the Agenda 21, and the set of attributes typically assessed in NFIs provides part of the information sought. In this context I would also expect that the integration

of more data sources into NFIs increased in the future. Much information, also geo-referenced and locally specific information is out there.

New technologies and methohds and its potential impact on NFI´s

In this chapter, technologies and methodologies are discussed of which a certain potential for the "improvement" of NFIs may be expected.

Remote sensing

The early NFIs relied practically completely on field observations, and still in the 1960s and 1970s when in developing countries FAO supported and carried out many Technical Cooperation Projects (TCPs) implementing NFIs, field observations were the single most important information source. Aerial photographs were used in some cases, and at the end of that period, first experiences with the newly available Landsat MSS were made. After that period, however, satellite imagery entered rapidly into National Forest Inventories, particularly in tropical countries, and one can observe a shift of emphasis from field observations to image interpretation. In some cases, mere satellite-imagery-based forest cover mapping was then denominated a "forest inventory". Map products derived from satellite image interpretation have since been dominating in many tropical countries the picture of forest inventories. Mapping studies cost less (at least when we assume that the necessary hard- and software is available from other projects), need less planning, smaller teams and less broad expertise, are independent of weather and do finally provide maps as the major product, that are usually more easily accepted and better "marketable" than mere statistics and tables with error specifications.

Today, an efficient integration of different information sources is sought, including remote sensing, and it is recognized that field observations are indispensable for a large range of variables that can not be observed from remote sensing imagery (not at all, or not within an acceptable range of accuracy), and that remote sensing is the choice when mapping and landscape level analysis are concerned.

What may remote sensing imagery being used for in the NFI

context? We may distinguish some major points:

- *Direct observation and estimation of relevant attributes*: The estimation of forest area (or forest type area) is a natural task for remote sensing imagery. Given the right imagery and a remote-sensing-workable definition of cover categories this classification can be carried out with high accuracy. However, also field sampling provides (usually) sufficiently precise results, where classification accuracy will naturally be superior; although rare classes will be better observed in the imagery - when detectable with sufficient accuracy. The imagery based area estimation does not only provide summary statistics, but allows at the same time the description and analysis of spatial arrangement and fragmentation of the forest area. However, also sample based approaches to estimate the fragmentation status can be developed (e.g. Kleinn 2000a), where a full cover mapping is not required.

  There are not many more attributes that can be directly observed from remote sensing imagery. Crown sizes of individual trees and crown cover can be taken from suitable imagery. These attributes may support classification and can be taken as co-variables in analysis and modeling. Individual tree heights can be taken from large scale air photos, and laser scanning offers possibilities for an automated generation of height profiles in larger areas; though utility for NFIs is expected to be minor.

- *Modeling*: Imagery may be co-registered and matched with field observations constituting the input for models. Then, a whole area cover is not necessary, but limited local takings would suffice. Air photos or very high resolution satellite imagery plots around the location of the field samples may be taken to raise the general information content of field samples and allow to extend the spatially very limited field plot information to a sort of landscape level information on attributes such as fragmentation and spatial arrangement of land use classes and landscape elements. IKONOS and Quickbird, for instance, allow purchasing relatively small sections of imagery; also, for tailor made local solutions many non-traditional carriers for aerial cameras and video-cameras are described such as model airplanes, balloons, small Zeppelins, ultra light airplanes etc. These devices offer good opportunities for local takings, yet their implementation requires equipment, infrastructure and skills that are usually not available in a NFI. One may see the major analytical utility of remote sensing imagery in NFIs in complementing the information that field plots provide, or, in more general terms, in linking remotely

sensed data to other georeferenced data. These models, relating remote sensing features (in particular those that come from the ever increasing spatial and spectral resolution of the imagery) to attributes relevant to the NFI, may then improve estimations and, applied and extrapolated to the whole area (when wall-to-wall cover is there), generate thematic maps that contain forestry relevant information. Based on the *knn*-approach the Finnish NFI has long implemented a corresponding modeling approach (Tomppo 1990) and in the field of geostatistics much research is ongoing and spatially more accurate results and higher precision of estimations may be expected by this methodological development.

- *Mapping*: If the issue is mapping, spatial analysis, and georeferenced information, remote sensing options are the only operational way. However, "mapping" and particularly "national scale mapping" is not necessarily seen as a generic task in the context of NFIs. While the traditional NFI reports contain more tables than maps, the spatially more specific presentation in map format is significantly increasing and georeferenced information is considered the major standard product of future NFIs. When doing a large area forest cover mapping, it is not a big step for NFIs toward a landscape inventory that covers other land use types (or a tree inventory covering all tree resources), thus automatically extending the scope of NFIs and increasing its utility for other sectors. The mapping options that remote sensing offer contribute significantly to a better visibility and to a more client-oriented presentation of NFI results. Guldin (2000) writes "The FIA program will provide maps that are both accurate and pretty".

- *Large area change detection and analysis*: As a combination of the above listed points, remote sensing allows spatially explicit observation of changes of forest types over large areas. For this particular task, remote sensing is indispensable.

Digital cameras is a form of terrestrial remote sensing. It can be used for general documentation purposes in the field and to carry out digitally single tree measurements in the photographs. Yet, terrestrial analogue photography is available for decades and has not been widely used in NFIs. The possibilities of photographic documentation are obviously not considered a major advantage for NFIs, so that the new technical solution of digital cameras is not expected to bring in new impulses.

Satellite navigation systems

The development of satellite navigation systems was a major breakthrough in many fields. GPS has been the first system in place, operated by the US Ministry of Defense. The acronym GPS is also used for satellite navigation systems in more general terms. In the early years, signals of GPS were artificially blurred in order to decrease precision for common users. Also, there was and is the possibility that in times of political crisis the system is only available for a selected core group of users (where NFIs usually do not belong to).

GLONASS is the satellite navigation system operated by the Russian government, and the European Commission launched recently a program for their own system named "Galileo", which is expected to be operational in 2008. There are various significant advantages when three independently operated satellite navigation systems are in place, as long as they offer reliably a full functionality. When future receivers are capable of processing signals from all three systems, coverage will be significantly improved, particularly for applications where the range of the visible sky is limited like in dense forests. Precision of position is likely to increase because of a higher likelihood to encounter better satellite constellations everywhere.

There are five basic categories of applications for satellite based navigation systems, which are briefly discussed with respect to their potential role in NFIs (Trimble 2000):

1. *Location: determining a basic position*, and

2. *Navigation: getting from one location to another,*
   are those basic functions of satellite navigation systems that are of most obvious utility in NFIs. In fact, navigation is the most important, as usually target points (field plot locations) are geographically defined by coordinates and need to be located in the field, either to establish new plots or to find plots that were established earlier. The traditional approach is to prepare trip and navigation with maps, identifying optimal starting points, measuring distances and azimuths in the maps as indication for navigation in the field, and then following these indications in the field with angle and distance measuring devices. Reference objects and observations are recorded in a sketch map to facilitate finding the plots again during the next measurement cycle. Still, maps and local expertise will be needed to plan for the optimal access route to the field plots. GPS navigation may replace the subsequent distance and angle measurements. Plots

can be reached with higher accuracy, particularly in regions with a less dense road infrastructure and where there are not many map-identifiable references.

GPS works perfectly in most regions when navigation is outside closed canopy layers. Though much improvement has been achieved, the measurements inside dense forests are still not consistently working in a fully operational manner everywhere. Searching for a canopy gap that allows suitable measurements can be time consuming, then quickly offsetting some of the benefits of a "quick" navigation; from the nearest GPS-able gap a non-GPS navigation must be carried out to find the eventual location for the field plot.

What is at the end the benefit in the field? In many cases, particularly when open areas have to be crossed, navigation is much faster (and less costly) with GPS. A benefit of the higher accuracy itself, however, is not that obvious: as long as predefined plot locations are reached in the field strictly according to the display of the navigation tools used (be it GPS or tape/compass), it does not make a difference for the statistics generated by field-plot-based inventories, whether we reach a pre-defined position for a field plot within an accuracy of ±50m or of ±5m (as long as the field crews do not influence this determination of location subjectively).

However, accuracy in determining position is also a crucial issue when co-registration with maps or satellite imagery for the purpose of modeling is concerned: when in a model the field plot observations are to be matched, for example, with the spectral responses of their corresponding pixel. Then, location accuracy is important to remove "white noise" from the model, and the gain in accuracy offered by GPS is likely to improve the models and the corresponding extrapolations and predictions (e.g. Halme and Tomppo 2001).

3. *Tracking: monitoring the movement of people and things.* When field crews use GPS to navigate to the field plots, then the route on which they went can automatically be recorded so that the sketch map of the access path, which is traditionally drawn by hand and without exact scale, is directly registered; GPS thus offers the automatic creation of sketch maps which may be enhanced and complemented by verbal descriptions of reference points and waypoints. Tracking may also be useful for supervision of field work when interest is to cross-check whether the field teams did come sufficiently close to the projected field plot locations.

4. *Mapping: creating maps of the world.* Immediate map creation by direct measurements from satellite navigation systems is usually not an issue in NFIs; and neither the fifth basic function,

5. *"Timing: bringing precise timing to the world"* has relevance for NFIs.

Usage of GPS means investment in hardware and training; but the cost is relatively low and the use not complicated. Field crews do usually prefer GPS receivers over the conventional position determination procedure.

Measurement devices (field measurements)

The tree attributes measured in the field are essentially diameters and heights; for navigation, plot establishment and recording of tree positions, measurement of distances and angles are required, where GPS as an independent approach was discussed in the preceding section.

It is mainly the ultrasonic and laser devices that facilitate distance (and angle) measurements. For navigation to plot locations electronic distance measurements make field work much faster, though GPS may replace it. When tree positions are to be measured by distance and azimuth from the plot center, these devices facilitate the survey considerably. Connected to a mobile data logger data can directly be stored without the need for paper form sheets.

What is true for GPS holds also for new measurement devices: field crews are more motivated employing at least some "high tech" devices and receiving corresponding training. This may also have a positive effect on the quality of the gathered data. On the other hand, they may be nervous about carrying along under their responsibility devices that cost several thousands of dollars!

Some new ideas are being tested currently like horizontal laser scanning where, from a plot center, the surrounding are laser-scanned and the backscatter of the trees allows recording diameters (also in different heights at the tree). This technique does currently not have practical relevance, though.

Automatization of the measurement of some variables may be possible in the future, speeding up the field measurements. Yet it is not expected that significant increases in accuracy can be reached.

Mobile information and communication technology

Mobile data loggers are in actual use in NFIs since the late 1980; it is not a new technology but one the potential of which is maybe not utilized to the extent possible. Bringing the entry of data into a digital data base as close as possible (in terms of time and space) to where the data are generated has a positive effect on data quality; errors and inconsistencies, when identified by checking procedures directly in the field, allow the field crews to immediately correct the erroneous observations. Data input may be done via keyboard, or per cable, or wireless from electronic measurement devices.

A next step is that the mobile data loggers are directly connected via mobile communication and Internet access to a central data base. Then, the central data base would be permanently up-dated and check-procedures could be adjusted immediately and uniformly for all field crews. However, the marginal gain in "quality" by this online data entry is expected to be lower than that reached by immediate digital storage of data in the field; a periodic data transfer (once in a week or so) appears to be sufficient.

Coverage for mobile phones is in many regions poor, particularly in less populated rural areas where many NFI field plots are located. Therefore, mobile telephone communication directly from the field (increasing safety for field crews, and allowing an online data entry to a central data base) is technically not feasible everywhere.

Mobile Information and, where applicable, communication technology help streamlining field work and improving data quality; and may also raise the motivation of field crews.

Software and algorithms

This chapter addresses methodological options that do in general refer to software and algorithms development. Major issues may be

- *Presentation of data and information*: GIS and web-GIS offer many possibilities of presentation of results, and of improved data and information access by the users. An online presentation of NFI results increases their visibility and utility, particularly when the information system offers an interactive information retrieval. Corresponding approaches are in development (e.g. EFIS: Kennedy et al. 2001). While tables and statistics were the traditionally standard product, current and future results presentations will be dominated by map-presentations

and the combination of cartographic and table formats are becoming standard.

- *Data analysis and modeling*: Model development in the context of remote sensing data analysis has been addressed before as a field where much development is to be expected.

  But also in the more traditional modeling issues of volume functions, which are available world-wide, there appears to be space for improvement: their accuracy and local validity is frequently put into doubts. Models to estimate biomass and biomass components are much less available as are those for carbon estimation. Data quality, particularly of volume related attributes could considerably be increased by improvement of these traditional models. Uncertainty in biomass estimations has been identified as one of the major factors that determines the uncertainty in carbon estimations. Also, improvements are expected in what refers to relating NFI observable attributes to aspects of biological diversity.

  With respect to data usage, growth models and large area prediction of the development of forests and their functions (scenario modeling) depend, among others, on NFI data (e.g. Päivinen et al. 1996). Fostering the usage of NFI data in politics, economy and research would increase the visibility of NFIs. However, it is not clearly regulated everywhere, who has the right to use NFI data. A more open data policy would probably help getting more institutions interested.

Means of transport

Relevance of means of transport for NFIs may not appear obvious. The first NFIs around 1920 in Finland, Norway and Sweden used strip sampling where field crews spend weeks in the field following transects that were laid out passing straight through the provinces. Horses were used to transport all necessary equipment for measurements and living; the field crews, consequently, consisted of many more people than today. Though strip sampling is statistically not the most precise technique, it was considered an adequate approach when practical feasibility was taken into account. The rapid improvement of road infrastructure and the further development of cars allowed later to move away from strip sampling to spatially disjoint clusters of subplots, increasing statistical precision considerably. A cluster design would have been impossible at the beginning of these inventories because "unproductive" travel

time would have been big. Here, the technological development (cars and roads for individual transport), had a direct impact on the methodological development of NFIs. However, while the issue of technological development of means of transport does not appear to further influence the current development of NFIs significantly, the time consuming and physically demanding access to field plots continues to be a relevant point in many regions.

Sampling options

Sampling is employed for the assessment of the vast majority of attributes gathered in NFIs. Only for a limited number of attributes (like "forest area" and related variables) there is the technological possibility to make a full cover assessment by satellite imagery. Sampling techniques have undergone some development in the history of NFIs (see also previous section), where in the early times the forest inventory designers did pioneering statistical work in sampling theory. From the beginning, sampling for NFIs was driven by a blend of statistical and practical considerations. The large set of attributes assessed in NFIs does not allow a simple optimization of sampling and plot design.

Systematic sampling is the most frequently used *sampling design* in NFIs, perhaps in forestry in general, some times in combination with stratification and/or other estimators. The most frequently applied *plot design* is that of clusters of subplots, where the subplots tend to be fixed area circular plots or Bitterlich plots in temperate and boreal forests, and elongated rectangular plots (strip plots) in tropical regions. In some NFIs, such as in the Swiss NFI and in the early Chinese NFI, however, individual plots (and not clusters of plots) are/were used.

New sampling techniques are being developed, discussed and presented in forestry research constantly. Some of the more recently described techniques do have promising features and allow impressive gains in precision for specific inventory questions, like adaptive cluster sampling or importance sampling. However, it does currently not seem that the well established proven duo of systematic sampling with cluster plots has found a serious competitor yet. However, modifications and extensions of the cluster plot design to adjust for the assessment of particular attributes (for example in the context of observing indicator variables for biological diversity, or to more efficient-

ly record rare objects) may be promising. Also, the efficient integration of different data sources, particularly that of field samples with various remote sensing imagery has the potential to further increase the performance of NFIs (e.g. Schreuder 2001).

Organizational and institutional issues

Another methodological option is the combination of NFIs with surveys conducted by other sectors, which is, in fact, a necessity when multi-resource inventories are to be put into place. Building bridges to other sectors implies to integrate other institutions in the process of a NFI. Interaction is mainly seen with the agricultural sector, particularly when NFIs are to be developed to landscape inventories and assess attributes also in agricultural areas. Objectives would have to be compared and possibly harmonized, and chances for synergies identified. The sharing of resources, of expertise, of technical capacity and of manpower would probably be in mutual interest and allow to make the assessments more cost-efficient and more visible.

Conclusion

NFIs are dynamic undertakings. Their scope and also the expectations toward them change. Technological and methodological developments will continue contributing to this change of NFIs in all its stages from planning to result presentation, though revolutionary changes are not expected.

When we analyze the potential impact of the described technological and methodological developments for the estimation of some core attributes like "forest area", "volume/biomass/carbon", "ownership", "industrial/non-industrial wood extraction" or "biological diversity", we do not expect a significant contribution on what refers to precision and accuracy of the estimation of state and change. Improvement mainly expected on the methodological side by improved algorithms and models, particular for the estimation of the derived attributes "volume/biomass/carbon", "wood extraction" and "biological diversity".

The discussed technological and methodological options help improving the overall performance of NFIs in several respects. Any new technological and methodological options

Table 1. Summary matrix of evaluation of new methodological and technological options for NFIs. A "+" indicates where positive effects are expected

Methodological and/ or technological options	Main phases of an NFI				
	Planning	Implementation	Data quality and data management	Analysis (including modeling)	Reporting
Remote sensing		+		+	+
Satellite navigation systems		+		+	
Measurement devices		+			
Mobile inf. and comm. Technology		+	+		
Software and algorithms			+	+	+
Means of transport					
Sampling options	+		+		
Organization and institutional issues	+	+			+

need to be integrated into the process of NFIs carefully, and the author agrees with Iles (1995), "that the big gains are to be made by systems which show balance, backup and flexibility". However, the major impediment for NFI implementation is probably in many regions its cost, and the challenge is to justify in economic terms the expenses for a national level information procurement of the forest resource.

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References

Cunia, T. 1978: On the objectives and methodology of national forest inventory systems. In: Proceedings of the IUFRO International Conference on National Forest Inventory. Bukarest June, 18–14, 1978. XI–XXVIII.

Czaplewski, R.L. 1989: Combining Inventories of Land Cover and Forest Resources with Prediction Models and Remotely Sensed Data. Proceedings of the International Conference and Workshop on Global Natural Resource Monitoring and Assessment Preparing for the 21st century. Venice, Italy. Volume 3:1079–1089.

DFID. 2001. Developing needs-based inventory methods for non-timber forest products. Application and development of current research to identify practical solutions for developing countries. Report on a workshop held in Rome 4–5 May 2000. 103p.

European Commission 1997a: Study on European Forestry Information and Communication System – Reports on forestry inventory and survey systems. Volume 1 – Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein. p.1–673.

European Commission 1997b: Study on European Forestry Information and Communication System – Reportes on forestry inventory and survey systems. Volume 2 – Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, Czech Republic, Hungary, Poland. p. 675–1328.

Guldin, R.W. 2000. Remote Sensing at the dawn of the new millennium: A Waschington DC perspective. Keynote remarks presented at the RS2000 Conference, April 13, 2000, Albuquerque, NM.

Hagberg, E. (1957). The new Swedish national forest survey. Unasylva Vol. 11, No.1.

Halme, M. & Tomppo, E. 2001. Improving the accuracy of multisource forest inventory estimates by reducing plot location error – a multicriteria approach. Remote Sensing of Environment 78: 321–327

Husch, B. 1971. Planificación de un inventario forestal. FAO: Estudios de silvicultura y productos forestales No. 17. 134p.

Iles, K. 1995. Constructing a Safety Net in the Circus of High Technology. IUFRO World Congress, Tampere, Finland.

Kennedy et al. 2001. EUROPEAN FOREST INFORMATION SYSTEM –EFIS. A step towards better access to forest information. Paper presented at the IUFRO Conference *Collecting and Analyzing Information for Sustainable Forest Management and Biodiversity Monitoring with special reference to Mediterranean Ecosystems*, Palermo, Sicily (Italy) 4–7 December 2001. <http://www.geolab.unifi.it/iufro_conference/present/kennedy/1.htm> visited April 2002.

Kleinn, C. 2000a. Estimating metrics of forest spatial pattern from large area forest inventory cluster samples. Forest Science 46(4):548—557.

Kleinn, C. 2000b. On large area inventory and assessment of trees outside forests. Unasylva 200 (2000/1) Vol. 51(3–10).

Lund, G. (ed.). 1998. IUFRO Guidelines for Designing Multipurpose Resource Inventories. IUFRO World Series Vol. 8. 216p.

METLA 1994. Multi-source National Forest Inventory of Finland, History. http://www.metla.fi.ohjelma/vmi/nfi-hist.htm, visited April 2002.

Päivinen, R., L. Roihuvuo, M. Siitonen. 1996 (eds.). Large –scale forestry scenario models: experiences and requirements. EFI Proceedings No. 5. 318p.

Persson, R. and K. Janz 1997: Assessment and Monitoring of Forest and Tree Resources. World Forestry Congress. Antalya, Turkey. Topic 1 p. 17–29.

Schreuder, H. 2001. Sampling using thematic mapping, very large scale photgraphy, and ground sampling for measurement and strategic surveys. Electronic proceedings of the IUFRO 4.11 conference on Forest Biometry, Modelling and Information Science, held at the University of Greenwich, June 2001. <http://cms1.gre.ac.uk/conferences/iufro/proceedings/Schreuder4.pdf > visited April 2002.

Tomppo, E. 1990 Designing a Satellite Image-Aided National Forest Survey in Finland. In: The Usability of Remote Sensing For Forest Inventory and Planning, Proceedings from SNS/IUFRO workshop in Umeå 26 – 28 February 1990. Swedish University of Agricultural Sciences, Remote Sensing Laboratory, Report 4. 43–47

Trimble. 2002. How GPS works http://www.trimble.com/gps/triangulating1.html, visited April 2002.

Biodiversity Indicators in National Forest Inventories

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Abstract

Future global forest assessments should incorporate a greater emphasis on biodiversity. This could be partly achieved through use of indicators, which should be appropriate for use at the local scale, but enable information to be aggregated at larger scales. Many indicators of forest biodiversity have been developed in recent years, within the various processes focusing on sustainable forest management. Here we identify eight generalised indicators common to some or all of these processes, which are appropriate for implementation at the local scale. Methods are highlighted by which data to support these indicators might be derived from standard forest inventories. In addition, we suggest that information collected at the local scale may be aggregated by summarizing data in categorical form, and presenting them in relation to forest area. Such an approach would assist countries in contributing to the C&I processes of which they are a part, as well as meeting their reporting obligations to international conventions.

Introduction

It is now widely recognised that assessments of forest biodiversity are essential if forest resources are to be effectively conserved and sustainably managed (Hunter 1999). However, any assessment of forest biodiversity faces a number of challenges. Firstly, given its complexity, there is a need to express biodiversity in the form of simplified variables based on indirect measures, typically in the form of indicators (Noss 1990, 1999). Secondly, as decisions relating to forests are made at a variety of scales, there is a need to aggregate data across different scales for monitoring and reporting purposes (Noss 1990, Turner

1995).

The Expert Consultation on the Global Forest Resources Assessment (FRA) 2000 ('Kotka III') recommended that the assessment should address key indicators that might contribute towards a better understanding of the status and trends in forest biological diversity, specifically relating to the naturalness, protection status and fragmentation of forest ecosystems. These were subsequently incorporated into the FRA 2000 report (FAO 2001c). In addition to estimates of forest area and changes in forest cover, the FRA 2000 report provided statistics on the proportion of forest area incorporated within protected areas, the distribution of forest area by ecological zone, and the number of endemic and threatened species for seven species groups (FAO 2001c). This information provides a useful basis for monitoring future changes in the status of forest ecosystems, and associated biodiversity. However, in conclusion, the FRA 2000 highlighted the need to monitor trends not only in forest quantity, but also in forest quality, and suggested that future action focus on the further development, testing and implementation of indicators related to globally accepted criteria for sustainable forest management (FAO 2001c).

The aim of this paper is to explore how future global forest assessments might provide more detailed information on status and trends in forest biodiversity, specifically through use of indicators. Such indicators should be appropriate for use at the local scale, but should provide information that can be readily aggregated at larger scales, to be consistent with the overall FRA approach (FAO 2001c). To ensure that future assessments are practicable, they should employ indicators of biodiversity that can be generated from data collected by standard forest inventories as far as possible. In addition, the proposed indicators should build on the many international initiatives that have attempted to develop forest biodiversity indicators in recent years. This paper therefore firstly provides a brief overview of these initiatives, with reference to their policy context. The various frameworks for indicator development that have been proposed are then considered, and the methods by which appropriate indicators can be identified are highlighted. Finally, the application of forest inventory data to such indicators is examined. In this paper, we follow the definition of biodiversity provided by the Convention on Biological Diversity (CBD), which includes diversity within species, between species and of ecosystems.

Biodiversity indicators: Policy context and initiatives

The UN Conference on Environment and Development (UNCED) in 1992 recognised the importance of indicators for enabling countries to make informed decisions regarding sustainable development. The need for countries, as well as other organizations, to develop such indicators, was recognised explicitly in Chapter 40 of Agenda 21. During the decade following UNCED, a large number of initiatives have sought to identify indicators of sustainable development, including those undertaken as part of the Programme of Work implemented by the UN Commission on Sustainable Development (UNCSD 2001). Given that the concept of sustainable development embraces such a wide variety of different aspects, relatively few indicators relate explicitly to forest biodiversity. The relevant indicators presented by UNCSD (2001) include forest area as a percent of land area, wood harvesting intensity, protected area as a percentage of total area, and abundance of selected key species.

The Convention on Biological Diversity (CBD) provides a more explicit policy context for indicators of biodiversity. Article 7 of the Convention requires Parties to identify and monitor 'components of biodiversity important for conservation and sustainable use', and to identify processes or activities likely to have adverse effects on biodiversity. The text of the Convention also recognises the role of indicators in assisting Parties with monitoring the status of biodiversity and the effects of measures taken for its conservation and sustainable use. CBD (2001) provides an overview of how the issue of biodiversity indicators has been dealt with by the Convention. To date, meetings held under the auspices of the CBD, such as the various Conferences of the Parties (COP), have sought to encourage Parties and Governments to identify appropriate biodiversity indicators (for example, COP5, decision V/24, paragraph 4), and to increase regional cooperation and capacity-building for the development and use of indicators. Decisions (such as those made by COP4) have stressed that the primary role of indicators should be as a tool for management of biological diversity at local and national levels, and for assessing implementation of the Convention, but have also emphasised the need to adopt the ecosystem approach in indicator development. Proposals have also been made for a 'core

set' of biodiversity indicators suitable for use by Parties in compiling their national reports, and to enable the effectiveness of measures taken to be evaluated (CBD 1997a). Indicators specifically relating to forest biodiversity have also been proposed (CBD 1997b).

The Forest Principles and Chapter 11 of Agenda 21 call for the identification of criteria and indicators (C&I) for evaluating progress in national efforts to practice sustainable forest management. As a result, a large number of national, regional and international initiatives have been developed, including ITTO, the Pan-European (or 'Helsinki') Process, the Montreal Process, and the Tarapoto, Lepaterique, Near East, Dry Zone Asia and Dry Zone Africa processes, which have each generated sets of C&I (Grayson and Maynard 1997, FAO 2001a, Castañeda 2001). Currently, around 150 countries are participating in these processes (FAO 2001b). While the different processes share similar objectives and overall approach, they differ in structure and specific content (FAO 2001b).

Development of C&I for sustainable forest management has also been encouraged by the Intergovernmental Panel on Forests (IPF), which was established by the CSD to develop an international consensus on forest issues, specifically relating to implementation of Agenda 21. The IPF, together with its successor the International Forum on Forests (IFF), recommended more than 270 proposals for action to be adopted by the international community. A number of these proposals related explicitly to the further development and implementation of C&I for sustainable forest management. Implementation of these proposals is currently being assessed by the United Nations Forum on Forests (UNFF).

Comparison of the large number of indicators relating specifically to biodiversity that have been generated indicates that many are common to more than one process (CBD 1997b). However, field evaluations of C&I undertaken by CIFOR in a number of different countries indicated that most, if not all, of the proposed C&I relating to biodiversity for use at the local level are in some sense deficient (Prabhu et al. 1996). In particular, many of the criteria appeared either to be impractical, or of little relevance to forest management. In response, CIFOR proposed a preliminary list of indicators, together with a practical framework for applying biodiversity C&I in field situations (Stork et al. 1997).

Frameworks for the development of biodiversity indicators

It is widely recognised that some form of framework or conceptual model is required in order for meaningful indicators to be developed (Holdgate 1996). The most widely used is the 'pressure-state-response' (P-S-R) framework, which was developed by the OECD (OECD 1993) on the basis of the "stress-response" model developed by Friend and Rapport (1979). The P-S-R framework states that human activities exert pressures on the environment (such as clearance of forest for agriculture), which can induce changes in the state of the environment (for example, the extent of forest cover). Society may then respond to changes in pressures or state with policies and programs intended to prevent, reduce or mitigate pressures and thereby reduce environmental damage. Indicators provide tools for identifying P-S-R relationships, both at the reporting stage and during policy analysis.

The P-S-R framework has been widely applied to indicator development; for example it is explicitly recognised by the CBD (CBD 1997a). A variant of this approach, namely the "Driving Force – State – Response" (D-S-R), has been applied by the CSD (CSD 2001). In the D-S-R framework, the term "pressure" has been replaced by that of "driving force" in order to accommodate more accurately the addition of social, economic, and institutional indicators. In addition, the use of the term "driving force" allows that the impact on sustainable development may be both positive and negative, as is often the case for social, economic and institutional indicators.

The PSR scheme was further expanded by the European Environment Agency to include drivers and impacts, forming the DPSIR framework (EEA 1998). Both the PSR and the extended DPSIR models are based on the fact that different societal activities (drivers) cause a pressure on the environment, causing quantitative and qualitative changes of it (changing state and impact). Society has to respond to these changes in order to achieve sustainable development. According to the DPSIR framework, different indicators of sustainability may be developed, relating to drivers, pressure, state, impact and response.

A number of other indicator frameworks have been proposed by researchers. For example, Hyman and Leibowitz (2001)

suggest that development of a conceptual model based on ecological principles can enable the relevance of different indicators to be evaluated, by identifying the relationships between proposed indicators and assessment 'endpoints', such as biodiversity. Noss (1990) presents a hierarchical framework for development of biodiversity indicators, recognising that three attributes of biodiversity, composition, structure and function, can be considered at a number of different levels of organization. Stork et al. (1997) provide a framework based on a conceptual model of the relationship between anthropogenic activities affecting forests, and the processes that influence biodiversity. Indicators may therefore be developed for particular human interventions or mediators (pressure indicators), as well as processes maintaining biodiversity, and biodiversity itself (state indicators). An operational framework is provided by these authors illustrating how indicators for forest biodiversity could be developed and applied in practice.

These examples highlight some of the approaches that have been employed in development of biodiversity indicators. However, it should be emphasized that research in this area has been characterised by a high degree of confusion in the terminology adopted, and uncertainty about which methods are the most appropriate (Larsson and Esteban 2000). For example, the terms 'framework' and 'conceptual model' are often used interchangeably. Here, we support the suggestion of Boyle (1998) that a conceptual model and a framework are both required for indicator development, the former to define the relationship between the indicator and the endpoint, and the latter to categorize the variables, and define which are appropriate for assessment.

Use of forest inventories for assessing biodiversity

A variety of different approaches for assessing biodiversity are available (Groombridge and Jenkins 1996, Jermy et al., 1995, Heywood 1995). These range from Rapid Biological Assessment (Beattie *et al.* 1993) to All Taxa Biodiversity Inventory (Yoon 1993). These approaches vary with respect to sampling intensity and requirement for taxonomic expertise, and therefore cost. Where the aim is to explicitly address changes over

time, methods are required that are repeatable, and can provide measures that are comparable between sampling events. As resources are often limiting, there is also a need to adopt approaches that are practical and efficient, and that can be sustained over time.

Future global forest resource assessments will need to address not only biodiversity, but biophysical status and development of forests, information about how forests are used, and the types and quantities of benefits that are derived from forests (FAO 2001c). Therefore, there is a need to integrate biodiversity assessments with inventories of other forest characteristics. Biodiversity assessment should also be undertaken in a manner that ensures accordance with the criteria and indicators processes with which a particular country is affiliated, together with international reporting obligations such as the CBD and CSD.

Although forest inventories and biodiversity survey methodologies differ in a number of important respects, there are a number of commonalities between the two approaches (Vanclay 1998). Methods of forest inventory have principally been developed for estimating the standing volume of wood in forests and for recurrent measurements to indicate changes in stand structure and growth with time. Traditionally, such inventories focus on assessing timber yield, and therefore do not generally incorporate measures of other ecosystem components, such as animals or non-woody plants (Burley and Gauld 1995). However, in recent years, there has been an increasing effort to establish sample plots explicitly for the purposes of biodiversity assessment in forests. For example, in 1986, UNESCO MAB and the Smithsonian Institution began a joint initiative (SI/MAB) to establish a global network of forest areas under different management regimes, together with protocols for biodiversity monitoring (Dallmeier and Comiskey 1998b). These protocols have been adopted at nearly 200 research sites in 23 countries (Dallmeier and Comiskey 1998b).

In many countries, however, forest inventories are inadequate or entirely lacking. For example, Kapos and Jenkins (2002) examined the extent to which existing forest inventories can serve as a source of information appropriate for biodiversity assessment and monitoring, with a focus on tropical moist forest. Results indicated that existing forest inventories, surveys or networks of permanent plots are often inadequate for providing a representative assessment of forest biodiversity. For these reasons, there will often be a need to design and

implement a new inventory system. The following section suggests how such an inventory might be designed and implemented in practice, focusing on use of biodiversity indicators in conjunction with standard forest inventory approaches.

Biodiversity indicators and national forest inventories: a Proposed approach

As noted by Stork et al. (1997), most of the forest biodiversity indicators that have been proposed to date are not amenable to practical implementation, or are not appropriate for use at the level of the Forest Management Unit (FMU). This reflects the early emphasis on development of national-level C&I (e.g. under the Helsinki and Montreal Processes), which are not sufficiently sensitive to be useful at the FMU level (Raison et al. 2001). With respect to biodiversity, where important changes may only be detected at the local scale, data collected within the FMU can potentially be aggregated or extrapolated to larger scales, to assist with reporting at the national or regional level (Raison et al. 2001). In this way, trends in indicators at the FMU level could help adjust forest management approaches to ensure that national goals are met. At the same time, national-level indicators are required for the development and updating of national and international policy instruments (Castañeda 2001).

Whilst recognising that indicator development is dynamic, and that research employing novel approaches could contribute greatly to further indicator development (Prabhu et al. 2001), we focus here primarily on biodiversity indicators that have been proposed by existing C&I processes. Specifically, we examine how data required for such indicators could be derived through the use of forest inventory approaches. We suggest that this approach to forest biodiversity assessment could assist countries in implementing the C&I processes in which they are participating (Castañeda 2001), as well as helping them meet their international reporting obligations for the CBD and CSD.

Selection of indicators

As noted by Dallmeier and Comiskey (1998b), a clear statement of goals and objectives is critical to the development of

any assessment or monitoring programme. The selection of indicators will depend upon the precise objectives of the assessment, and the framework for indicator development that has been adopted. Ideally, the relationship between selected indicators and endpoints should be analysed using appropriate statistical approaches (Hyman and Leibowitz 2001). Although many indicators of forest biodiversity have been proposed, many have been poorly tested and require rigorous validation in order to be interpreted with confidence (Noss 1999). The suggestions made here should therefore be viewed as tentative.

Although a large number of different biodiversity indicators have been proposed (Prabhu et al. 1996), those appropriate for implementation at the FMU level can be divided into eight generalised groups. These are:

- Forest area by type, and successional stage relative to land area
- Protected forest area by type, successional stage and protection category relative to total forest area
- Degree of fragmentation of forest types
- Rate of conversion of forest cover (by type) to other uses.
- Area and percentage of forests affected by anthropogenic and natural disturbance.
- Complexity and heterogeneity of Forest Structure
- Numbers of forest-dependent species

Conservation status of forest dependent species

Some of these, such as area of different forest types and protected forest area, are common to all of the C&I processes, and international reporting obligations. Others, such as forest structure and area affected by disturbance, are recognised by a minority of the processes considered here (Table 1). In this assessment, we did not consider indicators of genetic variation, as these will generally require sophisticated laboratory-based analyses (Namkoong et al. 1996; but see Jennings et al. 2001).

Structural characteristics of forest stands are widely recognised to be of fundamental importance for biodiversity (Noss 1990, 1999, Ferris et al. 1998, Ferris and Humphrey 1999). Forest stands tend to be structurally heterogenous, owing to variation in the relative abundance of different structural components in both vertical and horizontal planes (Ferris and Humphrey 1999). Structural complexity may determine habitat availability for plant, animal and microbial communities, and therefore influence diversity of such groups of organisms (Ferris and Humphrey 1999). Structural features of forest stands are also

relatively easy to assess in practice (Ferris et al. 1998, Boyle and Sayer 1995).

Similarly, the incidence and intensity of both natural and anthropogenic disturbance have a major influence on forest biodiversity. Disturbance may take the form of small-scale processes such as the senescence and death of individual trees, or large-scale effects caused by hurricanes or fire. The disturbance regime can profoundly influence forest structure and composition, and therefore affect the availability of habitat for different groups of organisms. However, assessing disturbance can be difficult in practice; often it will be necessary to develop or adapt indicators of disturbance at the local level according to the particular characteristics of the disturbance regime prevalent at the site (Ramírez-Marcial et al. 2001).

Methods of assessment and analysis

The data required for the biodiversity indicators considered here can largely be provided through the use of traditional forest inventory approaches, supported by the application of remote sensing and geographic information system (GIS) technologies. A full description of appropriate methodologies is beyond the scope of this paper; however, an overview of the approaches relevant to each indicator is provided on Table 2, together with references to sources of more detailed information on particular techniques. Practical examples of forest biodiversity assessment relating to forest inventories are provided by Dallmeier and Comiskey (1998a), Bachmann et al. (1998) and Boyle and Boontawee (1995).

Vanclay (1998) provided a detailed overview of different biodiversity survey techniques, with particular reference to forest inventory approaches. Most programmes focusing on monitoring of forest biodiversity employ establishment of permanent sample plots so that measurements can be repeated over time (Dallmeier and Comiskey 1998a, Bachmann et al. 1998). Some form of stratification is generally implemented, as this permits increased efficiency; however, if no prior data are available, then a systematic sampling approach may be adopted (Vanclay 1998). Sample size is of critical importance in biodiversity surveys, as both bias and precision are affected (Vanclay 1998). Determination of an appropriate sample size will depend on the inventory goals, the nature of the forest being inventoried, and allowable sampling error.

Appropriate analysis and presentation of the data collected is also of critical importance. As many of the biodiversity indicators considered here (Table 2) relate directly to forest area, GIS is of particular value for both data analysis and presentation. GIS is essentially a spatially referenced database that allows different data layers to be combined and presented as maps. As datasets can be overlayed, GIS is of particular value for analysis of spatial data; many software packages now provide tools for analysis of areas, perimeters, distances and other measures. For example, spatial data relating to species distributions or protected areas can be overlaid onto maps of forest cover, to examine the linkages between them, and generate statistics relevant for use as indicators. GIS also offers a particularly powerful tool for communicating information.

Methods are also required that enable results of forest inventory gathered at the local scale to be aggregated for reporting at the national scale. In addition, data need to be presented in a manner that will permit regional and global scale evaluations of resources, as well as enabling monitoring of change over time. We propose that this can most readily be achieved by summarizing data in categorical form, and presenting in relation to forest area. This approach links directly to the indicators of the extent of forest types, but also offers a meaningful way of expressing other indicators. For example, forest fragmentation as evaluated by an index of spatial integrity can be expressed as forest area belonging to each class of spatial integrity (Figure 1). A country might characterise the structural complexity of its forest resources in terms of the total area of forest within different classes of canopy openness or crown depth, or numbers of canopy layers. Species richness could similarly be presented as area of forest possessing more than a certain number of tree species within a given area. Such categories could be expressed in qualitative terms determined according to local or national conditions. For example, disturbance classes of high, medium or low timber extraction could be defined on the frequency of cut stumps encountered in inventory plots.

Role of remote sensing

Remote sensing technologies are potentially of great value to forest biodiversity assessment, by providing tools for mapping and monitoring vegetation. Maps derived from remote sensing images can serve as a basis for resource assessment and conser-

vation planning, or as a basis for stratifying field sampling efforts.

Many different types of remotely sensed data are available, ranging from aerial photography and videography to complex multispectral instruments mounted on satellites or (rarely) aircraft. The criteria which determine the usefulness of data from a particular satellite or other instrument for biodiversity-related assessment include spatial resolution (or pixel size), temporal resolution (or return time), spectral resolution (or numbers and types of spectral bands in which data are recorded), and cost of the data. Spatial resolution (ranging from 10 x 10 m to 1100 x 1100 m) determines both the detail which can be detected and the extent or scale of investigation which is practicable (local/landscape/regional). Temporal resolution (return times of 1–44 days) determines not only the absolute frequency of observations possible, but the probability of obtaining cloud free imagery for any given location. Increasing spectral resolution usually increases the subtlety of differences among vegetation types that can be detected in the images (Tanner et al 1998). The satellite sensor data currently of use in biodiversity assessments are principally from Landsat-MSS and Landsat-TM, from SPOT-HRV. Global analyses tend to be based on data with coarser spatial resolution, such as NOAA-AVHRR and MODIS, but they are less useful at more local scales. For national forest assessments, the higher resolution forms of remote survey, Landsat TM, SPOT or aerial photography are preferred.

All approaches to the analysis of remote sensing data require heavy investment in verification or ground truthing, and this requirement increases with the level of detail sought. Structurally distinctive vegetation types may be located with a high degree of confidence and with relatively little ground verification, but more subtle resolution of vegetation types requires far greater investment in ground verification. In many cases, reconnaissance flights can provide a useful intermediate level of verification, with detailed ground sampling then being required with less frequency. Stratified sampling using both aerial reconnaissance and intensive fieldwork has been recommended for verifying satellite data (Groombridge & Jenkins 1996). In general, only strongly contrasting vegetation types can be mapped with a high degree of consistency without intensive fieldwork.

There is as yet little evidence that remote sensing can pro-

vide any information on species level diversity. It may provide indications of ecosystem level diversity as indicated by spatial distribution of different vegetation types, which has implications for species diversity, but the relationship between the two is not direct nor clearly defined. However, mapping distinctive vegetation types from remotely sensed data provides a basis for mapping distributions of species that are closely associated with distinctive vegetation types and for identifying, prioritising and stratifying areas for more intensive field study. This approach is used by the Nature Conservancy in its Rapid Ecological Assessment methodology to provide an integrated picture of areas of conservation importance at national and regional scales (Grossman et al. 1992). It could equally be applied to any programme of field sampling and inventory.

The most reliable use of remotely sensed data is in generating maps of forest cover in contrast to non-forest vegetation. These can then be combined with ground data and other ancillary data in GIS to:

- evaluate the extent of forest of particular types or with given characteristics (e.g. Hall et al.1991);
- measure changes in forest cover over time (e.g. INPE 2000)
- evaluate some measures of pressures on forests, such as wilderness or accessibility indices (Lesslie & Maslen 1995).
- evaluate the condition of forest ecosystems, including fragmentation (Chatelain et al. 1996, Kapos et al 2000).

Conclusions

A considerable effort has been devoted to development of indicators of sustainable forest management in recent years, which has generated a large number of indicators relating to forest biodiversity. Many of these have been found to be impractical for application at the local level. In addition, the effectiveness of different indicators has rarely been evaluated, and their relevance remains largely untested. This may reflect a lack of conceptual models concerning the processes influencing forest biodiversity. Future research is likely to generate new insights into the relationships between indicators and the variables or processes of interest, together with a more explicit consideration of the uncertainty surrounding these relationships.

Similarly, a variety of different frameworks are available for

the development and implementation of biodiversity indicators. Although some of these (notably PSR) are now in widespread use, future research is likely to produce more refined methods of structuring and organising indicators. In particular, there is a need to develop practical tools that can assist in the development and application of biodiversity indicators, based on such frameworks. The provision of such tools, together with a programme of capacity building, would help increase the use of indicators among decision makers, and improve the quality of environmental monitoring. To date, despite the international effort focusing on indicator development, only rarely have such indicators been implemented in a practical way to inform policy development or management interventions.

Here we identify eight generalised indicators for forest biodiversity that are consistent with those developed by C&I processes, but are amenable to practical implementation at the local level. For each of these indicators, it may be necessary to adapt them to local circumstances and the characteristics of the particular forests being assessed. However, methodologies for assessing these variables are available, and could be implemented at relatively low cost, through integration with standard forest inventory approaches.

Of particular importance is the need to aggregate information collected at the local scale to provide information at higher levels, such as nationally. We propose that this can be achieved by summarizing data in categorical form, and presenting in relation to forest area. Such an approach would enable countries to present information to the C&I processes of which they are a part, as well as meet their international reporting obligations to the CSD and CBD. In the context of the latter, the process of national reporting is still under development. The second national reports generally focus on response measures undertaken by parties to the Convention. In future, it is likely that consideration will be given to monitoring the effectiveness of these response options, and their impact on biodiversity. The approaches outlined here would provide an appropriate method for achieving this, with respect to biodiversity associated with forest ecosystems.

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References

Bachmann P., Köhl M., and Päivinen R (eds.) (1998) Assessment of biodiversity for improved forest planning. Kluwer Academic Publishers, Dordrecht / London.

Beattie, A. J.; Majer, J.D.; Oliver, I. 1993. Rapid biodiversity assessment: a review. *In:* Rapid Biodiversity Assessment. Proceedings of the Biodiversity Assessment Workshop 3–4 May 1993, Macquarie University, Sydney, Australia. Sydney, Australia: Macquarie University, Research Unit for Biodiversity & Bioresources, 4–14.

Boyle M 1998 Developing policy performance indicators for Ontario Ministry of Natural Resources MSc thesis, University of Waterloo, Canada.

Boyle T.J.B.. and B. Boontawee eds (1995): Measuring and monitoring biodiversity in tropical and temperate forests. CIFOR, Bogor, Indonesia.

Boyle TJB and Sayer JA (1995) Measuring, monitoring and conserving biodiversity in managed tropical forests. Commonwealth Forestry Review, 74, 20–25.

Burley J and Gauld I (1995) Measuring and monitoring forest biodiversity. A commentary. In: Measuring and monitoring biodiversity in tropical and temperate forests. Ed. by T.J.B. Boyle and B. Boontawee. pp. 19–46. CIFOR, Bogor, Indonesia.

Castañeda F. (2001) Collaborative action and technology transfer as means of strengthening the implementation of national-level criteria and indicators. In Criteria and indicators for sustainable forest management, ed. by RJ Raison, AG Brown and DW Flinn. pp. 145–163. IUFRO Research Series No. 7. CABI Publishing, Wallingford, UK.

Chatelain, C., Gautier, L. & Spichiger, R. (1996). A recent history of forest fragmentation in southwestern Ivory Coast. *Biodiversity and Conservation* , 5, 37–53.

CBD 1997a Recommendations for a core set of indicators of biological diversity. UNEP/CBD/SBSTTA/3/Inf.13

CBD 1997b Indicators of forest biodiversity. Working document prepared for the meeting of the liaison group on forest biological diversity. UNEP/CBD/SBSTTA/3/Inf.23.

CBD (2001) Global biodiversity outlook. Secretariat of the Convention on Biological Diversity, Montreal, Canada.

Dallmeier F and Comiskey JA (eds) (1998a) Forest biodiversity research, monitoring and modeling. Conceptual background and Old World case studies. Man and the Biosphere Series vol. 20. UNESCO, Paris and the Parthenon Publishing Group, Carnforth, Lancashire.

Dallmeier F and Comiskey JA (1998b) Forest biodiversity assessment, monitoring, and evaluation for adaptive management. In: Forest biodiversity research, monitoring and modeling. Conceptual background and Old World case studies. ed. by F. Dallmeier and JA Comiskey. pp. 3–16. Man and the Biosphere Series vol. 20. UNESCO, Paris and the Parthenon Publishing Group, Carnforth, Lancashire.

EEA (1998): *Europe's Environment – The 2nd Assessment*, European Environment Agency, Office for Publications of the European Communities, ISBN 92-828-3351-8.

FAO (2001a). Criteria and indicators for sustainable forest management: a compendium. Forest Management Working Papers no. 5, FAO, Rome.

FAO (2001b) State of the world's forests, 2001. FAO, Rome.

FAO (2001c) Global forest resources assessment. Main report. FAO, Rome.

Ferris R and Humphrey JW (1999) A review of potential biodiversity indicators for application in British forests. Forestry 72 (4), 313–328.

Ferris-Kaan R., Peace A.J. and Humphrey J.W. (1998) Assessing structural diversity in managed forests. In: Bachmann, P.; Köhl, M.; Päivinen, R. (eds.) Assessment of Biodiversity for Improved Forest Planning. pp. 331–342. Forestry Sciences Vol. 51. Dordrecht, The Netherlands: Kluwer Academic Publishers;.

Friend, A. and Rapport, D. (1979) *Towards a Comprehensive Framework for Environment Statistics: A Stress-Response Approach.* Statistics Canada, Ottawa, Canada.

Grayson AJ, Maynard WB (1997) The world's forests – Rio +5: international initiatives towards sustainable forest management. Commonwealth Forestry Association, Oxford, UK.

Groombridge B and Jenkins MD (1996) Assessing Biodiversity Status and Sustainability WCMC Biodiversity Series No 5. World Conservation Press, Cambridge.

Grossman, D.H., Iremonger, S. and Muchoney, D.M. (1992). *Jamaica: A Rapid Ecological Assessment.* The Nature Conservancy, Arlington, Virginia, USA.

Hall, F. G., Botkin, D. N. Strebel, D. E. Woods, K. D. & Goetz, S. J. (1991). Large scale patterns of forest succession as determined by remote sensing. *Ecology*, 72, 28–640.

Hawthorne W and Juam Musah A 1993 Forest protection in Ghana. ODA, Kumasi.

Heywood VH (Ed.) (1995) Global biodiversity assessment. UNEP/Cambridge University Press, Cambridge.

Holdgate, M. 1996. From care to action: making a sustainable world. IUCN / Earthscan, London

Holopainen, Markus; Wang, Guangxing. 1998. Digitized aerial photographs for assessing forest biodiversity. *In:* Bachmann, Peter; Köhl, Michael; Päivinen, Risto (eds.) Assessment of Biodiversity for Improved Forest Planning. Forestry Sciences Vol. 51.Dordrecht, The Netherlands: Kluwer Academic Publishers; 249–254.

Hunter ML (ed.) (1999) Maintaining biodiversity in forest ecosystems. Cambridge University Press, Cambridge.

Hyman JB and Leibowitz SG (2001) JSEM: a framework for identifying and evaluating indicators. Environmental Monitoring and Assessment 66, 207–232.

INPE (2000). Monitoramento da Floresta Amazônica Brasileira por satélite 1999–2000. INPE, Sao Jose dos Campos, SP, Brazil

Iremonger, S., C. Ravilious and T. Quinton (1997.). A statistical analysis of global forest conservation. In: Iremonger, S., C. Ravilious and T. Quinton (Eds.) A global overview of forest conservation. Including: GIS files of forests and protected areas, version 2. CD-ROM. CIFOR and WCMC, Cambridge, U.K.

Jennings SB, Brown ND, Boshier DH, Whitmore TC and Lopes J.do CA (2001) Ecology provides a pragmatic solution to the maintenance of genetic diversity in sustainably managed tropical rain forests. Forest Ecology and Management 154, 1–10.

Jermy C., Long, D., Sands, M., Stork, N., Winser S (eds.) (1995) Biodiversity assessment: a guide to good practice. Department of the Environment, HMSO, London.

Kapos, V., I. Lysenko and R. Lesslie. (2000). *Assessing Forest Integrity and Naturalness in Relation to Biodiversity*. 60 pp. UNEP-World Conservation Monitoring Centre, Cambridge, U.K for FAO FRA 2000.

Kapos, V. and Jenkins, M. (2002). Tropical Forest Management and Biodiversity Information and Indicators. Report to FRP DFID. UNEP-WCMC, Cambridge.

Lämå, T.; Ståhl, G. 1998. On the accuracy of line transect sampling of rare forest objects. *In:* Bachmann, Peter; Köhl, Michael; Päivinen, Risto (eds.) Assessment of Biodiversity for Improved Forest Planning. Proceedings of the Conference. 7–11 October 1996. Monte Verità, Switzerland. Forestry Sciences Vol. 51.Dordrecht, The Netherlands: Kluwer Academic Publishers; 273–281.

Larsson T-B. and Esteban JA (eds) (2000) Cost-effective indicators to assess biological diversity in the framework of the Convention on Biological Diversity – CBD. Report of an expert meeting, Stockholm, 1999. Swedish Environmental Protection Agency / Ministry of Environment, Government of Catalonia, Barcelona.

Lesslie, R. and Maslen, M. (1995). *National Wilderness Inventory Australia; Handbook of Procedures, Content and Usage* (Second Edition). Commonwealth Government Printer, Canberra, Australia.

Lund, H. Gyde. (ed.) 1998. IUFRO Guidelines for designing multipurpose resource inventories. World Series Vol. 8. Vienna, Austria: International Union of Forestry Research Organizations. 216 p.

Lund, H. Gyde; Wigton, William H. 1996. A primer for designing multiple resource inventory (MRI) and monitoring programs. *In:* Hassan, Haron Abu; Mun, Chin Yue; Rahman, Nasaruddin eds. Multiple resource inventory and monitoring of tropical forests. Proceedings of the AIFM International Conference, 21–24 November 1994. Seremban, Malaysia. Kuala Lumpur, Malaysia: ASEAN Institute of Forest Management; 125–143.

Margules CR and Kitching IJ (1995) Assessing priority areas for biodiversity and protected area networks. In: Measuring and monitoring biodiversity in tropical and temperate forests. Ed. by T.J.B. Boyle and B. Boontawee. pp. 355–364. CIFOR, Bogor, Indonesia.

McCormick, Niall; Folving, Sten. 1998. Monitoring European forest biodiversity at regional scales using remote sensing. *In:* Bachmann, Peter; Köhl, Michael; Päivinen, Risto (eds.) Assessment of Biodiversity for Improved Forest Planning. Proceedings of the Conference. 7–11 October 1996. Monte Verità, Switzerland. Forestry Sciences Vol. 51.Dordrecht, The Netherlands: Kluwer Academic Publishers; 283–289.

Namkoong G, Boyle T., Gregorius H-R, Joly H., Savolainen O., Ratnam W. and Young A. (1996). Testing criteria and indicators for assessing the sustainability of forest management: genetic criteria and indicators. CIFOR Working Paper No. 10. CIFOR, Bogor, Indonesia.

Noss RF (1990) Indicators for monitoring biodiversity: a hierarchical approach. *Conservation Biology* 4(4), 355–364.

Noss RF (1999) Assessing and monitoring forest biodiversity: a suggested framework and indicators. *Forest Ecology and Management* 115, 135–146.

OECD (1993): *OECD Core Set of Indicators for Environmental Performance Reviews*, Environmental Monograph No 83, OECD, Paris.

Prabhu, R., C. J. P. Colfer, P. Venkateswarlu, L. C. Tan, R. Soekmadi and E. Wollenberg. 1996. Testing criteria and indicators for the sustainable management of forests: phase I. Final report. CIFOR, Jakarta, Indonesia.

Prabhu R., Ruitenbeek HJ, Boyle TJB, Colfer CJP (2001) Between voodoo science and adaptive management: the role and research needs for indicators of sustainable forest management. In Criteria and indicators for sustainable forest management, ed. by RJ Raison, AG Brown and DW Flinn. pp. 39–66. IUFRO Research Series No. 7. CABI Publishing, Wallingford, UK.

Raison RJ, Flinn DW, and Brown AG (2001) Application of criteria and indicators to support sustainable forest management: some key issues. In Criteria and indicators for sustainable forest management, ed. by RJ Raison, AG Brown and DW Flinn. pp. 5–18. IUFRO Research Series No. 7. CABI Publishing, Wallingford, UK.

Ramírez-Marcial N., González-Espinosa M., and Williams-Linera G. (2001). Anthropogenic disturbance and tree diversity in montane rain forests in Chiapas, Mexico. Forest Ecology and Management 154, 311–326

Stern, Margaret J. 1998. Field comparisons of two rapid vegetation assessment techniques with permanent plot inventory data in Amazonian Peru. *In:* Dallmeier, F.; Comiskey,J.A. (eds.) Forest biodiversity research, monitoring and modeling – Conceptual background and Old World case studies. Man and the Biosphere Series Vol. 20. Paris, France: UNESCO; 269–283.

Stohlgren, Thomas J.; Bull, Kelly A.; Otsuki, Yuka. 1996. Comparison of rangeland vegetation sampling techniques in the Central Grasslands. Journal of Range Management 51(2):164–172.

Stork NE, Boyle TJB, Dale V, Eeley H., Finegan B., Lawes M., Manokaran N., Prabhu R and Soberon J. (1997) Criteria and indicator for assessing the sustainability of forest management: conservation of biodiversity. CIFOR Working Paper no. 17. CIFOR, Jakarta, Indonesia.

Tanner, E.V.J., V. Kapos and J.B. Adams. (1998). Tropical forests – spatial pattern and change with time, as assessed by remote sensing. in press. in Newbery et al. (eds) *Population and Community Dynamics*; 37th Symposium of the British Ecological Society. Blackwell Scientific Publications, Oxford, UK

Turner SJ (1995) Scale, observation and measurement: critical choices for biodiversity research. In: Measuring and monitoring biodiversity in tropical and temperate forests. Ed. by T.J.B. Boyle and B. Boontawee. pp. 97–111. CIFOR, Bogor, Indonesia.

UNCSD (2001) Indicators of sustainable development: guidelines and methodologies. United Nations Commission on Sustainable Development, New York.

Vanclay JK (1998) Towards a more rigorous assessment of biodiversity. In: Bachmann, P.; Köhl, M.; Päivinen, R. (eds.) Assessment of Biodiversity for Improved Forest Planning. pp. 211–232. Forestry Sciences Vol. 51. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Veldkamp A and Lambin EF (2001) Predicting land use change. Agriculture Ecosystems and the Environment 85, 1–6

Yoon, C.K. 1993. Counting creatures great and small. Science 260:620–622.

Table 1. Coverage of biodiversity indicators among C&I processes for sustainable forest management, and sets of indicators produced by international organizations or processes.

*Refers not to an officially endorsed list of indicators, but a provisional list of forest biodiversity indicators published in an information paper (CBD 1997b). Note: at time of writing, the Pan-European indicators are being revised; if adopted, the revisions proposed in June 2002 will substantially broaden the coverage of the indicators in this process, to include most of the categories listed here.

Generalised biodiversity indicator	Montreal	PanEuropean	Tarapoto	Dry Zone Africa	Dry Forest Asia	Lepaterique	Near East	ATO	ITTO	CIFOR	CSD	CBD*
Forest area by type, and successional stage relative to land area	√	√	√	√	√	√	√		√	√	√	√
Protected forest area by type, successional stage and protection category relative to total forest area	√	√	√	√	√	√	√	√	√	√	√	√
Degree of fragmentation of forest types	√			√		√			√	√		√
Rate of conversion of forest cover (by type) to other uses.			√	√		√				√		√
Area and percentage of forests affected by anthropogenic and natural disturbance.			√			√				√		√
Complexity and heterogeneity of Forest Structure			√					√		√		
Numbers of forest-dependent species	√	√		√	√	√	√			√	√	√
Conservation status of forest dependent species	√	√		√	√	√	√	√	√	√		√

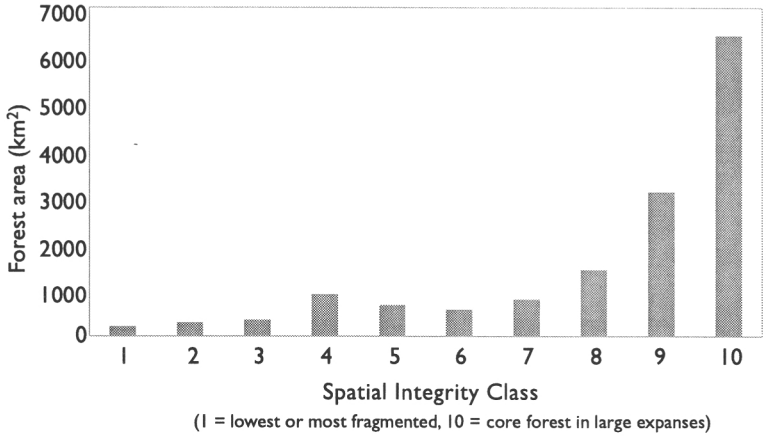


Figure 1. Forest area of Belize by spatial integrity class

Table 2. Methods for collecting information required for biodiversity indicators

Indicator	Methods	Considerations	References
Forest area by type, and successional stage relative to land area	Remote sensing or aerial survey combined with carefully designed sample of ground inventory plots. Remote survey provides estimate of forest extent. Plots provide ground truth and refinement of estimated forest extent derived from remote survey, as well as data on composition and structure that in turn can be used to identify forest types and successional stages.	• Remote survey data need to be of appropriate scale and resolution. • Sampling design of inventory needs to be of adequate intensity and representativeness. Remote survey can be used for stratification. • Ground inventory must incorporate measures that elucidate forest type and successional stage, such as diameter class distribution, species composition and occurrence of distinctive structural elements such as vines and epiphytes. • Forest types need to be defined in a national context, but with reference to international systems such as UNESCO or IGBP to facilitate regional and global assessments.	Holopainen and Wang 1998 McCormick and Folving 1998.
Protected forest area by type, successional stage and protection category relative to total forest area	Remote sensing or aerial survey combined with sample of ground inventory plots and mapped data on protected areas (and/or PA inventory data). Remote survey provides estimate of forest extent. Plots provide ground truth and refinement of estimated forest extent derived from remote survey, as well as data on composition and structure that in turn can be used to i dentify forest types and successional stages. Overlay of protected areas boundaries to determine proportion protected.	• Protected area boundary maps need to be available in (or converted to) electronic form. • IUCN management categories are the most widely accepted classification of protection. Mapped boundaries need to be attached to category. • Care needs to be taken to avoid double counting of forest in overlapping protected areas.	Iremonger et al. 1997
Degree of fragmentation of forest types	GIS analysis of forest cover data derived from above approaches to provide summary statistics on forest area belonging to spatial integrity classes (or other fragmentation index)	• Thresholds used in spatial integrity analysis will need to be determined in accordance with the resolution of the spatial data and national biodiversity priorities. • Regional and global summaries may need to be based either on qualitative combination or on regional/global analyses.	Kapos et al. 2000

Rate of conversion of forest cover (by type) to other uses.	Re-iteration over time of above approaches and comparison of results. Initial estimate will require use of historical data, which may require calibration for comparison. Land use data are needed if specific changes in use are to be reported. Change in cover is more easily verified.	• The timescale of re-assessment needs to be decided. • Reassessment methods need to be consistent over time, including with respect to scale and resolution (or cross calibration needs to be performed) • The possibility of reestablishment of forest cover needs to be included	Veldkamp and Lambin 2001
Area and percentage of forests affected by anthropogenic and natural disturbance.	Recording in ground inventory of frequency or intensity of characteristic evidence of principal forms of disturbance, e.g. paths, cut stumps, fire scars, evidence of grazing animals. Extrapolation via remote survey and spatial analysis.	• Factors recorded and disturbance classes will need to be determined according to national conditions and needs. Therefore, regional and global summaries will need to be based on qualitative classes. • Spatial analysis of exposure or accessibility to human activity can serve as useful indicator of anthropogenic pressure related to disturbance	Ramírez-Marcial et al. 2001
Complexity and heterogeneity of forest structure	Ground-based forest inventory that includes measures of stand structure and canopy openness.	• The importance of various structural characteristics varies with management priorities. Therefore specific measures may need to be decided in the national (or local) context and aggregation based on classification of forest area.	Ferris-Kaan et al. 1998, Ferris and Humphrey 1999
Numbers of forest-dependent species	Ground-based forest inventory can provide tree species richness, and could be used to express forest area in terms of tree species richness classes. Other species groups require purpose-designed sampling of their own and skilled survey teams – likely to be outside the scope of forest inventory. Estimates can be derived from review of national fauna lists combined with distribution data and/or habitat requirement information.	• DBH thresholds will determine the richness recorded; data are more complete if broader DBH ranges are adopted • For non-tree species, defining and confirming forest dependence is problematic. • Measurement of species numbers in relation to survey area and/or sampling effort is essential for monitoring or cross-comparison of the data.	Vanclay 1998 Dallmeier and Comiskey 1998b
Conservation status of forest dependent species	Species lists (see above) cross-referenced to national and global assessments of conservation status (e.g. Red Lists, CITES, etc.) and/or specific assessments	• Endemic species should be among national priorities for inventory and assessment. • Global and national conservation status may be very different.	Hawthorne and Juam Musah 1993

The Feasibility of Low-Intensity Sampling in National Forest Inventories

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Abstract

Information about the world's forests is less exact than normally expected by, e.g., politicians. As a result it is difficult to make qualitative statements about, e.g., the forest area change in the world. Nevertheless, considerable resources are used to prepare for important agreements at the international level based on available incorrect information. In addition national decision support require more detailed information, which is also often missing or inaccurate.

To improve knowledge about forests in countries where the existing forest database is of poor quality, a ground based, low-intensity systematic national forest inventory (NFI) may be effective in providing an overall qualitative assessment. In this paper the benefits and possible data-qualities from such low-intensity NFIs are examined.

Results from three recent NFIs were used to study standard errors in low intensity NFIs. Two of these, the Swedish NFI and a pilot low-intensity NFI in Costa Rica, are based on systematic tracts. The third is an assessment of the Armenian forests using compartments as the sampling base.

The Armenian results were surprising as the growth was measured to be to 2.86 ± 0.17 m^3/ha, yr., or twice the previous official number. Stump measurements indicated cuttings to be about six times the allocated maximum allowable cut. The inventory results thus became an incentive for change in the Armenian forest policy.

Based on simulations of standard errors from the Swedish and Costa Rican examples it was concluded that, e.g., total forest area and standing volume can be estimated with fairly good precision also with a low number of inventory tracts. As expected, variables found only on a small proportion of the

forest area would gain high relative standard errors, but the absolute errors may be acceptable. For example, the estimated absolute confidence limit for final fellings based on 500 tracts was 0.6–1.0% in the Swedish NFI.

To conclude low intensity NFIs may not fulfill all demands from a professional forest inventory view on a national or global level. However, it seems, as it is feasible to get fairly advanced data from low intensity forest inventories. Also, the information from such an inventory may promote national forest policy work and new inventories that can further improve the national professional capacity.

Introduction

FRA 2000 the best global forest database so far – but it is built on weak data

This paper stems from the fact that the available information about the forest resources of the world is much more rudimentary than normally expected, and the notion that few politicians seem to be aware of this. For this reason conclusions about the forest development are based on incorrect or insufficient information leading to faulty decisions. With this as background the feasibility of low-intensity forest inventories, using on-the-ground sampling, for filling the information is analyzed.

The obvious prime objective of all forest resources assessments or inventories is to support decision making, or at least it should be like that. However this is not always the case in reality. There are many other reasons for collecting or in some other way prepare data on the forest resources. It could, e.g., be to serve the international enquiries, not always having the motivation, financing or the institutional set-up to be able to produce really good data. The latest FRA effort which was built on a cooperation between FAO, as the coordinating agency, and the member countries and other parties, recently presented its main report "Global Forest Resources Assessment 2000" (FAO 2001a). For some time to come this report will probably be the most comprehensive report on the state of the world's forest.

However, as written in the "State of the worlds forests 2001" (FAO. 2001b, p. 29) "Demand has grown for a broad range of information on forests at the national and international levels.

Reliable information on the status and trends of forest resources helps give decision-makers the perspective necessary for orienting forestry policies and programs. Such information is useful for monitoring progress towards sustainable forest management and for framing international discussions and agreements on such vital issues as deforestation, biological diversity, desertification, global climate change, wood supply and sustainable development."

But, the problem with the FRA approach today is that the information collected is hardly any better than the information presented by the national correspondent. And, as written in "State of the world's forests 2001" (FAO 2001b) "Only a handful of countries maintain continuous national forest inventories with comparable time series". Actually, the simple fact is that for most developing countries and for a surprisingly large proportion of the industrialized countries, basic, unbiased and objective on-the-ground data is totally missing. In other cases the existing inventory only covers parts of the country, or it may be outdated, or otherwise unsatisfactory, resulting in poor accuracy and poor or unknown precision. Out of 136 developing countries reporting to FRA 2000, 39 have had no forest inventory, 21 have had only partial inventories and 34 had forest inventory data older than 1990 (FAO 2001b).

In other words available data can be far from the true values on the country level, and even on a more regional or even the global level data can be really biased without any knowledge about this by the decision-makers.

But even worse, the decision support for the decision-makers in the reporting countries are very often rudimentary and of limited value, with unknown negative effects on the country economy and its environment. Existing data sets, besides becoming outdated, often include severe systematic errors. In some areas both growth figures and harvesting rates have for example been proven to be largely underestimated (c.f. Thuresson et. al 1999). In addition to this illegal or legal cuttings have in many areas reduced the validity of old existing data sets.

Often it is concluded that the existing forest information is neither sufficient nor adequate in supporting the urgent decision needs on normative and strategic planning levels. That is, e.g., for establishing new legal allowable cutting volumes and other related forestry legislation matters, but also for the planning of investments in industry capacity, establishing well balanced environmental protection policies, etc.

In the FRA 2000, and also in the FRA 1990, the lack of basic on the ground forest inventories were to some extent compensated by the analyses of satellite remote sensing data. This may have gained valuable information for regional and global analyses on, e.g., forest areas and forest area change. However, for many other similarly important variables, such as above ground woody biomass, growth and yield figures, merchantable wood, non-wood forest products, different bio-diversity indices etc. satellite data are weak or useless. For management variables and for finding out the dynamics in the forest caused by natural or human impact, remote-sensing data alone is of course of little or no value. On the other hand remote-sensing data can be much more useful together with a large enough sample of forest inventory plots (Tomppo et al. 2002).

Global information needs

As a result of the poor basic forest information it is difficult to say something qualitative about for example the forest area change in the world, the role of the forest in the global climate change and the sustainable wood supply. The questions are many but the answers are few, much due to the lack of a fair knowledge about the forest, the natural and the human initiated dynamics of the forest, and all those other basic facts that can support good decisions.

Conferences are held making policies about how to go forward with the world's forests, such as the 1992 RIO-conference and the upcoming summit on sustainable development in Johannesburg. The Kyoto processes are considering the forests as one important key to solve the climate change problems and modelers all over the world is trying to figure out how, based on the available information. Probably all foreign aid agencies have their own agenda on how to utilize and develop the forest resources for the benefit of the people in the aid countries and most countries are producing their own forest policy documents. That is, huge resources are used every year to analyze and prepare important decisions about the worlds forest. Thus, there is a great need to improve the knowledge about the forests in a broad sense, and for many important variables the only qualitative way to do it, is to go out in the forests and measure what is there.

The information gap between existing forest records and the data sets required for policy making both on country and global

level is primarily qualitative. By "qualitative" information is meant data sets with a high degree of stability, i.e. with known statistical properties and sufficiently small errors.

In this situation a ground based systematic and objective low intensity national forest inventory, when possible supported by aerial or satellite photographs, may be effective to get an overall qualitative assessment of the forest resources. FAO is currently developing a project model for supporting national forest assessments along these lines. In this paper the possibilities and benefits of a low intensive sampling and the possible data-qualities from such an inventory are discussed.

National information needs

Promoting national capacity

There is a device saying that – "You don't know what you want before you know what you can get" and this is often the case when it comes to forest inventories. If the decision-maker do not have any hard data, decisions will be based on other available information, "guesstimates" or just pure assumptions. But as soon as more trustworthy and objective data are available, decisions makers will go for these data instead, because good data can seldom be neglected. Further on, when they see the strength of basing the decisions on hard data, more data will be asked for – other variables, higher area resolution, and time series of data. This is the authors' experience from decision-makers in Sweden and they are likely valid elsewhere as well.

This means that a low intensity forest inventory might not fulfill all data demands from a professional forest inventory view. However, the data provided from such an inventory might light a candle of interest in better data in both time and space. This may promote national forest inventories that will further improve data, but also the national professional capacity.

Strategic and operational information needs – the case of armenia

Another device is that "Sometimes it better to be more or less correct than exactly wrong".

Sometimes the local administrations have data that it is compiled from stand based subjective forest inventories and the data is often old. The inventory systems are sometimes estab-

lished since many years and solidly anchored in the forestry administration. On paper data looks very reliable, with two decimals and all… However, when scrutinized, with for example an objective forest inventory, the surface might crack.

One example of this is the republic of Armenia, where the old former Soviet Union (FSU) inventory result still formed the database available in 1998, when SIDA financed a *strategic* objective inventory (Thuresson et al. 1999) of the Armenian forests. The purpose was to get a better decision support for the ongoing forest policy development in the country. In this low intensity forest inventory 300 sub-compartments, stratified by volume and age from the old FSU inventory data were inventoried (with an average of 10 circular plots with the radius 10 m in each compartment). On average three persons inventoried one sub-compartment per day excluding preparation work.

The results were probably surprising for the decision-makers. For example the growth was measured to be to 2.86 ± 0.17 m^3/ha, yr. compared with the old official figure of 1.4 m^3/ha,yr. Also, stump measurements indicated the cuttings to be about 600 000 m^3/ha, yr. (on 215 000 ha) which could be compared with the official maximum allowable cut of 100 000 m^3/ha,yr.

Based on the new information a seminar for policy-makers in Armenia was held. For many it was hard to accept the big differences between the old forest state figures and the sample based stratified random sampling. However all participants concluded that the illegal cuttings were a big problem and not carried out in a sustainable manner. The forest policy had to be updated and for this process further local inventory processes were needed.

In this case the objective inventory served as a wake up call, but it also induced further inventory activities by the local authorities. Here the local counterpart played an important role as transferor of knowledge and vision maker for the next round – the *operational* stand based full cover inventory.

It is important to note that both levels of inventory are needed. For strategic decision making, reliable data without bias and with a known precision is needed. This is normally achieved by a systematic sampling of field plots over the entire area of interest. However, these inventories do not provide information for operational forestry. Therefore, and secondly, a full cover inventory to facilitate management planning is also needed. Many variables needed at the strategic level are not needed at the operational level, and vice versa. Links between

the strategic and operational levels are of course important. But, as we have seen above, the common approach to use the operational inventories to generate national level data is often inappropriate.

Material and methods

To explore the "feasibility", or estimate the precision in beforehand, of any kind of inventory is a difficult task. To do the same thing in general, on a global level, is practically impossible.

First, the precision quality and the variables wanted from an inventory must be predefined by the decision-makers before the inventorer is able to design the inventory. And, as pointed out in the introduction above, the information needs of the decision-makers vary, depending on the information that is already available.

Second, the forest and other conditions vary widely between and within countries, with all kind of forests and vegetation types, from tropical and temperate rain-forests with thick well stocked forest, to arid or sub-arctic areas with a sparse and low vegetation. It's just not possible to define any kind of inventory covering all these different situations simultaneously.

Third, the variability within the areas of interest can vary on all levels, on the sub plot level, on the plot level, on a landscape level and on different regional levels. This greatly affects the standard deviation between the different measurements and therefore the expected standard error of the estimations and thus the optimal way of designing the inventory.

Therefore, we need to simplify the problem. One way to do this is to use examples, which will be the way forward in this paper. Three already carried out inventories are used to exemplify different possible outcomes from different parts of the world and with different intensities in the inventories.

The examples are the Swedish national forest survey (Li & Ranneby 1992), a low intensity sampling carried out in Costa Rica (Kleinn et al. 2001) and a low intensity sampling carried out 1999 in Armenia (Thuresson et al. 1999, see also above).

From these inventories we can draw conclusions that can be used in a wider sense. For this purpose we will study a handful of variables that normally are considered important ones in both national forest inventories and on a global level of decision making. Unfortunately, there are only a couple of compa-

rable variables with more or less the same definitions in the different cases.

The Swedish National Forest Survey

The majority of the forest area of Sweden is in the temperate boreal zone or within the "Taiga" region. Therefore it can be looked upon as representative for large parts of the big temperate boreal zones in the Northern Hemisphere. Although, there is an important anomaly – the Swedish forest are managed more intensively than most other areas within this region. This probably also means less autocorrelation in space and time and probably also a larger variation between plots, than in the rest of the region.

On the other hand precision studies are at hand and in Li & Ranneby (1992) where coefficients of variation in percent (relative standard errors) are presented for a large number of variables measured by the Swedish National Forest Survey (NFS) 1983–1987.

The NFS was designed as a systematic cluster sampling, where the clusters are circular sample plots (5–10 m in radius) along the sides of a square tract. The sizes of the tract sides and the distances between the tracts varied from 400 m to 1800 m depending on the region in Sweden. In the southern part the tracts were smaller and with shorter distances between the tracts (5 km) and in northern Sweden the tracts were bigger and with longer distances between the tracts (5–22.5 km). The tract system was designed for a team of 3–4 persons to work on one tract per day (including travels).

Within each tract there were in average 4–5 volume plots and 9–10 stump plots and also regeneration plots. On all plots, land use classes are registered. The total number of tracts, volume plots and stump plots were about 2250, 20000 (10000 on forestland) and 20000 (on forestland) respectively per year.

In this paper a rough method is used to simulate the coefficient of variation of a low intensity sampling of the following variables: Area of forest land; Total standing volume m^3ob/ha on forest land; Harvested area – clearcuttings (on forest land); and total harvested volume m^3ob on forest land.

Costa Rica pilot inventory

Costa Rica is situated in the tropical region and will here

represent this region. In Costa Rica a recent pilot forest inventory (Kleinn et al. 2001) provides precision estimates for low-intensity sampling.

This inventory was designed as a systematic grid sampling of a combination of aerial photographs, being interpreted for, e.g., land use classes, but also clusters with on the ground measurements. A total of 159 photographs, with the on the ground sides of about 2.7 tot 4.5 km, representing 2/3rds of Costa Rica was available. 40 locations close to the photographs were sampled, and 34 quadratic forest inventory tracts were measured. These consist of 1 ¥ 1 km reference unit with an inner tract of 500 x 500 m. On the sides of this tract sub-plots of the size 150 x 20 m were established. Within these subplots all trees > 30 cm (dbh) were measured. Also in three nested plot levels 20 x 10 m plots and circular plots with the radius 3.99 m and 1.26 m smaller trees and saplings were measured and counted. The time consumption in field per tract varied between 7 and 12 full working days (excluding preparation and office work). It is noteworthy that not only tree measurements were carried out on the tracts but also interviews with landowners on land use, etc.

Four variables from the Costa Rican inventory were studied: 1) total forest area; 2) tree resources outside forest (TROF), which is all land outside forest with the capacity to hold trees; 3) Commercial volume (> 30 cm dbh) on forest and; 4) Commercial volume (>30 cm dbh). Number 1 and 2 were estimated from the 159 photographs and number 3 and 4 were estimated based on the 34 sample inventory tracts.

Simulating standard errors

From the inventory examples presented above a simple simulation of standard errors with different number of samples have been carried out.

Due to the large distances between the tracts in the different examples it is a reasonable assumption that there is no significant autocorrelation between the tracts. Therefore it is also fair (but not strictly correct) to estimate the coefficient of variation in percent with different number of clusters than the original inventories (CV – relative standard error) by the following simple formula (e.g. Lindgren 1984):

$$CV_n = CV_A \leftrightarrow \sqrt{\frac{A}{n}},$$

where:

CV_n is the coefficient of variation with n (simulated) tracts (or plots with some restrictions),

CV_A is the coefficient of variation with A (as in Actual number in the examples) tracts (or plots with some restrictions).

Results

The Swedish National Forest Survey

When simulating the coefficient of variation (CV) in percentage, for a single year inventory with 50, 250 and 500 tracts systematically spread over a country, based on the Swedish Forest Survey 1983–1987 the results in Table 1 were reached.

It is obvious from the figures in Table 1 that total area and standing volume can be estimated with fairly high precision even with a low number of low-labor tracts. However, it is also obvious that clear-cut areas, harvested volume, and if deforestation rate had been estimated, all are variables estimated with low precision. For these variables changes are found only on a small proportion of the area, (normally 0.5–2% per year) and it is therefore natural with high relative CVs in percentage of estimate. Instead the absolute CVs of, e.g., clear-cut area (or

Table 1. Simulated relative standard errors of a single inventory for some variables given different numbers of tracts (Swedish NFS design as 1983–1987)

	Coefficient of variation in percent of estimate (CV %, relative single standard errors)			
No. of tracts	**Total forest area**	**Clear-cut area per year on forest land**	**Total standing volume**	**Total volume harvested on forest land**
50	7,5	48,0	9,0	33,0
100	5,3	33,9	6,4	23,3
250	3,4	21,5	4,0	14,8
500	2,4	15,2	2,8	10,4

equivalent deforestation areas) would be fairly low, as the estimate in percentage of the total area is low.

The Costa Rican Inventory

When simulating the coefficient of variation (CV) in percentage, for a single year inventory with 50, 250 and 500 photographs (1&2) or tracts (3&4) systematically spread over a country, based on the Pilot forest inventory in Costa Rica the results in Tab. 2 were reached.

Here we see that the aerial photo interpretations of forest area and TROF show fairly low CVs with a few hundred photos interpreted. In the Costa Rican inventory 159 systematically distributed photos were interpreted.

The commercial volume estimates show higher CVs, but considering that only trees > 30 cm is included in the estimate the figures seems fairly good, depending of course on the wanted precision.

Forest change estimates

A variable presented by the FRA 2000 that historically has rendered large interest is the forest cover change estimate. There is no estimation of forest cover change in the Costa Rican inventory or in the NFS of Sweden. However, in the Swedish NFS the area of clear-cuttings are estimated and CVs simulated with different number of tracts from this is presented in Table 1.

Table 2. Simulated relative standard errors based on a single inventory in Costa Rica for some variables given different numbers of photographs (variables 1,2) or tracts (variables 3,4)

	Coefficient of variation in percent of estimate (CV %, relative single standard errors)			
No. of photos/ tracts	**1. Total forest area**	**2. TROF (tree resources outside forest)**	**3. Commercial volume (> 30 cm dbh) on forest**	**4. Commercial volume (> 30 cm dbh) on TROF**
50	6,8	9,3	14,3	31,7
100	4,8	6,6	10,1	22,4
250	3,0	4,1	6,4	14,2
500	2,1	2,9	4,5	10,0

The simulated CVs from direct plot measurements on clear-cut area are high, 48% with 50 tracts and 15.2% with 500 tracts, meaning double confidence intervals of 96% and 30% respectively at the 95% probability level. As the clear-cut area normally is about 0.8% of the forest area of Sweden (a figure that could represent the deforestation rate in many areas) absolute confidence limits of 0–1.6% with 50 tracts and 0.6–1.0% with 500 tracts are reached. With 50 tracts the results are with little value for the country decision-maker. However, already with 500 tracts the result would be very informative for many decision-makers and much better than today's available information in many countries.

Discussion and conclusions

Sample based on-the-ground forest inventories are essential – with or without the support of remote sensing

Since the 1970s and increasingly during the 1980s and 1990s remote sensing have been considered as the main source of forest information in many areas, such as, e.g., large parts of Africa (Holmgren & Persson 2002). And even if remote sensing can give valuable information it will seldom serve the information needs of local decision-makers. Often these satellite (because that has been development the last two decades) based "inventories" are motivated with low costs and "high tech".

However, the high tech is superfluous from the information point of view and often from other reasons as the infrastructure setup is missing. Also, other information than the image can give is wanted and on the ground forest inventories might be worth the costs.

Even if there are many practical difficulties with forest inventories, it is obvious that most important variables must be measured, counted or observed in the forest. It is also obvious that international processes are becoming more and more demanding when it comes to data variables and the quality of the data (see e.g. Braatz 2002 and Prins 2002).

Remote sensing, either as in the Costa Rican case with aerial photographs or satellite remote sensing can be used in many ways to improve the data precision and the geographical reso-

lution as described by Tomppo & Czaplewski (2002). However, also in those cases on-the-ground forest inventories are needed and the more of the on-the-ground plots the better the satellite image based estimates will be.

Therefore traditional sample based on the ground forest inventories will have to be planned and executed the coming ten years, to a much larger extent than the last decades. This will be necessary to fulfil the needs of the international society and the growing interest and need for forest inventory data in many countries.

The cost factor

In the Costa Rican inventory the costs per tract were estimated to about 2000 US$ which was a fairly high cost but it included indirect costs as planning, travel, etc. Also, not only forest variables were measured. Different land use areas were measured and interviews with the local population about their use and needs from the forest were carried out. In addition to this little more than 30 tracts were inventoried, meaning that the indirect costs for planning etc. were high. Furthermore, with more tracts the time consumption per tract would probably drop due to the training factor and the fixed cost being lower per tract. Thus the cost per tract in similar inventories in future can most probably be reduced.

Assuming half the cost per tract considering efficiency gains with larger and better planned inventories, and 500 tracts. The cost would then be about 500 000 US$. Is that a too high cost? Well, lets turn the question around – do we afford not to get the correct information, instead of discussing actions from information we know is incomplete, incorrect and with unknown errors leading to unknown decision costs?

Some conclusions

Different variables render different optimum inventory methods. However, most often the chosen inventory design is a compromise between different optimum solutions. So are the examples used in this paper, meaning that the examples in no way produce the best possible precision for presented the variables. However, the examples are inventories that have proved to work in reality with fairly low standard errors for some of the more important variables.

Even if the examples of low intensive inventories in this paper are limited in number and the analyses are fairly straightforward some things can be concluded.

Low intensive forest inventories can gain information of use both for the local and the global decision-makers with or without additional information from remote sensing data. Even such low precision inventories might, as in the Armenian case (Thuresson et al. 1999), give information that changes the whole perspective of the forest resources. This can indirectly lead to that decision-makers initiate more intense forest inventories and information analyses. That is, the low intensity forest inventory might lead to further inventory work with capacity building and better information as result.

The costs of such low intensity forest inventories might seem high for many of the developing countries, but in an international perspective and from the decision makers points of views the costs might anyway be well worth the pay. The outcome of this, of course, depends on how different decision-makers value the correctness of data and if the willingness to pay also is reflected in inventory investments. Here, the international society probably has the key to future information about the forest resources.

In other words – it is feasible to get fairly advanced data from low intensity forest inventories. Though, the decision-makers will have to be convinced about the better usability of data from such inventories, compared with other available information if money is to be raised.

References

FAO. 2001a. Global Forest Resources Assessment 2000. FAO. FAO Forestry Paper 140. 479 pp. ISBN 92-5-104642-5

FAO. 2001b. State of the world´s forests 2001. FAO. 181 pp. ISBN 92-5-104590-9

***Braatz S. 2002. Current international reporting requirements – mandates, mechanisms, overlaps and potential synergies. *Unasylva* 210. ***

Cochran W.G. 1977. Sampling Techniques. Third edition. John Wiley & Sons, New York. 428 pp. ISBN 0-471-16240-X.

***Holmgren P. & Persson R. 2002. Why did we end up here? – The evolution of global forest assessments. *Unasylva* 210. ***

Kleinn C., Ramirez C., Chaves G. & Lobo S. Pilot forest inventory in Costa Rica. Report to FAO FRA. 57 p.

Li C-Z. & Ranneby B. 1992. The precision of the estimated Forest Data from the National Forest Survey 1983–1987. Swedish university of agricultural sciences, Dept. of forest survey. Report 54. 54 p. ISSN 0348-0496.

Lindgren O. 1984. A study on circular plot sampling of Swedish forest compartments. Swedish University of Agricultural Sciences, Section of Forest Mensuration and Management. Report 11. 153 p. ISSN 0349-2133.

***Prins K. 2002. Criteria & indicators– the case of the Pan-European Process. *Unasylva* 210. ***

Tomppo E., Czaplewski R. & Mäkisara K. 2002. The role of remote sensing in global forest assessments. Report to the Kotka IV meeting July 1–5, 2002.

Thuresson T., Drakenberg B. & Ter-Gazaryan K. 1999. Armenia Forest Resources Assessment – Report on a sample based forest resource assessment of the forests possible for exploitation in Armenia. National Board of Forestry, Jönköping, Sweden.

Tomppo E. & Czaplewski R. 2002. Role of independent remote sensing studies in global forest assessments. Invited report to the Kotka IV FRA meeting 2002. *

FAO's Approach to Support National Forest Assessments for Country Capacity Building

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Introduction

The Food and Agriculture Organisation (FAO), has been reporting on forest resources for the last half a century. All countries in all regions are systematically covered. As demand of information is continually increasing, the forest resources assessment (FRA) has to widen the thematic coverage, improve data production and compilation methodologies. Countries are key players in the entire process of data production. Together with the international processes and forums, they provide FAO with the necessary orientations global forest resources assessments. The last global assessment (FRA 2000) was the most comprehensive in terms of volume of information collected and processed and the number of parameters analysed. FRA 2000 concluded however, that the level of availability and reliability of information is still low in the developing countries.

Rationale

FAO's periodic global assessment of the forests was designed to monitor *changes and trends* of different parameters of the resources. Processes within the forests – degradation and/or improvement- and between forests and other land use classes through afforestation, deforestation and reforestation are important parameters to monitor through successive assessments. With the implementation of the Kyoto protocol on climate change, accurate *estimates of carbon stores* in the forests and trees outside forest at the national level is becoming increasingly important. *Monitoring of criteria and indicators of sustainable forest management*, biodiversity, etc is becoming at the

centre of interest of policy makers and managers of resources at all levels.

The *role of forests and trees outside forest in food security* is valuable and need to be properly assessed by the national forest inventories and global forest assessments. Forests and trees provide food, shelter, employment and other wood and non wood goods and a wide range of services that are vital to people in the rural areas to sustain their livelihood. National inventories should thus address these issues and assess such a role. It should also establish the role of man and woman in resources management and use.

It is not difficult to find arguments for *standardised collection of forest and forestry information* that can be used for international analyses or comparisons (eg Lanly 1996, Lund 1996). The argument from the United Nations Conference on Environment and Development (UNICED) 1992 is often called upon. The United Nations conventions on biological diversity, climate change and desertification are other milestones. On a more general level, international economic analyses and forecasting require reliable input concerning the forestry sector. The implementation of these international processes require monitoring of the forest (and other) ecosystems including the production of goods and services, as well as the legal and political frameworks for the management of land and natural resources.

Public consumption of environmental *information is on the increase as the sophisticated communication technologies help the access to information* through different media.

The international assessments of forests and forestry have developed from a timber oriented mode some decades ago, to include *broad environmental factors*, as well as *socio-economic aspects*. The imaginary land use boundary between forests and agricultural land has become vague as *trees are increasingly grown outside the forests*, and the values of non-wood forest products are being accounted for. Several environmental parameters, such as carbon cycling and biodiversity, are not confined within the land use classifications. It is thus clear that international assessments of forests and forestry should increasingly be cross-sectoral and include interactions with agriculture and remote benefits from the forest.

The FRA support to national forest inventories aims at helping countries in developing or strengthening their *capacities for continued national inventories. It also aims at* broadening *the*

knowledge base of the countries on forests and tree resources at the national level based on reliable field data *collected at a moderate cost* on a wide range of *biophysical and on management and uses parameters*. The inventory approach is designed as a compromise between the volume of data needed, the precision of results and the cost of the survey. Moderate investment in data collection is expected to stimulate and encourage recipient countries and donors alike to invest in forest resources monitoring through continuous inventories.

The approach is founded on *collaborative partnership* between concerned governments and donors with *FAO facilitating the cooperation*. The *Committee on Forestry* in its fifteenth session in March 2001 was informed on the approach and *supported, in principle the idea*, recognizing its potential to improve the availability and quality of national level data and information and as useful complement to FAO's periodic global forest resources assessments.

Objectives

The long-term objectives of the approach will be to contribute to the sustainable management of forests and TOF by providing decision makers and stakeholders with the best possible, most relevant and cost-effective information for their purpose at local, national and international levels. It aims also at assisting the countries in developing baseline information from a statistically verifiable data on the state of the forestry resources, their uses and management.

Specifically, FAO's support to national forest assessments aims at:

- Generating a set of information on a wide range of forest and tree parameters on the basis of a harmonised set of variables and a vegetation classification system and standard forest and tree survey sampling design for continuous monitoring.
- Assessing the state of the resources, the ways they are managed and used and their contribution to food security and poverty alleviation.
- Assisting the countries in building up their national capacities to design, plan and implement national forest inventories and to manage the generated information.
- Promoting multilateral co-operation and international partnerships for global forest and tree resources monitoring

Inventory methodology

Forest and Tree Survey Sampling Design:

Forest inventory refers commonly to measurements of several important parameters of forests and trees and to the analysis of abundance and distribution of individuals. The inventory in forestry is, in most cases, based on sampling. Different options of sampling design exist to survey a given forest area in a country. Each option is chosen to fit given characteristics of the surveyed population and to satisfy specific needs of information on some selected parameters for a given budget. Random sampling is commonly used. It may be simple random sampling with or without stratification. It may also be double or multistage sampling, double or multiphase sampling, etc. Systematic sampling may also be unrestricted or stratified.

An inventory may be based on temporary or permanent sample plots depending on the objectives of the survey. Monitoring of resources relies often on permanent sample plots. In order to improve precision of results temporary plots may be added to existing permanent plots in successive surveys.

For a number of motives including practicality, data quality, cost implications, the *systematic sampling* was chosen for forest and tree data collection. The systematic sampling in forest inventory is: (i) easily planned, (ii) faster in execution and mostly cheaper; (iii) it gives better estimates of the mean than unrestricted random sampling and even stratified random sampling in large areas, because the variation which may be considerable in such areas is better represented in the sample for which the distribution of the sample plots within the surveyed population is homogeneous; (iv) it gives thus better precision compared to random sampling. Ir P.J.D Versteegh, (1976); Lee White and Ann Edwards, (2000);

The selection of the sample site (or tract[1]) population has been done on the basis of the latitude/longitude grid. Tract location is chosen in the intersections of degrees. If a higher number of tracts is required in a country, additional tracts may be selected every half degree or even every quarter degree. The density of tracts may be higher on one axis than on the other.

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[1] The sample site of 1 km^2 area where a cluster of 4 sample plots are located is called "Tract".

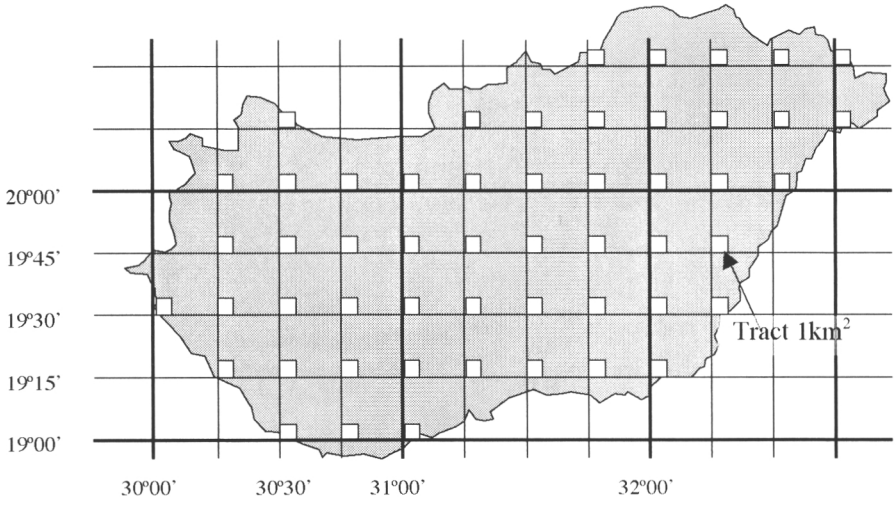


Figure 1. Illustration of systematic distribution of sample sites in the country

The density of tracts may vary also according to the defined strata. For the purpose of standardising the approach, the south-west corner of the tract is taken to correspond to the intersection of the lat/long lines.

The sampling design is built up around the following principles:

i) Stratification based on forest types and land use classes is discarded as strata may change over time and render stratified sampling irrelevant with permanent samples. But stratification on basis of relatively stable strata such as ecological zoning may be applied to countries with pronounced differences in ecosystems such as humid and dry forests (Cameroon), desertic and non-desertic climate (Algeria), etc.

ii) The sampling is designed to include tree resources outside forest and an array of biophysical and management/uses parameters of forest and TOF.

iii) The approach foresees establishing sample plots to monitor changes over time between forests and other land use classes and the processes within the forests;

iv) Biophysical data and the management and use information will be geo-referenced and integrated to enable assessing the size and state of the resources in relation to their geographic location in the country and their social context;

v) Data quality is guaranteed and measurement methods are harmonised;

Sampling intensity

The sample size in this methodology is the number of sample plots where population characteristics are measured. The precision of estimates is in general closely correlated to the sample size, which as it increases, the precision of estimates increases. For equal sample size, the precision of estimates may be improved when stratification on the basis of certain variables of interest is applied. The proposed stratification on the ecological zoning is not likely to improve precision of estimates significantly but rather to apply different sampling intensity to each stratum which leads to different levels of precision among strata.

The sampling intensity proposed to survey the forest and tree resources at the national level is variable from country to country. It should be based within limits of a sample size of 50 to 500 sample sites per country. Each tract contains a cluster of 4 permanent plots of half hectare each. This is deemed to yield, at the national level, estimates of forest and land use attributes at acceptable precision. Precision of less abundant attributes decreases with the decrease of their frequency of occurrence in the country.

Tract and plot configuration

a) Tract of 1km x 1km has been chosen as the standard size to lay out a cluster of 4 independent sample plots. The tracts serve to generate forest type/land use maps from aerial photographs and very high resolution satellite data when available in the country and hence to generate areas. They are also used to collect various variables on social and forest attributes. Aerial photography taking is a costly operation even on a sample basis and recent ones are very often unavailable in the countries. Areas of forest types and land use classes can also be generated from the sample plots as shown below.

b. Cluster layout: The cluster sampling is statistically sound design and frequently used in forest inventories. It is employed to lower the cost of the survey. In this methodology, each cluster is composed of 4 plots placed within a tract of 1km2. The plots are strips of 20m x 250m. They are located at 250m apart from each other as shown in figure 3 below. Since the sampling is non-stratified, each plot will have one or more classes (forest, other wooded land, other land, water), depend-

ing on the heterogeneity of the site in terms of forest types/land use classes.

In order to minimise the effects from systematic or periodic variations within the surveyed populations, the 4 plots will be placed in perpendicular orientations. This is also proven practical in the fields as the field crews, during the survey, progress from the first plot to the last one without walk backwards for measurements. The way back to the road is easier to find.

c. Plot configuration Plots have dimensions of 20 x 250m (horizontal distances)

Plot Ssructure and measurements:

The plot is designed to cross the maximum possible of variations within and between the classes, but long strips are discarded for practical reasons. Each plot will include nested plots in three locations. The first is centred at 5 m from the beginning of the plot, the second ones at 125m and the last at 245m. Two levels of nested plots are taken. The first consists of sample areas of 20m x 10m (200m^2) for measurements of trees with DBH within the range of 10 to 30cm. The second level consists of circular sample areas of 3.99m radius or 50m2 each. These

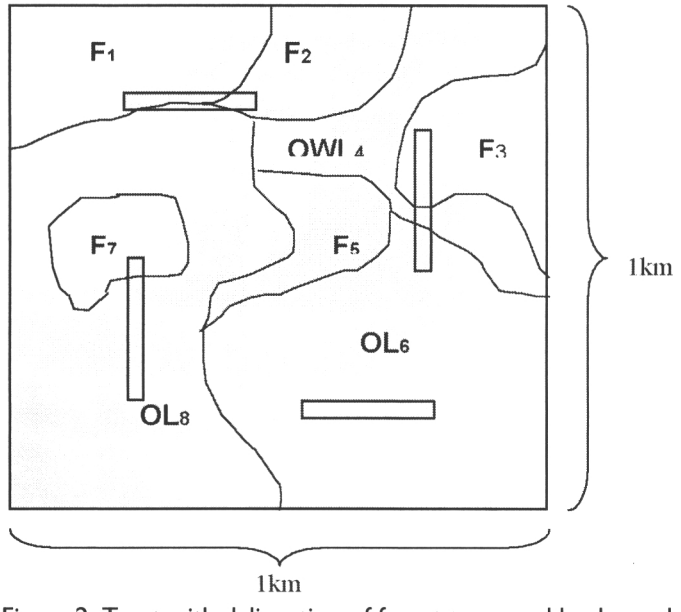


Figure 2. Tract with delineation of forest types and land use classes

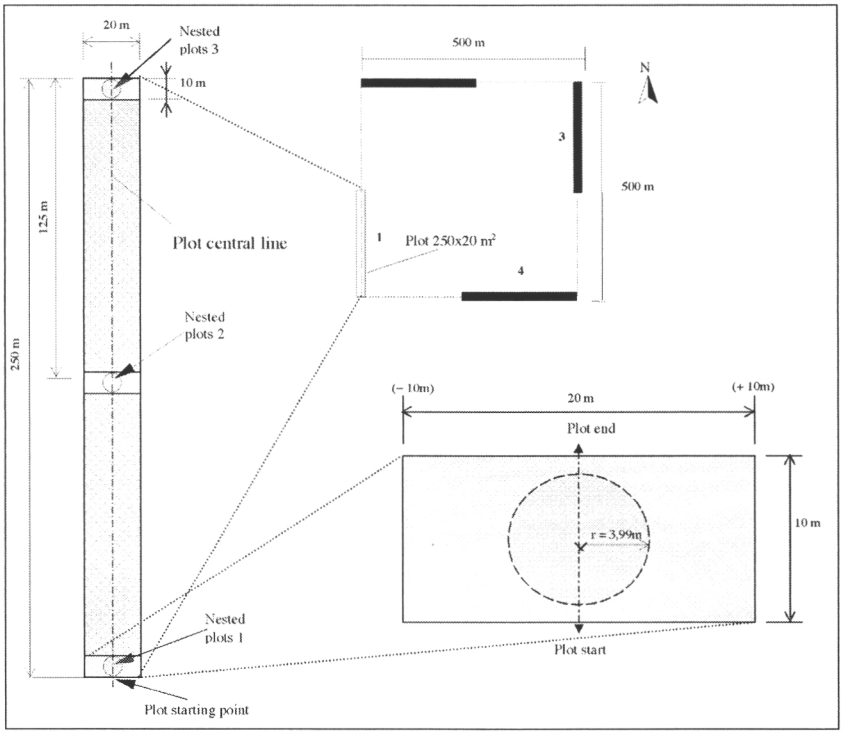


Figure 3. Plot design

In forest areas:

Measurement unit	Trees measured	Unit form and maximum area
• Whole plot	dbh ≥ 30cm	20x250m = (5000m²)
• Nested plot level 1	dbh ≥10cm and <30cm	20x10m (3 nested plots=600m²)
• Nested plot level 2	dbh <10cm and h≥1.3m	r=3.99m (3 nested plots=150m²)

In non-forest areas:

Measurement unit	Trees measured	Unit form and area
• Whole plot	dbh≥ 10cm	20x250m =(5000m²)

small size nested plots are foreseen to records saplings of the tree species, soil information and topography (See list of variables). The location of the nested plots is shown in figure 3. In non-forest areas, the nested plots will not be materialised, and the measurements will be carried out on all trees of DBH of 10cm and above.

d. Tree location plan

For each permanent plot, a schema with tree location will be prepared for control and future measurements in the monitoring

process. Limits of each forest type and other land use class will be identified on the ground and accurately drawn within the plot schema. Horizontal distances along X-axis and Y-axis will be measured and recorded for each tree in all forest types and land use classes falling within the plot. Distance measurements may be done along the slope and corrected to horizontal using the slope correction factors. In future surveys, changes in the land use or within the forest conditions in the plots will be mapped.

Remote sensing:

Use of remote sensing techniques to classify vegetation and land use is optional: If up-to-date air photos or high-resolution satellite scenes are available for the site, forest types and land use classes can be delineated to produce site map using the remote sensing technique. The areas generated from air photo interpretation will be used for area estimation. The maps serve also to lay out the sample plots and as reference base for future monitoring work.

Data collection model

Variables like ecological zones, fragmentation of the forest, topography, local population and its livelihood, access and infrastructure are tied to the tract where plots are located and are part of it. Data on products and services are measured, estimated, or gathered from interviews or ocular observations from sub-plots (forest types and other land use classes) which are tied to the plot. In the case of use of aerial photography and delineation of land use classes over the whole tract, a number of resources management and use variables will be collected in the different classes found in the tract.

The tree characteristics as well as forest and TOF products/ services with corresponding species and users are collected at sub-plot level corresponding to forest type or land use units in the sample plot within the tract.

Variables

The long term objective of the survey is to contribute to sustainable forest and tree resources management. Three groups of variables have been defined to cover the social, economic and

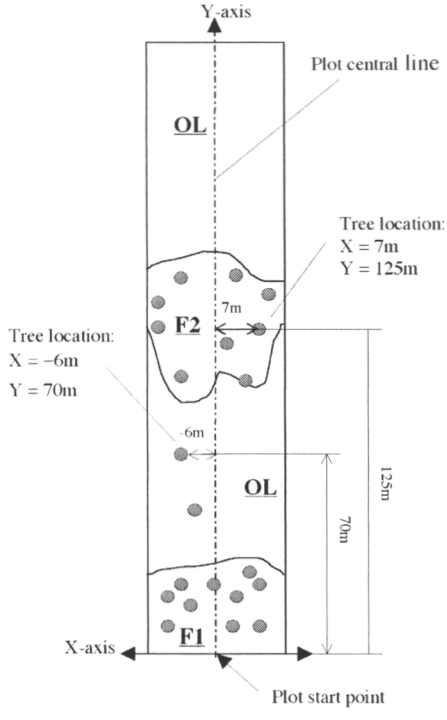


Figure 4. Tree and forest type/land use classes distribution with a plot

environmental aspects. They will enable to describe the forest and TOF resources in the country. The extent of variables is defined taking into account the need to produce different outputs in the predefined forest and tree attributes such as land use/land cover area, volume, biomass and carbon, resources management and state, biodiversity and uses of resources. The variables are also chosen to provide the necessary information for both national and global decision making. The set consists of a core of global variables that will permit to monitor and report on global issues like forest product trade, biodiversity, ecosystems, climate change, etc and a more detailed group that may still be tailored to satisfy the national information requirements. The attributes, outputs and variables are given in Table 1 and in Annex 1.

Through the identified and listed variables, the inventory will provide an insight on the extent and quality of the resources, the way they are managed by Government agencies and by the local populations and to which extent these contribute into the national economy and in food security in general.

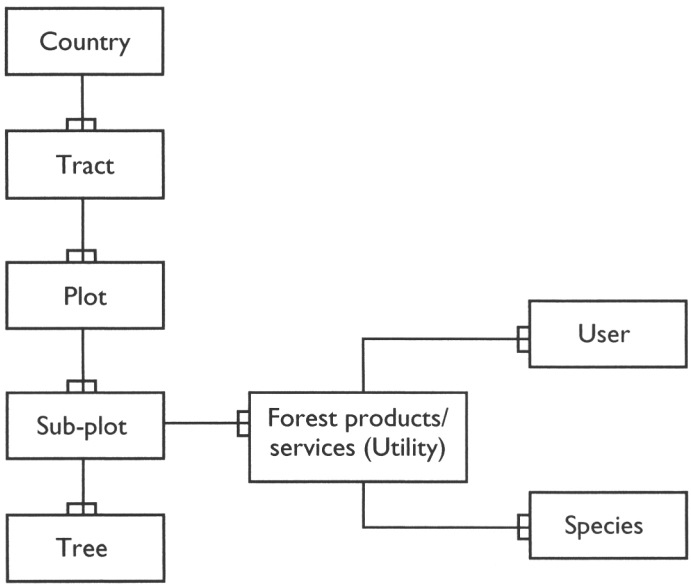


Figure 5. Data collection concept

For the purpose of national inventories of forest and tree resources, a vegetation/land use classification system has been developed on the basis of the global classes used by FRA 2000. The FRA global classes are used as a standard base to design a harmonised country classification system with the necessary desegregation that meets national information requirements and to reflect, to the extent possible, the characteristics of forest types and other land classes in the country (see classification system in Annex 2).

Outputs

The inventory methodology was designed to yield a wide range of outputs on a number of attributes. Depending on the countries needs of information, the field data can be processed to produce an undefined array of outputs. The table below gives a sample of outputs resulting from a national forest and tree inventory.

Information system

National forest inventories produce considerable amount of data at different levels and for different purposes. A functional information system is fundamental to structure and manage the collected inventory data, store it and process it to generate the information that meets national and international requirements. Support to national forest inventories includes the development of a national information system on forest and tree resources. A global information system on forests and trees including all surveyed countries will be developed.

The base for the information system will be a well-structured database, which will include various levels of internal relations. An undefined number of analyses can be carried out on the stored data. The system will permit storage of data from sequential surveys in order to detect and estimate changes and establish trends. The information system should therefore be a base for historic database, up-dated information and for changes and trend analysis. The system will enable reporting on global and national issues.

Overall approach and arrangements

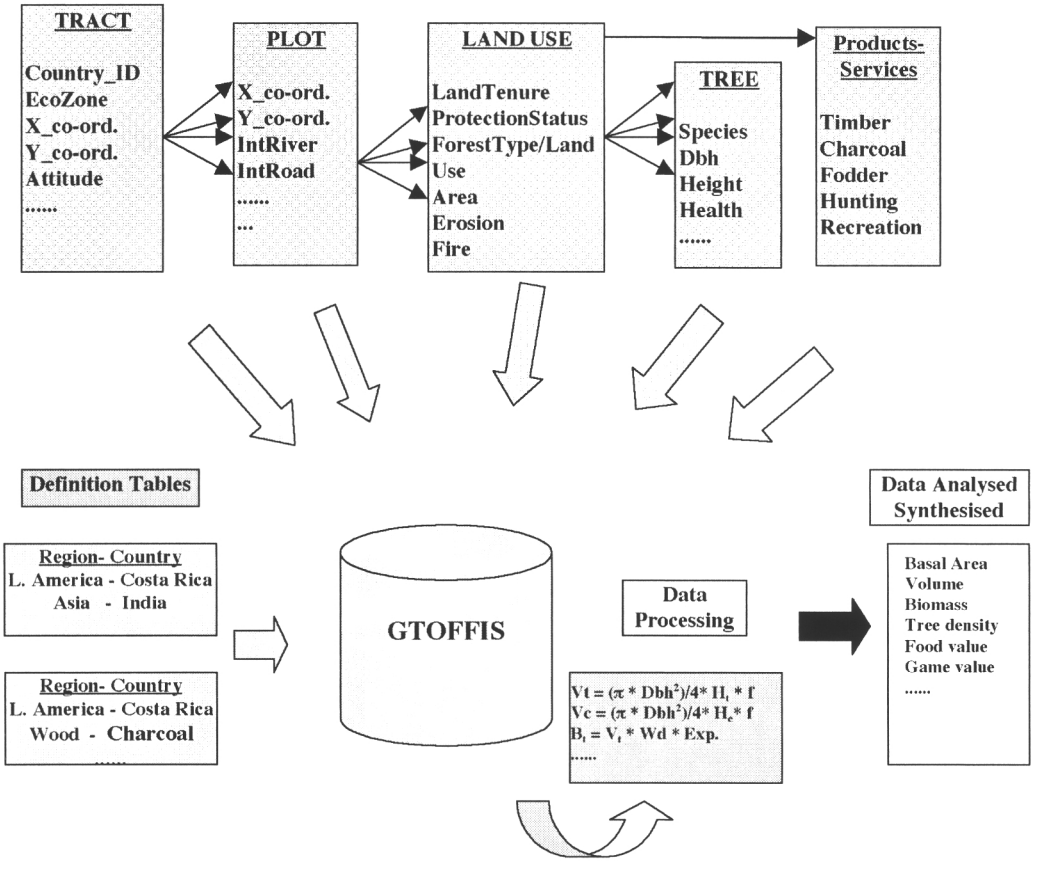
In line with the goal of the national capacity building effort, the approach was designed to be implemented by a national team. Design, planning and field implementation of the project activities are to be carried out by a group of national foresters with assistance provided by FAO. FAO would therefore take the coordinating and facilitating role in the process. It would assist in the development of methodology, seek funding and partners, help countries to build up their capacities to survey the forest and TOF resources and manage the generated information.

Through FRA programme, the regional offices and its representations in the countries, FAO would work with the countries to make the national forest inventory in the countries a fully participatory exercise. National steering committee would be formed and ensures participation of national institutions by their know-how and background information. The committee will ensure best use of the inventory results. A national coordinator would be nominated to oversee and co-ordinate the project activities.

Table 1. Attributes, outputs and corresponding variables

Attributes	Outputs	Variables
Land use/cover area	**Natural forest area**	
	Natural coniferous forest area	Land use classes, area
	Natural broadleaved forest area	Land use classes, area
	Natural mixed forest area	Land use classes, area
	Forest plantations	
	Coniferous plantation area	Land use classes, area
	Broadleaved plantation area	Land use classes, area
	Mixed plantation area	Land use classes, area
	Forest area by crown cover class (open/closed canopy forest)	Land use classes, area
	Mangroves	Land use classes, area
	Primary forest area	Land use classes, area
	Secondary forest area	Land use classes, area
	Other wooded land area	Land use classes, area
	Other land cover area	Land use classes, area
	Inland water area	Land use classes, area
	Forest area by ecological zone	Land use classes, area, ecological zones
	Others classes/categories areas	Land use classes, area
Volume	Total volume by forest type	Height, DBH, classification
	Total volume by management type	Height, DBH, management options
	Total volume by protection status	Height, DBH, protection status options
	Total volume by ecological zone	Height, DBH, ecological zones
	Total volume of TOF	Height, DBH, classification,
	Commercial volume by forest type	Stem height, DBH, classification , timber quality
	Commercial volume management type	Stem height, DBH, management options, timber quality
	Commercial volume by species	Stem height, DBH, tree species list, timber quality
	Commercial volume by ecological zones	Stem height, DBH, species, classification, timber quality
	Commercial volume of TOF	Stem height, DBH, species, classification, timber quality
Biomass & Carbon	Biomass in forests	Volume in forest, wood density, expansion factors
	Biomass of TOF	Volume outside forest, wood density, expansion factors
	Biomass by ecological zones	Volume by ecological zones, wood density, expansion factors
Management	Proportion of forest/tree resources by management system	Management options, disturbances, stand origin, sylvicultural treatments, timber exploitation, sylvicultural treatments, timber exploitation
	Proportion of forest under a protection status	Land use classes Designation/protection status
	Forest area by ownership	Land use classes, ownership
Forest health	Forest health	health options, degree of attack options, fires
Biodiversity	**Inside forest**	
	Communities	Tree species recorded and other sources on vegetation communities
	Occurring species	Recorded tree species occurring in the sample
	Endemic species	Tree species & additional sources on endemic species
	Threatened species	Tree species & additional sources on threatened species
	Population abundance	Tree species and frequency of species population
	Forest fragmentation	Fragmentation options
	Forest structure	Stand structure options
	human impact on natural population and habitats	Disturbances, wood and NWFP collected

	Outside forest	
	Occurring species	Tree species occurring in the country
	Endemic species	Tree species & additional sources on endemic species
	Threatened species	Tree species & additional sources on threatened species
	Population abundance	Tree species and frequency of species population
Uses of resources	**Non wood forest products**	
	Food	Products, species and parts of plants, trends of demand and supply, season and frequency of extraction, user rights, first user, end user
	Medicine	Products, species and parts of plants, trends of demand and supply, season and frequency of extraction, user rights, first user, end user
	Building material	Products, species and parts of plants, trends of demand and supply, season and frequency of extraction, user rights, first user, end user
	Crafts	Products, species and parts of plants, trends of demand and supply, season and frequency of extraction, user rights, first user, end user
	Others classes/categories areas	Products, species and parts of plants, trends of demand and supply, season and frequency of extraction, user rights, first user, end user
	Wood products	
	Timber	Products, species and parts of plants, trends of demand and supply, season and frequency of extraction, user rights, first user, end user
	Other wood products	Products, species and parts of plants, trends of demand and supply, season and frequency of extraction, user rights, first user, end user
	Services	
	Social and poverty alleviation	Cultural, spiritual, employment, recreation,
	Economic	Marketed products impacting economies
	Environmental	Soil and water conservation (soil texture and moisture, organic matter) landscape and topography (aspect, slope and relief), biodiversity conservation, scientific value, agriculture functions (wind breaks, shade, etc.)
	Use rights	User right of products and services, conflicts, land tenure
	Accessibility	Access to sample site, distances to infra-structure (school, market, roads, hospitals)



References

Lee White et Ann Edwards, 2000. Conservation en forêts pluviale africaine, Méthodes de recherche. The Wildlife Conservation Society, New York, USA.

Ir P.J.D. Versteegh, 1976. Statistics in Forestry, Part II, Inductive Statistics, International institute for Aerial survey and Earth Science, ITC, The Netherlands.

Holmgren P. & Persson R. 2002. Why did we end up here? – The evolution of global forest assessments, *Unasylva* 210

Michael Kohl and Risto Paivinen, 1996. Definition of a system of nomenclature for mapping European forests and for compiling a pan-European forest information system. Joint Research Centre, European Commission and European Forest Institute.

Kleinn C., Ramirez C., Chaves G. & Lobo S, 2000. Pilot forest inventory in Costa Rica. Report to FAO FRA

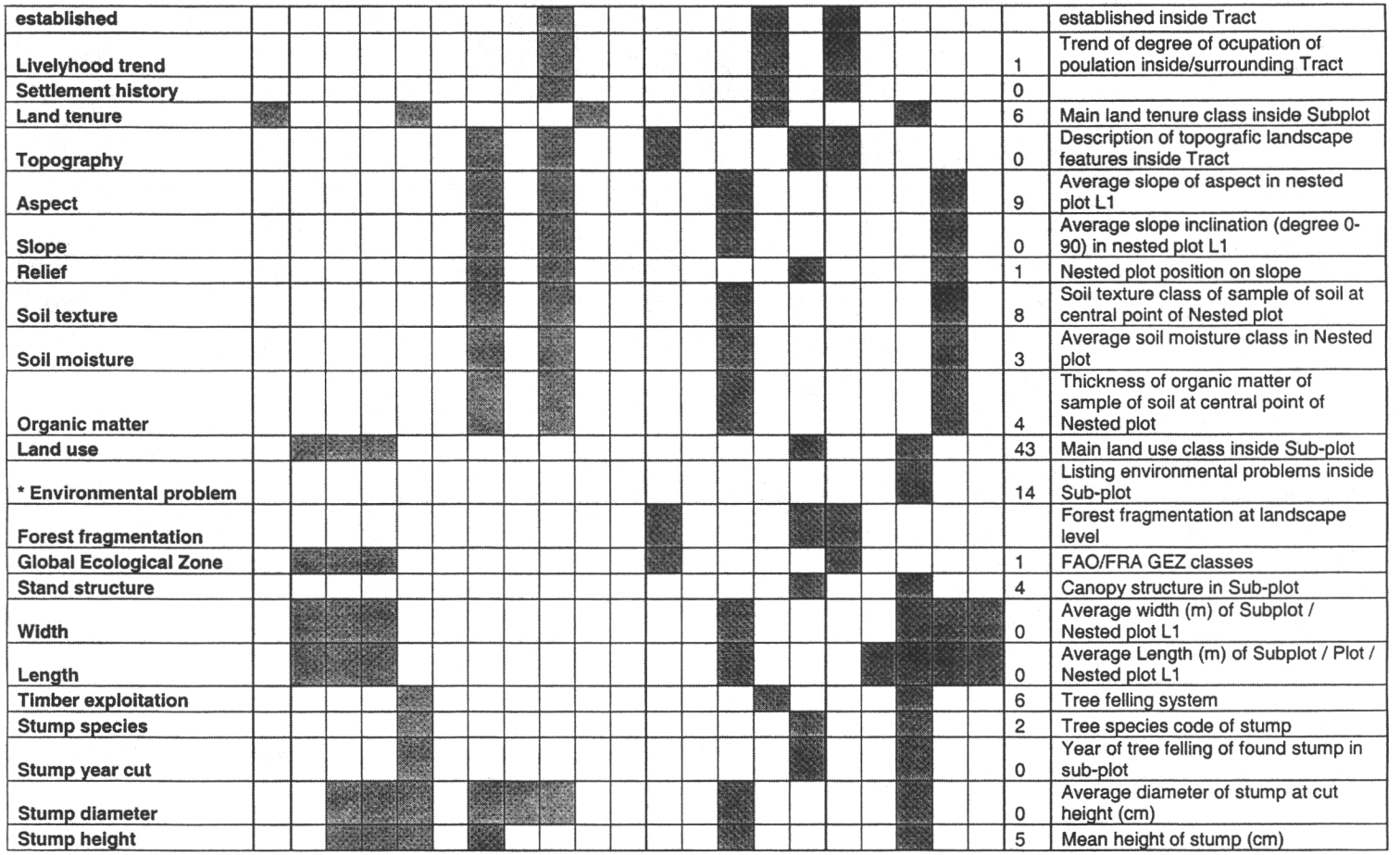
Journal of Forestry, 1999, Volume 97. Forestry Inventory and Analysis. USA. Annex1: Variables

Annex1: Variables

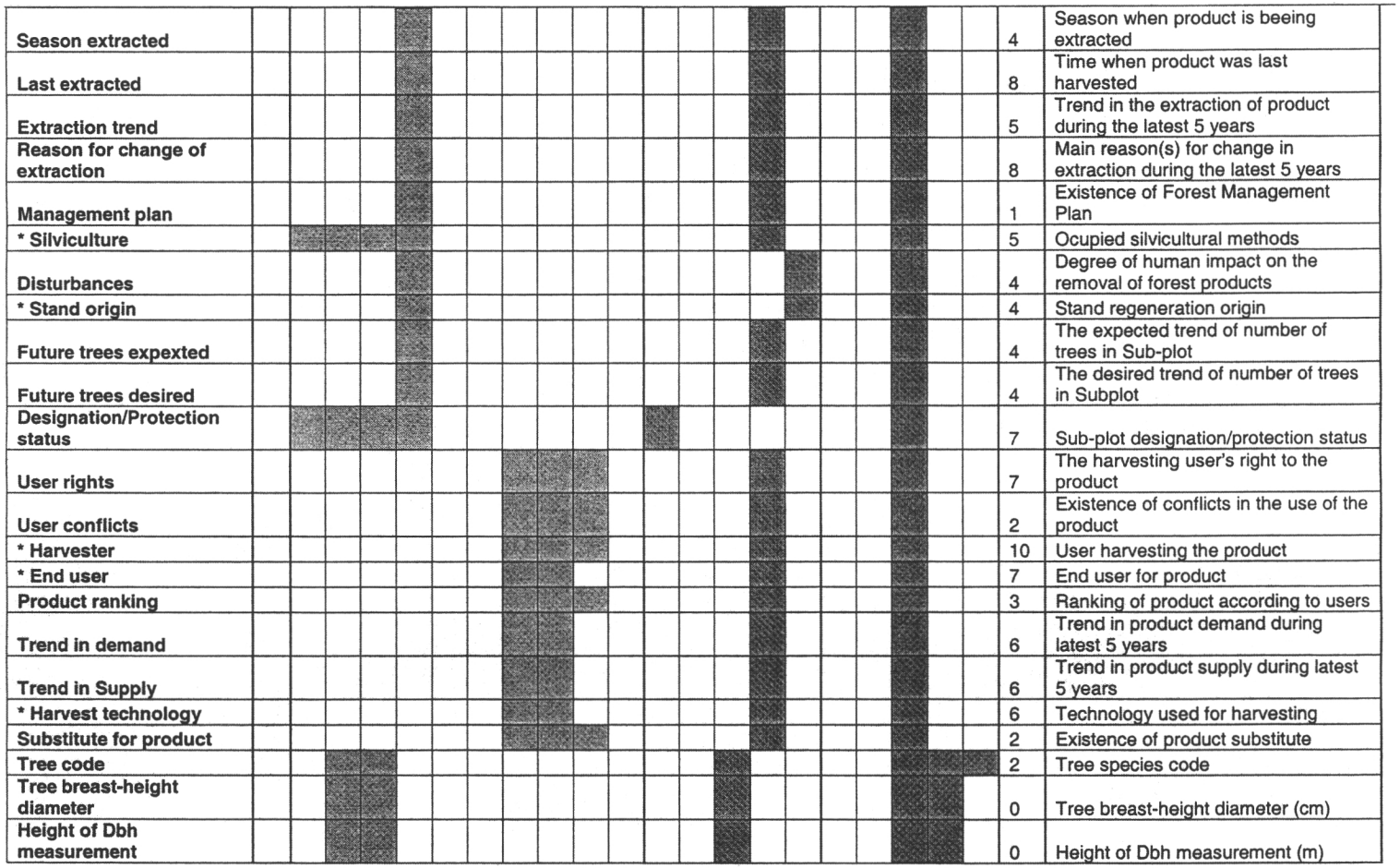
		Indicators for SFM											Data collection											
							Use of resources						Source					Level						
Variables	**ADMINISTRATIVE**	**Land use/-cover area**	**Volume**	**Biomass and carbon**	**Management**	**Forest Health**	**Biodiversity**	**Products**	**Services**	**Use right**	**Accessibility**	**Office (GIS, maps, ancillary data)**	**Input during the field**	**Field measurement**	**Interviews**	**Estimation**	**Tract**	**Plot**	**SubPlot**	**NestedPlot L1**	**NestedPlot L2**	n Options (0 = measured)	**Description**
Country	■											■					■						FAO/FRA terminology
ADM1 (State)	■											■					■						National sub-division
ADM2 (Province)	■											■					■						National sub-division
ADM3 (District)	■											■					■						National sub-division
ADM4 (Locality)	■											■					■						National sub-division
Tract number	■											■					■						Field site number given in NFI
Plot number	■											■						■					Plot number in actual cluster (1-4)
SubPlot number	■												■						■				Sub-plot number in actual Plot
Topographic map number	■											■					■						National map number
Topographic map name	■											■					■						National map name
Air photo number	■											■					■						Photo number
Tract central point Latitude	■											■					■					0	Theoretically calculated position (decimal degree, North) of Tract central point
Tract central point	■											■					■					0	Theoretically calculated position

Longitude																						(decimal degree, East) of Tract central point
Tract central point altitude																					0	Altitude of Tract central point (m)
Starting date																					0	Date when field team begins the work in the plot
Ending date																					0	Date when field team ends the work in the plot
Worktime																					0	Effective time spent working at plot (h)
Tract access time																					0	Time spent for accessing the Tract (h) from road *
Leaving road Latitude																					0	Reading of Latitude (decimal degree, North) where leaving road to access Tract
Leaving road Longitude																					0	Reading of Longitude (decimal degree, East) where leaving road to access Tract
*** Crew**																					1	Persons working in the inventory team at the actual Tract
*** Informant(s)**																					1	Person(s) accompanying the inventory team in the Tract providing S.E. information
Plot starting point description																					0	Drawings and description of reference points defining Plot starting point
Permanent marker type																					1	Type of starting point marker
Marker displacement distance																					0	Distance (m) of actual marker position to plot starting point
Marker displacement bearing																					0	Bearing (0-360 degrees) from actual marker position to Plot starting point
Marker Latitude																					0	Reading of Latitude (decimal degree, North) of permanent marker position
Marker Longitude																					0	Reading of Longitude (decimal degree, East) of permanent marker position
Plot starting point Latitude																					0	Theoretically calculated position (decimal degree, North) of plot starting point
Plot starting point																					0	Theoretically calculated position

Longitude																							(decimal degree, East) of plot starting point
Plot centre(125m) Latitude																						0	Reading of Latitude (decimal degree, North) at centre of plot
Plot centre (125m) Longitude																						0	Reading of Longitude (decimal degree, East) at centre of plot
Plot end (250m) Latitude																						0	Reading of Latitude (decimal degree, North) at end of plot
Plot end (250m) Longitude																						0	Reading of Longitude (decimal degree, East) at end of plot
Tree distance X																						0	Distance from Plot starting point (m) to tree along Plot central line
Tree distance Y																						0	Distance from Plot central line (+/- m) to tree
Distance to nearest all-weather road																						0	Distance (km) along actual access path from Tract centre to nearest all-weather road (inside tract = "0")
Distance to nearest seasonal road																						0	Distance (km) along actual access path from Tract centre to nearest seasonal road (inside tract = "0")
Distance to nearest hospital																						0	Distance (km) along actual access path from Tract centre to nearest Hospital/Medical service (inside tract = "0")
Distance to nearest school																						0	Distance (km) along actual access path from Tract centre to nearest school (inside tract = "0")
Distance to nearest settlement																						0	Distance (km) along actual access path from Tract centre to nearest settlement (inside tract = "0")
Distance to nearest market																						0	Distance (km) along actual access path from Tract centre to nearest market (inside tract = "0")
Population dynamics																						2	Trend of population size inside/surrounding Tract during the latest 5 Years
Population main activity																						1	Main activity of Tract population
Population size on site																						0	Actual size of population inside Tract
First settlement																						0	Year when first settlement was



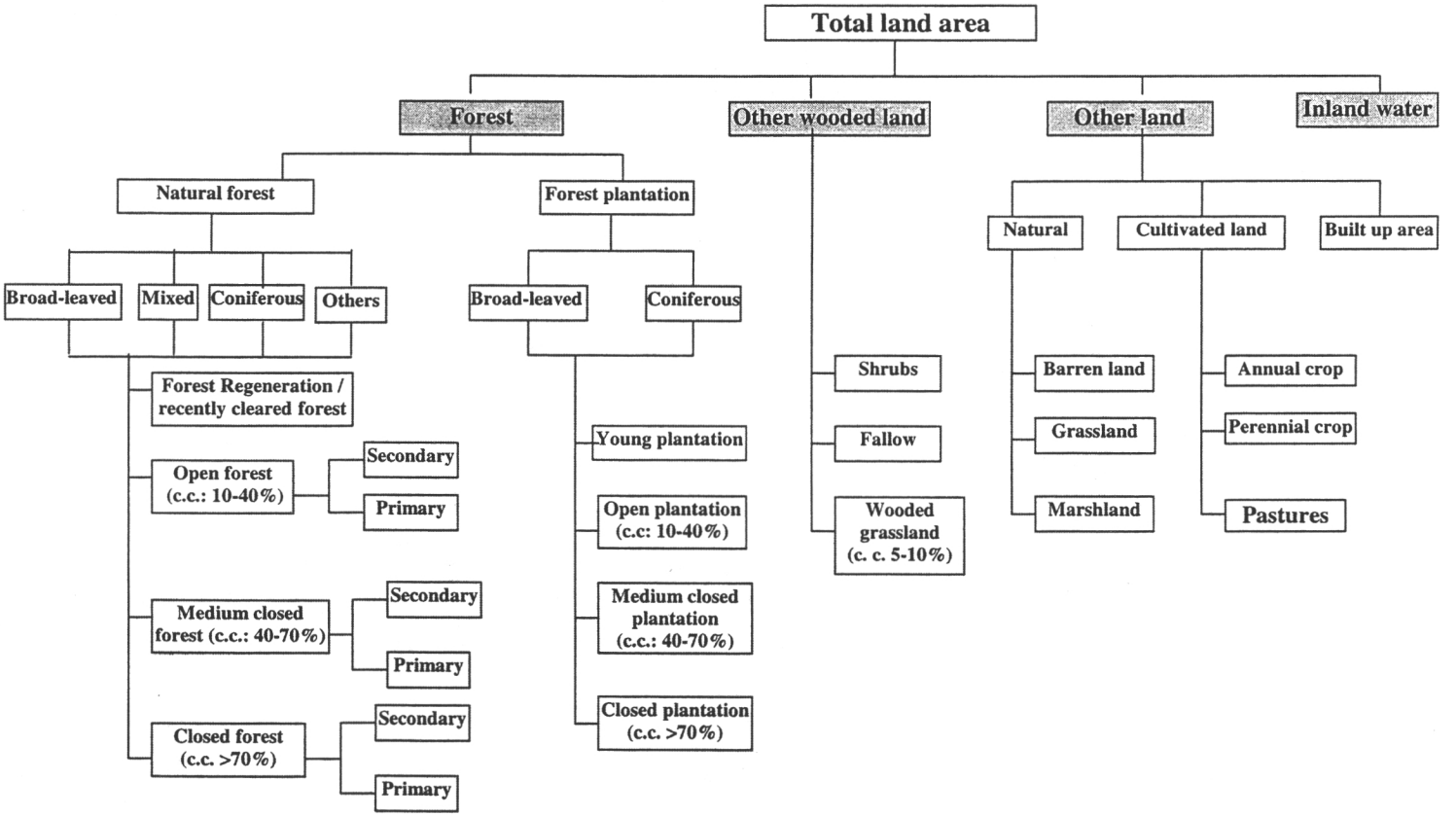
established		established inside Tract
Livelyhood trend	1	Trend of degree of ocupation of poulation inside/surrounding Tract
Settlement history	0	
Land tenure	6	Main land tenure class inside Subplot
Topography	0	Description of topografic landscape features inside Tract
Aspect	9	Average slope of aspect in nested plot L1
Slope	0	Average slope inclination (degree 0-90) in nested plot L1
Relief	1	Nested plot position on slope
Soil texture	8	Soil texture class of sample of soil at central point of Nested plot
Soil moisture	3	Average soil moisture class in Nested plot
Organic matter	4	Thickness of organic matter of sample of soil at central point of Nested plot
Land use	43	Main land use class inside Sub-plot
*** Environmental problem**	14	Listing environmental problems inside Sub-plot
Forest fragmentation		Forest fragmentation at landscape level
Global Ecological Zone	1	FAO/FRA GEZ classes
Stand structure	4	Canopy structure in Sub-plot
Width	0	Average width (m) of Subplot / Nested plot L1
Length	0	Average Length (m) of Subplot / Plot / Nested plot L1
Timber exploitation	6	Tree felling system
Stump species	2	Tree species code of stump
Stump year cut	0	Year of tree felling of found stump in sub-plot
Stump diameter	0	Average diameter of stump at cut height (cm)
Stump height	5	Mean height of stump (cm)



Season extracted	4	Season when product is beeing extracted
Last extracted	8	Time when product was last harvested
Extraction trend	5	Trend in the extraction of product during the latest 5 years
Reason for change of extraction	8	Main reason(s) for change in extraction during the latest 5 years
Management plan	1	Existence of Forest Management Plan
*** Silviculture**	5	Ocupied silvicultural methods
Disturbances	4	Degree of human impact on the removal of forest products
*** Stand origin**	4	Stand regeneration origin
Future trees expexted	4	The expected trend of number of trees in Sub-plot
Future trees desired	4	The desired trend of number of trees in Subplot
Designation/Protection status	7	Sub-plot designation/protection status
User rights	7	The harvesting user's right to the product
User conflicts	2	Existence of conflicts in the use of the product
*** Harvester**	10	User harvesting the product
*** End user**	7	End user for product
Product ranking	3	Ranking of product according to users
Trend in demand	6	Trend in product demand during latest 5 years
Trend in Supply	6	Trend in product supply during latest 5 years
*** Harvest technology**	6	Technology used for harvesting
Substitute for product	2	Existence of product substitute
Tree code	2	Tree species code
Tree breast-height diameter	0	Tree breast-height diameter (cm)
Height of Dbh measurement	0	Height of Dbh measurement (m)

Total tree height																							0	Total height of tree (m)
Comercial tree height																							0	Comercial height of tree (m)
Tree health																							9	Tree health condition
Extension of disease																							4	Extent of disease on affected tree
Timber quality																							0	Timber quality
Fire occurrence																							3	Ocurrence of fire in Sub-plot
Fire area																							5	Proportion of Sub-plot affected by fire
Canopy cover																							4	Vertically projected average canpy cover in Sub-plot
Canopy pattern																							3	Canopy cover pattern in Sub-plot

Annex 2: Vegetation classification system



Legend

FBØ:	Regeneration of natural broad-leaved forest
FB1P:	Primary open broad-leaved forest (cc: 10–40%)
FB1S:	Secondary open broad-leaved forest (cc: 10–40%)
FB2P:	Primary medium closed broad-leaved forest (cc: 40–70%)
FB2S:	Secondary medium closed broad-leaved forest (cc: 40–70%)
FB3P:	Primary closed broad-leaved forest (cc: >70%)
FB3S:	Secondary closed broad-leaved forest (cc: >70%)
FMØ:	Regeneration of natural mixed forest
FM1P:	Primary open mixed forest (cc: 10–40%)
FM1S:	Secondary open mixed forest (cc: 10–40%)
FM2P:	Primary medium closed mixed forest (cc: 40–70%)
FM2S:	Secondary medium closed mixed forest: (cc: 40–70%)
FM3P:	Primary closed mixed forest (cc: >70%)
FM3S:	Secondary closed mixed forest (cc: >70%)
FCØ:	Regeneration of natural coniferous forest
FC1P:	Primary open coniferous forest (cc: 10–40%)
FC1S:	Secondary open coniferous forest (cc: 10–40%)
FC2P:	Primary medium closed coniferous forest (cc: 40–70%)
FC2S:	Secondary medium closed coniferous forest (cc: 40–70%)
FC3P:	Primary closed coniferous forest (cc: >70%)
FC3S:	Secondary closed coniferous forest (cc: >70%)
PBØ:	Young broad-leaved forest plantation
PB1:	Open broad-leaved forest plantation (cc: 10–40%)
PB2:	Medium closed broad-leaved forest plantation (cc: 40–70%)
PB3:	Closed broad-leaved forest plantation (cc: >70%)
PCØ:	Young coniferous forest plantation
PC1:	Open Coniferous forest plantation (cc: 10–40%)
PC2:	Medium closed coniferous forest plantation (cc: 40–70%)
PC3:	Closed coniferous forest plantation (cc: >70%)
Sh:	Shrubs
Fa:	Fallow
WGL:	Wooded grassland (cc: 5–10%)
BL:	Barren land
GL:	Grassland
ML:	Marshland
AC:	Annual crop
PC:	Perennial crop
Pa:	Pastures
BUA:	Built-up areas
IW:	Inland water

Agenda Item 7

Recommendations for Future Global Assessments and Reporting

National Reporting to Forest-related International Instruments: Mandates, Mechanisms, Overlaps and Potential Synergies

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Abstract

Ten international conventions and agreements (or instruments) are identified as being most relevant to forests. National reporting requirements to these instruments, including report periodicity and content, both in general and in regard to forests in particular, are reviewed. In most cases, reporting on measures taken to implement commitments under the instrument consists of qualitative information on activities and means of implementation, such as policy, legislative or institutional measures. In a few cases, however, quantitative biophysical and socio-economic data on forest resources or resource use is required. Most instruments have provisions for information collection, analysis and exchange and for monitoring and assessment. In recognition of the need for quantitative data to assess impact of the measures taken, many of the instruments are working to develop impact indicators. Several of the instruments with a strong sustainable development dimension, are using or considering use of criteria and indicators developed under regional or international processes for sustainable forest management. These indicators represent a potential pivot point around which efforts for harmonization of information and data needs on forests can be focused. Efforts that are under way on harmonization of reporting on sustainable development, biological diversity, and forests are reviewed.

International conventions and agreements related to forests

In the absence of a global forest convention, the United Nations Forum on Forests (UNFF) serves as the main forum for international policy deliberations on forests. The work of the UNFF has been defined by the agreements made on forests at the United Nations Conference on Environment and Development (UNCED)[1] and by the proposals for action agreed upon by the Intergovernmental Panel on Forests (IPF) and Intergovernmental Forum on Forests (IFF) between 1995 and 2000. The UNFF is part of a broader process of UNCED follow-up, supported by the Commission on Sustainable Development (CSD). The CSD is a functional commission of the United Nations set up in 1993 to review progress, elaborate policy guidance, promote dialogue and build partnerships to facilitate the implementation of commitments made at UNCED.

In addition to the UNFF, which is a "soft-law" instrument, there are a number of legally binding international instruments that include articles and decisions that address forests or forest resources. They are as follows:

- Convention on the Conservation of Migratory Species of Wild Animals (CMS)
- Convention on Biological Diversity (CBD)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Convention on Wetlands of International Importance, Especially as Waterfowl Habitat (Ramsar Convention)
- International Tropical Timber Agreement (ITTA)
- Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention – WHC)
- United Nations Convention to Combat Desertification (UNCCD)
- United Nations Framework Convention on Climate Change (UNFCCC)

The table in Annex 1 provides information on the nine instruments and the CSD, including the year of entry into force/establishment, number of Parties/members, and objectives and relevance to forests of each instrument.

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[1] including Chapter 11 ("Combating deforestation") of Agenda 21 and the "Forest Principles"

Some distinguishing characteristics of the nine conventions are as follows:

- UNFF and ITTA are the only instruments focused specifically on forests and forest resources. The other instruments address forests in the context of environmental conservation (i.e., conservation of biological diversity, mitigation of climate change and combating desertification).
- CITES, CMS, Ramsar and WHC are concerned primarily with the conservation of biological diversity. CITES and CMS focus on conservation at the species level. Ramsar and WHC address the ecosystem level through the conservation of sites of international importance. The conservation of biological diversity is a major objective of the CBD, but the Convention's other objectives (sustainable use and equitable sharing of the benefits of biological diversity) give CBD a strong sustainable development dimension.
- UNFF, CBD, UNCCD, ITTA, and, to a somewhat lesser extent, UNFCCC, have a sustainable development emphasis. The wider scope of these five instruments give them greater relevance to overall forest policy than the other four instruments.

National reporting to key forest-related international instruments and to the CSD

Parties or members are committed to report on measures that they have taken to implement their commitments under the instrument and, in some cases, information and data related to progress in achieving them. The instruments' texts provide the mandate for reporting by Parties/members to the decision-making body of the instrument. Annex 2 provides the reference article mandating reporting under the nine instruments and the CSD, as well information on the periodicity of reporting, reporting guidelines, and more detailed information on the content of national reports. The forest-related content of national reports under the various instruments is summarized below.

CITES, CMS, Ramsar and WHC

National reports to CITES and CMS contain information related to the status of, and conservation efforts targeted at, species on their respective Appendices, which list species that are endangered, threatened or have an unfavourable conservation status. National reports to CITES consist of statistical informa-

tion on trade in those species on the CITES Appendices. The CITES secretariat maintains the Appendices lists and quantitative time-series databases of species trade statistics. CITES Appendices include 15 timber or woody species, some of which are commercially important. National reports to CMS provide information, mostly qualitative, on steps taken to protect species on CMS' Appendices, raise awareness of the role of CMS, provide financing, and implement resolutions of the Conference of the Parties (COP). Forests are relevant in that they are habitat to some of the species listed on the CMS Appendices. At its sixth session, the COP in 1999 approved the launching of an Information Management Plan. This includes the development of a database on listed species (COP 6 Resolution 6.5).

Ramsar and WHC focus on the conservation and management of specific protected areas. Ramsar is concerned with internationally important wetlands, a third of which are forested wetlands (1999 figure). The List of Wetlands on International Importance ("Ramsar sites") is a database of site information, mainly in narrative form. WHC focuses on sites of cultural and natural significance, including many forest sites. The WHC maintains the World Heritage List, compiled from member States inventories. When a country becomes a member State of WHC, it is obliged to submit an inventory of property (location and significance) situated on its territory and suitable for inclusion on the list. National reports to Ramsar provide information on measures taken to promote membership, implement the Ramsar Wise Use Guidelines, increase institutional capacity, promote international cooperation and mobilize financial assistance. Parties to the WHC must report on steps taken related to identify national heritage properties, legislative and administrative provisions and other actions taken for the application of the WHC, and the state of conservation of the World Heritage properties located on its territories.

CSD

National reporting to the CSD on implementation of the chapters of Agenda 21 provides a comprehensive picture of progress made in sustainable development since UNCED a decade ago. This provides a wider context for the four forest-related instruments that arose from UNCED: UNFF, CBD, UNCCD and UNFCCC. Countries are asked to provide national reports each

year on specific topic areas. They submitted national reports on forests in 2000. Country Profiles, providing an overall picture of progress in sustainable development across all chapters of Agenda 21, are compiled from the national report. The first Country Profile was prepared in 1997. It was updated in 2002 for the purposes of the World Summit on Sustainable Development (the WSSD or Rio +10), to be held in Johannesburg, South Africa in August/September 2002.

CBD

National reports to the CBD provide information on the implementation of commitments under the Convention, as defined in its Articles. The first national report (1997) focused on Article 6 – conservation and sustainable use of biological diversity. The second National Report (submitted in 2001 for discussion at COP 6 in April 2002) consists of a series of questions based on the Articles of the Convention and related decisions of the COPs addressed to Parties of the CBD. While several of the articles have some relation to forest biological diversity, those with the most direct relevance to sustainable forest management are: Article 8 (*in-situ* conservation); Article 8j (traditional knowledge), Article 9 (*ex-situ* conservation); and Article 10 (sustainable use of biological diversity).

In addition to the national reports, Parties were invited to submit a thematic report on forest ecosystems for consideration at COP 6. The thematic report provides information on the implementation of the three programme elements of the work programme on forest biological diversity, specifically: 1) the application of the ecosystem approach, 2) analysis of human influence on forest biological diversity and assessment of means to minimize negative influences, and 3) elaboration of the implementation of criteria and indicators for forest biological diversity. An expanded programme of work on forest biological diversity was approved at COP 6, and Parties have been invited to report through a voluntary thematic report to COP 7 in 2004 on their implementation of this programme (Decision VI/22).

UNCCD

Each Party to the Convention is required to communicate to the COP the measures undertaken to implement the UNCCD. The

content of the reports differ slightly depending on into which category(ies) a Party falls:

- Parties affected by desertification and drought, report on their strategies to combat desertification and provide relevant information on implementation of the strategies. Affected parties that have action programmes (National Action Programmes, or NAPs) also describe the programmes and their implementation. Groups of affected country Parties may make a joint communication on measures taken at the subregional and/or regional levels to implement the Convention.
- Developed country Parties report on measures taken to support the preparation and implementation of action programmes at all levels, including information on financial resources.
- Parties that are both affected and developed observe both obligations: to present a national report and a report as a developed country Party.

Information provided in these reports have relevance to sustainable forest management, in particular on measures taken in the NAP to improve natural resource conservation, monitoring and assessment of effects of drought and participatory processes used in NAP.

UNFCCC

Each Party to the UNFCCC is to submit initially and at certain intervals thereafter a National Communication, including:

- A national inventory of anthropogenic emissions of greenhouse gases (GHGs) by sources and removal by sinks (to the extent that capacities permit), and
- A general description of steps taken/envisaged by the Parties to implement UNFCCC.

In addition, each developed country Party and each other Party included in Annex I of the Convention should report on:

- Policies and measures it has adopted to limit its anthropogenic emissions of GHGs and protect and enhance its GHG sinks and reservoirs.
- A specific estimate of the effects that the policies and measures referred to above will have on anthropogenic emissions, with the aim of returning individually or jointly to their 1990 levels.

Each developed country Party in Annex I and developed country Party included in Annex II, report on measures taken related to technology transfer and provision of financial resources.

Since 1996, all countries listed in Annex 1 of the Convention must also provide an annual national inventory of GHG sources and sinks.

The methodology for the calculations for the inventory figures is provided by the Guidelines for National Greenhouse Gas Inventories of the Intergovernmental Panel on Climate Change (IPCC). In order to carry out the national inventory, very specific data on forests and forest resources are required, mainly for the calculations of GHGs in the land-use change and forestry section but also for some in the energy section. Data are needed on forest area and biomass stocks, changes in area and biomass, non-forest trees, removal of wood by timber harvesting and for fuelwood consumption, conversion of forest to other uses, CO_2 emissions/removals from soils, as well as GHG emissions from combustion of woody biomass and from the pulp, paper and print industries.

UNFF

Modalities for national reporting to the UNFF do not yet exist, although the elements constituting the monitoring, assessment and reporting (MAR) function of UNFF have been identified. At the first session of UNFF in 2001 (see E/2001/42/Rev.1), it was agreed that the MAR function would consist of the following:

- Progress in implementation of the IPF/IFF proposals for action;
- Progress towards sustainable management of all types of forests; and
- Review of the effectiveness of the international arrangement on forests.

Furthermore, UNFF 1 invited countries, regions, organizations and processes to report to the UNFF, on a voluntary basis, on their progress in implementation of the IPF/IFF proposals for action. It also stressed the importance of the use of regional and national criteria and indicators for sustainable forest management (SFM) as a basis for reporting on SFM.

Many of the IPF/IPP proposals for action address monitoring, assessment and reporting and related activities, such as a common understanding of forest-related concepts, terminology and definitions; streamlining reporting; and resource assessment and information management.

An ad hoc expert group is expected to be established after the third session of UNFF (May/June 2003) and will develop

proposals for UNFF's consideration on the MAR function of UNFF. In the meantime, the UNFF Secretariat will develop a reporting format for the purposes of national reports on implementation of proposals for action related to the agenda of UNFF 3.

ITTA

Parties to ITTA, 1994 are to provide statistics and information on timber, timber trade and activities aimed at achieving sustainable management of timber producing forests. Members are asked to submit data annually on their national production, trade, supply, stocks, consumption, and prices of tropical timber for the "Annual Review and Assessment of the World Tropical Timber Situation" of the International Tropical Timber Organization (ITTO).

Members are to supply other statistical data and specific indicators, as requested by the International Tropical Timber Council (ITTC), and to report on activities aimed at achieving sustainable forest management and on progress towards ITTO´s Year 2000 Objective.[2] At its 24th session (May 1998), the ITTC strongly urged member countries to apply the (revised) ITTO Criteria and Indicators for reporting in relation to the Year 2000 Objective (Decision 3 XXIV). At its 30th session the ITTC encouraged Member countries (Decision 9 XXX) to submit their first National level report by the end of 2001 using the ITTO reporting format (ITTO, 2001). ITTO will publish the "Status of Tropical Forest Management Report", largely based on the national reports provided.

The reporting format for the national level report is extremely detailed, calling for both qualitative and quantitative information on the ITTO indicators of the following criteria for sustainable forest management (SFM):

- *Enabling conditions for SFM* (laws, policies, regulations, institutional capacity, investment, economic instruments, technology, information, participation)
- *Forest resource security* (resource base – area, forest type, resource protection)
- *Forest ecosystem health and condition* (area/degree of damage

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[2] ITTO adopted the Year 2000 Objective in 1991 as the strategy by which all its member countries would progress towards achieving trade in tropical timber from sustainably managed forests by the year 2000.

from human activities and by natural causes, protection procedures)
- *Flow of forest products* (resource rights, harvesting levels; existence of management plans, management guidelines and long-term projections; etc.)
- *Biological diversity* (protected areas, threatened/endangered species, genetic diversity, monitoring and evaluation,
- *Soil and water* (area managed for and measures taken for soil/water protection
- *Economic, social and cultural aspects* (contribution to GDP, quantity/value on non-wood forest products, efficiency of use of harvested products, employment, occupational safety, cultural aspects and social uses, participation, indigenous people)

Information and indicators in the forest-related instruments

As indicated above, national reporting on implementation of commitments under these nine forest-related instruments is diverse in approach, content and degree of detail. What is apparent is that the information requested is most often descriptive and is focused on measures taken related to policy, legislation, capacity building, financing, or other "means of implementation." Only a few instruments require Parties to provide, on a regular basis, quantitative information related to forests or forest resources. Those that do are CITES (on species trade), ITTA (on timber trade and indicators of sustainable forest management) and UNFCCC (on GHG emissions and removals from forests and forest resource use).

The information provided by national reports on measures taken to implement the instrument is essential for making an overall assessment of progress in the implementation of the instrument. Several of the instruments have identified implementation indicators for this purpose. This information, however, is not sufficient to assess the impact of the measures taken in achieving the goals of the instrument. For that kind of assessment, quantifiable data, such as on the status and trends in resources, are needed.

Most of the instruments have provisions for information and data collection, analysis and exchange (e.g. Article 4 of CBD, Article 16 of UNCCD, Article 4 of UNFCCC), for, among other purposes, monitoring and assessment. However, what

data to be collected and how to fulfill international data needs is in most cases not defined.

In order to provide for global assessments of the state and change of the resource (forest, land affected by desertification, biological diversity) and to assess the impact of a convention or agreement, commonly agree impact indicators are needed. Several international instruments addressed here are now working to define indicators.

There is a risk that, as work continues under the various instruments to identify indicators for monitoring and assessing impact, that if different indicators are chosen countries' reporting requirements will be compounded and complicated, increasing the burden of complying with them. The important role that sustainable development indicators can play in helping countries make informed decisions and the need for harmonization of efforts to develop such indicators was internationally recognized at UNCED and embodied in Chapter 40 of Agenda 21. The United Nations has recently published a set of indicators of sustainable development that can help harmonize efforts to assess progress toward sustainable development goals (UN, 2001).

Many of the forest-related instruments discussed here are working on indicators. The work of the UNCCD and CBD is summarized below.

The UNCCD began working to develop benchmarks and indicators even before it entered into force. It has identified implementation indicators, but work is still underway to identify: a) the type of data needed to assess the status and trends of desertification and b) impact indicators to monitor biophysical, socio-economic and institutional impacts of the NAPs. To date, 14 primary impact indicators have been identified that are relevant in the African context. These were discussed by the Committee on Science and Technology in October 2001 (see report ICCD/COP(5)/CST/7). The CST recommended that these indicators be further defined and also considered by other regions, with a view to developing common sub-regional or regional indicators.

The CBD has been working for several years to develop a set of indicators that can be used to monitor and assess biological diversity. A core set of indicators was considered at the third meeting of the Subsidiary Body for Science, Technology and Technological Advice (SBSTTA) in 1997 (UNEP/CBD/SBSTTA/INF.13). A second set was developed and presented to

SBSTTA 7 in November 2001 (UNEP/CBD/SBSTTA/7/12). COP 6 decided that an ad hoc expert group should be convened to refine the indicators further (Decision VI/7). COP advised that regional approaches to indicator development be promoted and that these processes are taken into account in the development of the CBD's indicators. Specifically, the COP 6 decision on forest biological diversity:

> *Recognizes* existing criteria and indicators for sustainable forest management including forest biological diversity at the national and regional levels, and *agrees* that these should be applied where criteria and indicators are needed for the purposes of the expanded work programme, and recognizes the need for further development and selection of criteria and indicators for the assessment of the status and trends of forest biological diversity at the national and regional levels (Decision VI/22, para. 34)

Criteria and indicators for sustainable forest management

Criteria and indicators (C&I) for sustainable forest management (SFM) were developed to provide countries with a framework for defining SFM and assessing progress toward this goal. Criteria and indicators are tools to help identify trends in the forest sector, determine the effects of forest management interventions over time, and facilitate decision making in national forest policy processes.

Criteria define essential elements against which the sustainability of forest management is judged. Each criterion is defined by indicators, which are monitored periodically to provide an indication of whether a country is moving towards or away from sustainability.

ITTO began work on criteria and indicators for sustainable forest management in 1990. Today there are nine major C&I processes, involving approximately 150 countries and covering most of the world's forested area.[3]

The processes are similar in objectives and approach, but differ somewhat in content and structure. They have all developed criteria and indicators for use at the national level. The

[3] African Timber Organization (1993), Dry Forest Africa (1999), ITTO (1992) Dry Zone Africa (1995), Lepaterique Porcess (Central America)(1997), Montreal Process (1995), Pan-European Forest Process (1993), Tarapoto Proposal (1995), Near East Process (1996).

criteria identified by the processes correspond fairly closely, all incorporating, in some fashion, the following fundamental elements of SFM:

- extent of forest resources and global carbon cycle;
- forest ecosystem health and vitality;
- biological diversity in forest ecosystems
- productive functions of forests
- protective functions of forests
- socio-economic functions and conditions
- political, legal and institutional frameworks

As discussed above, national reporting to ITTO Year 2000 Objective is based on the ITTO Criteria and Indicators. UNFF has recognized criteria and indicators for sustainable forest management as a basis for reporting on SFM. CBD has also recognized criteria and indicators for SFM as useful to its work on forest biological diversity.

There is clearly strong acceptance of criteria and indicators of SFM as the basis for impact indicators related to forests. This convergence offers potential for harmonization of information across the forest-related instruments and improvement of reporting on forests. This was indicated in a proposal for action agreed upon by the IPF in 1997, which "recommended that criteria and indicators be used by FAO and other relevant organizations in order to improve consistency in reporting on forest assessment and sustainable forest management." (E/CN.17/1997/12, paragraph 115(e))

Concerns over the reporting burden on countries: Efforts to harmonize reporting to international instruments

The burden on countries to fulfil the various international reporting requirements was noted in a Report of the Secretary-General to the fifth session of the CSD in 1997, as follows:

> "Concern at the increasing number of national reports that countries are required to submit has been growing and expressed in various forums. Member States have noted that they must prepare reports not only for the Commission but also to comply with the requirements of conventions, agreements reached at major conferences and global programmes of action. For all countries, the requests constitute a burden; but for countries with limited capacity, the burden has become over-

whelming. It has also become apparent that some of the information being requested is duplicative and redundant" (E/CN.17/1997/6).

Streamlining of reporting on sustainable development

The CSD report made various proposals for the streamlining of requests within the UN context for national reporting on sustainable development issues. The focus was on streamlining the reporting process, rather than on streamlining the content of the reports, which respond to legal commitments or legislative mandates. It was agreed that countries would not need to report separately to the CSD on issues in which they report to Conference of the Parties of international conventions and other intergovernmental bodies. The country need only make these reports available to the CSD secretariat.

Another proposal made to CSD 5 was to have a UN system-wide sustainable development website developed, which would not only provide all national reports to the CSD but would have electronic linkages to reports and databases of related UN conventions. The Secretariat to the CSD is currently working on this site, with hopes to have it available in the near future. As well as linking to national reports to international bodies, it would provide links to national databases on environment and development, where possible.

Harmonization of reporting on biological diversity

Over the past few years, some major initiatives have been taken to streamline national reporting on biological diversity, in particular to the five biodiversity conventions: CBD, CITES, CMS, Ramsar and WHC.

In 1998 the secretariats of these five treaties and United Nations Environment Programme (UNEP) commissioned World Conservation Monitoring Centre (WCMC) to undertake a feasibility study to identify opportunities for harmonizing information management between the treaties. In October 2000, UNEP convened a workshop in Cambridge, U.K. to explore ideas for a more harmonized approach to national reporting to

international agreements and to develop pilot projects for testing the ideas at national and international levels (WCMC, 2000). Pilot project ideas were proposed for testing various approaches to information management: modular reporting, consolidated reporting, linking reporting to State of Environment reporting processes, and information management and regional support. The pilot projects are underway in four countries.

Another initiative has been taken by the Environmental Management Group (EMG). The EMG is a forum for UN agencies and secretariats of multilateral environmental agreements as a mechanism for enhancing interagency cooperation in the field of environment and human settlements. The EMG is chaired by UNEP. At its first meeting in January 2001, the EMG identified harmonization of environmental reporting, with a focus on biodiversity-related conventions, as needing additional attention. A background paper was prepared and discussed at the EMG's third meeting in October (UNEP 2001). The results of the analysis have contributed to documentation prepared for the WSSD on enhancing complementarities among international agencies.

At a regional level, the European Environment Agency is working on a project to streamline reporting systems for the 64 environmental agreements to which the European Commission is a party (EEA, 2001).

Harmonization of reporting on forests

The concern over reporting burden has also been strongly expressed in the international forest dialogue. A proposal for action (19a) of the IPF encouraged:

> "countries, ITFF[4] member organizations and other relevant international and regional organizations to develop harmonized, cost-effective, comprehensive reporting formats for collecting and synthesizing national forest information to meet the diverse demands for reliable and timely data by various forest-related international organizations and instruments. There is a need to incorporate information on relevant criteria and indicators for

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4 The Interagency Task Force on Forests established in 1995 to support the work of the IPF and subsequently the IFF. The ITFF has been superseded by the Collaborative Partnership on Forests (CPF) – see text later in the paper.

> sustainable forest management, including indicators on environmental, social and economic functions .... into such reporting formats in order to reduce reporting burdens on countries and increase the timeliness and consistency of reporting." (E/CN.17/2000/14)

The UNFF, at its second session (March 2002), invited "the Collaborative Partnership on Forests members to streamline reporting requests and, to the extent possible, to synchronize their reporting cycles so as to reduce reporting burden on countries" (E/CN.18/2002/14).

In April 2002, the CBD, by Decision VI/22, adopted the expanded work programme on forest biological diversity, which includes as one of its activities to "seek ways of streamlining reporting between the different forest-related processes, in order to improve the understanding of forest quality change and improve consistency in reporting on sustainable forest management" (Programme element 2, goal 1, objective 2, activity a).

A few preliminary efforts have been taken to date to on the issue of harmonizing reporting on forests, as follows:

- Expert Meeting on Synergies Among the Conventions on Climate Change, Biological Diversity, Desertification and the Forest Principles, held in Sede Boqer, Israel in March 1997 (UNDP, 1997). Among the topics discussed was reporting requirements and recommendations for harmonization.
- Workshop on Finding Synergies between Forest-Related Multilateral Environmental Agreements, convened by Ecologic – Institute for International and European Environmental Policy in Berlin on 7–8 December 2000 (Tarasofsky and Oberthuer, 2001)
- International Expert Meeting on Monitoring, Assessment and Reporting on the Progress toward Sustainable Forest Management, hosted by the Japan Forestry Agency and held in Yokohama, Japan, from 5 to 8 November 2001 (Forestry Agency, Japan, 2002).

There is strong potential to build on these efforts and those on harmonization of reporting on sustainable development and on biological diversity. The three efforts should be compatible and complementary.

The Collaborative Partnership on Forests is in the process of establishing a "CPF Task Force on Streamlining Forest-related Reporting Requirements". The CPF was established in 2001 to support the work of the UNFF and to increase cooperation and collaboration on forests among its members. The CPF consists

of 13 international organizations, institutions and instruments that have substantial programmes on forests. They are: FAO (Chair), Center for International Forestry Research (CIFOR), ITTO, International Center for Research in Agroforestry, Secretariat of the CBD, Secretariat of the Global Environment Facility, Secretariat of the UNCCD, Secretariat of the UNFCCC, United Nations Department of Economic and Social Affairs, United Nations Development Programme, UNEP, the World Bank and the World Conservation Union (IUCN). The objective of the Task Force is to propose ways to streamline forest-related reporting requests, synchronize reporting cycles and facilitate the provision of information by CPF members in order to reduce the reporting burden on countries.

Conclusions

The UNFF is the international instrument with exclusive focus on forests and the most comprehensive coverage. Although its predecessors, the IPF and IFF, adopted many proposals for action related to monitoring, assessment and reporting, the modalities for reporting to the UNFF itself have not yet been agreed upon.

National reporting to the other eight instruments and the CSD vary in their nature and content. The forest-related content of CITES, CMS, Ramsar and WHC, while relevant, is limited in scope.

The other five instruments – UNFF, ITTO, CBD, UNCCD and UNFCCC – all have considerable forest content and a strong sustainable development dimension. These five are most relevant to the issue of comprehensive international reporting on forests. National reports to UNFCCC and ITTO are strongly quantitative, whereas the content of national reports to CBD and UNCCD are qualitative, focusing on the means of implementing commitments under these conventions. Perhaps because of the difficulty of assessing the impact of their actions without quantitative measures, both CBD and UNCCD have been working to identify impact indicators, or biophysical and socio-economic indicators on which quantitative data can be collected.

There seems to be a very promising convergence of acceptance of criteria and indicators of sustainable forest management as the basis for assessing the state and trends in forests,

forest resource use and the equitable sharing of the benefits of that use. UNFF, ITTO and CBD have all accepted the criteria and indicators of SFM as the basis for assessing progress in their forest-related work.

Various important efforts are under way on streamlining and harmonizing reporting on sustainable development, biological diversity, and forests. The work to develop proposals for the streamlining of forest reporting anticipated to be undertaken by a CPF Task Force, can build upon similar efforts carried out for sustainable development by the CSD and on biological diversity by the five biodiversity conventions.

References

CSD. 1997. Proposals for the streamlining of requests for national reporting. E/CN.17/1997/6.

European Environment Agency. 2001. EEA support to the European Community in reporting obligations within the framework of international environmental conventions. EEA Technical report 62. http://reports.eea.ev.int/Technical_report_No_62/en/tech62.pdf

Forestry Agency, Japan. 2002. Proceedings of the International Expert Meeting on Monitoring, Assessment and Reporting on the Progress toward Sustainable Forest Management, Yokohama, Japan, 5–8 November 2001.

Harrison, J. and Collins, M. 1999. Harmonizing the information management infrastructure for biodiversity-related treaties. Paper prepared for the "Interlinkages-International Conference on Synergies and Coordination between Multilateral Environmental Agreements, UN University, Tokyo, Japan, 14–16 July 1999. (http://www.geic.or.jp/interlinkages/docs/harrisoncollins.pdf

ITTO. 2001. Reporting formats for the ITTO criteria and indicators for sustainable forest management of natural tropical forests. ITTC(XXX)/12, 20 April 2001. Available electronically at http://www.itto.or.jp/Index.html.

Tarasofky, R.G. and Oberthuer, S. 2000. Forest-related multilateral environmental agreements: a survey of provisions and interactions. Paper presented at the Workshop on Finding Synergies between Forest-related Multilateral Environmental Agreements, Berlin, Germany, 7–8 December 2000. (http://www.ecologic.de)

UN. 2001. Indicators of Sustainable Development: Guidelines and Methodologies. NY, UN.

UNCCD. 2001. Benchmarks and indicators. Note of the Secretariat on the Report of the Permanent Inter-State Committee on Drought Control in the Sahel (CILSS) and the Sahara and Sahel Observatory (OSS) on their initiative on the development of benchmarks and indicators. (ICCD/COP(5)/CST/7).

UNDP. 1997. Synergies in National Implementation: the Rio Agreements. NY, UNDP.

UNEP. 2001. Harmonization of information management and reporting for biodiversity-related treaties. (Prepared for the third meeting of the Environmental Management Group, 10 October 2001)

WCMC. 2000. Towards the harmonization of national reporting. Report of a workshop convened by UNEP. Cambridge, UK, 30–31 October 2000. (see http://www.unep-wcmc.org/convent/treaties.htm)

Annex 1

International conventions and agreements related to forests

Instrument	Date: entry into force or establishment	Status of participation	Objectives	Relevance to forests
Commission on Sustainable Development (CSD)	1993	53 members elected for terms of three years. All UN member States may participate in sessions, but without voting rights.	To review progress in implementation of recommendations and commitments made at UNCED, elaborate policy guidance and options for future activities to follow up UNCED and achieve sustainable development, and to promote dialogue and build partnerships for sustainable development.	Commitments made at UNCED include Chapter 11 ("Combating deforestation" of Agenda 21) and the "Forest Principle" (i.e., the "Non-legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests".
Convention on the Conservation of Migratory Species of Wild Animals (CMS)	1 November 1983	79 Parties (as of Feb. 2002)	To conserve wild animal species that migrate across or outside national boundaries by developing and implementing cooperative agreements, prohibiting taking of endangered species, conserving habitat, and controlling other adverse factors.	Forests are important habitats to some migratory species listed on the appendices of the CMS (i.e., endangered species and species with an unfavourable conservation status). Range States for these species are to conserve and restore habitats critical for the species' survival.
Convention on Biological Diversity (CBD)	29 December 1993	183 Parties (as of March 2002)	The conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising from the utilization of genetic resources.	Many of the articles of the convention relate to the conservation and sustainable use of biological resources, including forest resources. Those most relevant to sustainable forest management are: • Article 7, which requires Parties to identify and monitor components of biological diversity important for conservation and sustainable use, and to identify processes and activities with adverse impacts on the conservation and sustainable use of biological diversity. • Article 8, which address *in situ* conservation, including within and outside protected areas, rehabilitation and restoration of degraded ecosystems, and actions to minimize negative impacts of alien species • Article 8j, which addresses the roles and rights of traditional and local communities related to forests • Article 10, which addresses sustainable use of biological diversity. At COP 4 in 1998, a work programme on forest biological diversity was adopted. An expanded programme was adopted at COP 6 in 2002.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	1 July 1975	158 Parties (as of June 2002)	To prevent the overexploitation, due to international trade, of species listed in the Convention's appendices. Various levels of control or restrictions are placed on the trade of these species.	Some 15 timber or woody species, some of which are commercially important, are included on CITES appendices.
Convention on Wetlands of International	21 December 1975	132 Parties (as of June	Wetland conservation and wise use, recognizing wetlands as ecosystems that	Ramsar promotes the conservation and wise use of wetlands considered internationally important, including mangroves and forested peatlands. As of

Importance, Especially as Waterfowl Habitat (Ramsar Convention)		2002)	are extremely important for biodiversity conservation in general and for the well-being of human communities.	November 1999, 306 of the 1028 sites on the Convention's List of Wetlands of International Importance were forested wetlands.
International Tropical Timber Agreement **(ITTA)**	1 January 1997 for an initial period of four years (Successor agreement to ITTA, 1983).	57 members (as of July 2001)	To provide an effective framework for consultation, international cooperation and policy development among all members with regard to all relevant aspects of the world timber economy, including international trade in tropical timber, and to enhance the capacity of members to implement a strategy for achieving exports of tropical timber from sustainably managed sources.	While primarily a commodity agreement aimed at regulating international trade in tropical timber, the scope of ITTA and the work of the International Tropical Timber Organization (ITTO) also includes forest conservation and management issues. In 1990 the ITTA Council adopted the Year 2000 Objective, which states that exports of tropical timber should be from sustainably managed sources by the year 2000. Much of the work of ITTO relates to policy development and projects.
Convention Concerning the Protection of the World Cultural and Natural Heritage **(World Heritage Convention - WHC)**	17 December 1975	167 Parties (as of May 2002)	To define and conserve the world's cultural and natural heritage, by drawing up a list of sites (the World Heritage List) whose outstanding values should be preserved for all humanity and to ensure their protection through closer collaboration among nations.	Of the 721 sites currently on the World Heritage List, 41 are tropical forests and many are temperate and boreal forests.
United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa (UNCCD)	26 December 1996	179 Parties (as of May 2002)	To combat desertification and mitigate the effects of drought, particularly in Africa, in an integrated approach aimed at contributing to sustainable development in affected areas.	UNCCD addresses biophysical and socio-economic aspects of desertification and the effects of drought. The aspects of the Convention that are particularly relevant to forests include vegetation conservation and traditional knowledge.
United Nations Forum on Forests **(UNFF)**	18 October 2000	Membership open to all member States of the UN	To promote the management, conservation and sustainable development of all types of forests and to strengthen political commitment to this end.	UNFF is recognized as the foremost forum for discussion of international forest policy. The UNFF is primarily concerned with facilitating the implementation of the IPF/IFF proposals for action, which represent an international forest policy agenda.
United Nations Framework Convention on Climate Change **(UNFCCC)**	21 March 1994	186 Parties (as of Dec. 2001)	To stabilize greenhouse-gas (GHG) concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, and to achieve this level within a timeframe sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.	Forest play an important role in mitigating climate change through serving as reservoirs, sinks and sources of GHGs, particularly carbon. Forests are addressed directly or indirectly in several provisions of the UNFCCC (Articles 4.2, 4.1(c) and 4.1 (d)) and its Kyoto Protocol (Article 3.4). Parties to the Convention committed themselves to carrying out national inventories of GHG emissions and carbon sinks, including forests. Sustainable forest management, reduction of deforestation, and afforestation and reforestation are all included in UNFCCC as measures to mitigate climate change. The Kyoto Protocol (not yet entered into force) identified quantified emission limitation or reduction commitments by Parties, which can be met by, among other actions, afforestation, reforestation and (avoided) deforestation. Joint implementation and the Clean Development Mechanism offer potential opportunity for financial transfers between Parties wishing to meet some of their commitments through forest-related activities in other countries.

Annex 2

National Reporting to International Conventions, Agreements and Commission on Sustainable Development

Instrument (and mandate for reporting)	Guidelines for reporting, and national reports and databases, with website addresses	Periodicity / date(s) of issue[5]	Content of national reports
Commission on Sustainable Development **(CSD)**	**Country profiles** (based on national reports submitted to CSD) available at: http://www.un.org/esa/agenda21/natlinfo/	Every five years 1997: Prepared for the Earth Summit +5. 2002: Updated for World Summit on Sustainable Development.	A report on each of the chapters of Agenda 21, including information on the status of cross-sectoral issues (decision-making structures, capacity building/technology issues, finance, regional/international cooperation) and statistical data/indicators
	National reports: status of implementation of the Agenda 21 chapters and other issues to be discussed at that year's CSD session *National reports on forests were provided for CSD 8 (2000)	Annual 2000	1. Brief statement of current situation of SFM and achievements 2. Progress in the implementation of IPF/IFF proposals for action 3. Policy and legal framework 4. Information: participation in criteria and indicators (C&I) processes; use of C&I for reporting and policy purposes; dissemination of information on SFM 5. Overriding issues (forestry-poverty linkages; consumption and production trends)
	National assessment reports: self-appraisal of the country's efforts to implement Agenda 21 over the 10-year period since UNCED.	2002	Policy measures taken, specific challenges encountered and constraints faced.
Convention on the Conservation of Migratory Species of Wild Animals **(CMS)** (Article VI)	The model format provided by Resolution 4.1 (1994), has been updated for voluntary use on a trial basis for COP 7 (Sept 2002). See http://www.wcmc.org.uk/cms/	Every three years	New reporting format: Appendix I species: general information on steps taken to protect species; species specific information on population size, trends and distribution, efforts in research, monitoring and habitat protection Appendix II species: CMS agreements Party has undertaken to conserve species Role conservation of migratory species plays in national and regional priorities Use of satellite telemetry Membership – steps taken to encourage non-Parties to join CMS Actions taken to increase national and global awareness of importance of CMS Mobilization of resources Implementation of COP Resolutions

Convention on Biological Diversity **(CBD)** (Article 26)	**National Report to the Convention on Biological Diversity** Guidelines for reporting (second report)Ñ http://www.biodiv.org/world/nr-guidelines.asp?t=s or UNEP/CBD/COP/5/13/Add.2 Access to national reports: http://www.biodiv.org/doc/world/asp	Every four years First report: 1997 Second report: 2001 Third report: 2005	Contents of first National Report: implementation of Article 6 Contents of second National Report: Reporting on the implementation of the articles of the Convention and related COP decisions addressed to Contracting Parties, including on the following Articles: 5 (Cooperation); 6 (General measures for conservation and sustainable use); 7 (Identification and monitoring); 8 (In-situ conservation); 9 (Ex-situ conservation); 10 (Sustainable use of biological diversity); 11 (Incentive measures); 12 (Research and training); 13 (Public education and awareness); 14 (Impact assessment and minimizing adverse impacts); 15 (Access to genetic resources); 16 (Access to and transfer of technology); 17 (Exchange of information); 18 (Technical and scientific cooperation); 19 (Handling of biotechnology and distribution of its benefits); 20 (Financial resources); 21 (Financial mechanism); 22 (Relationship with other international conventions); 23 (Conference of the Parties); 24 (Secretariat); 25 (Subsidiary Body on Scientific, Technical and Technological Advice); 26 (Reports)
	Thematic Reports (on thematic programme areas of the CBD; timetable decided by COP)		
	Thematic Report on Forests (considered by COP6, April 2002) Guidelines for reporting: http://www.biodiv.org/world/nrguidelines.asp?t=thm Access to reports: http://www.biodiv.org/world/reports.asp?t=fr	2001	Reporting on implementation of the work programme on forest biological diversity (Decision IV/7): Element 1: Ecosystem approach Element 2: Analysis of the ways human activities influence biological diversity and assessment of ways to minimize or mitigate negative influences Element 3: Elaboration and implementation of criteria and indicators for forest biological diversity
	Voluntary thematic national report on the implementation of the expanded programme of work on forest biological diversity	2003	Decision VI/22 calls for Parties to submit voluntary reports on the implementation of the expanded work programme on forest biological diversity to COP 7, including the following information: 1. Priority actions that Parties have identified 2. Successes in implementing the programme 3. Challenge and impediment The report format to be prepared by the CBD secretariat and approved by the Bureau of the COP.

Convention on International Trade in Endangered Species of Wild Fauna and Flora **(CITES)** (Article VIII, para. 7)	**CITES Annual Reports** Reporting guidelines: http://www.cites.org/eng/notifs/1999/085a.pdf **Biennial Reports**	Annual Biennial	Reporting on statistics on trade of species included in the CITES Appendices, including the kind and quantity of specimens, country of origin or destination, purpose of trade, source of specimens, and permit or certificate number. Report on legislative, regulatory and administrative measures taken to enforce the provisions of CITES.
Convention on Wetlands of International Importance, Especially as Waterfowl Habitat **(Ramsar Convention)**	**National Reports** Reporting format for national reports to COP8 (2002) http://www.ramsar.org/cop8_nr_natl_rpt_intro_e.htm	Every three years	Reporting on measures taken to: 1. Increase Ramsar membership 2. Implement and further develop the Ramsar Wise Use Guidelines 3. Raise awareness of wetland values and functions 4. Reinforce institutional capacity 5. Ensure conservation of all sites on the Ramsar List 6. Increase the number of Ramsar sites, particularly of under-represented wetlands types 7. Promote international cooperation and mobilize financial assistance 8. Provide the Convention with required institutional mechanisms and resources
International Tropical Timber Agreement **(ITTA)** (Article 29)	ITTO/UNECE/FAO/EUROSTAT Joint Forest Sector Questionaire (for use in the ITTO Annual Review and Assessment of the World Timber Situation) http://www.itto.or.jp/inside/joint_forest/index.html Input to Year 2000 Objective Review Reporting format: http://www.itto.or.jp/Index.html	Annual	1. Production and trade of all timber by ITTO Producers and Consumers 2. Direction of trade in volume of primary tropical timber products between major ITTO Producers and Consumers 3. Major tropical species traded 4. Prices of major tropical timber and selected competing softwood products 5. Trade in secondary processed wood products

Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention) **(WHC)** (Article 29)	Periodic Reporting on the application of the World Heritage Convention Reporting Guidelines:[6] Reporting format: http://www.unesco.org/whc/reporting/periodic.htm Explanatory notes: http://whc.unesco.org/reporting/prexpl.htm Reports not available on the Web	Each State Party reports every 6 years (with rotation by region) Arab States 2000 Africa 2001 Asia & Pacific 2002 Latin Am & Caribbean 2003 Europe & N. America 2004/2005	Section 1: Application of the WHC by State Party 1.1. Introduction 1.2. Identification of cultural and national heritage properties 1.3. Protection, conservation and presentation of the cultural and natural heritage 1.4. International co-operation and fund raising 1.5. Education, information and awareness building 1.6. Conclusions and recommended actions Section 2: State of conservation of specific World Heritage properties II.1. Introduction II.2. Statement of significance II.3. Statement of authenticity/integrity II.4. Management II.5. Factors affecting property II.6. Monitoring II.7. Conclusions and recommended action

United Nations Convention to Combat Desertification **(UNCCD)** (Article 26) (also decision 11/COP.1)	**UNCCD National Reports** http://www.unccd.int/cop/reports/menu.php	First reporting 1999 – affected African countries 2000 – other affected countries 1999/2000 – non affected countries Second reporting 2002 – all regions Reporting will be done for each future ordinary session (2003, 2005, 2007 … etc.), with non-affected countries reporting to every session, and affected countries reporting to every other session, alternating between African countries and countries in other regions	**(a) Reports on national action programmes** • Strategies and priorities of sustainable development plans and/or policies • Institutional measures taken to implement UNCCD • Participatory process used in national action programme (NAP) • Consultative process used in NAP and partnerships with developed country Parties • Measures taken or planned in NAP, *i.a.* to improve: economic environment, natural resource conservation, institutional organization, knowledge of desertification; and to monitor and assess drought effects • National and financial allocations and financial and technical assistance received • Benchmarks and progress indicators **(b) Reports on joint, subregional and regional action programmes** (SRAPs and RAPs, repectively) • Areas of cooperation under the programme and measures taken or planned • Consultative process used in the preparation and implementation of the SRAPs or RAPs and partnership agreements with developed country Parties and other interested entities • Financial allocations by affected country Parties of the subregion or region in support of implementation and financial assistance and technical cooperation received and needed • Benchmarks and progress indicators used **(c) Reports of developed country Parties** • Consultative process and partnership agreements in which they are involved • Measures taken to support the preparation and implementation of action programmes at all levels, including information on the financial resources they have provided, or are providing, both bilaterally and multilaterally. **(d) Reports of affected developed country Parties not preparing action programmes** • Strategies and priorities, within the framework of sustainable development plans and/or policies, to combat desertification and mitigate the effects of drought and any relevant information on their implementation.

United Nations Forum on Forests **(UNFF)** (Ecosoc Resolution 2000/35)	Not yet available The UNFF Secretariat to suggest a format for country reports to UNFF 3 on implementation of the IPF/IFF proposals for action. Thereafter, an ad hoc expert group shall provide advice to UNFF on monitoring, assessment and reporting.	To be determined	No reporting modalities have as yet been decided. UNFF 1: a) identified the three areas for UNFF's monitoring, assessment and reporting function as: • Progress in implementation of the IPF/IFF proposals for action; • Progress towards sustainable management of all types of forests; and • Review of the effectiveness of the international arrangement on forests. b) invited countries, regions, organizations and processes to report to the UNFF, on a voluntary basis, on their progress in implementation of the IPF/IFF proposals for action, c) stressed the importance of the use of regional and national criteria and indicators for sustainable forest management (SFM) as a basis for reporting on SFM

United Nations Framework Convention on Climate Change **(UNFCCC)** (Article 12)	**National Communication** Guidelines for Annex 1 Parties: http://unfccc.int/resource/docs/cop5/07.pdf (under revision: to be addressed at COP 8) Guidelines for Annex 1I Parties: Decision 10/CP.2 (not available on web) Communications available at: http://unfccc.int/resource/natcom/index.html	Each Annex I Party shall make its initial communication within six months of the entry into force of the Convention for that Party. Each other Party shall make its initial communication within three years of the entry into force of the Convention for that Party, or of the availability of financial resources in accordance. Least developed country Parties make their initial communication at their discretion.	Annex I Parties: report of implementation of commitments under Articles 4.1 and 12, including: • Greenhouse gas inventory information • Policies and measures • Projections and the total effect of policies and measures • Vulnerability assessment, climate change impacts and adaptation measures • Financial resources and technology transfer • Research and systematic observation • Education, training and public awareness
	National Inventory (Annex 1 countries) UNFCCC guidelines provide a common reporting format http://unfccc.int/resource/docs/cop5/07.pdf Intergovernmental Panel on Climate Change Guidelines for National GHG Inventories (IPFF Guidelines) provide methodology http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm	Annual	Balance of GHG emissions and removals from: in energy section: • from woody biomass combustion • from pulp, paper and print industries in land –use change and forestry • changes in forest and other woody biomass stocks - in forests, distinguishing between tropical, temperate, and boreal; plantations and other forests; various species; and in - non-forest trees - removed in commercial harvest, traditional fuelwood consumption, other wood use • forest and grassland conversion - distinguishing between various types of tropical, temperate and boreal forests - distinguishing between immediate release by fire and delayed release from decay • abandonment of managed lands - areas and rate of regrowth of various types of tropical, temperate and boreal forests • CO_2 emission/removals from soil - area of cultivation of different types of soils

Forest Resource Assessment and Indicators of Sustainable Forest Management: the European Experience

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Introduction

International forest resource assessments have been carried out at the regional and global levels for at least 50 years. The concept of "environmental indicators" is more recent, and the first "criteria and indicators of sustainable forest management" were only developed in the late 1980s (by ITTO), amid a certain amount of confusion and suspicion. Both exercises aim to improve knowledge and understanding of the forest in all its facets, yet the synergies between the two approaches have been slow to be discovered. This article aims to describe briefly the synergies which have been found between the forest resource assessment work at the European level, led by ECE/FAO in Geneva, and the criteria and indicator process under the auspices of the Ministerial Conference on the Protection of Forests in Europe.

Main events 1990–2002

In 1992 (just after the Rio Conference), the forest resource assessment of the temperate regions ("TBFRA 90") was issued. The low level of political commitment to the exercise was evident through the limited resources deployed, and the poor quality of some of the data supplied. Despite attempts to address the multiple functions of forests, the great majority of the data with acceptable precision concern either forest area or wood supply.

In 1993, at Helsinki, the European ministers, under the

influence of the "spirit of Rio", make a number of ambitious commitments to sustainable development, and to an integrated holistic approach to forest sector questions. They also commit themselves to monitoring progress towards sustainable forest management.

In 1993, a major, global level, scientific/technical meeting in Montreal develops the idea of criteria and indicators of sustainable forest management. Subsequently the process splits on regional lines.

In 1995, the "Montreal process" is launched, and the scientific community, mostly in North America, starts to draw up "criteria and indicators of sustainable forest management" to guide and monitor policy decisions.

Very soon after the "pan-European process" (later to be known as the Ministerial Conference on the Protection of Forests in Europe, MCPFE) starts to draw up its own set of criteria and indicators. Unlike the Montreal process, the main actors are official government experts, very aware of the political dimension of the choices they are making and of the need to produce a credible and feasible set of comparable data, to demonstrate to a sceptical world the sustainable nature of European forest management. Furthermore, ECE/FAO and other international agencies participate in the discussion, mostly to guide the delegates as to what is feasible, drawing on experience with TBFRA 1990, and other pre-existing activities. By contrast, the Montreal process is inclined to a more ambitious discussion of what information should be collected, with less account taken of feasibility.

The first set of criteria and of quantitative indicators at the pan-European level is agreed in 1994, with qualitative indicators (addressing issues connected with policies, legal instruments etc.) in 1995.

Simultaneously the Finnish Liaison Unit of the process carries out a pilot study of the feasibility of data collection on the quantitative indicators, sending a questionnaire to national MCPFE contact points. The results are disappointing: some data are missing, others clearly non-comparable and yet others contradict data supplied in other exercises, such as TBFRA 1990.

Around 1996, work starts in earnest on TBFRA 2000[1], notably on designing a questionnaire and definitions, in consultation with experts and the national correspondents who will later have to supply the data. The latter provide a powerful "reality check", stating clearly that certain data can not be supplied with an acceptable degree of accuracy.

In view of the fact that the indicators have been drawn up with the experience of TBFRA 1990 in mind and that many of the parameters identified as indicators are already included in the TBFRA 2000 draft questionnaire, it is decided that data on quantitative indicators for the ministerial conference planned for 1998 will be collected in the context of TBFRA and other existing international arrangements, notably the International Cooperative Programme on Forests under the ECE Convention on Long Range Transboundary Air Pollution.

Early data from TBFRA 2000 (not completely validated) are supplied to the 1998 Lisbon Ministerial Conference for most of the list of quantitative indicators. The remaining quantitative indicators and all the qualitative indicators are left to countries to report. The quality of the data reported to the ministers is adequate in comparability and coverage.

After an intense validation process, the final TBFRA 2000 data are published in 2000, and subsequently incorporated into the global FRA data set. The data published in 2000 represent a significant improvement on those issued in 1998.

In 2001, a process to revise the MCPFE indicators in the light of experience is launched; a revised set will be proposed for approval at the political level in summer 2002.

A report on quantitative indicators of sustainable forest management to the Vienna Conference in 2003 will be based on updated FRA data with, where possible, more recent information. The framework used will be "Lisbon plus", i.e. the first set of indicators (not the new set which have not been approved yet), but with modifications in a few areas where progress is widely accepted, notably the use of the new MCPFE classification of protected and protective forests.

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[1] "TBFRA 2000" in this paper refers to the approximate temperate and boreal region (Europe, CIS, US, Canada, Australia, New Zealand and Japan) for which the FRA 2000 work was co-ordinated by UNECE/FAO in Geneva. However, no formal or definite assignment of regions has been made for global forest assessments.

Distribution of responsibilities between FRA and "criteria and indicators" process

The data collection in Europe for the Ministerial Conferences (Lisbon 1998 and Vienna 2003) has been as follows:

- The framework for data collection has been the list of indicators approved at the policy level by MCPFE
- The TBFRA 2000 questionnaire was modified at the design stage to reflect the needs of the policy dialogue for information as evidenced by the list of indicators.
- The TBFRA 2000 and the indicators process retained their separate identities to the benefit of both: thus, for instance, TBFRA 2000 experts were able to reject indicators or definitions which they did not find realistic. Thus, the parameters requested in FRA usually, but not always, reflect precisely the wording of the relevant indicator.
- There was no separate questionnaire for the indicators: data were supplied by the TBFRA 2000 correspondents as part of a wider data set. Appropriate parameters were then extracted from the set for submission to the political level.
- The TBFRA 2000 process laid great store on transparency (sources of data, methods of adjustment to international definitions). This gave credibility to the extracted indicator data which thus had a "pedigree".
- In the revision process currently under way, there has been a constructive dialogue between the various policy constituencies expressing their needs for information and the possibilities of the data providers to satisfy the needs.

Advantages of the cooperative arrangements

Each country is asked to supply data only once, and as a part of a consistent data set, provided by a group of correspondents who are well aware of the technical issues and of the special needs of international comparability

- The pressure from the policy process and the various new "constituencies" (e.g. conservation experts) pushed the TBFRA 2000 correspondents (mostly based in national forest inventory agencies) to widen their horizons, make contact with new sources and seek new partners
- The political visibility of the process undoubtedly improved the quality, coverage and timeliness of replies (for all FRA parame-

ters, not only those on the list of indicators), and helped correspondents to claim increased resources for what had been a relatively low profile, technical task. With a ministerial conference under preparation in the coming months, providing inadequate data or not replying to the questionnaire seemed very unattractive options to the correspondents.

- There is now a reasonable certainty that the data being collected at the international level through FRA do in fact correspond as closely as possible to the needs of the policy process, reducing the temptation to set up parallel processes, use unofficial or inadequate data sources etc.
- The inclusiveness and transparency of both processes, and the links between them have reduced the likelihood of sterile data quarrels ("My data is better than yours" "You are manipulating the results" etc.) It is now widely accepted at the European level that the data set collected by FRA in cooperation with MCPFE and many other partners, and presented to the regional policy process is the best possible at the moment, and that efforts to improve it should be undertaken through the existing framework.

Disadvantages and scope for improvement

In the author's opinion, there are few disadvantages to the existing cooperation between MCPFE and ECE/FAO at the regional level in the field of indicators. However, there is of course scope for improvement.

One possible disadvantage is the difficulty of reconciling the political and the data collection timetables. For instance, it is clear that if the ministers had met in 1999, rather than 1998, they would have had a much better data set in front of them.

Resources are not adequate for the ambitions of the operation, whether in the secretariats or for the national correspondents. More could be done in the field of validation and user friendly presentation and promotion of the results. Likewise national forest inventories and their partners need more funds to expand their data collection to get better quality data (or any data at all) on the "new" parameters being built in to the process.

Even in the pan-European region, there are some countries with a very weak forest information infrastructure, where even the core data (e.g. forest area) are out of date, have no error estimate, are based on partial information or are simply una-

vailable. These countries tend to be the also those with the most urgent forest sector problems. The international community should be prepared to help these countries to strengthen their institutions to provide at least the minimum necessary information to make soundly based policy decisions.

This strong and beneficial cooperation between FRA and the criteria and indicator processes has so far been concentrated in the European region. Although the regional FRA operation is closely integrated with the global FRA, there is no such coordination mechanism between the different regional processes (Montreal, Tarapoto, ITTO etc.). Indeed, it appears to have been decided that the regional lists should not be combined into a single global list, although there are strong similarities between many of the lists, as was pointed out by FAO to the Kotka III meeting. As the data collected by FRA at the global level have become *de facto* the global core data set, it is important that this data set takes account of the needs of the policy process in all regions (as expressed through the lists of indicators), and that the regional lists develop in full awareness of the possibilities of the leading global data collection exercise to provide information. At present coordination of lists of parameters and reporting methods between FRA and the various regional processes is in its infancy: in the author's view, this aspect should be developed as matter of urgency.

Revised list of MCPFE indicators[2]

The fourth and last workshop of an intensive year-long process will take place in Calabria, Italy from 6–7 May to prepare a list of MCPFE indicators revised in the light of experience. The workshop's proposals will be finalised by an advisory group of representatives of relevant international organisations[3], and submitted to the "expert level meetings" in summer and autumn 2002. Assuming agreement is reached there (which is likely since there has been informal policy level participation in the workshops from the beginning), the ministers will be asked to approve the revised list at the Conference in Vienna in April 2003.

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[2] It was decided at the outset that the six criteria should not be changed.

[3] MCPFE, ECE/FAO, TBFRA team of specialists, EEA, ICP Forests and EFI.

The draft list submitted to the Calabria workshop is attached. Although some modifications are certain before final approval, this list is a clear indication of the challenges which will face the FRA community in the coming years. Particular challenges are in the following areas:

- More informative and comparable data on protected and protective forest (Note the distinction between protected and protective forests)
- Much fuller information on social/economic aspects such as share of GDP, employment, labour force, recreation
- Continuing search for better proxies for information on forest management (increased importance of close-to-nature silviculture) and forest biodiversity (dead wood, endangered forest species etc.)
- Use of new data sources such as the Level II sample plots of ICP Forest.
- Strong demand, notably from the conservation community, to classify data by forest type. So far the solutions proposed (classification by coniferous/broadleaved/mixed) have not been fully satisfactory and more ambitious proposals have been, rightly, considered unrealistic at present. This discussion is unlikely to fade away.

Those involved in FRA work in Europe and other regions, as well as the global level, should examine these revised indicators with constructive and careful attention as a strong indication of the demands that they will be expected to satisfy in the near future. Some of the parameters are specific to Europe, but many others could be applied, if data were available, in other regions or even world wide.

Conclusions

The use of FRA channels to provide data on quantitative indicators to MCPFE, and the necessary close cooperation to achieve this has proved highly beneficial to all concerned. The international community has been supplied with a high quality, politically relevant data set in an efficient way and the regional FRA work has benefited in visibility and focus from the political attention it has received. All partners have the intention to continue and deepen this cooperation.

Challenges for the future:

- Respond to the newly revised data needs as articulated in the revised set of MCPFE indicators at present under preparation
- Extend the approach to other regions and to the global level
- Use the political visibility gained to attract more resources to strengthen capacity in the international organisations but above all in those countries with a weak information infrastructure so that they can in future participate in the policy discussion alongside countries with strong institutions and capacity.

Revised list of MCPFE quantitative indicators as of April 2002 (not final)

Criteria	No.	Indicator	Full text	
C 1: Maintenance and Appropriate Enhancement of Forest Resources and their Contribution to Global Carbon Cycles	1.1	Forest area	Area of forest and other wooded land, classified by forest type	
	1.2	Growing stock	Growing stock on forest and other wooded land, classified by forest type	
	1.3	Age structure and/or diameter distribution	Age structure and/or diameter distribution of forest and other wooded land, classified by forest type	
	1.4	Carbon stock	Carbon stock of woody biomass and of soils on forest and other wooded land	
C 2: Maintenance of Forest Ecosystem Health and Vitality	2.1	Deposition of air pollutants	Deposition of air pollutants on forest and other wooded land, classified by N, S and base cations	
	2.2	Soil acidity and eutrophication	Chemical soil properties (pH, CEC, C/N, organic C, base saturation) on forest and other wooded land related to soil acidity and eutrophication, classified by main soil types	
	2.3	Defoliation	Defoliation of one or more main tree species on forest and other wooded land in each of the defoliation classes 2, 3 and 4	
	2.4	Biotic damages	Forest and other wooded land with damage caused by biotic agents, classified by forest type	*Merge ?*
	2.5	Abiotic damages	Forest and other wooded land with damage caused by abiotic agents, classified by forest type	
	2.6	Human induced damages	Forest and other wooded land with human induced damage, classified by forest type	
C 3: Maintenance and Encouragement of Productive Functions of Forests (Wood and Non-Wood)	3.1	Increment and fellings	Balance between net annual increment and annual fellings of wood on forest and other wooded land	
	3.2	Roundwood	Value and quantity of marketed roundwood	
	3.3	Non-wood goods	Marketed quantity and value and quantity harvested of non-wood goods	*Merge ?*
	3.4	Services	Value of marketed services on forest and other wooded land	

	3.5	Forests under management plans	Proportion of forest and other wooded land managed according to a formal or informal management plan
C 4: Maintenance, Conservation and Appropriate Enhancement of Biological Diversity in Forest Ecosystems	4.1	Threatened forest species	Number of threatened forest species, classified according to IUCN Red List categories in relation to total number of forest species
	4.2	Deadwood	Volume of standing deadwood and volume of lying deadwood, classified by forest type
	4.3	Introduced tree species	Area of stands of forest and other wooded land dominated by introduced tree species
	4.4	Naturalness	Area of forest and other wooded land which is undisturbed by man, semi-natural or plantations
	4.5	Genetic resources	Area of stands managed for conservation and utilisation of tree/ forest genetic resources (in situ and ex situ gene conservation) and area of stands managed for seed production
	4.6	Tree species composition	Area of forest and other wooded land, classified by number of tree species occurring and by forest type
	4.7	Regeneration	Area of regeneration within even-aged stands, uneven-aged stands and coppice, classified by regeneration type ***Shift to C3 ?***
	4.8	Protected forests	Area of forest and other wooded land protected to conserve biodiversity, landscapes and specific natural elements, according to MCPFE protection categories
C 5: Maintenance and Appropriate Enhancement of Protective Functions in Forest Management (notably soil and water)	5.1	Protective forests – soil, water and other ecosystem functions	Area of forest and other wooded land designated to prevent soil erosion, to preserve water resources, or maintaining other forest ecosystem functions, according to MCPFE protection category "Protective Functions"
	5.2	Protective forests – infrastructure and managed natural resources	Area of forest and other wooded land designated to protect infrastructure and managed natural resources against natural hazards, according to MCPFE protection category "Protective Functions"
C 6: Maintenance of other socio-economic functions and conditions	6.1	Contribution of forest sector to GDP	Contribution of forestry and manufacturing of wood and paper products to gross domestic product ***Merge ?***
	6.2	Net revenue	Net revenue from forestry

	6.3	Forest holdings	Number of holdings, classified by ownership categories and size classes
	6.4	Forest sector workforce	Number of persons employed and labour input in the forest sector, classified by gender and age group, education and job characteristics
	6.5	Occupational safety and health	Frequency of occupational accidents and occupational diseases in forestry
	6.6	Right of access	Area of forest and other wooded land where public has a legal right of access
	6.7	Cultural and spiritual values	Number of sites within forest and other wooded land designated as having cultural or spiritual values
	6.8	Energy from wood resources	Share of wood energy in total energy consumption, classified by origin of wood

Σ = 33 indicators

Generic Scope of Global Forest Resources Assessments – What Are They About?

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Introduction

Why are we surveying forests? What is it that we want to achieve? These questions are fundamental to all forest inventories and assessments, but seem often to be hidden under layers of technologies and methodologies used to generate new data. This paper examines the underlying goals and establishes a generic scope of forest resources assessments, with particular reference to global information.

In doing this, a number of concepts and terms are defined, drawing to the extent possible from internationally accepted formulations. The first is "forest resources assessment" where the term "forest" is used in the sense expressed by FAO's global forest resources assessments (FAO 2001). However, "forest resources" refers not only to forests, buth rather to forest *and* tree resources, thus encompassing also trees outside of forests as well as as other wooded land, as defined by FAO. The word "assessment" is used with the meaning "determination of importance or value" (Anon. 1983) which implies not only an assembly of baseline statistics, but also further analyses and quantification of the benefits from (or values of) forests. Therefore, "forest resources assessment" encompasses not only the biophysical constitution of forest resources, but also the management and uses of these resources. Finally, "assessment" includes developments over time, describing trends in the past, as well as providing required parameters for scenario development.

The paper first examines objectives of forestry, and establishes a generic goal function against which progress should be measured. Secondly, the goal function is applied to the global case, disaggregating it into a set of users and objectives that should be considered at the global level. Thirdly, the relative

importance of users and objectives are examined to establish a basis for the priorities within a global assessment. Finally, a possible conceptual design of global forest resources assessments is suggested.

Objectives of forestry – the goal function

Obviously, forest resources assessments are made to serve the objectives of forestry, or other objectives where forests constitute a significant factor.

So which are the objectives? The simple answer is that it varies greatly with time, scale and users involved. At the global level, over the long term, and involving national governments, an overall objective has been formulated as "Sustainable forest management". This concept includes objectives such as preservation of biological diversity, reduction of athmospheric carbon, reverting desertification, provision of wood and non-wood products, alleviating poverty and securing food supply.

At a national level, forestry objectives are often more interwoven with other sectors and may include high employment levels, contributions to the national economy and the common rights to use forests. Environmental objectives are common at the national level and often conflict with more economic-oriented ones. In such cases, policies tend to state that several goals shall be considered in the management of forests.

At the local management level, involving e.g. a private land owner and considering next year's income, the objectives may be radically different, typically aiming at a high personal well-being and involving factors such as possible income of logging, financial flows and benefits of alternative land uses.

The components of a generic goal function must therefore include three dimensions: users, objectives and area. By users are meant the different beneficiaries of the forest, for example the land owner, or the world's population as a whole. By objectives are meant the explicit goals that are expressed by one or several users. By area is meant the entire land area studied, broken down into reporting units.

For each combination of user, objective and reporting unit, there exists a value, or *utility* that we want to study over time. Utilities may be measured in tangible terms, such as monetary income, or intangible terms, such as a index. Common to all utility measures is that a higher value is always better than a

lower, i.e. more money is better than little money and a higher biodiversity index is better than a lower.

Utility measures may not be easily comparable across users, objectives or areas. This is different from neoclassical economic theory, which suggests that all objectives in a goal function should be reduced to monetary terms, to be able to compare them. The development of environmental economics has highlighted that utilities cannot always be directly compared, and that other ways to evaluate multiple objectives must be found. One way to achieve this is to work with weights. The weight is specific to one combination of user, objective and reporting unit and serves the purpose to normalise the utility so that comparisons can be made, and the overall benefit calculated. The process of identifying weights under different planning conditions is a critical phase for an assessment.

The above reasoning can then be formalized as:

$$U = \sum_{A}\sum_{S}\sum_{O} u_{a,s,o} \cdot w_{a,s,o}$$

where:

U = Overall utility
u = utility related to one reporting unit, one user and one objective
w = weight factor related to one reporting unit, one user and one objective
A,a = reporting units
S,s = users
O.o = objectives

The task for forest resources assessment is to calculate *U* under different conditions (scenarios), which implies estimating the individual utilities *and* calculating the effect of different sets of weights on the overall utility. To be meaningful, the sets of weights should be chosen to represent possible real-world situations.

The implementation of a goal function may be simple, for example when the only objective is for a single user (the land owner) to consider incomes from harvesting a single stand. In this case the utility (money) as well as measurement techniques are well defined. The goal function will have only one user, one objective and one reporting unit, and will therefore not require

any weights to be applied.

Very seldom, however, can the objectives be expressed by one single parameter. Even in the simple harvesting case above, one would expect the land owner to have other objectives, such as long-term productivity, wildlife preservation or investment plans that may affect the decisions. Therefore, multiple parameters must usually be considered and weighed together into an overall assessment to prepare for decisions. This weighting can be done informally through direct judgements.

This paper will not further address the analytical process of comparing and combining objectives. Instead, the focus will be on the data requirements to make the analysis possible. From the above analysis it is concluded that the data specification for a forest assessment should aim at providing the value (utility) for all (or the most prioritized) combinations of users and objectives.

Users, objectives and data elements to consider in global assessments

Theoretically, a global forest assessment should include entirely the three goal function dimensions, that is all land, all users and all objectives (over time). Obviously a substantial generalization is required to make global assessments feasible. In the following a systematic classification of the goal function parameters is suggested, relevant for a global assessment.

When disaggregating the three dimensions, the reporting units are the easiest to define. All land is considered, and countries constitute the reporting units, together with some additional territories. One may also consider to break down at least larger countries to sub-national reporting units. In FRA 2000, the number of reporting units was just over 200 (FAO 2001). It is assumed that the national level continues to be the natural reporting format for global assessments.

One definition of user groups to consider is proposed in Table 1. While there are no sharp boundaries between some of the categories, the set of user groups is intended to cover all cases.

As for the objectives, there are several ways to define these. One approach is to define all utilities as either a product or a service, and the subdivide these main categories. In Table 2, a

Table 1. Possible user groups (11) to consider in a global assessment

User categories	Specific user groups in goal function
Local users	Land owners and land use rights owners The wider public (local population)
National level users	National government The wider public (national population) Private sector
International users	Intergovernmental organisations International processes The academic community (science) Non-governmental organisations Private sector (multinational corporations) The wider public (everyone)

Note: Specific users in the identified groups are those normally associated with forestry and the environment. There may be variations in objectives within a group, for example the international processes which would include trade agreements as well as CBD.

Table 2. Objectives (12) to consider in a global assessment

Overall objective	Specific objective in goal function
High and sustained economic benefits from the land[1]	Income from wood products Income from non-wood forest products Income from forest services Income from non-forest products (e.g. agricultural products)
Sustained provision of intangible benefits	Sustained biological diversity Value of cultural services Value of recreational services
High contribution to national economy	Food security level Provision of employment Income of international trade Tax incomes
Secured user rights	Quality of land management

[1] Note that benefits refer to on-site derived benefits, that is value added through processing is not included. For example, the income of roundwood at roadside is included, but the income of sawn timber is not.

different approach has been chosen. First the utilities (products AND services) to which a direct economic value can be attached are singled out. Secondly, the services that do not have a direct economic value are put in one category. Thirdly, the contributions to the national economy are grouped together, including both tangible and intangible utilities. Finally, a separate category is assigned to user rights.

One special consideration is that all land should be included in the assessment. This serves the purpose to include all forest and tree resources in the assessment. Said differently – forest products and services may be generated from any piece of land regardless of its current tree cover, ecological function, or legal classification. This reduces the dependency on explicit and global definitions of forest-related terms.

We have now defined a possible set of data elements for a global forest assessment. For each country, it is composed by a matrix of 11 users and 12 objectives. Following the goal function logic, the utility and weight would be estimated and assigned for each of these combinations to arrive at the overall utility. For each of these combinations, methods would have to be developed for the estimation of quantities and values. Furthermore, agreed terms and definitions are needed to make the results comparable between countries.

In Table 3., an indication of the relative importance of each combination of user and objective is made. This may serve as a guide for further simplification. For example, it could be reasonable to focus the global assessment on the 31 combinations of users and objectives that are considered highly important. On the other hand, such simplifications may miss important parameters. In this case, the ecnonomic benefits of non-wood forest products would be entirely excluded. Another approach would be to keep all data elements, but have each reporting unit (i.e. country) make a similar prioritization of the combinations of users and objectives to consider. This way, the varying situations between countries could be acknowledged and a varying set of reported variables still fit within a global assessment framework.

Data and data tables in global assessments

This section brings the above analysis into a more concrete design of the information that may be requested from a global

Table 3. Indicative relative importance of user-objective combinations, seen across all countries

OBJECTIVES		USERS											
		Local users		National users			International users						
		Land/Lanuse owner	Wider public	Government	Wider public	Private sector	Organizations	Processes	Academia	Ngo's	Private sector	Wider public	H/M/L
High and sustained economic benefits	Wood	H	L	H	L	H	M	M	L	L	H	L	4/2/5
	Non-wood forest products	M	L	M	L	L	M	M	L	M	M	L	0/6/5
	Services	M	M	M	H	L	M	M	L	M	M	L	1/7/3
	Non-forest products	H	L	H	L	H	M	M	L	L	H	L	4/2/5
Sustained provision of intangible benefits	Biodiversity	L	M	H	H	L	H	H	H	H	M	H	7/2/2
	Cultural services	L	M	L	M	L	M	M	L	M	L	M	0/6/5
	Recreation	L	M	M	H	L	L	L	L	L	L	M	1/3/7
High contribution to the national economy	Food security	L	M	H	H	L	H	H	L	M	L	H	5/2/4
	Employment	L	H	H	H	M	M	M	L	L	L	M	3/4/4
	Trade	L	L	H	M	H	M	M	L	L	H	M	3/4/4
	Taxes	L	L	H	L	L	L	L	L	L	L	L	1/0/10
Secured user rights		H	M	M	M	H	M	M	L	L	M	M	2/7/2
	H/M/L	3/2/7	1/6/5	7/4/1	5/3/4	4/1/7	2/8/2	2/8/2	1/0/11	1/4/7	3/4/5	2/5/5	31/45/56

Note: Direct comparisons of cells only valid within columns.

forest assessment.

The normal way to assign values to utilities is to use monetary terms. For several of the identified forest benefits this is possible, but clearly not for all. Monetary values require that the product/service quantities are first known and that market prices are applied to these quantities. Monetary terms provide a standard that makes it straightforward to compare reporting units and to establish comparable trends. Monetary terms are therefore preferred.

The alternative to monetary values is to use indices (or indicators). Indices can, if appropriately applied, also be used

to establish trends. Direct comparison with other benefits is of course not possible, but by using weights as described above, it is possible to generate integrated scenarios. Comparisons with other reporting units may not be possible if the index has been constructed in different ways.

Table 4 indicates how the value can be measured for the identified objectives. Note that the current level as well as the trend should be estimated for all values. Since the current level of benefits may not be considered sustainable, it is important to complement some of the value measures with a sustainability measure. The sustainability measures should tell to what extent the current levels and trends can continue over the very long term. They may indicate how the current extraction level relates to a sustainable level.

These value and sustainability measures, together with trend information for each, are together a specification for the main result table of a global forest asssessment. This main table may be broken down to show the same information by user group, as specified above.

Finally, it should be emphasized that each data element in the result tables is a highly aggregated estimate, based on various data sources and analyses. Likely, a disaggregated set of benefits should also be reported for each objective in Table 4, for example dividing the income from wood products into industrial wood of different types and wood energy. It is critical for the authenticity and validity of a global assessment that all data sources and analyses applied are documented in a transparent way. This is also required to make it possible for future assessments to return to the results and make new, comparable estimates in the future.

Discussion

This paper attempts to establish a generic platform for global forest resources assessments. It does so by approaching the assessment from a value-of-benefits perspective. This is the traditional way to define a forest assessment. It was, however, easier to define the value when only the wood products were considered (e.g. Zon 1910). The introduction of more complex and intangible benefits from the forest, such as biological diversity, calls for a conceptual review of what global assessments should ultimately include.

Table 4. Specification of the main result table for a global forest assessment. Value and sustainability measures for the identified forestry objectives are to be estimated for all reporting units as indicated.

Overall objective	Specific objective in goal function	Value measure[1] (incl. trends)	Sustainability measure
High and sustained economic benefits from the land[1]	Income from wood products	V	yes
	Income from non-wood forest products	V	yes
	Income from forest services	V	yes
	Income from non-forest products and services (e.g. agricultural products)	V	yes
Sustained provision of intangible benefits	Sustained biological diversity	I	yes
	Value of cultural services	I	yes
	Value of recreational services	I	yes
High contribution to national economy	Food security level	I	no
	Provision of employment	I	no
	Income of international trade	V	no
	Tax incomes	V	no
Secured user rights	Quality of land management	I	no

1) V=Monetary value (implicitely includes quantity), I= Index

A suggested framework for a global assessment is developed in the paper, based on the assumption that further analyses and scenario developments are to be carried out based on the results. While an ultimate goal function for forestry is defined, there is no single result to be calculated by n assessment. Instead, the final evaluation of all utilities (benefits) from forests is subject to a separate analyses where the relative weights on each benefit must be considered. These weights may be different depending on the purpose of the analysis, the area studied and the point in time. Thirty years ago, almost all weight would have been on the value of wood production. Today, the value of sustained biological diversity is likely very high. In the future other benefits may be emphsized. The purpose of the current framework is to be independent of purpose, area or point in time and instead aim at a generic assessment design.

The paper has bearings on current international attempts to develop criteria and indicators of sustainable forest management. However, a more generic definition of global forest

assessment was sought, as current discussions on criteria and indicators tend to elaborate around existing data and indirect measures of utility (Holmgren & Persson 2002). The current paper instead elaborates on options when all benefits for all beneficiaries are to be included in an assessment.

It is acknowledged that a complex assessment, as outlined above, must be flexible in its implementation. That means that provision of source data, and analyses applied on these, must be allowed to vary between countries. The key properties of the assessment are instead that (a) the end result is well defined and as far as possible comparable in space and over time, (b) the source data and analyses applied are well documented in a transparent way.

References

Anon. 1983. Webster's ninth new collegiate dictionary. Merriam-Webster. ISBN 971-08-1133-9.

FAO. 2001. Global Forest Resources Assessment 2000 – Main report. FAO Forestry Paper 140. ISSN 0258-6150. www.fao.org/forestry/fo/fra/main/index.jsp

Holmgren, P. & Persson, R. 2002. Why did we end up here? The evolution of global forest assessments. Kotka IV Background Paper 5–3.

Zon, R. 1910. The Forest Resources of the World. United States Agricultural Department, Forest Service Bulletin 83. Washington.

The Role of Remote Sensing in Global Forest Assessments

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Introduction, objectives and alternative survey scenarios

The approach of FRA 2000 by FAO was the reliance on the participation of individual countries for both supply and analysis of information. It is hoped that this approach will lead to further capacity building in countries (FRA 2000 –main report). While countries firmly support this approach, it has sometimes been criticised on the basis that country information may be inaccurate, incomplete, out-of-date, or internationally inconsistent (Stokstad, 2001; Czaplewski, 2002). According to the FRA 2000 main report, many countries still lack reliable primary information at the national level. Some examples of country level changes in FRA 1990 and FRA 2000, as well as reliability assessment of TBFRA 2000[1], support this concern. One goal of the future assessments will be to further strengthen country capabilities and participation. In this way, FAO intends to improve the information quality as well as to assist developing countries in their inventories. FAO should also work towards reducing the interval between successive assessments, or towards the establishment of continuous regional assessments.

FAO conducted a remote sensing study of tropical forests in FRA 2000 for assessing the area changes between 1980–1990 and 1990–2000. Stratified sampling with a sampling ratio of 10 % was applied. The purpose was to complement the assessment based on country information and to bolster FAO's understanding of land-cover change processes in the tropics, especially

[1] "TBFRA 2000" in this paper refers to the approximate temperate and boreal region (Europe, CIS, US, Canada, Australia, New Zealand and Japan) for which the FRA 2000 work was co-ordinated by UNECE/FAO in Geneva. However, no formal or definite assignment of regions has been made for global forest assessments.

deforestation, degradation, fragmentation and shifting cultivation, among others.

FAO plans to continue to use country information and independent remote sensing surveys in future assessments, but also to emphasise field observations as a means of gathering broad and representative information.

The objective of this paper is to discuss opportunities to carry out a remote sensing aided forest resource survey (RSFS), independent of the countries' own inventories for the whole globe. The emphasis is in the global level change estimates. For technical purposes, large region level estimates are also considered, e.g., estimates for Europe, North America, South America, with a possible distinction into Temperate, Boreal and Tropical zones. The global level estimates are constructed from the large region level estimates.

The different opportunities for remote sensing data acquisition are presented. Parameters that require quality control most urgently and for which the available resources give possibilities in RSFS are areas of forest land (FL), other wooded land (OWL) and other land (OL) as well as their changes. Tree stem volume and biomass are also key variables in assessing the status of worlds forests. The estimation of these variables requires thorough field measurements. We also demonstrate how the sampling designs and related errors could be improved with the help of existing data sources, e.g., global land cover maps. This analysis is the main emphasis of this paper. The aim is neither to present real final sampling designs nor error estimates, but rather outline methods which could be used in evaluating different designs when available resources are known. The FRA 2000 global forest map of FAO (Zhu and Walter 2001) is applied in our simulation study. Other land cover maps will probably be available when planning and implementing a future RSFS.

One of the basic questions in RSFS will be the availability of field data. Field sampling is needed because all remote sensing based forest resource surveys may need to be supported by field observations/measurements. Field sampling intensity depends on the available budget, variability of the target parameters in the field and the applied remote sensing material. Often, a minimum number of field plots are required for each image scene. A successful relative calibration of images may reduce this need. Field measurements and designs are, however, outside the focus of this paper. Possible rough cost estimates are

presented if an independent sample will be collected.

The alternatives of RSFS vary depending on the ground sampling and remote sensing sampling densities. The variation can be illustrated in the space of 'Remote sensing intensity' and 'Field work intensity' dimensions (Figure 1). Both sampling densities are affected by the applied remote sensing material. The sampling intensities may vary also by regions, see below. The analyses behind this paper is elaborated in considerably more detail in Tomppo et al. 2002.

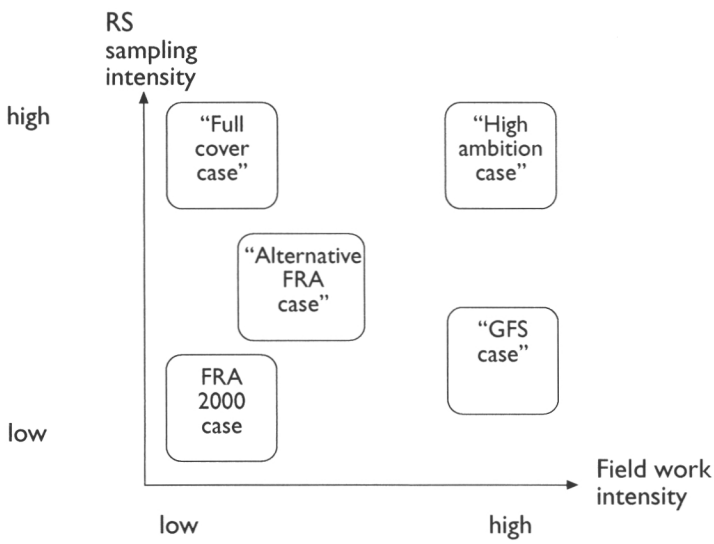


Figure 1. Examples of different sampling designs (adopted from Peter Holmgren).

Inventory regions and sub-regions

The regions of the independent remote sensing aided survey could be groups of countries, continents or sub-continents. For optimal sampling strategies, the regions can be further stratified into sub-regions on the basis of the vegetation zones, information needs, existing information and the possibilities of the control inventory, as well as remote sensing data (see, FAO 2001 b and Appendix 1). Regional designs are relevant because of specific information needs, technical reasons and variability of the target variables. Aggregation to global level is, however,

the goal of the RSFS survey.

Analysis units can be determined on the basis of the variability of the variables of interest, e.g., percent forest or forest area change. The information from earlier assessments can be utilised in identifying the regions and analysis units. The land areas and forest areas of continents are given in Table 1 (FAO 2001a).

Table 1. Forest area by region 2000 (FAO 2001)

Region	Land area	Forest area	% of land area	% of all forests	Net change 1990–2000
	mill. ha	mill. ha			mill. ha/year
Africa	2978	650	22	17	-5.3
Asia	3085	548	18	14	-0.4
Europe	2260	1039	46	27	0.9
North and Central America	2137	549	26	14	-0.6
Oceania	849	198	23	5	-0.4
South America	1755	886	51	23	-3.7
Total	13064	3869	30	100	-9.4

Africa is divided into 6 sub-regions, Asia into 5, Europe into 4, North and Central America into 3, Oceania into 2 and South America into 2 sub-regions in FAO FRA 2000 main report (FAO 2001 a). These sub-regions, possible combined with vegetation zones, could be suitable sampling design units for RSFS. The optimisation with respect to changes may require more detailed stratification of the target areas. The changes are often clustered and local variation in changes is high (Drigo 2002). The highest relative change rates of the regions of Table 1 occur in Africa, South America and Oceania. A challenging task is to get a priori information about change hot spot areas. Remote sensing data, e.g., medium resolution data (e.g., MODIS) can be utilised in this task.

Review of methods

Two-stage stratified random sampling and visual interpretation has been the approach in the global Tropical surveys in FRA

1990 and FRA 2000 (FAO 1996, FAO 2001 a, FAO 2001 b). The advantages of the visual interpretation is the possibility to utilise contextual information and expert knowledge in the analysis more easily, sometimes in a more effective way, than in digital methods. Visual interpretation of multi-date satellite imagery can be more accurate than digital classification to identify changes in land use, such as deforestation, degradation, fragmentation and shifting cultivation. Visual interpretation is, however, laborious and is sensitive to subjective factors. These things become more critical in global surveys with varying vegetation zones. Areas with sparse cover of trees and woody vegetation, such as semi-arid lands and boreal tundra woodland, are especially difficult. Visual interpretation may have some role, depending on the approach, e.g., in estimating reference data from very high resolution remote sensing data (e.g. Ikonos) for digital analysis with high and medium resolution data, and also in feature extraction. Some most commonly used digital analysis methods are recalled in this chapter.

The traditional method applied in remote sensing has been discriminant analysis and its different versions. This method is relevant when the goal is to estimate a limited number classes, e.g., vegetation types or land cover classes (FL, OWL, other land). Regression analysis has been used estimating quantitative variables, e.g., tree stem volume and biomass. Non-parametric methods, e.g., k nearest neighbour estimation (k-nn estimation) and artificial neural networks have the advantages that they can be used for estimating simultaneously all inventory variables. Particularly, k-nn method is under intensive research in Europe and North America and has also been applied in operative inventories.

The availability of reference data for digital image analysis or visual mage interpretation will be one key problems in remote sensing aided global survey. In principle, a certain minimum number of field plots for each image scene is needed. This could partly be overcome by relative calibration of images which makes it possible to utilise reference data from neighbouring image scenes.

Covering the globe with image samples

Taking into account the objective of the global survey, the price of the images and needed workload, sampling may be the only

feasible way to utilise remote sensing data in the case of high and very high resolution remote sensing data. Total cover is feasible with medium resolution data, such as MODIS. Examples of required image numbers and prices are given in Table 2 with some sampling options. MODIS, Landsat ETM and Ikonos are used as examples. The prices vary by region and dealer; a price of 600 USD for Landsat ETM and 2700 USD for Ikonos have been applied in the example. MODIS images are supposed to be charge free. The total price in the example is dominated by the Ikonos images.

Survey design cases and the evaluation of the cases

Identification of the parameters to be estimated

In the FRA global survey, the key variables are areas of forest land, other wooded land and other land, as well as their changes over time. Optional variables are tree stem volume and tree biomass, together with changes. Earlier remote sensing studies support the assumption that a breakdown into rough species groups should be possible by means of remote sensing aided analysis. The parameters which are possible to estimate using remote sensing aided method depend on the intensity of the field sampling. The estimation of the volume of growing stock and biomass of trees presumes a moderate field sampling inten-

Table 2. The number of needed images and estimated costs with 0.1 % and 1 % Ikonos sampling options

Region	n images needed			Image cost, 000 USD			
	MODIS full coverage	**Landsat** *ETM+10%* *coverage*	**Ikonos** 0.1 % coverage	**Ikonos** 1 % coverage	**Landsat** ETM+10% coverage	**Ikonos** 0.1 % coverage	**Ikonos** 1% coverage
Africa	6	97	331	3 309	58	951	8 992
Asia	6	100	343	3 428	60	986	9 315
Europe	4	73	251	2 511	44	722	6 824
N&C America	4	69	237	2 374	42	683	6 453
Oceania	2	28	94	943	17	271	2 564
South America	3	57	195	1 950	34	561	5 299
Total	25	424	1 452	14 516	254	4 174	39 446

sity and measurements of tree components. There are many studies concerning the accuracy of the above mentioned variables with field measurements and remote sensing data. Rather dense field sampling grid has been applied in most of these studies. There are few studies with very sparse field sampling intensity. The accuracy of estimates with sparse field sampling could be one topic in a possible global pilot study.

A couple of survey cases are given in the following. They are only tentative. The final error analysis needs more time than what was available for this study, and also possible pilot studies. A method to forecast sampling error through simulation is outlined in Tomppo et al. (2002) . The FRA 2000 land cover map of FAO, produced by EROS Data Center has been applied in that study. Other global forest cover maps may also be available for the possible global survey. These will be very useful data sources in planning sampling designs in a similar way.

Examples of global level costs

In order to get an idea of the level of the field measurement costs and to be able to compare those with remote sensing aided surveys, a rough calculation is first given in which only field data are used. The area represented by one field plot varies here from 30 000 ha in areas with no changes to 10 000 ha with a relative annual change of 0.8 %. The total costs with these assumptions exceed USD 100 mill., and USD 10 mill. if only one tenth of the plots are applied (Table 3). The costs of images corresponding 10 % Landsat ETM+ cover together with 100 field plots per image scene are given in Table 4. Comparisons of the costs of the tables 3 and 4 show that field data dominate the cost.

Demonstration of the standard errors in Europe and CIS

For demonstrating the behaviour of the standards errors computed with the methods given in Tomppo et al. 2002, we conducted the following experiment. The area of Europe and CIS was covered with two optional Landsat ETM+ densities 1)

Table 3. An example of the number and costs of field plots in a global survey utilising field data only

Region	Land area	Forest area	Net change 1990–2000	Net change 1990–2000	Area represented by one plot	Number of field plots	Estimated costs
	mill. Ha	mill. ha	mill. ha/year	% / year	ha		000 USD
Africa	2 978	650	-5.3	-0.815	13 692	69 221	30 457
Asia	3 085	548	-0.4	-0.073	28 540	30 010	13 205
Europe	2 260	1039	0.9	0.087	28 268	44 751	19 690
N&C America	2 137	549	-0.6	-0.109	27 814	27 421	12 065
Oceania	849	198	-0.4	-0.202	25 960	10 898	4 795
South America	1 755	886	-3.7	-0.418	21 648	49 035	21 575
Total	**13 064**	**3869**	**-9.4**	**-0.243**		**231 336**	**101 788**

Table 4. Estimated costs with 100 field plots per Landsat ETM image and 440 USD/ plot

Region	Field data 000 USD	Image data 000 USD	Total costs 000 USD
Africa	4 254	58	4 312
Asia	4 407	60	4 467
Europe	3 228	44	3 272
N&C America	3 053	42	3 094
Oceania	1 213	17	1 229
South America	2 507	34	2 541
Total	**18 661**	**254**	**18 916**

a stratified random sample of 150 scenes and 2) a stratified random sample of 300 scenes. The first option is near to the density applied in tropics in FRA 1990 and FRA 2000. We assumed that a digital image analysis of one Landsat TM scene requires 5 working days. An acquisition cost of USD 600 was assumed for one Landsat scene and a cost of USD 400 for one working day for an image analyst. The field data costs were not included in the first two options (Table 5). In the options 3 and 4 (Table 6), the costs of 100 field plots per one Landsat scene are included, USD 44000 per scene. The number of Ikonos scenes was computed in such a way that total costs, including the image cost and two working days for one Ikonos scene, were same as with Landsat options. Two different acquisition prices were assumed for Ikonos, (1) USD 2700 and (2)

USD1000.

The number of Ikonos samples varies under these assumptions from n=111 to n=7767. Note that field data costs are not included in the Ikonos options. We have assumed that forest area and change in forest area can be interpreted from Ikonos or similar images without field data. The validity of this hypothesis must be tested in future analysis.

We use simulations to evaluate the feasibility of multiple-resolution remote sensing for FRA 2010 objectives. The simulation has the following components (Tomppo et al. 2002).

- Construct a realistic hypothetical population that fully covers a very large region. The selected region was Europe and the Commonwealth of Independent States (CIS). The combined land area[2] is 2.7-billon hectares, of which 38% is forestland and another 4% is other wooded land.
- Simulate changes in forest cover in this hypothetical population

Table 5. Two Landsat ETM+ cover options with a processing time of 5 working day per image and the number of Ikonos scenes with two price options corresponding to the same total costs as Landsat options. Ikonos is assumed to require 2 working days per scene. The cost of 400 USD has been used for one working day

Europe & CIS	Option 1: 150 Landsat scenes	Option 2: 300 Landsat scenes
Survey cost, 000 USD	390	780
Ikonos option with same cost. No of scenes à USD 2700	111	223
Ikonos option with same cost. No of scenes à USD 1000	217	433

Table 6. Two Landsat ETM+ cover options with a processing time of 5 working day per image and the number of Ikonos scenes with two price options corresponding to the same total costs as Landsat options. Ikonos is assumed to require 2 working day per scene. The cost of 400 USD has been used for one working day. With Landsat ETM+, the costs of 100 field plots with a unit costs of USD 440 have been included

Europe & CIS	Option 1: 150 Landsat scenes	Option 2: 300 Landsat scenes
Survey cost, 000 USD	6 990	13 980
Ikonos option with same cost. No of scenes à USD 2700	1 997	3 994
Ikonos option with same cost. No of scenes à USD 1000	3 883	7 767

over a 10-year time interval.

- Simulate estimates of forest area from satellite data with multiple resolutions (1-km, 30-m and 1-m) for the entire hypothetical population at the beginning (2000) and end of the 10-year time interval (2010).
- Compare alternative sampling designs to statistically estimate the area of forest cover and changes in forest cover during the 10-year interval.
- Predict the statistical precision and cost of these alternative designs for possible use by FRA 2010 in the future.

The standard errors and coefficients of variation for the estimates obtained with Landsat image analysis are given in Table 7. The corresponding errors for estimates obtained with Ikonos image interpretation with two different Ikonos image price assumptions are presented in Table 8 when field measurement costs are excluded from Landsat options, and in Table 9 when field measurement costs are included in Landsat image options. The overall net rate of change in this hypothetical population is relatively small, which makes the coefficient of variation high for the changes of forest area in all alternatives. Tomppo et al. (2002) show another example for one ecological zone within this hypothetical population, in which the net rate of change is greater and the coefficient of variation is smaller. The error level is near acceptable in all cases.

A somewhat surprising result is that the errors with Ikonos images are about at the same level as, or even smaller than, those with about same number of much larger Landsat images. This appears to be caused by methods used to reduce variability with sub-strata (Tomppo et al. 2002). This technique appears more successful with smaller sampling units, at least with the hypothetical population constructed for this study.

The availability of very high resolution images for global surveys is a concern. The needed double coverage of mages for change analysis makes the situation more complicated with very high resolution images, see conclusions and discussion.

Our simplified simulation model shows that high resolution (e.g., Landsat ETM+) and very high resolution image based

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[2] Europe has a total land area of 565,930,000-ha; 31% is forest land and 7% is other wooded land (FAO 2000). CIS has a total area 2,213,036,000-ha; 40% is forest land and 4% is other wooded land. Europe covers 21% of the simulation population, while CIS covers 79%.

forest survey can meet the accuracy requirements of a possible independent remote sensing aided forest survey with moderate costs. The final conclusions would need further analysis and more resources than what was available in this study. The procedure described here could be repeated in the other regions of the globe as well, with some other remote sensing based material, and with other variables than which were used here.

Conclusions and discussion

Satellite images have been successfully applied in the Forest Resource Assessment 1990 and 2000 in tropics. So far, the global wall-to-wall forest cover maps have been based on low or medium resolution images. A good reference list of large region remote sensing applications, either with low, medium or some high resolution images, is given by Zhu and Walter (2001). It is expected, that global wall-to-wall mapping applications with high resolution images will appear in few years. This does not eliminate the necessity for an independent remote sensing aided forest resource survey. The strength of this type of survey would be the forest inventory with exact FAO defini-

Table 7. Predicted standard errors and coefficients of variation when Landsat images are applied

	150 Landsat scenes	300 Landsat scenes
Standard error (in respective unit of measure)		
Forest area time 0 (km^2)	388 587	253 377
Other Wooded land area time 0 (km^2)	42 661	28 373
Change in forest area from time 0 to time 10 (km^2)	30 100	19 365
Change in other wooded land area from time 0 to time 10 (km^2)	7 912	5 254
Rate of change in forest area %/10-years	0.38	0.25
Rate of change in other wooded land area %/10-years	0.96	0.65
Coefficient of Variation (%)		
Forest area time 0	3.85	2.51
Other Wooded land area time 0	3.90	2.60
Change in forest area from time 0 to time 10	122.70	78.94
Change in other wooded land area from time 0 to time 10	4.94	3.28
Rate of change in forest area	157.85	104.40
Rate of change in other wooded land area	6.58	4.46

Table 8. The standard errors and coefficients of variation when Ikonos images are employed. Field plot costs of Landsat images are excluded

	111 Ikonos scenes	217 Ikonos scenes	223 Ikonos scenes	443 Ikonos scenes
Standard error (in respective unit of measure)				
Forest area time 0 (km^2)	310 644	221 359	214 476	152 643
Other wooded land area time 0 (km^2)	51 478	36 606	36 194	25 671
Change in forest area from time 0 to time 10 (km^2)	36 469	26 533	25 436	18 248
Change in other wooded land area from time 0 to time 10 (km^2)	10 817	7 791	7 629	5 441
Rate of change in forest area %/10-years	0,34	0,25	0,24	0,17
Rate of change in other wooded land area %/10-years	0,60	0,43	0,43	0,30
Coefficient of Variation (%)				
Forest area time 0	3.08	2.19	2.12	1.51
Woodland area time 0	4.71	3.35	3.31	2.35
Change in forest area from time 0 to time 10	148.66	108.16	103.69	74.39
Change in other wooded land area from time 0 to time 10	6.75	4.86	4.76	3.40
Rate of change in forest area	142.03	103.58	99.75	71.43
Rate of change in other wooded land area	4.10	2.97	2.90	2.07

Table 9. The standard errors and coefficients of variation when Ikonos images are employed. The field plot costs of Landsat analysis are included

	1197 Ikonos scenes	3883 Ikonos scenes	3994 Ikonos scenes	7767 Ikonos scenes
Standard error (in respective unit of measure)				
Forest area time 0 (km^2)	71 972	51 381	50 695	36 194
Other wooded land area time 0 (km^2)	12 083	8 626	8 503	6 066
Change in forest area from time 0 to time 10 (km^2)	8 579	6 124	6 033	4 301
Change in other wooded land area from time 0 to time10 (km^2)	2 549	1 820	1 795	1 279
Rate of change in forest area %/10-years	0.08	0.06	0.06	0.04
Rate of change in other wooded land area %/10-years	0.14	0.10	0.10	0.07
Coefficient of Variation (%)				
Forest area time 0	0.71	0.51	0.50	0.36
Other wooded land area time 0	1.11	0.79	0.78	0.56
Change in forest area from time 0 to time 10	34.97	24.96	24.59	17.53
Change in other wooded land area from time 0 to time 10	1.59	1.14	1.12	0.80
Rate of change in forest area	33.55	23.94	23.62	16.82
Rate of change in other wooded land area	0.97	0.69	0.68	0.49

tions and estimates with current state and changes, together with standard errors, which are computed under strict quality control. A representative field sample would support this goal. Country capacity building could be one benefits of this type survey. Existing wall-to-wall forest cover maps could be utilised in planning the design of the survey. For a possible global survey, its role should be assessed against the existing and coming other global surveys.

The satellites launched after the FRA 1990 and FRA 2000 surveys, and new satellites under planning, increase noticeably the availability of optical area satellite images for a possible remote sensing aided survey in FRA 2010. The most interesting satellite programs are Landsat and MODIS, and possibly some programs with very high resolution images, like Ikonos and QuickBird. Landsat 7 with the ETM+ sensor was launched in 1999. The next Landsat launch has been planned for year 2006, (URL http://ldcm.usgs.gov). The images of Spot and IRS-1 satellites can be used for completing the image cover if Landsat images are not available, e.g. due to cloud cover. The medium resolution instruments, e.g. MODIS, MERIS and IRS-1C/D WiFS can be used global wall-to-wall mapping. The spatial resolution for estimating changes may be problematic. The instruments have, however, promising potential for planning global remote sensing and field sampling designs.

Sampling might be the only relevant approach with high resolution images (Landsat ETM+, Spot, IRS-1 LISS-III). The number of the needed Landsat ETM+ scenes with 10 % sampling for the entire globe is about 400 – 450 and the estimated costs about 255 000 USD. The price can be compared to the costs of pure field measurement based survey. The minimum field measurement costs for this type of survey could be around 10 million USD and likely costs around 100 million USD (Table 5, chapter 5).

The operative use of satellite images in forest inventories has begun about ten years ago, in spite of the fact that satellite image research has been active almost 30 years. The progress in estimation and error estimation methods, as well as in image analysis methods can be utilised in the survey.

The main emphasis in our study is outlining how the evaluation of sampling design in a remote sensing based survey could be done and in presenting rough error estimates for the variables 'Area of Forest land' and 'Area of Other wooded land' in our test area, Europe and CIS. A hypothetical simulation model

based on FRA 2000 land cover map was applied. Our study shows promising results in the applied test area, e.g., that high resolution and very high resolution image based forest survey can meet the accuracy requirements of a possible independent remote sensing aided forest survey with moderate costs. The final conclusions would need further analysis and more resources than what was available in this study. The procedure described here could be repeated in the other regions of the globe as well, with some other remote sensing based material, and with some other variables than which were used here.

One fact which should be taken into account in planning the remote sensing based survey is the availability of satellites images from an earlier time point, particularly if very high resolution satellite images will be used. Very high resolution images are not necessarily archived and the images are taken only by request. There are two different options to handle this problem, 1) either to order the image from time 0 early enough, 2) to develop a multi-resolution technique for change detection part (which can, of course, be also utilised in analysing the current status). The early order presumes fast decisions and might be unrealistic taking into account the current status of very high resolution satellites. Thus the option 2 in which high resolution images are acquired from time 0 and very high resolution together with high resolution images are acquired from time 10 may be a more realistic option.

The existing and coming medium resolution satellite images, in addition to existing and coming wall-to-wall land cover maps, provide information sources for planning both a possible field measurement based and remote sensing based sampling designs. Based on this fact and our experiment, we are convinced that an independent remote sensing aided global forest survey could be carried out with reasonable costs. We are also convinced that this type of inventory would have its role both in justifying the estimates obtained from other sources and in country capacity building.

References

Czaplewski, R. 2002. On sampling for estimating global tropical deforestation. Forest Resource Assessment Programme. Working Paper 60. FAO. Rome 2002. (http://www.fao.org/forestry/fo/fra/index.jsp)

Drigo, R. 2002. Trends and patterns of Tropical land use change. Manuscript. FAO, Rome.

FAO 1996. Forest Resource Assessment 1990. Survey of tropical forest cover and study of change process. Forestry Paper No. 130. Rome.

FAO 2001 a. Global Forest Resource Assessment 2000. Main Report. Forestry Paper 140. FAO, Rome. ISSN 0258-6150. (http://www.fao.org/forestry/fo/fra/main/index.jsp).

FAO 2001 b. Pan-Tropical Survey of Forest Cover Changes 1980–2000. FAO FRA 2000 Working Paper 49. FAO. Rome. (http://www.fao.org/forestry/fo/fra/index.jsp).

Stokstad, E. 2001. U.N. Report suggests slowed forest losses. Science 291, 2294.

Tomppo, E., Czaplewski, R and Mäkisara, K. 2002. The role of remote sensing in global forest assessments. Forest Resource Assessment Programme. Working Paper 61. FAO. Rome 2002. (http://www.fao.org/forestry/fo/fra/index.jsp)

Zhu, Z. and E. Walter. 2001. Global forest cover mapping. FRA Working Paper No. 50. Rome. 29pp.

Possible Future Directions for the Global FRA Process

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Introduction

The purpose of this paper is primarily to provide input to group work discussions at Kotka. A major objective with Kotka is to provide guidance to future global forest assessments. The paper outlines options and proposals for

(a) the scope,
(b) the reporting format and frequency,
(c) tools and methods, and
(d) organisation

of the global FRA process.

Options related to the overall scope of global forest assessments

The overall target for global forest resources assessment should be defined. Three optional formulations are provided.

"Forest inventory approach"

As is, but complemented with additional variables for eg fuel-wood, biodiversity, and more details on forest types, biomass change etc. No evaluation of forest resources done.

Pros:

- Known process;
- Likely less controversy of final results (could also be bad).

Cons:

- End use of information unclear (What was the question?);
- Leads likely to narrow focus on biophysical forest data;
- Detailed data specifications needed;
- Many countries lack detailed information.

"Criteria approach"

Report on progress towards SFM related to regionally established Criteria (e.g. positive or negative development by Criteria). Report at global, regional and country level, using relevant indicators at different levels. Background data and analysis process well documented (requires quality control).

Pros:

- Integration with policy processes;
- Focusses on established goal functions;
- Directed towards monitoring of progress towards Sustainable Forest Management;
- Allows for full set of results also where some baseline data are missing;
- Limited set of "end-variables" – easy overview.

Cons:

- Difficult comparison across regions, Criteria (and indicators) need to be harmonized;
- Difficult and untested estimation of changes in Criteria (requires country participation);
- Reporting required for different scales as evaluation of Criteria may differ at country, region and global levels;
- The FRA process is less independent and generic and leaves to "external" processes to define its contents;
- The C&I processes have not requested this approach to fill their data requirements.

"All forest benefits approach"

Report on actual supply and (relative) value of forest products and services, including trends. Possibly including sustainability aspects (e.g. to what extent will maintained wood extraction cause reduced benefits?). Intermediate data and analysis process well documented (requires quality control).

Pros:

- Fully generic and independent approach that can be sustained;
- Produces value estimations – results are useful for further scenario developments and policy analyses;
- Allows for varying depths in background data;
- Manifests an information supply role for FRA to any forest-related process;
- Comparisons with other sectors facilitated;
- The design of the assessment does not rely on detailed variable specifications.

Cons:

- Difficult and partly untested valuation of products and services;
- Initially, data gaps for many countries.

Proposals related to reporting format and frequency

While previous global assessments have been delivered at approximately ten year intervals, there seems to be consensus that this is a too long period to meet the current requirements for international forestry information. On the other hand, forest resources information is not regularly and only infrequently updated at national level. It is probably desired to make the most recent information from all countries available through the FRA process. At the same time, a reasonable interval for official updates of global datasets must be identified, to avoid confudion and mixing of uncomparable data.

Regional level requirements must also be considered by the FRA process. Specific requests for reports, such as the MCPFE, occur with irregular frequencies and often with a different region specification compared to FAO's. Regional efforts and initiatives should ideally feed into the FRA process and become a tool to improve also the global datasets. But it may not be desirable to influence regional initiatives to follow the format and frequency of the global FRA process. Instead, dynamic synergies should be sought between regional work and the FRA process.

The following proposals are made for the different geographical scales:

National level reporting

Whenever new national forest information is presented by countries, it seems desirable to make this information available to international users through the FRA channels. Therefore, it should be made possible to update national level data in the FRA databases on a continuous basis, and make the information available through the FAO internet channels.

Obviously, it is the individual countries that have knowledge about when and how to present new information.

Proposals:

(a) Create technological tools for remote updating of information in FAO's country profiles, (b) Promote country ownership of national forest information in the country profiles,
(c) Provide continuous FRA secretariat support for country updates.

Regional level reporting

Requirements for regional level reporting is less regular and are normally formulated by bodies external to the FRA process, such as the C&I processes.

The geographical extent of regions may vary and overlap. Reports may be required for, e.g., Europe as well as the Mediterranean.

Global FRA report include divisions into regions/sub-regions. However, this is mainly a practical consideration to make the publication easy to traverse. There is (so far) no explicit request for regional level analyses in the global FRA reports.

Proposals:

(a) The global FRA process should be a source of data and information for any regional reports, although in most (or all) cases, these reports are requested by FRA-external processes;
(b) The FRA process should actively support regional reporting initiatives, particularly C&I, and make use of opportunities to improve data and information also for global level reporting.

Global reporting

The frequency of global reporting has been extensively discussed since the delivery of FRA 2000. Obviously, the users want more frequent information. But on the other hand, new information about forest resources are generated only at relatively long intervals. Countries are therefore not in a position to report frequently, and more frequent reports may become repetitions of earlier data.

In addition to the above, data items and analyses are identified and added to global datasets as the global assessment becomes more sophisticated. It is probably desirable to establish reporting mechanisms that disseminate this broadening dataset more often than every decade.

Information partnerships between international organisations are likely to continue to evolve. This implies that organisations

increasingly draw directly and dynamically from partner organisations' databases when presenting information.

Finally, if Kotka IV recommends (and COFO 2003 endorses) a revised scope for global assessments as suggested above, it is reasonable to produce a report that uses the new format soon, even if some data gaps will remain.

Proposals:

(a) Based on the recommendations from Kotka IV, a reporting format for global assessments will be developed for endorsement by COFO 2003;

(b) Countries will be asked to update/revise/complement their information during 2003–2004;

(c) The next global forest resources report will be issued in 2005 (which coincides with the timing set by UNFF to report on progress of SFM);

(d) The 2005 report would be considered "intermediate" in that there would be no strict requirement to cover all countries and areas;

(e) Depending on the progress, a decision on the timing of the next comprehensive global assessment report should be taken by COFO 2005. The next assessment should be issued somewhere in the period 2006–2010.

Proposals related to tools and methods

Kotka IV will extensively discuss tools and methods, presented also in several background papers. These proposals are indicative and may be enriched by discussions under other agenda items.

Proposals:

(a) to continue enhancing the direct collaboration with all countries as the base for future global assessments. Provision of information, as well as analyses and validation of findings are important functions to be provided by countries. Country correspondents have an important role in organizing the assessment work between national institutions.

(b) to promote the use of FAO's Information and Communication Technology (ICT) resources to make the global assessment work more efficient. Specifically to develop interfaces with the Forestry Information System (FORIS), to facilitate direct input by country correspondents;

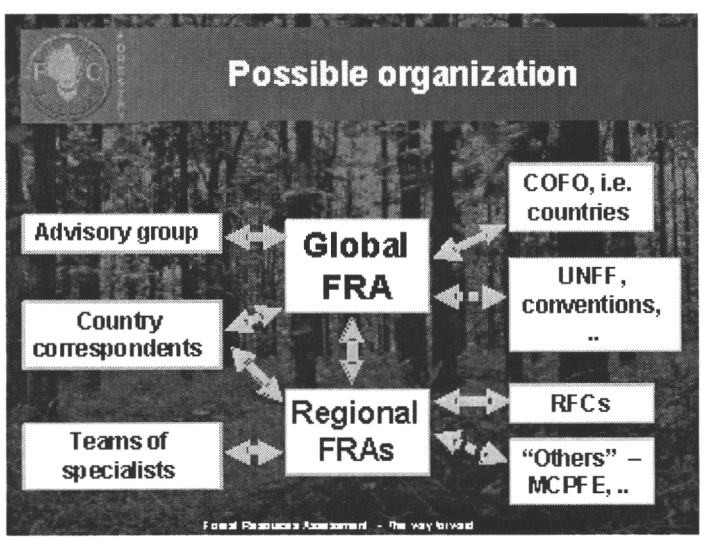
(c) to seek partnerships for a continued independent remote sensing survey of forest cover changes, with global scope and based on sampling.

Proposals related to organisation

The below figure indicates the proposed relationships between the FRA secretariat(s), partners and statutory bodies.

Comments:

- The "Global FRA" includes not only the secretariat function by the FRA programme, but also technical backstopping and input from a range of units at FAO, including also FAO's decentralized offices (including UNECE/FAO).
- An advisory group to the Global FRA is proposed. See Appendix 1.
- Country correspondents would be communicating with the global FRA, and also be a focal point for regional level initiatives and/or additional information requested at the regional level.
- "Teams of Specialists" refers to regional arrangements for working with experts. This may take the form of ToS, or a different form depending on the circumstances. Such arrangements can be led by the Fao decentralized office, or another suitable body.
- The RFCs (Regional Forestry Commissions) fill an important function in the FRA process at the regional level.
- The relationship to FAO-external bodies is dashed in the figure.



Appendix I

Draft rationale and terms of reference for advisory group to global forest resources assessments

Background and Rationale

The Global Forest Resources Assessment process is coordinated by FAO and implemented in close collaboration with countries and partner organizations. The mandate and scope of the assessments are agreed and endorsed by the Committee on Forestry (COFO)[1]. Other international forest-related bodies also acknowledge and support the FRA process, notably the IPF and IFF who included the FRA 2000 in their proposals.

Technical guidance to the FRA process has mainly been made through Expert Consultations organized by FAO and partenrs. Notably the four meetings held in Kotka, Finland, have provided in-depth technical recommendations that have constituted the framework for the global assessments 1990 and 2000, as well as recommendatons for future approaches.

While the Expert Consultation is an effective mechanism for developing recommendations with broad consensus, the need to also establish an advisory group to the FRA process has been identified. Compared to expert consultations. the advisory group would be relatively small and could meet more frequently and provide continuous guidance to the FRA secretariats. It would also serve the purpose of bridging over to important international partners to FAO, as well as to regional interests in the FRA field.

The advisory group would be informal. Participation would be on a personal basis. FAO would nominate participants, taking into consideration regional and institutional representation.

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1 The Committee on Forestry (COFO) is the most important of the FAO Forestry Statutory Bodies. The biennial sessions of COFO (held at FAO headquarters in Rome, Italy) bring together heads of forest services and other senior government officials to identify emerging policy and technical issues, to seek solutions and to advise FAO and others on appropriate action. Other international organizations and, increasingly, nongovernmental groups participate in COFO. As the need arises, FAO also convenes special meetings of forestry ministers, nongovernmental organizations and private industry.

The advisory group would meet at least once every year.

Endorsement for the establishemnt of an advisory group will be sought from COFO 2003.

Tasks

- to advise FAO and its partner organizations on the implementation of Global Forest Resources Assessments;
- to advise on the concept, classifications, definitions and methods of the forest resources assessment implementation, taking into account current developments concerning indicators of sustainable forest management, UNFF, other relevant international processes, as well as other requirements and expectations on the global forest assessment process;
- to advise on the organization and distribution of tasks between FAO, partner organizations and countries in the implementation of global assessments;
- to advise on communication of forest resource assessment results, and implications of results to a wider circle of users;
- to advice on development of collaboration and synergies between international initiatives related to forest assessments;

Composition

The advisory group would consist of about 14–16 persons with the following criteria.

FAO would seek to have one expert from each of the six FAO regions represented.

In addition, about five experts from international bodies such as UNEP, UNFCCC, CBD, ITTO, UNFF would be sought for.

About two additional experts representing e.g. ngo's or universities would be included.

FAO would nomiate a chair person from one of the above categories.

The FRA secretariat would be represented by three persons, including also the UNECE/FAO. One of these would act as rapporteur.

Assessing and Reporting Forest Carbon Stock Changes for FRA, UNFCCC and Kyoto Protocol: a Concerted Effort?

Dieter Schoene, FAO, Rome
FRA 2000 in past negotiations

Following four years of negotiations since initially agreeing on the Kyoto Protocol (KP), Parties to the United Nations Framework Convention on Climate Change (UNFCCC) set a new landmark in the fight against Climate Change with the Marrakesh Accord (MA) in November 2001 (UNFCCC, 2001). Parties acknowledged the three major roles of forests in Climate Change: Forests are a source of carbon dioxide (CO_2) when destroyed or degraded; forests react sensitively to a changing climate; sustainably managed forests provide a unique environmental service by removing CO_2 from the atmosphere and offering an alternative to fossil fuels. In Marrakesh, Parties capitalized on the latter, the climate change mitigation function of forests. As a result, forests in industrialized countries and reforestation projects in developing countries may contribute the lion's share of Parties' current CO_2-reduction commitments.

In crafting rules and modalities for forests in climate change mitigation, negotiators often resorted to information offered in FRA 2000 (FAO, 2001), and in particular TBFRA (UN-ECE/FAO, 2000). Thus, TBFRA data on forest carbon stocks and annual carbon balances served as substitutes, when industrialized and transition countries failed to estimate their forests' carbon sequestration capacity during negotiations. With some notable exceptions, country allowances for carbon credits from forest management contained in the MA reflect TBFRA data, discounted by 85%, to account for effects other than those due to direct human activity since 1990.

Many other facets of FRA also shaped discussions, e.g. information on the age structure and carbon increment of forests which had been established before 1990 – an important

threshold year for gaining carbon credits, data on annual afforestation, reforestation and deforestation and natural losses. Finally, many negotiations resulted in forest-related definitions, which concurred with ("forest") or deviated from ("reforestation") FRA terminology. Overall, FRA 2000 may have facilitated past climate change negotiations through its role as a neutral, objective source of information on forests.

Future roles of FRA in a climate change regime

FRA may also facilitate negotiations on the role of forests for the second and subsequent commitment periods, due to start in 2005. However, when comparing some recent reports on forest carbon stock changes to the UNFCCC (Löwe et al, 2000) with corresponding numbers in TBFRA (UN-ECE/FAO, 2000) , discrepancies emerge (Figure 1). Similar incongruities appear in reports by developing nations, e.g. on carbon emissions from deforested lands (Herold, 2001).

Therefore, conflicts are conceivable and even likely, if country reporting on forest carbon stock changes for UNFCCC and KP on one hand and the process for periodic Forest Resource Assessments on the other hand proceed without coordination

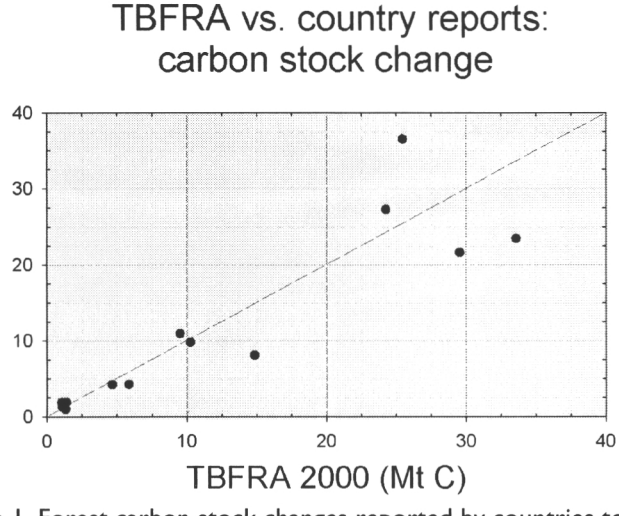


Figure 1. Forest carbon stock changes reported by countries to the UNFCCC differ from those inFRA

and produce conflicting information on a forest environmental service, for which markets and market prices will emerge in the near future.

Even more disappointing, without such cooperation a unique opportunity for reducing country reporting burdens and improving the quality of assessment and reporting will have been lost. Although FAO relies on and uses information provided by countries, its role in respect to national forest inventories is not purely passive. In past assessments, FAO has complemented country sources with models and its own and extraneous information; it aids countries through its programme in support of national forest assessments (FAO, 2001). Many developing nations face serious problems in carrying out and reporting forest carbon inventories (Herold, 2001). In these cases, information acquired by FAO for FRA purposes could support coordinated carbon reporting. Developed countries should recognize the need for reporting consistently and efficiently for the dual purposes considered here.

Finally, assessing forest carbon stock changes is still a fledgling art. An analysis of the causes of the discrepancies between country reporting and FRA assessment of carbon stock changes (Figure 1) revealed that differences are partially due to differing definitions for forest, timber volume and volume growth and biomass. However, ill-defined, inconsistently applied and poorly known biomass expansion factors (BEF) are the predominant cause (Figure 2). These factors are applied to convert commercial timber volume or increment to biomass. These conversion factors differ by species, age, stand structure, site and they diverge when applied to growing stock, growth and harvest (Fang and Wang, 2001); (Schoene and Schulte, 1999); (Brown, 2001). Closing knowledge gaps in carbon assessments is a crucial and urgent prerequisite for consistent reporting under the UNFCCC and FRA; it warrants a concerted effort.

Climate Change related reporting obligations intersect with FRA

Parties to the UNFCCC must submit in certain intervals National Communications, also containing, to the extent capacities permit, a national inventory of anthropogenic emissions by sources and removals by sinks, including forests (OECD, 1999).

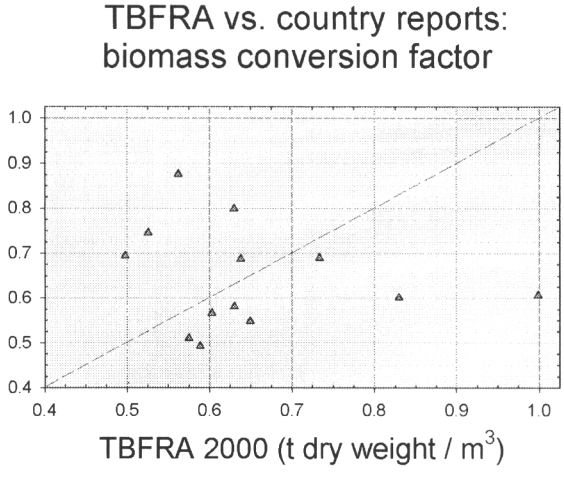


Figure 2. Conversion factors from timber volume to biomass used by countries in reports to the UNFCCC differ from those used in FRA

Since 1996, all countries listed in Annex I of the convention, that is, industrialized countries and countries in transition to a market economy, must also provide annual national inventories of their greenhouse gas sources and sinks, again including forests (UNFCCC, 2000).

In addition, KP and MA (UNFCCC, 2002) require reporting of "supplementary information" on sinks, beginning with the first year of the commitment period, 2008. They also set stringent consequences for not meeting these reporting obligations, e.g. excluding offending Parties from emission trading or the CDM. Some of this supplemental information could overlap with FRA information. Examples are afforestation, reforestation and deforestation since 1990, or carbon pools of forest ecosystems which countries may exclude from accounting, if they can demonstrate that these pools do not represent a source. FRA might also be perused when carbon removal through afforestation and reforestation cannot compensate for emissions from deforestation during the first commitment period. In these instances, countries can avoid carbon debits by proving that their entire managed forest offset such net deficits.

Parties only report carbon stock changes for their *managed* forests; they have defined "forest management" and "forest" in the MA. Definitions are not identical to those in FRA, but are comparable; harmonization and possible adjustment appear feasible.

Assessing forest carbon stock changes for UNFCCC and Kyoto Protocol

The KP obligates Annex I Parties to have in place by 2007 a national system for estimation of greenhouse gas emissions and removals. Standards for such national systems remain to be developed. However, Annex I Parties must prepare annual inventories through the first commitment period following the so-called "1996 Revised IPCC Guidelines" (RIG) (IPCC/OECD/IEA, 1996), prepared by the Intergovernmental Panel on Climate Change (IPCC). These guidelines, which also cover forests, are currently being updated and complemented by IPCC, elaborating "Good Practice Guidance" (GPG) for carrying out and reporting national carbon stock change assessments for forests and other land uses. Scheduled for completion by 2003, GPG will offer a set of methods, arranged in "tiers" of increasing reliability and data needs, for national carbon stock change assessments in forests.

Basically, Annex I Parties are bound to compute annual carbon stock changes in forests by the following formula

$$\Delta C = (A \times i) - H$$

where

$\Delta C \approx$ Current annual carbon stock change of the managed forest in tons

A≈ Managed forest area in hectares

$i \approx$ Current annual carbon sequestration in tonnes per ha of the managed forest

$H \approx$ Annual fellings on the managed forest in tonnes carbon

In the lowest "tiers", default values offered in the GPG, or from other applicable sources, frequently FAO data may be used for all or some of these factors. In higher tiers, country or forest specific values may be used instead for greater accuracy and precision, e.g. forest inventory information.

Actual forest timber and carbon increment over a commitment period may differ considerably from default values, yield tables or computer models as a result of age structure and aging of a forest, normal climatic variability and climate change, natural calamities, management and silviculture, harvesting, fruiting, the effects of atmospheric pollution and elevated CO_2

concentrations (Kramer, 1988); (Hasenauer, 2000); (Assmann, 1961).Moreover, expansion factors for timber growth, which differ from those applicable to growing stock, are hardly known.

Annual harvest volume is highly uncertain in most cases, and sometimes based on simple estimates, particularly where small private ownerships prevail. The forest products yearbook (FAO, 2000) is frequently considered an authoritative source. However, it reflects uncertain country data. Converting harvest data to biomass and carbon introduces further error: BEF for harvest volumes differ from those applicable to growing stock. Calculating forest carbon stock changes as the difference between these uncertain variables compounds uncertainty.

TBFRA provides data for changes in forest growing stock between two successive assessments, as well as data on increment and fellings. Therefore, an exploratory assessment of the reliability to be expected from the IPCC method described above is feasible. Figure 3 depicts results. Large errors may occur, and less than 50% of estimates fell within an interval corresponding to 30% of the carbon stock change obtained through two successive forest inventories.

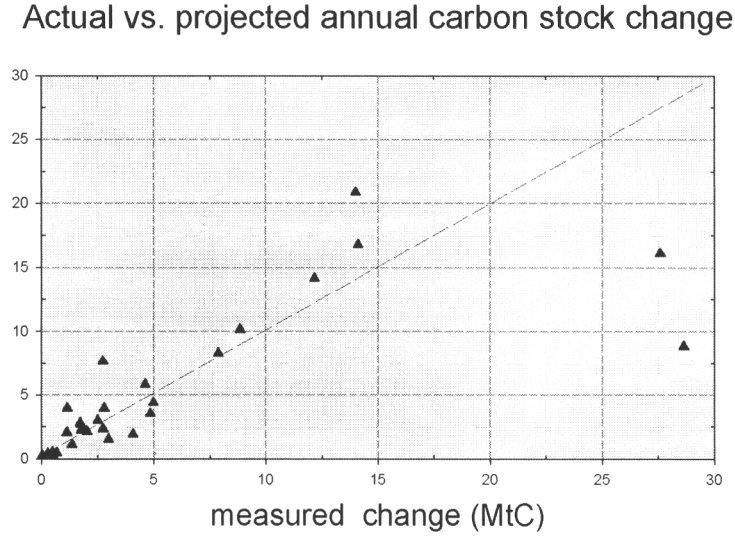


Figure 3. Annual changes in growing stock reported in FRA differ from those calculated from growth and harvest by the IPCC method

Summary and conclusions

UNFCCC, KP and MA granted a significant role to forests in Climate Change mitigation. The agreements also established strict reporting obligations which also cover forests and the procedures for carbon stock change assessment. Country reports on carbon stocks and their changes in forests overlap information contained in FAO's Forest Resource Assessments. Discrepancies between these sources of information have already emerged and could cause conflict in the future. Divergence results from ill- defined terms, inconsistent country reporting, as well as from knowledge and methodological gaps in carbon stock change assessment. Coordinating and co-operating within and among countries, UNFCCC, IPCC and FRA could produce harmonized information of better quality.

References

ASSMANN, E. 1961. Waldertragskunde. BLV, München. 490 p.

BROWN, S. 2001. Measuring carbon in forests: current status and future challenges. Environmental Pollution. 116:363–372.

FANG, J. Y., AND Z. M. WANG. 2001. Forest biomass estimation at regional and global levels, with special reference to China's forest biomass. Ecological Reserach. 16:587–592.

FAO (Ed.). 2000. FAO Forest Products Yearbook 1996–2000. FAO, Rome. 250 p.

FAO (Ed.). 2001. FAO Forestry Paper, 140: Global Forest Resources Assessment 2000. FAO, Rome. 481 p.

FAO, F. D., Forest Resources Division. 2001. Support to National Forest Assessments. www.fao.org/forestry.

HASENAUER, H. 2000. Country Reports: Austria. P. 29–34 *in* S. Kellomäki, T. Karjalainen, F. Mohren, and Lapveteläinen (*Editors*) Expert Assessment on the likely impacts of Climate Change on forests and forestry in Europe. European Forest Institute, Joensuu,Finland.

HEROLD, A. 2001. Reprting of emissions and removals from land use change and forestry in Greenhouse Gas Inventories of Non-Annex I National Communications. paper provided for the Consultative group of Experts on Non-Annex I National Communications, Sub-group on inventories, Öko-Institute, Berlin. 21 p.

IPCC/OECD/IEA. 1996. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. *in* J. T. Houghton, L. G. Meira Filho, B. Lim, K. Treanton, I. Mamaty, Y. Bonduki, and D. J. Griggs (*Editors*) . UK Meteorological Office, Bracknell.

KRAMER, H. 1988. Waldwachstumslehre. Paul Parey, Hamburg. 374 p.

LÖWE, H., G. SEUFERT, AND F. RAES. 2000. Comparison of methods used within Member States for estimating CO_2 emissions and sinks according to UNFCCC and EU Monitoring Mechanism: forest and other wooded land. Biotechnology, Agronomy, Society and Environment: 4:315–319.

OECD (Ed.). 1999. OECD Information Paper: Monitoring, reporting and review of national performance under the Kyoto Protocol. OECD, Paris. 50 p.

SCHOENE, D., AND A. SCHULTE. 1999. Forstwirtschaft nach Kyoto:Ansätze zur Quantifizierung und betrieblichen Nutzung von Kohlenstoffsenken. Forstarchiv. 70:167–176.

UN-ECE/FAO (Ed.). 2000a. Forest Resources of Europe, CIS, North America, Australia, Japan and New Zealand. UN-ECE/FAO Contribution to the Global Forest Resources Assessment 2000. United Nations, New York and geneva. 447 p.

— (Ed.). 2000b. Forest Resources of Europe, CIS, North America, Australia, Japan and New Zealand. UN-ECE/FAO Contribution to the Global Forest Resources Assessment 2000. United Nations, New York and Geneva. 447 p.

UNFCCC. 2000. Review of the Implementation of Commitments and of other Provisions of the Convention. UNFCCC guidelines on reporting and review. FCCC/CP/1999/7.

— 2002. Report of the Conference of the Parties on its Seventh Session, Held in Marrakesh from 29 October to 10 November 2001. Addendum. Part 2: Action taken by the Conference of the Parties. FCCC/CP/2001/13/Add.1.

Working Group Reports

Group 1: National Assessment: Focus on FAO support

Key issues/ Topics	Conclusions	Recommendations
Capacity building/ awareness and maintenance	• Capacity building needs to be complemented in many countries by awareness rising and maintenance	• FAO should work with countries to build their national capacities and rise awareness for capacity maintenance
Technical design of the FAO approach	• Methodology development (baseline forest inventory) is a mandate of FAO as a service to member countries. • The approach proposed is technically acceptable but needs to be completed. Also, in many cases, already existing designs are appropriate and depending on local conditions other designs might be considered.	• FAO approach should be to continuously develop and adjust a package of technical design (including examples of existing nfis), definitions and relevant list of variables related to resources and their use.
Relevance for national forest policies	• Many countries need to develop nfi systems as a matter of priority. • Lack of experience in using nfi information in policy development processes probably hampers the awareness of utility of good forest information. As a consequence countries may place national forest inventories at a low priority. • National forest inventories are only sustainable if the information demand originates from national forest policy processes. • National forest inventories are important and relevant to many sectors and national policy processes. • Information generated in national forest inventories should allow the evaluation of goods and services of the forest.	• FRA programme should work together with the National Forest Programme Facility (nfpf), to improve the countries' awareness of the utility of good forest information. • FRA and the NFP facility should coordinate their activities regarding national forest information provision. • FAO should further emphasise its work towards international processes (IP) to raise the awareness of the importance of nfis in the IP work and also in the countries policy processes.

Key issues/	Conclusions	Recommendations
Relevance for international reporting	• National forest inventories are highly relevant for international reporting. • Information needs of the international community should be specified. • National forest inventories should take account of international reporting requirements and be able to provide information international importance.	• FAO should seek support from international processes and fora to allocate resources to countries for nfis. • FAO should undertake a survey amongst users of information at the international levels to specify information needed from nfis. • FAO should promote the results from nfis for use at the international level. • FAO should assist member countries to collect the data of international importance.
Arrangements in and contributions from countries	• Many countries do not have organisations to carry out nfis. • In many countries national commitment for forest monitoring is lacking or impeded by weak national resources.	• National forest inventories are not reflected in national policies in some countries. • FAO should provide assistance and work with countries to include forest resources monitoring in the national policies. • FAO should assist countries to develop their institutional capacities for national forest inventory and information manage ment. • FAO should seek commitment of countries for national forest inventories and resources monitoring. • FAO should help countries to develop analytical organisations for information generation, analysis and dissemination. • FAO assistance should also be directed to training facilities at all levels.
Financial aspects	• Many countries allocate limited or no funding for resources monitoring. • There are also countries with sufficient capacities to carry out nfis. • Financial resources to countries from international a ids are becoming scarce and allocation to forest information generation is reached low levels. • Only when countries themselves show long term commitment for national forest inventory by allocating	• FAO should work with the donor community to revive the interest in national forest inventories and allocate necessary funds. • Priority of FAO's assistance should be directed to those countries that show commitment for establishing sustainable nfi systems.

Key issues/	Conclusions	Recommendations
	adequate resources, nfis by experience are sustainable.	
Long term aspects of monitoring	• Long term monitoring provides important data and information to identify trends that may be helpful in the adjustment of national policies. • Long term monitoring is costly work and requires designs built on moderate investment. • FRA findings show that very few countries in the world have l ong term monitoring of their forest resources. • Long term monitoring requires permanent institution. • Networks between national, regional and international institutions and agencies could play important role in the exchange of information and experiences. • Intra- and inter-sectoral reference groups are useful to provide inputs to nfis.	• FAO should assist countries to design and implement low cost national forest inventories.

Group 2: Scope of National Forest Resources Assessments

Categories of variables	National forest inventories	Other source data	Combination of sources	Priorities	Comments
Forest area by type		Yes		High	Most important figure. Because of the gap of information on this category it is important to fill out this figure, and may be done by using a forest inventory data. Most of this information should be collected. Need of forest standard definitions on forest and forest type definitions
Forest use	Yes			High	Comparable time series (at a specific point in time).
Threats (forest fires, damages, diseases, poor quality harvest practices, etc)	Partial	Partial		High	There is a need to identify risk areas and areas affected. Information could be provided for regions/ ecozones.
Health and vitality	Partial			High	Related to threats
Land tenure and ownership (state, communal, private)	Yes			High	There is no problem to collect this information in small private owners in some countries. There is a low capacity to report on this issue in developing countries.

Categories of variables	National forest inventories	Other source data	Combination of sources	Priorities	Comments
Growing stock, standing timber volume, wood biomass and carbon stock	Yes			High	FRA seeks on harmoni zation with others working on this issue for example UNFCCC
Wood supply potentiali	Partial			Medium	There are differences n needs to assess this variable.
Timber increment	Yes			Medium	There are other sources available to collect this information
NWFP	Potential for information			High	It is important to evaluate first the existing resources, and removals and use should be a later step. Large data gap and is difficult to aggregate information at national level and from across countries. Lack of funds, methods and capacity to assess.
Use of timber (including energy), and non wood forest products	Partial	Yes		High	This is and issue to be covered by special studies. There are some experiences to collect this information but there is need of other sources to complete the collection of this information.

Categories of variables	National forest inventories	Other source data	Combination of sources	Priorities	Comments
Income, value derived form forest resources	Partial	Yes		High	It is difficult to evaluate the value of forest resources, and it is needed to be done locally. There was a discussion on the importance to report on this matter in FRA. It was agreed that guidelines are needed.
Contribution to the GDP/GNP	Partial	Idem		High	Idem
Economic viability (revenue management costs)	Potential for information/in some cases no possible	Idem		High	Idem
Forest services (recreation water supply soil conservation)	Partial	Idem		High	Idem
Carbon balance	Partial				FAO should refer to the report on UNFC CC
Biodiversity	Partial			High	There are methods proposed and discussions taking place on how to report on biodiversity indicators. Lack of norms is a problem for assessment and evaluation.
Protective forests	Partial			Medium	

Categories of variables	National forest inventories	Other source data	Combination of sources	Priorities	Comments
Forest conservation protection status	Partial				Assistance is required at national level to identify and assess unique forest types
Governance and management planning (illegal logging)	Partial			High	Need to access information outside the forest sector
Public awareness	No			Low	Not relevant on international assessment but is important for forest policy development
Stakeholder participation	No			High	All potential actors play a role.
Forest dependency and employment	No	Yes		High	Difficult to assess the level of dependency
Cultural and spiritual values	Potential for information			High	Difficult to assess; methods and approaches need to be developed.
Research training education	No	yes		High	Idem

Current status of information and the main driving forces

The driving forces for national assessment have evolved from general assessment of timber supply to reporting on wide range of values and services that forest provides.

Main driving forces identified were:

1. National policies and laws
2. Sustainable forest management practices, including conservation, rural community development, social policies, land tenure and land use change, protected areas and forest health
3. International commitments like: Climate change mitigation, CBD ITTO etc. Criteria and indicators of sustainable development and forest management.

There is pressure from international and domestic NGO's for improved forest management and forest protection.

4. International pressure for reporting in order to access the international and domestic markets (criteria and indicators of SFM as framework for forest certification
5. Market is one of the main motivations that countries have to collect information. Commercial companies want to have information on economic, social and ecological aspects of their business.

Recommendations

NFI's are essential data sources for forest resource assessments. Given significant gaps of information and low level of response by many nations for many variables, countries should initially focus on getting reliable basic data (forest area, forest land use). This should be done using methods that are comparable between assessment periods.

Global FRA process should be consistent with (and sensitive to) current capacities/abilities of countries to supply data. It is important that FAO promotes the establishment and development of national forest inventories that allow the collection of information at a national level.

Forest assessments should move from timber assessment to a more broad assessment that evaluates forest resources. FAO should facilitate development of methodologies for assessing this broader range of forest services, values, functions, including biodiversity that may be adapted for use at the national levels. These assessments should include absolute quantities as well as estimates of value.

FAO should facilitate translation from national to international definitions of major variable. FAO should continue to facilitate the development of guidelines on how to achieve harmonized reporting at the international level. FAOU should support the development of national forest system and to accept information in a no harmonize definitions.
Mapping of forest resources through remote sensing bus be verified by field sampling and is important for science and education.

FOAO should facilitate analysis of the reasons for gaps in reporting information. Potential reasons include: low priorities at the national level, national capacity, lack of funds, and lack of evaluation methods.

FAO should rely on the UNFCC and IPCC to develop methodologies for assessing and reporting on carbon stocks and balances. Reports to the UNFCCC should form the basis for international reporting on forest carbon balance. There is no need for separate reporting through the FRA.

Countries should improve capacity to report on the accuracy and reliability of the data submitted to FRA. FAO could assist countries in developing methodologies and reporting guidelines.

FAO could play a role on how to assess the level of stakeholder participation of forest issues.

Group 3: Conclusions

1. A global forest resource assessment has many functions including to:

- Provide an accurate picture of the status and trends in forests and forest resources globally
- Provide countries with the ability to view their forest sector within regional and global contexts
- Increase support for national forest assessments and data collection efforts
- Provide data required for monitoring and assessment functions of international instruments
- Provide accurate data for scientific and technical studies
- Provide accurate data for investment decisions and private sector development
- Substantiate the contribution of forests to global economic, environmental and socio-cultural values

2. FRA has multiple users including
- National governments
- Regional processes
- International instruments (convention and agreements)
- Scientific and academic communities including education
- NGO's and the public
- Private sector entities

3. FRA can best serve the needs of all users by providing consistent, reliable and accurate data. Further to contribute to concepts, definitions and methods

4. The expansion of FRA 2000 to include forest goods and services was a positive development

5. To streamline the process to reduce reporting burden of the countries

6. Regional Forestry Commission has an important role to play in increasing political support for country involment in FRA and in efforts related to harmonizes reporting and coming to a common understanding of definitions, concepts and methods.
7. Other than TBFRA there no support was expressed for separate regional FRA as it was felt that it would increase the reporting burden of countries.

Recommendations

General

The emphasis of the future FRA should be four fold

- Increasing accuracy, reliability and compatibility of the data,
- Developing new alternative methods and definitions for forest resources assessments
- Building national capacities to collect and provide better quality information and
- Expanding to include more information for contributing for various criteria and indicator processes.

Specific

- Following the recommendations of COFO 2001, FRA should continue to be a broad assessment that includes various aspects of forest resources, such as climate change, carbon storage, and biological diversity, forest health and resource use. In particular, it is recommended that FRA is guided by criteria like the following as approved by the criteria and indicator processes to define its scope.
- Extent of forest resources and global carbon cycle, forest ecosystem health and vitality, biological diversity, productive functions, and socioeconomic functions
- For this purpose, FRA should identify key parameters for collecting information at the international level. Some of these parameters may be included in the Global FRA and some in the regional FRA like TBFRA.
- FRA should consolidate and improve the quality of the current datasets and develop effective and productive partnership at national, regional and global level with governmental and non governmental bodies.
- FRA should present the big or total picture of the world's landscape by providing georeferenced, verified and harmonised data set not only on forest but trees all over the landscape.
- The set of parameters in the future FRA should be chosen based on the relevance in relation to the above compatibility with current requirement of indicators etc and feasibility for countries to report.
- The format of the reporting at the international level should be guided by the commonalities among demand by different international processes and for the purposes the format should be based on the national and regional needs.
- FRA should facilitate synergies between different international processes by identifying commonalities among international

requirements.

- FRA should continue to develop the potential to satisfy information needs of forest related international processes.
- FRA should develop and maintain a global core set of variables as source data and make use of external available, relevant and credible datasets and develop necessary linkages with them
- FRA should support national capacity building efforts to improve quality and to reduce current gaps in the international information.
- FRA should continuously updated national and global information as and when new information is available and contribute to international processes as required. Five year report will be useful but 10 years interval is tight for comprehensive global reports.
- The FAO should contact the government of each country to confirmation of the identity of the national correspondent. The FAO should also use this opportunity to raise the profile of the GFRA and emphasise the important role played by the national correspondents.
- The FAO should ask the national correspondent of each country to provide a time table for updating its information in order to confirm expectations for delivery of the GFRA data requirements in their plans for inventory update keeping in view the demands of international processes.
- The group endorsed in principle the draft TOR for establishing an advisory group for GFRA. The draft should be modified to make explicit the fact that the task mentioned in the TOR relate to the GFRA. The composition of the advisory group should be expanded to increase representation from Regions and non governmental users.
- International conference on C & I at Guatemala may like to indicate common set of C & I to GFRA so that it may help GFRA to identify key parameters to collect necessary information and to maintain data set at the global level for making productive contribution to these processes.

Group 4

Wednesday 03.07.2002. 09.00 – 12.00.
Minutes from 1st group session.

Brief Introduction of participants

It was agreed to allocate the time as follows; 1 hour to agenda item 7, 1 hour to the group topic of remote sensing and 1 hour for tying up the work.

Part 1: Wednesday 03.07.2002. 09.00 – 12.00. Minutes from 1st working group session

Title: Agenda item 7 Recommendations for future global assessments and reporting

Should Global forest assessments continue to rely on national data and reporting?

Consensus for FAO to continue relying first and foremost on existing national data. FAO to provide backstopping and a global frame.

- FAO should help with quality assurance/quality control.
- FAO could do additional analysis
- FAO could do additional work to harmonise, fill gaps by means of a global framework and harmonise results
- Need for country buy-in FAO should negotiate approach with countries as partners.
  For countries with no national data, FAO should build a harmonised method/toolbox base technique for filling gaps, harmonize (convert data to common format)

Recommendation
FAO should help countries to establish a basic national inventory.

FRA should continue to rely primarily on national data and fill gaps by means of a global framework

Is the "all (forest) benefits – all (forest) beneficiaries" an appropriate scope for global assessments?

"All (forest) benefits" is idealistic – so far basic data has lots of gaps, so job #1 is to get basics in good shape.

May depend on demand for new information
Options not mutually exclusive *"All forest benefits"* is ultimate goal, articulate it more and move towards it.
Where are the boundaries of *"All forest benefits"* is it a finite tasks? Many others work in related areas. Unclear where "boundary" exists under all *"All forest benefits"*. What are implications for others working in related areas outside forestry.

Grey zone social / economic issues.
Need to clarify boundary of what FRA would do in assessment

Recommendation
FAO should focus first on improving the quality of data for the current scope of FRA.

How should C&I be incorporated in global forest assessments

FRA can focus on forest indicators- need clear boundary between forest C&I and others

Difficult to incorporate C&I without changing inventory procedure. Some national inventory procedures are changing towards measuring biodiversity indicators to respond to C&I. As countries accept C&I reporting, programs will evolve to address more C&I.
Varying rates of implementing.
C&I themselves still evolving
FRA can encourage countries to respond to C&I to start with
Look for common regional indicators do a comparative studies
Need for distinguishing between forest and non-forest indicators

Recommendation
FRA should concentrate on Forest Resources indicators (common to the whole globe) and clarify which to include.

Recommendations on scope and frequency of global reporting, including linkages between FRA and Conventions

Frequency:
Continuous updating by country as new data are available
- data + metadata.

If so what is the role of FRA?

- Quality assurance
- Filling in gaps
- Support follow up to help countries fill in information

Lots of complications – not trivial. Some topics updated at different rates could be complicate in database.
Good ultimate goal – may need to be modular, allow updates of different components w metadata.
Possible corporation with GFIS – struggling with the same problems.

Cycle:
10 year cycle. Too long for customers – suitable for data providers (due to work load)
Countries have their own cycles which are not synchronised with the FRA cycle.
5 years is a reasonable cycle for FRA repeating.

Option: Full Assessment 10 years / update at 5 years intervals.

Recommendations for regional level reporting including links to global reporting

If C&I are regional, there is a natural link to regional reporting
May impose additional work
Keep countries as units in database – enable users to define own regiona by selecting countries
Regions may want to amend definitions (eg "forest") for their own purposes.

Recommendation
FRA could facilitate and support but not take the lead

Recommendations on harmonization of international reporting

Work towards reducing country reporting burden. Avoid multiple reporting.
Depends on international conventions to agree to use FRA database.

Recommendation
Encourage FRA to take initiative to meet with some international conventions try to create data presentations to meet their needs.

Ultimate goal is that every country should only have to submit one report to FRA and the international conventions.

Point *1.7 & 1.8* will be considered with group topics

Recommendations on the organization of global assessments, including the establishment of a Global Advisory Group.

Concerning organization of global assessments – the objective should be to ensuring getting good data for FRA and to provide good support to countries.

Advisory group.
Options:

1 advisory group composed of two subgroups. (user and technical)
2 different groups (one large user group and one smaller technical group)

Maintain the FRA neutrality while including customer needs and uses.

Recommendation
Keep TBFRA (but keep delineation between FRA and TBFRA open). Leave the option open for new regional FRA's – but they are not required. Membership in regional FRA should be agreed by FRA, regional FRA + Country.

Part 2: Independent remote sensing surveys

Should they continue and why?

- To fill in gaps.
- – plan inventories with low resolution data
- – resolution to do actual inventory
- Provide quality control- consistency check for national inventory. Check consistency of data. (Possibly more error in RS than in definitions)
- Can be cheaper than individual work in separate countries.

RS of what?:

- Cover and cover change
- Improve country data – fill gaps
- Possible fire monitoring

Objective(s)

- Improve precision where countries have no/poor data. (Full coverage for uncovered countries.)
- Provide consistent time series of change (possible repeat of 1980–1990–2000 FRA RSS)
- Global Forest Cover Map for visualization. (like in FRA 2000 possibly with higher resolution image eg. MODIS) Possible external contract.

1. Improve precision where countries have no/poor data.

- FAO should incorporate RS into inventory work at national level capacity building or;
- Intensify; sample or wall to wall mapping in countries with poor data or;
- Countries could be grouped for independent intensified study.

2. Provide consistent time series of change

Proposal – new sample to assess current status and change

- replaces existing sample
- severs link to past change? Can link be maintained?
- If change of methods try to maintain link to past data

Goal: Ensure consistent time series from 80's – consistent global coverage.

Pros and cons of a global RS survey:

+ provides more spatial information on forest
+ Provides consistent estimates across regions-continent level
- Possible waste of resources e.g. In countries with existing coverage
+ improve scientific quality of survey.

Working Group 4

Wednesday 04.07.2002. 09.00 – 12.00.
Minutes from 2nd group session.

Chairman Andrew Gillespie provided a brief description of remaining schedule for work.

The first three bullets of the agenda for working group 3 were treated simultaneously in the beginning of the session, i.e. the following:

- Information possible (and relevant) to extract from remote sensing material
- Design of future independent remote sensing surveys, including budget surveys
- Relevance of wall to wall provision of images.

Erkki Tomppo was initially asked to provide a brief overview of the work related to assessing opportunities to carry out a remote sensing aided forest resources survey for the whole globe, independent of the countries own estimates.

Emphasis of the work by Tomppos and Czaplewski was on

- assessing relevance and expected accuracy of the survey.
- outlining possible methods for planning and evaluating alternative sampling designs
- assessing global level change estimates.

The focus of the presentation by Tomppo was what options exist for producing continent level estimates of forest land area (state and change). A comparison of standard errors resulting from sampling was presented using the following two options:

- Landsat TM (150 km X 150 km, 30 m resolution) and;
- IKONOS (10 km x 10 km, 1m resolution) imagery,

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- A third option is multistage sampling using Landsat + Ikonos and possibly MODIS.

The message is that IKONOS option is worth considering although area is small (low error for state and change)

Possible role of MODIS (500 m) wall to wall, as sample base to optimise sampling.

Stratification has to be clarified? By ecozone? By region?

Objective	TM	IKONOS	MODIS	MULTI STAGE
1. Improve precision in countries of poor data	1 (wall/wall)	1 (sample basis) Costs 13 US$ /1000 ha	2 (wall/wall)	1
2. Regional assessment (State and change)	1 (sample basis) Costs 0.5–2 7–30 mill US$	1 (sample basis) Costs 0.5–3 mill US$	2 (wall/wall)	1
3. Global assessment (State and change) Consistent time series LU	1 (sample basis) Costs 3–12 40–120 mill US$	1 (sample basis) Costs 0.5–2 7–30 mill US$	2 (wall/wall)	1
4. Global forest map for visualization (wall/wall)	2+	3	1	1

Legend: (1 most feasible, 2 middle, 3 least feasible)

Recommendation

FAO to commission study of most suitable method for incorporating an independent remote sensing survey into FRA. The study should consider various options and for each option address: Feasibility Cost Benefit Accuracy and reliability Cover classification system Reporting units (region, ecozone, others…) How to incorporate groundtruthing element Potential likely partners Based on the above items make a recommendation for FRA

Funding and partnerships

- Large buys – discounts
- Kinds of partners needed
  - Data providers – potential sources of discount data
  - Country inventory departments – field data, expertise, familiarity
  - Research organisations (IUFRO member organisations for technical expertise)
  - Donors interested in results, e.. UN organisations
  - Contractors to do actual image analysis

Recommendation
FRA should recognize that there are many kinds of partners who are potentially relevant to FRA. FRA should seek to identify and build relations with those partners.

Role of National Governments

- One of the partners
- May have multiple roles
  - Provide data, imagery, control data, expertise
  - Funds
  - "blessing" – FRA is both scientific and political – both interests must be addressed Role for countries to review, comment on results of RS survey.

Recommendation
FRA must continue to involve countries in FRA both as providers of data and expertise as well as reviewers. FRA should continue to ensure t he scientific credibility and neutrality of FRA products.

Potential for integrated approach
- Needed for basis of RS interpretation
  - May use existing data to begin with (may increase heteroge neity)
  - Then add to it
    - Fill in gaps
    - Get harmonized data
  - Very dense grid to define potential sample points.
  - Subsample from grid to ensure minimal sample in each country
  - Sample units linked to RS image
  - If FRA uses existing plots may need to rely on aggregated or intersected data.

Problems related to FAO global grid : Certain human created features may follow lines of longtitude and latitude (e.g. boundaries). Distance between plots would be largest nearest equator.

- Possibly a sparse global sample grid, then intensify where more data is needed.
  - Could make mapping cheaper in long run established data base of ground truth
  - Main benefit is capacity building which needs to benefit country.

Objective is not "fixed sample grid". Global grid, should:

- fulfil data needs for global assessments in combination with national needs.
- So consider utilizing existing ground data
- If no existing ground data, collect some using system to meet national and global needs
- Global grid is one possibility
- Others are possible
- Consider stratification by forest area

Recommendation

A global ground sample grid may not be the most efficient way to support the global remote sensing survey, however such as grid may have many other useful purposes (e.g. national capacity building) If FRA chooses to implement a global ground sample grid, it should done in such a way as to allow a variety of flexible linkages to support a global remote sensing survey.

How to provide continuous technical support to FAO?

Recommendation

FAO write the terms of reference to do a more complete study of RS options for FRA
(ToR will include outlining the study components and advice on how to involve RS research community
Involve technical expert group (review ToR).
Open participation in study to remote sensing community.

Outline

- General comments – future global survey (bullet by bullet)
- Specific focus on RS
  Objectives – why have individual RS
  Options to reach objectives.
  – Pros and cons
  – Cost

  How independent of national systems? – role of countries.
  Role of field samples with / without RS. – integrated inventory
  How to provide continuous technical support to FAO.

Minutes of the Sessions

Monday 01.07.2002

Morning Session

Chaired by: Risto Seppälä, IUFRO/METLA.

1. Opening of the meeting

The meeting was officially opened by Mr. Aarne Reunala, representative of the Government of Finland, Peter Holmgren of FAO and Christopher Prins of UN ECE who welcomed the participants.

2. Opening hearing and press conference

Participants briefly introduced themselves. A short meeting with the press took place, and interviews of some participants were carried out during the break.

3. Objectives of the expert consultation

Mr. Risto Seppälä (IUFRO President/Professor METLA) was elected as a chairperson for the expert consultation. Susan Braatz (UNFF), Christopher Prins (UN-ECE) and Adrian Newton UNEP would co-chair different sessions. It was agreed that rapporteurs for the plenary sessions and the working groups would be selected from the FAO participants.

The objectives of the meeting were presented and adopted in plenary. The agenda was revised and approved without any amendments.

The meeting participants would be divided into four working groups with different focus as presented in the agenda. Participants were requested to fill out a formula defining their first and second preferences. Composition of and chairpersons for the individual working groups would be decided at a later stage in connection with organising the group work. A drafting committee composed of the rapporteurs and chairpersons of the working groups and the chairperson of the meeting would be established for producing the draft conclusions and recommendations of the meeting.

4. Reports from on-going activities

Two background papers were presented:

1. Priorities of the FRA programme, by P. Holmgren (FAO), and;
2. Analyses based on FRA-2000 results deforestation and agriculture by K. Govil (FAO)

Question (Q): A question was raised on how to increase the interaction between and make better use of the complementary nature of forest information provided/required by different institutions for example GTOS, FRA, UNFCCC, CBD, and others, in order to combine the reporting for a common approach and mutual benefit:
Answer (A): There are different types of information requested. Most of the initiatives mentioned provide information that is not necessarily combined with ground sampling. There is a need to integrate information regarding use and users and to formulate the demand for information. Remote sensing techniques do not provide this type of information. Remote sensing remains an important tool for use e.g. as an independent study for calibration as it is independent of country reports.

(Q) How are priorities defined? Has there been a user demand study to clarify user requirements for information types and level of accuracy.
(A) Apart from the work done at Kotka III expert consultation, no specific user requirement studies have been done. In general national level information is mostly required.

(Q) How will FRA support to National Forest Assessments be structured?
(A) FRA wishes to promote full national data ownership. The topic will be dealt with in depth at a later presentation.

(Q) What are the concrete examples of FRA role in the international forestry agenda?
(A) FAO provides a neutral forum. The FRA process is not pursuing a political agenda but is more of a service function providing information. Among others there are obvious synergies between FRA and the global climate debate.

(Q) It was requested to clarify the decision making process behind the FRA process and any regional connections.
(A) FRA responds to the mandate given by FAO´s Commission on Forestry (COFO) which represents the member state governments and which is the superior body on forestry related issues. COFO convenes biennially in *odd* years. The Regional

Forestry Commissions which convene biennially in *even* years also provides guidelines to FRA with a more regional focus. The conclusions and recommendations of Kotka IV expert consultation will be presented to COFO 2003 for endorsement. The day to day operational decisions concerning the FRA programme are taken within FAO Forest Department.

(Q) It was asked whether the initial work on the Global Forest Survey (GFS) was attempting to establish a long-term *de facto* minimum standards for the level of national reporting of basic core parameters?
(A) During the GFS discussions the strata were the countries. It is a national responsibility to provide national data. For future FRA's, national data should remain a main source of information. A GFS could complement the national data and probably rely much on the same set of variables for defining the minimum requirements (i.e. concerning tables and data quality).

(Q) It was asked to elaborate on the need for independent remote sensing surveys?
(A) Independent Remote Sensing Surveys can be used for data calibration. In FRA 2000 it has been used for calibration at regional level for tropical Africa. FRA always goes through a process of validation of data with the countries.

(Q) How can FRA secure feedback from different stakeholders, in particular from the data users?
(A) A deeper discussion on user requirements can be undertaken if it is recommended by the expert consultation.

(Q) How can this forum contribute to increased support for forestry in countries with low forest cover?
(A) As forestry activities do not play a main role in most of the countries economies it is difficult. One should not expect that large budgets would be allocated to activities related to forest inventory.

(Q) How does FAO view inventories other than NFI's as sources of information like the examples from Europe Koring, LUCAS & ICF.
(A) FAO uses country information as reported by the national authorities as the primary data source. Other relevant sources can be used e.g. regional information contained in Africover,

but all information must be validated with the national authorities of the concerned countries.

Monday 01.07.2002

Afternoon Session

Chaired by: Christopher Prins, UN-ECE.

Welcome address by the Principal of Kymenlaakso Polytechnic

Mr. Jouko Ylisaari, the Principal of the meeting venue Kymenlaakso Polytechnic, gave a welcome address and briefly described the venue and the educations provided.

4.2 Report on expert consultation on definitions:

Dieter Schoene of FAO summed up the findings of expert consultation on forest definitions held at FAO Rome in January 2002 and was arranged by IPCC (represented by WMO), UNEP, CIFOR, IUFRO and FAO with the purpose of developing more consistency in the field of forestry definitions. The importance of maintaining national definitions suited for national conditions was highlighted along with the importance of being able to translate the national definitions according to international requirements.

The conclusions of the January meeting were;

- to focus work on definitions towards reducing the national reporting burdens
- to make use of existing definitions before producing new ones, and that;
- apart from the definition of reforestation FRA and the Kyoto protocol use largely similar definitions.

It was pointed out that the development of definitions is a continuous process involving both standardization and harmonisation to fit definitions used in national assessments into multinational definitions and vice versa. A task group has been allocated the task of developing the conceptual framework for the continued work on definitions for the follow up meeting in September 2002.

During the current Kotka IV expert consultation definitions will not be discussed as this falls beyond the scope of the consultation and there has already been an intensive work on

harmonizing of FRA definitions of international relevance.

(Q) The final version of the Kyoto protocol employs two optional definitions for reforestation. How can the consequences of differences be interpreted?
(A) FRA can spread publicity and make aware of these differences so that uncritical use of data is avoided.

(Q) A new set of definitions will likely arise some time after the 2nd meeting on definitions in September 2002. What do we do for definitions in the meantime – develop new definitions?
(A) FRA already has a comprehensive set of national assessments. It was added that definitions are not the discussion topic of the current meeting.

(Q) Different definitions have been employed in the past by national assessments and international organizations. How can similar differences be avoided in the future?
(A) There are plenty of national definitions. These have developed as they best suit the national conditions. National reporting should be done using national definitions.

(Q) Time is needed to harmonise definitions between the various international reporting processes. Reporting of human induced changes needs to be included. Currently FRA reports both natural and human induced changes.
(A) It is an open possibility that FRA's definitions should be further refined.

5. Review if the Global Forest Resources Assessment 2000

5.1 Comparison between Kotka III recommendations and FRA 2000 output

A comparison between the Kotka III recommendations and the results of FRA 2000 was presented. The results of FRA 2000 covered the 10 topics recommended by Kotka III. Lacking in-depth coverage of some areas mainly owed to a lack of national information.

(Q) It is important to make an analysis of who the consumers of FRA data are. There seems to be clear linkages to processes like IPCC, which has specified definitions, but does not itself un-

dertake data collection.
(A) FRA is not shying away from any such connection and indeed sees this issue as central to the Kotka IV process.
(Q) It was asked to clarify what was meant during Kotka III by FRA undertaking evaluation.
(A) FRA should put value on different goods and services – i.e. objective reporting. FRA should not make evaluation of whether a development is positive or negative.
(Q) Will monetary evaluation of goods and services not reduce transparency?
(A) The transparency is still there if the data is presented in such a manner that it is clear how final values were derived.
(Q) Should working groups build on the conceptual approach from Kotka III?
(A) We are not starting from scratch. A variation from Kotka III will probably add data and produce more input in data tables. It is important to utilise what has been gained during FRA 2000 and to move forward.

5.2 User perspectives on the FRA 2000 process

The document was based on the interviews made to users other than government representatives.

The presentation underlined that forestry issues are politically hot and that forestry data is more relevant than ever.

The transparency of FRA 2000 along with the changed methodology for change estimation (abandonment of the deforestation model used for some countries during FRA 1990) was perceived as improvements.

The poor quality of primary data (especially for tropical countries) and the changed definitions for reporting for developing countries between FRA 1990 and 2000 were perceived as negative for the overall usage of FRA 2000. The users require long-term consistent trend data. It was pointed out that over the last 50 years FRA has employed shifting baselines from one survey to another.

Increased collaboration with other agencies and institutions (incl. educational institutions and NGOs) was mentioned as one possibility of increasing data capture and improving the qualitative aspects. The primary message of the presentation was that there is a need for a harmonised replicable methodology and for long term projections.

A discussion followed on the user concerns on the accuracy/precision of the estimates. The provision of uncertainty esti-

mates by national correspondents or an international body would seem problematic as indicators used in the absence of hard data provide great sources of errors and that expert opinion are impossible to assign errors to. It was pointed out that IPCC instructions is developing a chapter for guidance on estimating uncertainties that may have interest for the FRA process.

In a following discussion FRA was described as a bottom up approach, which is time consuming, but with the advantage of being more politically credible than a top down approach, building on e.g. remote sensing and more rapid appraisals. Increased use of remote sensing would provide more consistency between units but would reduce political credibility and national data ownership.

It was emphasized that remote sensing does not substitute groundwork but may be valuable for calibration purposes. National support should not be sacrificed for accuracy/consistency. The need for political buy-in of countries to data collected by external sources is essential.

The role of FAO and FRA can be seen as to develop the broad framework and leaving the minor details to national level. A harmonization of the assessment procedure, like e.g. ISO standards, may be considered. Some in-depth consideration should be given to how much information to include in FRA and how to capture the non-conventional forest parameters

FRA stated that only countries with long term NFI's are able to produce long term consistent trends of forest cover and forest cover change. It may not be enough to rely entirely on national information, but it should also be considered whether more remote sensing will produce more certainty as many remote sensing surveys merely produce new data needing calibration algorithms when converting form one survey to another. There are clear limits to how many variables can be captured from satellite images. The only way to capture much of the missing information is through on the ground work.

The presenter commented that the optimal situation would be a situation where both approaches complement each other (consistency from the remote sensing study and trustworthiness from the groundwork) and that national political support is also needed for independent studies.

5.3 Why did we end up here? History of the FRA 2000 process

A description of the history of the FRA process was given.

GFRA should be based on the needs of information that are required by the governments and users. Politically it is important to have different parameters that allow making comparisons between countries.

(Q) What is the place of LFCC in FRA?
(A) All countries are in principle treated equally. This practise will continue. LFCC will also be covered by FRA Support to National Forest Assessments.

Tuesday 02.07.2002

Morning Session

Chaired by : Kari T. Korhonen, METLA.

Group topics and compositions were presented.

6. National forest assessments and their links to global assessments

6.1 Information gaps at national level situation and cases

It was clarified that FRA 2000 estimations were based on national reports and country information produced at national level. Sometimes this information has not been updated recently and/or is not very reliable. Where there was no solid source of information expert opinion was employed.

The same questionnaires for FRA 2000 were used in all countries. There were differences in the way these were answered depending on the interest that each country has in their forest resources, and how the forestry sector is prioritised in the country.

(Q) How does FRA generate country estimates for countries with no NFI?
(A) We use other data provided by national forest authorities.

(Q) Is the information status of LFCC different from other countries?
(A) Due to the low importance that forests have in these countries it is perceivable that less have been invested in NFIs

6.3 Review of technological and methodological options to meet national information needs

The importance of establishment of permanent plots was highlighted, as this is the only way to generate a reliable timeseries.

GPS are useful for navigational purposes. To find exact locations within permanent sample plots conventional measurements and/or some kind of discrete/invisible marking of centerpoint is needed

It was pointed out that estimations of carbon storage capacity could be incorporated in forest inventories, as it is an indicator of sustainability. Carbon storage should be considered in the working groups.

Country reports
Papers from Poland, India and South Africa describing the national views on international reporting and its linkages to national level reporting were presented.

National participation in reporting was found to be important because it generates national results/inputs and helps disseminate international results. From national level there was agreement the there was a need for the international community taking on a web based data-warehouse function for the provision of data related to all forestry parameters.

A couple of questions were asked regarding the forest cover of South Africa:
(Q) Is the forest cover of South Africa increasing or decreasing?
(A) They are assumed to be roughly stable as far as state forest and plantations are concerned. Woodland however is decreasing.

(C) An issue was raised on why woodlands was not included as natural forest and it was pointed out that there should be clarity on whether forest is classified according to structure. It was noted that although reliable and accurate plantation data exists it is not always available for public reporting purposes.

6.4 Biodiversity indices in national forest inventories

Measuring valuable indicators/species in each country could contribute to biodiversity evaluation. There are plenty of potential indicators which when identified, will lead to a need for evaluating the importance of global biodiversity and the responsibilities. Indicators could e.g. be such as valuable forest types (nationally/globally) occurrence of deadwood/fungi/insects etc. and the essence is how to capture these. Actual biodiversity information is lacking. It is important to make research in all existing information and recover the data that may be relevant.
(Q) A question of scale: Can biodiversity concerns be included in large-scale inventories and be of any use at all?
(A) The first important step is describing fragmentation the difficulty is then to relate this to species.
(C) It is essential that indicators are compatible over time and harmonised at a global level. But this is a very challenging task.

(C) Information at local level is important as it can be used for national decision making. Advantage should be taken of research work that has already been done by others and use should be made of FAOs work in supporting national forest assessments for data capture.

6.5 Feasibility of low intensity sampling approach for national inventories.

(Q) A question concerning how to capture rarely occurring events in a low intensity sampling was raised. The problem was exemplified by the problems of data capture using low intensity systematic sampling from high value pine forest occurring sporadically in Guatemala.
(A) If the occurrence of such areas is known is advance, stratification might be the answer.

6.6 FAOs support to national forest inventories and assessments.

The concept employed by FAO for support for pilot national forest assessments was described.
(Q) Why is there no potential for low-resolution satellite images for stratifying areas? This would seem especially relevant in LFCCs?
(A) The design is not based on stratification according to vegetation cover, as the delineation of this may change. The essence is to develop a monitoring system.

(C) A comment related to the choice of sampling intensity stated that the needed precision level should first be decided – then the sampling intensity should be decided depending on variability. Precision will inevitably vary according to attributes, for key parameters one should aim at high precision.

Tuesday 02.07.2002

Afternoon Session

Chaired by: Adrian Newton, UNEP/WCMC.

7.1 Current international reporting requirements – mandates, mechanisms, overlaps and potential synergies.

First group session mainly discussed international reporting requirements under the different conventions. A number of comments and questions followed:
(C) The difference in reporting requirements between FRA and other international bodies was noted. Collaboration/coordination between various the international bodies requesting national data should be increased. Currently it is up to individual countries to reuse data and replies for reducing the reporting burden.

(C) Concerning carbon assessments, there is a large difference between FRA and other sources. The main source of variation being the biomass conversion factor.

(Q) How are C-stocks in soils estimated?
(A) It is correct that most carbon is stored in soils. It is up to the reporting parties to include it in which case it should be proven what the changes are. Forest soils are difficult to sample as there are often rocks etc. and countries may therefore choose to stay out

(C) There is need to work on volume expansion factor in order reach an international agreement, e.g. net underground growth of fine roots should be included in expansion factor.

(Q) Should all forest areas be reported to IPCC?
(A) IPCC reporting concerns only managed forests, there are no reporting requirements for unmanaged forests.

(C) There is a necessity for a detailed dialogue between the forest inventory community and the carbon inventory community. Need for harmonization of information and interlinkages with FRA process.

(Q) Who has the responsibility/(reporting ownership) for trees outside forests (TOF)?

(A) TOF and agroforestry should be reported in Kyoto protocol but there is yet some lacking clarity about responsibility for TOF and agroforestry reporting.

It was clarified that the convention on genetic resources does not include forest.

7.2 Forest resource assessments and indicators of sustainable forest management: the European experience

(Q) A request for providing examples of concise use of FRA information leading to policy modifications was made.
(A) Reference was made to the data on carbon sequestration and its potential use in connection with the Kyoto Protocol. It is useful for politicians to know where we are to enable them to decide what to do.

(C) A comment was made concerning the good cooperation and implementation of indicators for MCPFE.

(C) There are no thresholds or targets for indicators of SFM on an international scale – this work should be done at the national level.

7.3 Generic scope of global forest resources assessments

A presentation by FAO stated that the goal function of the global FRA should be to provide the sum of the value of users, objectives and areas (FRA utility function).

FRA should provide global data on all users, objectives and areas. Monetary evaluation of these was suggested as a common unit of measurement. FRA should however not provide any means of weighting of these.

Concern was raise that a full set of C&I will not be available over the next 3–10 years. It might therefore be needed to select indicators that will be ready in the short term.

FRA should be a source of information for international process, and should be a process that will be valid over for more than 10-year periods.

Accuracy, time and sustainability should also be measured and reported, but there is still the question of whether there is enough information to make this type of evaluation.

A discussion followed concerning the need to focus on the process of where do we want to be and how do we get there.

7.4 Role of independent remote sensing studies in global forest assessments

Dr. Erkki Tomppo mad a brief presentation of his joint study with Ray Czaplewski on the above topic. The paper is available in full version as FRA working paper 61. Although volume estimates in the boreal regions should be possible, the study only considered forest area, OWL and Forest Area Change. Technologically wall to wall mapping is possible already, but prices are forbidding.

Using IKONOS imagery, a sampling intensity as small as 0.5–1.0 % cover would yield estimates of reasonable accuracy for Europe and CIS, change estimation needs a higher number of images. More work is required to establish the global sampling requirements and also on the requirements of Europe and CIS as the above mentioned are first estimates. At global level and until better estimates become available one would anticipate the sampling intensity to be somewhere in the range of 0.5–2.0% to produce a reasonably accurate estimate of forest cover. Again change assessment would need more intensive sampling.

7.5 Future options for global assessments: methods, mechanisms, contents, format and frequency

On the frequency for updating of global FRA it was commented that all data relies on NFIs and that several years are needed to revise databases, meaning that 2005 will be too early for the next major assessment, but may be suitable date for an intermediate assessment.

The discussion concerning future direction of the FRA programme continued after a short break for dinner.

A permanent advisory group convening regularly was suggested as a new element in the organization of the FRA work.

FRA work should focus on criteria as indicators are likely to change over time and the FRA process needs to generate data which is consistent over time.

It was emphasized that it is beyond the scope of FRA to assign weights to the previously mentioned (item 7.3) sum of values of users, objectives and areas. Some discussion followed stating that estimating all benefits would be difficult as there would also be losses.

A comment was made that there seemed to be a similarity of the presented approach to the all benefits approach employed

by the Millennium Assessment. A comment from FRA was that although there were some commonalities there were also substantial differences in the forests, products and services should be considered as a whole.

FRA is seen as the main road for national forest data to reach international fora. FRA in its part should be a neutral provider of data for the various international processes and conventions, e.g. CBD. However not all data for the international processes can be provided by FRA. The problems of improving country data where it may be lacking should receive high priority.

The assembly and assessment of national report are supposed to be contained within the regular budget of the FRA programme. Country visits and remote sensing surveys may make it more expensive and may require extra funding.

A possibility of undertaking regional FRAs exist (certain processes e.g. MCPFE request it). The core should however still be the same as employed by GFRA. The option for establishing regional teams like the one in Europe remains open. At regional level there is a wish for increased collaboration with the Regional Commission of Forestry.

A call for a reality check in how data is provided was raised stating that FAOs role should be to reduce reporting burden and to assist developing countries in upgrading reporting skills and to act as a facilitator for knowledge dissemination, e.g. by establishing web based groups for question and answers concerning terminology.

A call of caution was made to avoid getting locked on to too much detail at an early state but to await the continual guidance of the proposed permanent advisory group. The proposed establishment of the advisory group does not replace the Kotka expert consultation.

Thursday 04.07.2002:
Afternoon Session

Chaired by Susan Braatz, UNFF

Risto Seppälä initially had a few practical comments concerning the final day of the expert consultation and the departure on 05.07.2002.

It was agreed to present the group work in the following order which would give the most logical flow of discussions: Group 2, group 1, group 3 and group 4.

Group 2 – National Assessments
Focus: Scope and links to international reporting.

Presented by: Rodney Keenan, Bureau of Rural Sciences, Canberra

The inclusion of carbon accounting accounting as a task for FRA was debated at length and the suggestion met both support and opposition in plenum. Supporters ment that it was logical for FRA to get involved in carbon debate as least as far as Annex 1 countries are concerned. Opposing this was a statement that carbon accounting was more a task for UNFF.

There was a general consensus of the need for ground truthing of RS surveys

In 1981 FAO produced a forest inventory manual (FAO Forestry Paper 27). A question was raised whether this would be updated. FRA replied that there were plans of an update, possibly by means of a web based version. FAO may ask for the assistance of the experts present in the consultation for comments and review.

The advantage of meassuring and presenting continual rather than distinct data has distinct advantages for users in that it is possible to customise data interpretation by setting threshold values and grouping of data.

Group 1 – National Assessments
Focus: FAO support.

Presented by Mohammed Saket, FAO.

A discussion followed on the need for clarfication on what is meant by NFI. The response was that very briefly an NFI is to beunderstood as the whole process encompassing collection,

processessing and reporting of data.

Given the limited budget of the FRA Programme it was asked to inform on what are the priorities of the programme. It was stated that promoting lowcost inventory has high priority. It was commented that FRA may consider changing the title from lowcost NFI to another title that would also encompass other wooded land.

A point was raised concerning the need to specify reporting requirements. It was mentioned that most international protocols already have specified requirements.

The process of identification of country corespondents for international reporting should be done in such a way as to avoid double reporting and reporting from several sources and different interpretations.

Group 3 – Global Assessments

Focus: Overall scope and role.

Presented by Brian Haddon, Canadian Forest Service.

FRA has two main components:

a) Support to National Forest Resource Assessment and reporting and;
b) GFRA: development, maintenance and reporting: on the set of harmonized and validated data set providing as accurate as possible information on forest resources.

The idea of expanding scope of GFRA to include information relating to C&I was discussed. In any case further discussion on this should wait for the outcome on common set of C&I from the coming International Conference on C&I at Guatemala later 2002.

Building National Capacities and/or facilitating process of reporting to International processes dealing with C&I was indicated as important areas for future work.

Concern was raised on the groups intent to develop new and alternative definitions. The response clarified that what was actually meant was to refine existing methods.

A comment to recommendation no. 2 in the presentation was that collection of information was done by countries and aggregated at international level and that a reformulation of the proposed formulation should be considered.

The suggestion that countries should submit timetables for FRA reporting was questioned. The response was that the FRA

programme in some way should know what is in the pipeline at national level to know what can be expected for the next FRA.

Group 3 touched upon FRA reporting of actual value of parameters and change of value over time – but not causes over time.

The importance of harmonizing the international reporting requirements as well as the timing (years) of reporting was underlined.

A discussion on the formulation of recommendation no. 14 of the presentation followed.

The statement that FRA should provide accurate data as mentioned in the first bullet of the document was suggested rephrased as the data that FRA has to provide should be as accurate at possible.

It was suggested that bullet 6 & 7 of the recommendation should be merged as they carry a similar message.

Intergovernmental users should be included in users list.

It was suggested to include some cost issues in the suggested user survey along the lines of " how much are users willing to pay for extra the information that can be generated by an RS?"

Group 4 – Global Assessments

Focus: Independent remote sensing surveys.

Presented by Andrew Gillespie.

Importance of ground truthing in all RS surveys was emphasized by several members of the audience.

RS do not explain the reasons for change and it was not a recommendation to include such explanations in an RS. Some discussion followed on the improving possibilities for explaining changes in the boreal zones using modern RS imagery.

Country surveys should in all cases involve a significant component of country involvement. RS and National Forest Assessments should go hand in hand.

The importance to maintain ability to make long term continual analysis of change and trends (including to continue time series at the regional level). The group work did not decide on a methodology but pointed out that a continuation of the FRA RS survey is certainly one option.

To obtain a better foundation for deciding upon the nature of a possible RS component of FRA, it was recommended by Working Group 4 to conduct a Feasibility study for an independent RS study.

A discussion followed on the size of the advisory group – no agreement was reached but the decision was left to the drafting committee. It was argued that data users and providers should not be seperated in the advisory group. It was stated that a size in number of members should be decided for the proposed group. It was emphasized that the advisory group should be composed of representatives from different disciplines (but with forestry knowledge).

Conclusions

The Chairperson rounded the session off by summarizing the main commonalities between the presentations.

There seemed to be agreement that:

- 10 year intervals the major reports seemed suitable, with 5 year intermediate updates.
- FRA should provide support to countries in developing NFIs
- FRA should provide principles and guidelines for NFIs
- FRA reporting should be done at global/national level.
- To meeting the demands of the users of FRA data a user requirement survey should be conducted before next session of the expert consultation.
- At the international level there are scope for synergies between organizations e.g. FAO and UNEP.
- The priority must be to improve quality of the core information.

Scope of FRA

On the question of whether the scope of FRA should be widened. Responses were that it seems more impotant to fill in the existing gaps in information before widening the scope. The cost implications in widening the scope should also be considered, as it will imply increased reporting expenditures for most countries. It was suggested that the user requirement survey should be held before it was possible to decide on the scope. The cost implication of a possible widening of the scope of FRA should be clarified before making a decision on the possible widening of the scope.

An opposing wievpoint was that scope should be widened and quality indicators should be attached to parameters. It is important that politicians get information on the accuracy of parameters.

FRA stated that the redefining of the scope could be seen, not necessarily as expanding the data be rather as a consolidation and anchoring of data in the criteria. 3

Voluntary Papers

Sharing the Information at Global and European Level

Risto Päivinen
Andreas Schuck
European Forest Institute

Introduction

In the knowledge-based economy, the ability to create and use new knowledge is the competitive advantage. However, creating knowledge is not enough. Knowledge must be managed as an asset to be accessible, it must be shared before it can be used; and it must be used to complete the value chain (Simard, 2000). The focus of forest information services, such as Global Forest Information Service (GFIS) of International Union of Forest Research Oganizations (IUFRO), or European Forest Information System (EFIS) prototype of the European Union, would be on sharing knowledge to facilitate its use, thereby leveraging its value.

"Improving access to forest information" was also formally recognised as a priority by the United Nations Conference on Environment and Development in 1992 in Agenda 21, Chapter 40. The Intergovernmental Panel on Forests in 1997 re-introduced the importance of gaining access to information: *'Attention should be given to world-wide access to information systems'* (Päivinen et. al. 2000) The IUFRO World Forest Monitoring Workshop in Portland concluded in 1996: "an Internet-based information system is needed, which would be simple, decentralized and adaptable to changing information.

The International Union of Forest Research Organizations established 1998 a Task Force "to develop a strategy for, and implement, an Internet-based metadata system that will provide co-ordinated world wide access to forest information. Finally, the Intergovernmental Forum on Forests (2000) urged: "international organisations, doner countries and financial institutions to enhance access to forest-related information." In 2000, the EU Joint Research Centre (JRC) awarded the EFIS project to a consortium of organisations led by the European Forest Institute. An IUFRO GFIS Special Programme was established in 2001.

Global forestry information market

Simard (2002) presents a business model involving a marketplace comprising three sectors: providers, users, and information brokers (Fig. 1) The purpose of the market is to enable, support, and facilitate the exchange of forestry data, information, and knowledge among providers and users. Market is used here in the sense of information transactions irrespective of the exchange of money.

A. Providers create and disseminate information. Providers can be grouped into four organizational categories with broadly differing mandates, processes, and societal roles: academia, public sector, private sector, and non-governmental organizations (Fig. 1). Every forestry-related organization in the world distributes and/or provides some access to its information holdings. Dissemination ranges from traditional publications to electronic documents. It also ranges from disseminating only official reports to allowing interactive access to databases.
B. Users acquire information and apply it to addressing issues or solving problems. However, they often have difficulty in finding what they need, filtering relevant content, and applying it to their situation. Simard (2002) divides the user communities into four groups, based on the nature of their information needs: practitioners, general public, policy makers, and business (Fig. 1). Users are faced with a cacophony of providers and information. The primary challenge is to discover who has what information related to their needs.
C. Information Brokers, add value by facilitating information transactions depicted by arrows in Figure 1. They may provide repository services, publishing and reformatting services, search and retrieval services, manage financial transactions, and interpretive services.

Libraries have performed an information broker function for more than two millennia. GFIS and EFIS play an information

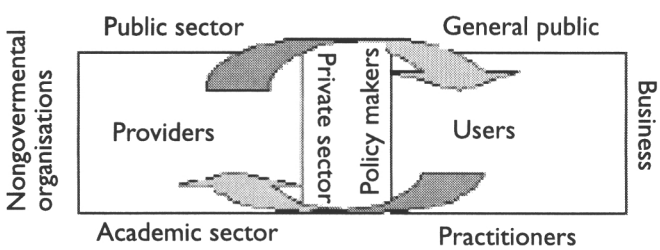


Figure 1. Data Providers and Users

broker role in the forestry information market.

Providers focus on organisational mandates; users on individual needs. There is a clear need for an information broker service to facilitate the exchange of information among providers and users.

A network of forest-related catabases

Using the Internet and WWW, the GFIS will be a distributed network of metadatabases, which catalogue the information resources of contributing GFIS partners. GFIS will function by providing a standardised core of metadata (catalogue) fields, a standardised set of key words on which to search and a standardised interface between web sites and the databases. This will enable the catalogues to operate in an interoperable environment. The EFIS follows the same principles.

The envisioned structure and information flow within the GFIS and EFIS is illustrated in Figure 2. EFIS and GFIS share the same basic structure and aim at technically compatible applications. It is both possible and desirable that the European Information System will be an integral part of the Global Service.

- Information Server: The GFIS Information Server will co-ordinate the house-keeping functions of the GFIS node network (e.g., user registry, general information, discussion forums, list servers, gateway to distributed metadatabases).
- Node: The first contact point for those accessing GFIS will be the existing web-site of a GFIS partner or node. From there, the user will be able to search all participating metadata catalogues for desired information.
- Resource Discovery System enables the search from the metadata.
- Metadata: These are 'data about data', and can be used to catalogue the data/information holdings of each GFIS node.
- Data/information: The content that the user requires. The data will be kept in its original location, and access to it will be defined as part of metadata by the data provider.
- Analysis toolbox enables the user to carry out an interactive analysis of data and combine different for integrated analysis

The basic functions of the Service are

- Data provision by the information provider, and
- Resource Discovery and
- Analysis by the user

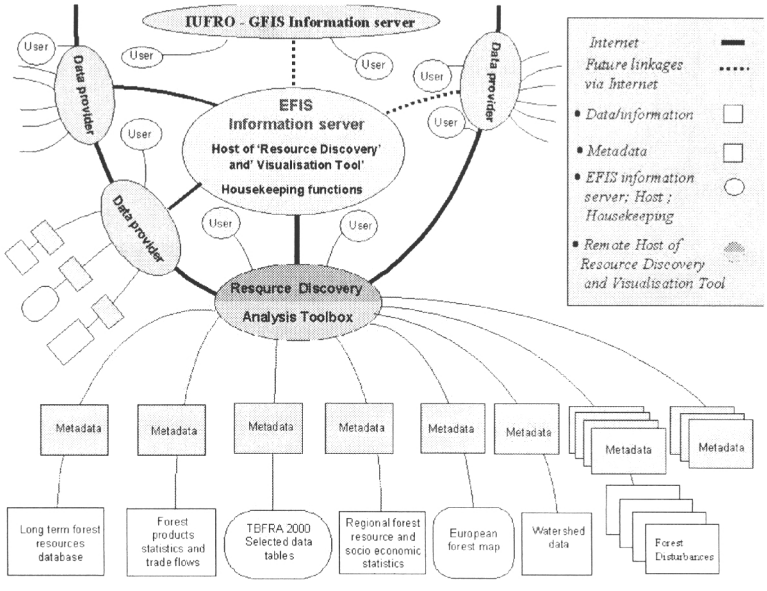
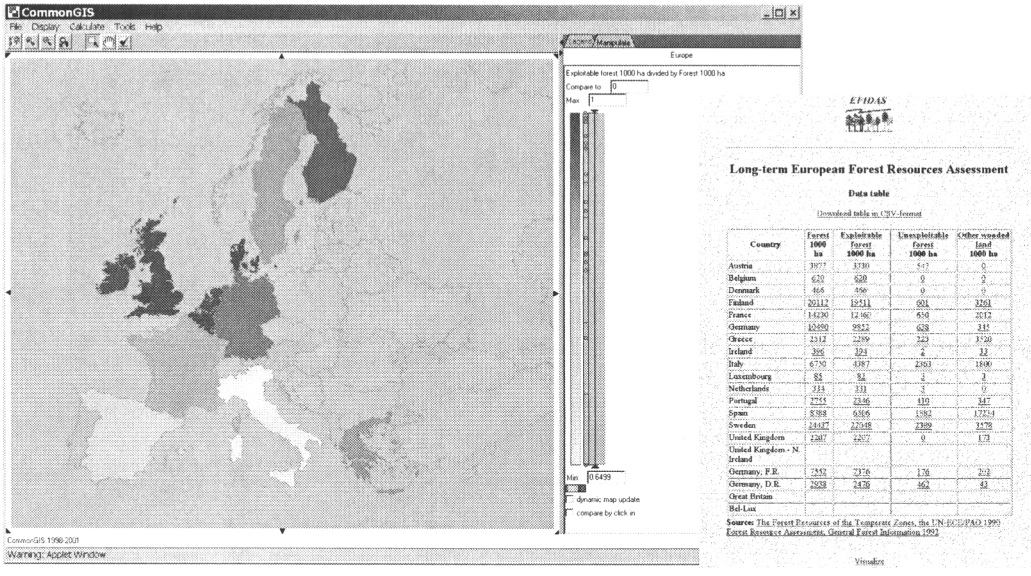


Figure 2. Principle structure of the European Forest Information System as a node for the Global Information Service (Schuck 2002).

For data provision, a metadata record is attached d to the data and made available for the service. In this stage, data itself will stay with the provider. The metadata is based on a set of fields that describe the information resource. There are 15 such fields including for example ('Publisher', 'Subject', 'Description', 'Format', 'Coverage' and 'Identifier'). The fields taken from the Dublin Core metadata Initiative (http://dublincore.org).

'Resource Discovery' allows retrieving forest information that is available to the system in the form of metadata. Once an information seeker has found a suitable information resource he or she may visit the identified website, by pressing the web link provided under the field 'Identifier' and browse the website and if available also data or databases.

Does the website contain data and made accessible they can then be further processed especially with regard to visual/ graphical display if linked to the so-called 'Analysis toolbox'. The Toolbox developed in the EFIS project allows to process both statistical and geo-referenced data. The following figures show the examples:



Country	Forest 1000 ha	Exploitable forest 1000 ha	Unexploitable forest 1000 ha	Other wooded land 1000 ha
Austria	3977	3330	647	0
Belgium	620	620	0	2
Denmark	466	466	0	0
Finland	20112	19511	601	3261
France	14290	12466	636	2012
Germany	10480	9852	628	335
Greece	2312	2289	223	3520
Ireland	395	394	2	22
Italy	6750	4387	2363	1800
Luxembourg	85	84	2	3
Netherlands	334	331	3	0
Portugal	3755	2846	430	347
Spain	8388	6806	1582	17274
Sweden	24427	22948	2389	3478
United Kingdom	2207	2207	0	173
United Kingdom - N. Ireland				
Germany, F.R.	7252	7376	176	202
Germany, D.R.	2928	2478	462	43
Great Britain				
Bel-Lux				

Source: The Forest Resources of the Temperate Zones, the UN-ECE/FAO 1992 Forest Resource Assessment, General Forest Information 1992

Figure 3. Using EFIS Resource Discovery to find information on forest resources. Data has been identified at EFI website. By pressing the button Visualise the identified data can be processed with the Visualisation Toolkit. Data source: UN-ECE/FAO, 1992.

Potential Applications

On the basis of the interaction with potential data providers and data users, information was collected concerning potential applications, desired technical developments and functionality options. An important development track will be to investigate the possibilities to tailor the system for different needs of data providers, data users and data disseminators in the European context. The systems like GFIS and EFIS have ' the potential to serve as:

A) reporting tool

For international reporting needs, FAO, the Kyoto Protocol process etc. The benefit for using this type of system would be harmonisation of information and avoiding multiple reporting. A system can serve reporting needs and information dissemination not only at the international but also at national or subnational level.

B)A decision support system

To bring together information from different sources, facilitate

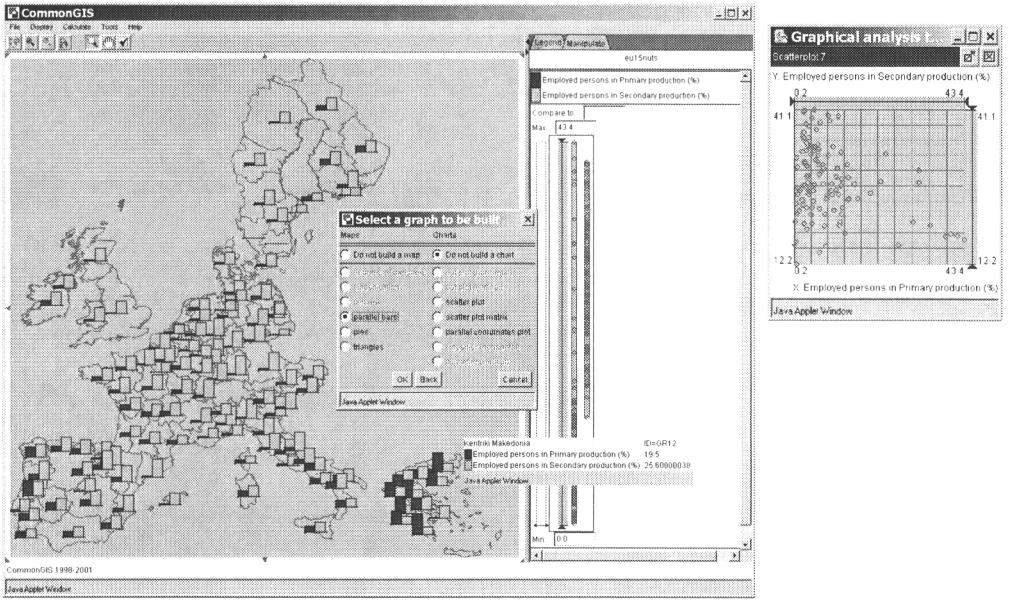


Figure 4. Employment rate in the primary and secondary production in Nuts 1 and 2 regions in the EU 15. Option chosen is '*Parallel Bars*' and '*Scatter plot*'. Source: Regional Forest Resource and Socio-Economic statistics in European Union countries available at EFI.

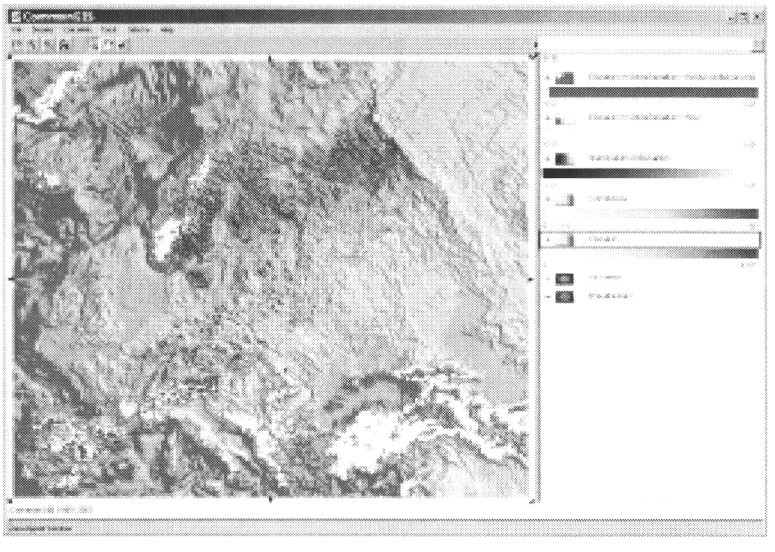


Figure 5. Processing of geo-referenced data. Coniferous forest area (forests with a proportion of >60% coniferous species) between 1000 meters and 1500 meters in elevation (red) in Europe. Other land between 1000 and 1500 meters in elevation (yellow).

holistic views and synthesis and by providing input for models, such as timber trend studies, global warming, etc.

C) A tool for research and education

A system has the benefit of utilising the linkage to geographical units (polygons). This approach is straightforward and allows effective delivery of the message that specific raw or aggregated data sets carry. In the information-gathering phase, it demonstrates outliers that can be identified and sorted; and in the analysis phase, it demonstrates interesting anomalies, which can be targets for further studies.

In order to achieve the establishment of both global and regional forest information services, further technical development is needed, as well as agreements on metadata and other standards. Without assistance arrangements for both data providers and users the user-friendly access to data cannot be guaranteed of other similar services ín agriculture, environmental and other related fields must be followed in order to fully utilise the possibilities of cross fertilisation

References

Päivinen, R., E. Landis, R. Mills, G. Petrokofsky, D. Langor, and A. Schuck. 2000. Global Forest Information Service. Proc: World Forestry Congress, Kuala Lumpur, 7-12 Aug. 2000.

Schuck, A. European Forest Information System. EFINEWS Vol 1. 2002. p. 16.

Simard, At. 2000. Managing Knowledge at the Canadian Forest Service. Natural Resources Canada, Canadian Forest Service, Ottawa, Ontario. 88p.

Simard, A. 2002. An Informtion Marketplace Approach for a Global Forest Innformation Service. Paper submitted to the World Forestry Congress 2003.

Sustainable Forest Management, Data Requirements and the Forest Resources Assessment – The European Experience

Abstract – Ewald Rametsteiner, MCPFE Liaison Unit Vienna

The "Ministerial Conference on the Protection of Forests in Europe" (MCPFE) is an ongoing initiative for co-operation between 44 European countries to address common opportunities and challenges related to forests and forestry. It also involves a broad range of international organisations and observer countries. The MCPFE's overall goal is to promote sustainable forest management (SFM) in Europe through a participatory and open pan-European co-operation, which respects the cultural diversity. Three Ministerial Conferences on the Protection of Forests in Europe have taken place, which are considered milestones of the development of international forest policy.

The pan-European criteria and indicators (C&I) were developed in the follow-up process of the Helsinki Resolutions, adopted in 1993. They constitute a common policy instrument, *inter alia,* for monitoring, assessing and reporting progress towards SFM. The 6 criteria represent the most important aspects of SFM on a conceptual level. Progress towards SFM is evaluated through 27 quantitative indicators and 101 descriptive indicators. Progress reports based on the pan-European C&I were issued in 1995, 1996 and 1998. For the last Ministerial Conference in 1998 the MCPFE reported on the status of SFM in Europe mainly based on the UN-ECE/FAO Temperate and Boreal Forest Resources Assessment 2000, as well as on some additional international and national sources.

At the Ministerial Conference in 1998 the ministers responsible for forests formally adopted the 6 criteria and endorsed the associated indicators by signing Lisbon Resolution L2. They also called for further improvement of the indicators. For that purpose a series of evaluations were conducted. An Advi-

sory Group (AG) was formed, representing relevant organisations in Europe including UNECE/FAO, and a wide range of experts was consulted through a series of four workshops to ensure that best use is made of the existing knowledge on indicators and data collection aspects in Europe. The AG recommended a set of improved indicators to the MCPFE that increased the number of quantitative indicators from 27 to 36 by increasing significantly the number of indicators for wider socio-economic functions. The AG recommendation decreases the number of qualitative indicators from 101 to 17. By mid 2002 this recommended set is to be discussed and adopted in the MCPFE.

Some observations made in the course of these developments are: the range of information demand increased considerably. Today, SFM is a comprehensive concept that embraces biodiversity, carbon and other forest related issues. Indicators are a key concept for monitoring, assessment and reporting on progress towards SFM. This tool has been taken up by several international processes, which are increasingly better co-ordinated. This makes the identification of international information demand more easy. In parallel, nine regional processes are elaborating criteria and indicators, covering more than 150 countries. The awareness of very similar criteria and indicators in these various processes is increasing, possibly resulting in the development of a global set of C&I. In Europe, the collaboration between the UNECE/FAO and the MCPFE in the development of indicators for SFM and in their monitoring, assessment and reporting has been very fruitful for both sides.

On indicators and related data, several issues turned up: data collection related to SFM comprises more than forest resources in the strict sense. Also the periodicity of demand for information by policy makers is difficult to align with the supply data. There are several areas where information demand is high, yet not sufficient data is available, including protected areas and the value of non-marketed services. This is to be seen on top of existing difficulties of general data availability, data quality and accessibility. A further data related aspect is the increased call for comparable data over time, which is a prerequisite to a key goal: monitoring progress towards SFM. Last but not least, data collected on fundamental forest aspects disproves widespread views of society, however these views persist, which indicates a need for more effective communication.

Some of the consequences that follow from the above are: an

active involvement of institutions involved in data collection in the development of criteria and indicators pays off, as it creates a win-win situation. Nevertheless, the wide range of data needed to monitor, assess and report comprehensively on SFM increasingly requires collaboration and coordination across data collectors. It is in their own and the policy makers interest to tailor data collection to actual needs and uses and thus avoid data "graveyards". Indeed, data collectors increasingly have to consider how to organise user-specific "just-in-time" access to their data. Success in attracting resources towards such ambitious goals is certainly a major obstacle.

Sudan's Experience in Forest Resources Assessment

Prepared by
Dr. Abdelazim M. Ibrahim

Review of past inventories

A number of localized forest inventories were conducted in the Sudan since 1958. The earliest relatively wide scale inventory, which was sponsored by the Canadian International Development Agency (CIDA) during the period 1983–1984, covered an area of 27 100 km^2 in the Blue Nile and Bahr el Ghazal provinces (Thirakul 1984). CIDA's inventory followed the standard Canadian methodology of aerial photography to determine area and fieldwork in the form of randomly selected sample plots to determine standing volume. The work was of high standard but expensive (costing approximately US $ 4/ha) and had very little involvement of Sudanese foresters. This type of inventory is regarded as more suitable for management purposes in areas of high potential where the value of the forest justifies the high cost.

To overcome the high cost of aerial photography a pilot study was carried out in 1987 by a team from Lund University of Sweden in the Gedarif area. Based on the results of this study the exercise was expanded to cover an area of 580 000 km^2 covering the whole Kassala province, Central and Eastern Sudan (Hellder 1991). The inventory was carried out as part of the Fuel wood for Energy Project GCP/SUD036/NET implemented by the Food and Agriculture Organization of the United Nations (FAO) and the Forests National Corporation of the Sudan (FNC), Sudan's specialist agency in forestry and funded by the governments of the Sudan and the Netherlands. The project used Landsat Thematic Mapper (TM) data combined with limited field data to map the woody biomass in 580,000 km^2. The limited fieldwork and problems of locational inaccuracies of field sample plots seem to have contributed to overestimation in some areas and underestimation in others. The inventory gave no details about species, size or number of trees making the output from that inventory of limited use to the

FNC.

The Sudan reforestation and Anti-Desertification Project (SRAAD) funded by Sudan Government and the United States Agency for International Development (USAID), which was started in 1989 over an area of 72 600 km^2, also utilized TM data but used a much higher number of field plots and visual interpretation of imageries. Location of sample plots in the field was carried out using the global positioning system (GPS) which helped to avoid locational problems faced by previous inventories. SRAAD project used systematic sampling 7km x 7km. The outputs of the project were stand and stock tables for the surveyed areas and image woody vegetation distribution maps. The project used both image analysis and geographic information system (GIS) technology (Anon 1990).

The first National Forest Inventory (NFI)

The need for a NFI was especially thought of after the completion of the second national forest product consumption survey (NFPCS) in 1995. The NFI had started in March 1995 and completed in July 1997. The two surveys were carried out by FNC with full support of FAO and the government of the Netherlands.

Objectives of the NFI

The prime objective of the NFI was to provide the FNC with basic information on the current state of the country's forest resources for the purposes of socioeconomic development, maintenance of environmental stability and enhancement of the quality of life for the people of the Sudan. The immediate objectives, however, were:

- To provide a reasonably accurate picture of the extent and conditions of the forest resources as regard forest type, species distribution, tree cover, volume and increment;
- To provide a general picture of the current land use patterns; assessment of the extent of environmental degradation with specific consideration to wind- and water- erosion;
- To provide up-to-date vegetation map; and
- Establish a mechanism to monitor the state of the resource and maintain a continuous forest inventory.

Area covered

The survey covered the whole of northern Sudan south of latitude16° N except for some inaccessible areas. The actual total area covered was 62.3 million ha (about 66% of the targeted area). This area accommodates the majority of the Sudanese people including more than 4 millions of locally displaced people and refugees from neighboring countries. Most of the agricultural activities and animal husbandry are also practiced in this part of the country.

Methodology

The methodology was designed taking into consideration the skills, experience and resources of the FNC available for the completion of inventory. The design was made in such a way as to enable the incorporation of details from management level inventories, as they become available. The GPS was used to allow the inventory to become a continuous forest inventory (CFI). The basis of this methodology is the measurement of fixed area plots on a systematic grid through out the inventoried area. Plot locations were determined by GPS. Plot details were similar to those used in the SRAAD Project (10-km grid). The total number of plots enumerated in the national inventory was 6160 plots. The inventory, however, did not use satellite imagery as initially planned therefore the maps produced gave rough land-use and forest type distribution.

Results

The results covered such parameters as land cover, land use, land condition, crown closure, number of species, volume of woody material, stand and stock tables, regeneration and a comparison of harvest level (annual allowable cut) and consumption in the inventoried area. In figure terms, the most salient parameters revealed by the NFI include: total number of tree and shrub species encountered in inventoried area (84 species); total area of forest with crown closure >10% (4.94 million ha); total volume of woody vegetation (166.8 million m^3); total average volume/ha (2.49 m^3); total annual allowable

cut calculated as 7% of total area (11.7 million m^3); total annual wood consumption for the 1995 (16.5 million m^3); total area constituted as forest reserves in the inventoried area (7.1 million ha) and total area of forest under forest management plans in inventoried area (116 274 ha).

Conclusions

- In spite of the shortcomings of NFI for having not covered inaccessible areas and having not used satellite images it did provide valuable information when coupled with the results of the NFPCS.
- The results of the two surveys have established a benchmark and allowed comparison between demand and supply of forest products. The results are also useful policy formulation and for decisions on management, reservation, biodiversity conservation, protection of endangered species, land use planning, and desert control measures. Based on the results of these two surveys a varieties of remedial measures has already been implemented (e.g. banning of horizontal expansion of mechanized farming at the expense of forests and rangeland, which has been a constant feature of Sudan's agricultural policy over the last century; the information provided by the TNFPCS which revealed that the contribution of forests to national energy supply amounts to 71% of the total energy consumed in the country had triggered efforts aiming at reduce wood consumption by about 50% in a 5-year time starting 2002; through using wood energy alternatives following the commencement of oil production in the country;
- The NFI provided an excellent base for monitoring environmental changes, forest areas and forest products in the country.
- The recent FRA 2000 study undertaken by FAO using remote sensing techniques considered areas not covered by the NFI has complemented the results of the NFI and gave a more reliable picture of the state of the forest resources of the Sudan.
- Support relevant to the completion, continuity and maintenance of the NFI process and management of the generated information is evidently needed to enable FNC and other national agencies involved in natural resources management to conduct their duties.

References

Anonymous (1990) Sudan Reforestation and Anti- deforestation (SRAAD) Pilot Project (Procedure Handbook).

Forest Product Consumption Survey in the Sudan. Forests National Corporation, Khartoum and FAO, Rome. May 1995.

Hellden, U. (1991). Woody Biomes Assessment for Resources Planning and Management, eastern Region of the Sudan. Final report FAO/TF/SUD/7033-2/NET/FODO. Lund University, Sweden.

National Forests Inventory for the Sudan. Forests National Corporation, Khartoum and FAO, Rome. July 1998.

Thirakul, S (1984). Forest Inventory and Market Demand Survey Report. The Forest Inventory Report. Bahr El Gazal and Central Region. Democratic Republic of the Sudan and Group Poulin Therjault. Quebec, Canada.

UNEP's Collaboration in the Global Forest Resources Assessment

The UN Environment Programme was founded in December 1972 in order to perform a number of inter-disciplinary tasks in the environmental field, with the secretariat serving as a focal point for co-ordination of environmental activities across the entire UN system. Among UNEP's functions are:

- analysis of the state of the global environment;
- assessment of global and regional environmental trends;
- provision of policy advice;
- provision of early warning information on environmental threats;
- catalysing and promoting international co-operation and action based on the best scientific and technical capabilities available.

UNEP's mandate has caused it to be involved in a wide range of environmental assessment activities, drawing on a well-developed network of regional centres of information and expertise. The Global Environmental Outlook process led by UNEP has helped to develop both improved data on global environmental issues and specialised working groups that draw on the substantial expertise of its regional collaborating centres to develop scenarios and forecasts of likely changes in those issues. The Millennium Ecosystem Assessment, of which UNEP is a co-executing agency, is building on these and other data to provide integrated ecosystem assessments, that is analyses of the capacities of ecosystems to provide goods and services important for human development.

UNEP has in the past collaborated closely with FAO in the production of the Global Forest Resources Assessment, beginning with the FRA 1980. The Global Environment Monitoring System of UNEP and FAO jointly conducted the 1980 Tropical Forest Resources Assessment, a milestone initiative that provided, for the first time, essential data on tropical deforestation. Subsequently, UNEP was closely involved in helping FAO to expand the coverage if the FRA to a wider range of forest goods and services. Specifically, UNEP helped with the incorporation of data on environmental aspects of forests, and especially

biodiversity, into the FRA2000.

Future global FRAs should continue this trend towards coverage of the wider values and benefits of forests and the interrelations among them, including their role in biodiversity preservation, global climate regulation, and mediation of hydrological cycles. The FRA should also address the pressures acting on forests and their effects on the goods and services forests provide, as well as the ways in which they are likely to change in the future.

UNEP's many global and regional assessment activities make it well-positioned both to contribute to the FRA and to help the FRA to make the best use of opportunities for collaboration and co-ordination among environmental assessments. Ongoing work with eight global environmental assessments (Table 1) will generate a technical report on harmonisation among them and further meetings among the managers of these assessments later this year. The outcomes of these deliberations can provide important input to the design and development of the FRA.

In terms of content, UNEP's principal contribution to the next global FRA will be in the generation and provision of information and tools relating to:

- biodiversity associated with forests;
- the interrelations between biodiversity preservation and other forest functions;
- the pressures acting on forest biodiversity, their impacts and future trends;
- response options for moderating such pressures.

UNEP's substantive contributions on these key issues could include:

1. Capacity building on biodiversity assessment, indicators and analyses from national forest inventories, including application of approaches on forest integrity and naturalness developed for FRA2000

UNEP-WCMC has extensive experience in developing biodiversity indicators for use by international bodies such as, FAO, GEF, WWF, and by national organisations. The approaches developed have included spatial analysis tools, including fragmentation or integrity indices, and gap and priority analyses, and tools for combining data on status and trends of species populations in target ecosystems (the Living Planet Index).

Table 1. Scope and scale of Global Environmental Assessments

Assessment	Scope	Scale	Lead organisation	Timetable
Millennium Ecosystem Assessment (MA)	Ecosystems – Goods & Services	Global, regional, national, local	UNEP	2001–2005
Global International Waters Assessment (GIWA)	International (transboundary) waters	Global, regional	UNEP	1999–2002
Global Environmental Outlook (GEO)	Environment	Global, regional	UNEP	GEO-3 report 2002, bi-annual
Forest Resources Assessment (FRA)	Forests	Global, regional, national	FAO	FRA 2000 Every 10 years
State of the World Forests		Global, regional, national		Bi-annual reports
World Water Assessment Programme (WWAP)	Freshwater	Global, regional, basins	UNESCO	2000, 1st Report 2003
IPCC – Third Assessment Report	Climate Change	Global, regional	IPCC	3rd report 2001
Dryland Land Degradation Assessment (LADA)	Drylands	Global, regional	FAO	In development from 2001
World Resources Report	Environment (themes)	Global, regional	WRI	Bi-annual

Many of these indicators are suitable for application at global, regional and national scales. UNEP-WCMC is currently co-ordinating a GEF Medium Sized Project on developing and *implementing* biodiversity indicators for national use, which will executed by partners in four countries. Work on forest indicators will be done by the Ecuadorian team.

Experiences from this project and from UNEP-WCMC's other work on indicators will provide an excellent basis for

developing capacity building materials and programmes to help countries obtain information on forest biodiversity from their national forest inventories.

2. Further development of the LCCS as a basis for harmonised assessment of the area, distribution and status of forest types world-wide

The work programme on forest biodiversity of the CBD calls for the development of an agreed classification of the world's forests that is meaningful for biodiversity as an essential tool to assess the conservation status of forests and their biodiversity. The LCCS developed jointly by FAO, UNEP and others provides an excellent tool for this task. UNEP with its regional networks can help to support the further development and validation of the LCCS, and collaborate in applying to produce a global forest classification that could be used to generate a global overview of the extent and distribution of forest cover types. However, the LCCS needs to be broadened to incorporate forest ecosystem types as well as a land cover classification, in order to strengthen its value to biodiversity assessment. UNEP could also help to support the use of the LCCS at national level and ensure symmetry between its national and international applications.

3. Analysis of unique and threatened forest types through the assembly of spatial data on pressures on forests.

The work programme of the CBD on forest biological diversity and the deliberations of the UNFF call for an overview of unqiue forest types, and the most threatened forest types world-wide. UNEP-WCMC can help to provide this in collaboration with partners by applying novel analyses to spatial data on cover of different forest types and combining these data with mapped data on patterns of diversity and indicators of pressure on forests.

The results of these analyses will be global maps of forest cover displaying indicators relating to forest biodiversity status and pressures. These will include spatial integrity of forest cover, naturalness or wilderness value, protection, taxonomic richness for selected groups of organisms (e.g. mammals, fishes, birds, tree species, etc.), and vulnerability of forests to

climate change and other threats. The maps could be accompanied by global and regional statistical summaries of each indicator, and guidance for adaptation of the indicators for national use.

Such maps could be used to define forest areas of particularly high biodiversity value (hotspots) and to identify those that are potentially in the best condition for retaining their biodiversity. They could also be used to highlight forest areas where biodiversity is subject to high degrees of pressure, and to identify the degree to which current management designations address these patterns. The maps would therefore serve as valuable tools for conservation planning.

Such approaches could usefully complement and support efforts to identify and assess those forest types of particular importance or with unique characteristics at the national scale, an element that should be incorporated in future forest resource assessments.

4. Development and application of scenario building approaches, including those used in the contexts of GEO and the MA to forecast trends in forest biodiversity, and capacity building for the use of these approaches at regional and national scales;

Scenarios are increasingly being used to inform policy development and implementation, by illustrating the possible outcome of current trends, and by highlighting the implications of different policy decisions. The development of scenarios has become an important tool by which scientists communicate the results of their research to decision makers, as well as constituting a significant research endeavour in its own right. An example is provided by the Intergovernmental Panel on Climate Change (IPCC), which has developed climate change scenarios through workshops and meetings involving experts in modelling, climate impact assessment and emissions scenarios. These scenarios have formed the basis of the decisions made by parties to the UN Framework Convention on Climate Change (UNFCCC), which provides the overall policy framework for addressing the climate change issue.

UNEP plays a substantial role in developing scenarios of future environmental change, through flagship initiatives such as the Global Environmental Outlook (GEO) and the Millennium Ecosystem Assessment. However, to date, the implications

of future environmental change for global forest biodiversity have received very little attention within such initiatives. Using its global biodiversity datasets and the scenarios of development and environmental change developed by the GEO, MA and other processes, UNEP-WCMC will be able to examine the future distribution and status of forest biodiversity at global and regional scales.

5. Tools for identifying priorities and implementing forest restoration programmes

Increasing recognition of widespread environmental degradation has led to a growth of interest in both the science and practice of ecological restoration. The main aim of such restoration is to re-establish the key characteristics of an ecosystem, such as composition, structure and function, which were present prior to degradation. It has been suggested that ecological restoration is a crucial complement to the establishment of protected areas for safeguarding biodiversity, and it is widely anticipated that restoration will become a central activity in environmental management in the future. The importance of forest restoration is recognised both by the UN Forum on Forests and in the work programme on forest biological diversity of the CBD.

A large number of restoration projects have now been initiated in different parts of the world, focusing on a variety of different ecosystem types, including grasslands, wetlands and forests. Experience of restoration projects to date has highlighted how difficult such ecological rehabilitation can be in practice. Although many degraded ecosystems display an ability to recover through natural processes if the causes of degradation are removed, in many areas the extent of degradation has been so severe that greater management intervention is required for restoration to be effective. For example, severely deforested areas may require large-scale tree planting in order for forest ecosystems to re-establish on a particular site. Restoration projects may also be difficult to manage or monitor, as it is often difficult to define with precision what the structure, composition or function of given ecosystem was like prior to degradation, particularly in areas where such degradation occurred a long time ago.

UNEP-WCMC, in collaboration with other partners including WWF and IUCN, has developed a number of tools for

prioritising areas and sites for restoration and for monitoring its progress and impacts on biodiversity. These include spatial analyses to identify areas that combine high feasibility for restoration with high potential benefits, especially for biodiversity. Adaptations of the analytical tools for evaluating spatial integrity and naturalness of forests can be used as additional tools for prioritisation and to monitor progress and cumulative impacts of restoration efforts at a range of spatial scales. Some of these can be applied at regional and global scales and others can be made available through capacity building programmes.

Conclusion

In conclusion, UNEP can contribute a number of useful tools and results of ongoing work to the implementation of a collaborative plan of action for the Global Forest Resources Assessment. It looks forward to helping to ensure that the distribution of forest biodiversity, its status and trends, the pressures acting on it and the response options for moderating these pressures are all addressed by the FRA process both globally and nationally.

Indonesia Forest Resources and National Forest Inventory

Dr. Harry Santoso

Abstract

Most of the tropical rainforest of Indonesia is lowland rain forest < 1000 m which cover about 65.42 million ha or 54.6 % of total forest area. Based on the synchronization between forest land use by consensus (TGHK) and provincial spatial plan (RTRWP), the total forest area in Indonesia are 120.35 million ha.

There are three projects of the National Forest Inventory (NFI) in Indonesia done by Ministry of Forestry up to now i.e. (i). Forestry Institution and Conservation Project (1989–1996) is financed by World Bank and assisted by FAO, based mainly on interpretation of Landsat MSS / Landsat TM image year 1986–1991, SPOT image and aerial photograph; (ii). Recalculation of Forest Resources (2001) is financed by national budget, based on interpretation of Landsat TM/ Landsat ETM-7 image year 1997/1998–1999/2000; and (iii). Master Plan for Land and Forest Rehabilitation (2002) is financed by national budget based on digital interpretation of Landsat ETM-7 image year 1999/2000.

Based on the latest NFI's project above, the major classification of forest cover is adapted in the forest vegetation and land use maps, comprises of 24 classes i.e. (i). 7 classes of forested area ranging from primary dry land forest to plantation forest; (ii). 15 classes of non forested area ranging from shrub/bush until airport; and (iii). 2 classes of not available data consist of cloudy and none. The distribution of forest cover area in Indonesia year 2002 (except Papua province because have not been finished yet) i.e: (a). 60.086 million ha are forested areas which is 52.557 million ha in the state forest land; 68.538 million ha are non forested areas where 27.626 million ha in state forest land; and 18.529 million ha are non data where 13.374 million ha in state forest land.

Introduction

1. Indonesia, an archipelago lying on the equator, comprises of about 17,508 islands, of which 6,000 are inhibited, and occupies a 5,100 km stretch from the Indian to the Pacific Ocean.
2. With the total land area of about 191 million hectares, Indonesia is endowed with rich ecosystem, species and genetic diversity particularly in its lowland rainforest and marine ecosystem.
3. Most Indonesian forests are highly diverse evergreen tropical rainforests with forests canopies at least 30 meters high, rich in lianas and climbing plants, and epiphytes. Indonesia has one of the largest expanses of tropical rainforest in the world, after Brazil and Zaire.

Forest type

4. Based on habitat factors such as soil, climate, altitude, topography, geology and rainfall, the tropical rainforest of Indonesia can be classified as follows : coastal forest, mangrove forest, swamp forest, peat swamp forest, lowland rainforest, sub montane rainforest, montane rainforest, sub montane and montane monsoon forest, heath forest, savannah forest, forest on lime stone, forest on ultra basic rocks and riparian forest.
5. The area of Indonesia forests by formation can be seen in Table 1. Most of them is lowland rain forest (< 1,000 m) which cover about 65,422,400 hectares (54.66 %).

Forest land use

6. Indonesian forests can be divided into the following types based on their use or function :
   a. Conservation and Park Forest, is for the preservation and conservation of the sources of the biological species diversity as well as of the system for life support, development of knowledge, education and tourism. Conservation and Park Forest is divided into Nature Reserve, Wildlife Sanctuaries, National Park, Grand Forest Park, Nature Recreational Park and Hunting Park
   b. Protection Forest, is forest area which has specific physical characteristics which function mainly for water catchment and control.
   c. Production Forest, is forest area open for the production of wood, rattan, resin and other non timber forest products.

Table 1. Classification and Area of Forest Types in Indonesia

No	Forest Type	Area (Ha)
1	Lowland rainforest, < 1000 m	65,422,400
2	Sub montane rainforest, 1000 – 2000 m	9,983,900
3	Montane rainforest, > 2000 m	2,909,300
4	Forest on ultra basic rocks	2,047,100
5	Forest on lime stone	7,942,400
6	Monsoon forest	17,300
7	Mixed savannah forest	2,669,900
8	Heath forest	3,747,400
9	Riparian forest	1,148,300
10	Lowland wetland forest	1,232,200
11	Peat Swamp forest	1,369,800
12	Swamp forest	4,690,300
13	Mangrove forest	3,322,000
14	Bamboo, nipah and sago forest	3,858,300
	TOTAL	119,700,500

Source: RePPProT (Regional Physical Planning Program for Transmigration), 1990

Production Forest is divided into Limited Production Forest, Permanently Production Forest and Convertible Production Forest.

7. The Indonesian state forest areas data has changed because of the progress of the spatial plan data both in provincial level (RTRWP) and district level (RTRWK). According to the Forest Land Use Plan by Consensus (TGHK) in year 1990 the forest area totals 141.77 million hectares. While in the implementation of the Act No. 24 of 1992 on Spatial Use Management, the Ministry of Forestry attempt to synchronize between TGHK and RTRWP with the purposes to establish a balance both spaces for forestry and others in order to form a forest land use as an integrated part of spatial regional plan. After the synchronization the total forest areas are 120.35 million hectares.
8. Based on Act No. 41 of 1999 on Forestry the forest areas should be designated by Minister of Forestry decree. Up to now the forest areas have been designated 108.57 million hectares consist of 23 provinces (formerly there are 26 provinces in Indonesia). Forest designation in the rest provinces have not been finished yet i.e. North Sumatra, Riau and Central Kalimantan. The forest areas by function can be seen in Table 2.

Forest cover distribution

9. The data of forest cover distribution is resulted from the National Forest Inventory (NFI) project. The NFI is both an institutional development and a forest resources information generating project.
10. The broad objective of the NFI project is to develop and establish an operational NFI system and forest resources monitoring capability in the Ministry of Forestry (MOF). This will have the function of production information on forest and land use for forestry sector policy formulation, planning, management and control at the national, provincial and district level.
11. There are 3 (three) project activities of NFI under Ministry of Forestry so far i.e. :
    a) Forestry Institution and Conservation Project (Forestry – I) in 1989–1996 financed by World Bank Loan and assisted by FAO, which was based mainly on the visual interpretation of 1986–1991 Landsat MSS / Landsat TM, manual mapping, and secondary data sources such as SPOT image, and aerial photographs.
    b) Recalculation of Forest Resources in 2001 is funded by National budget, was based on Landsat TM/Landsat ETM-7 image year 1997 / 1998–1999 / 2000.
    c) Master Plan for Land and Forest Rehabilitation in 2002 is funded by National budget, using the latest Landsat ETM-7 image of 1999–2000.

Table 2. Forest Land Use or Function in Indonesia (in million hectares)

No	Forest Function	TGHK (1990)	Synchronization of TGHK and RTRWP (1999)	Minister of Forestry Decree on Forest Designation (1999–2001)
A	Permanent Forest Area	111.774	112.275	94.900
1	Conservation and Park Forest	19.153	20.501	21.825
2	Protection Forest	29.649	33.520	29.037
3	Limited Production Forest	29.571	23.057	16.225
4	Permanently Production Forest	33.401	35.197	27.823
B	Convertible Production Forest	30.000	8.078	13.671
	TOTAL	141.774	120.353	*/ 108.571

Source: The Agency for Forestry Planning, Ministry of Forestry, 2001*/ Not including 3 provinces (North Sumatera, Riau and Central Kalimantan), *because the process have not been finished yet.*

12. The latest result of forest cover distribution based on the third project above is presented in Table – 3. The major classification which is adapted in the forest vegetation and land use maps comprises of 24 classes are as follow:

A. Forested area:
- Primary dry land forest
- Secondary dry land forest
- Primary swampy forest
- Secondary swampy forest
- Primary mangrove forest
- Secondary mangrove forest
- Plantation forest

B. Non Forested area:
- Shrub / bush
- Swampy bush
- Savannah
- Estate
- Dry land agriculture
- Dry land agriculture and shrub
- Transmigration
- Wet land
- Brackish water
- Opened land
- Mining area
- Settlement area
- Water body
- Swamp
- Airport

C. Non Data
- Cloudy
- None

References

– 2001, Recalculation of Production Forest, Protection and Conservation Forest, Second Edition. The Agency for Forestry Planning, Ministry of Forestry, Jakarta.

– 1996, Final Report : Indonesia Forest Resources Statistic (Except Java Island), Volume – 1, NFI Project, DG. Of INTAG, Ministry of Forestry, Jakarta.

– 1990, RePPProT – Regional Physical Planning Program for Transmigration, Ministry of Transmigration, Jakarta.

Table 3. Forest Cover Areas in the Major Islands of Indonesia Using Landsat ETM-7 image of 1999–2000 (*in million hectares*)

No	Major Islands	Item	Forest Area	Non Forest Area	Total
1	Sumatera	F	12.609	1.735	14.344
		NF	11.407	15.052	26.459
		ND	4.459	1.835	6.294
2	Kalimantan	F	26.186	3.257	29.443
		NF	10.333	8.132	18.465
		ND	3.877	1.397	5.274
3	Sulawesi	F	6.990	1.219	8.209
		NF	1.713	4.696	6.409
		ND	2.828	0.908	3.736
4	Java	F	1.860	0.488	2.348
		NF	1.223	9.390	10.613
		ND	0.044	0.366	0.410
5	Ball	F	0.062	0.031	0.093
		NF	0.034	0.341	0.376
		ND	0.035	0.068	0.103
6	Nusa Tenggara (East & West)	F	1.255	0.631	1.886
		NF	1.207	2.967	4.174
		ND	0.290	0.412	0.702
7	Maluku	F	3.594	0.167	3.761
		NF	1.709	0.332	2.041
		ND	1.840	0.157	1.997
8	Papua */	F	*/	*/	*/
		NF	*/	*/	*/
		ND	*/	*/	*/
	Jumlah	F	52.557	7.529	60.086
		NF	27.626	40,912	68.538
		ND	13.374	5.145	18.519
		Total	93.557	53.586	147.143

Source: The Agency for Forestry Planning, Ministry of Forestry (2002)

Note :

F = forested

NF = non forested

ND= not available data

*/ The analysis still on going for Papua province

Similarities and Needs on Forest Resource Assessment in Colombia and at the Global Scale

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Introduction

The main aim of this paper is to show the various noticeably similarities on information demand and framework for forest resources assessment within country and at the Global scale. Also, there is an interest in showing the ways the challenge for attaining better and integrated information for the forest sector is being undertaken at the country level. Due to its natural settings and present institutional arrangement and posed demands on environmental and forest information, the country could be a good laboratory for testing strategies, methods and mechanisms aimed to improve periodic forest assessment designs. On this matter, the paper is also an offer to FAO for seeking and finding in Colombia a good opportunity to test alternative ways of integrated forest resource assessment, as any improvement in either scale should beneficiate the other.

A comprehensive report on Colombian forest institutions and related information management was produced (2002) under FAO Regional Office project "Information and analysis for sustainable forest management: joining national and international efforts in 13 tropical countries of Latin America (GCP/RLA/133/EC)". A more detailed comparative analysis on forest cover and deforestation information generated in the country will be published shortly by Andrade and Van der Hammen[1].

Background

Colombia has undergone vigorous institutional changes during last decades. With regard to natural resources management, three main periods of time could be roughly characterized (Table 1). Since early nineties up to now, policies, regulations and planning related to the environment and forests resources have been improving[2], mainly due to public awareness and the rise of political will. This is reflected in the demand for information. A very slight halt in natural resources depletion seems to appear, but it is still difficult to assess due to weak capacities, and appropriate approaches and strategies.

Currently, the management of the environment and natural resources are under the head of the Ministry of the Environment and under the responsibility of 33 Autonomous Regional Corporations (ARCs) at the sub-national scale. At the national level, decision making processes are driven by the National Environmental Council[3] and by the National Council for Economic and Social Development[4]. Private sector and communities participate in driving the Regional Corporations by means of their involvement in their Steering Councils. Five research institutions joined the Environmental System to provide technical support. One of them (IDEAM), has a specific role and mandate in the preparation of environmental and forest information and statistics, apart of being the responsible and coordinating institution for the Environmental Information System.

The demands on information from the public opinion to the institutions changed, accordingly, to new situations. During the mentioned first period, most information and statistics were demanded for agricultural purposes related with national gross product and taxes management. Environmental issues were not in place. Although the country was mostly under forested land, there were very little knowledge about forest resources condition and pressures. During the second one, there were more

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[1] Contact ecosistemas@ideam.gov.co

[2] The adoption of the 1991 Main Chart and the 1993 Law 99 for the Environment System, in both cases, after several years of a comprehensive national discussion, are also very much responsible for the observed improvements.

[3] Open to the participation of private sector, NGOs and communities.

[4] With the participation of all ministries.

concern and environmental demands from society. Some sets of information related with forest management started to be prepared, mostly directed to timber and water management but also regarding wild fauna and flora. Environmental requests were put in place for resources harvesting and infrastructure development. Last years, are marked by a relatively high pressure from society to be better and widely informed. These demands are being pulled by processes involving land use planning, more sound and better informed decision making, sustainable forest management, global climate change issues, criteria and indicators for sustainable management of natural and planted forests, certification of forest goods and services, etc. Much of the demand comes from the mandate given by different environmental and socioeconomic policy documents, mainly the one related with biodiversity[5]. But with no doubt, the last one bigger and more comprehensive demand on forest information and statistics is arising since year 2000 by the approval of the National Forest Development Plan (NFDP[6]), which is targeted for the next 25 years. The discussion and approval of the NFDP was achieved after a very wide national consultation that took several years, thus reflecting very well desires of society.

Current institutional arrangement for statistics and information

Table 2 illustrate on four main institutions involved with forest information and statistics. It should be noted that many other institutions play important roles at national or sub-national levels, particularly the 33 autonomous regional corporations and CONIF. In short, the basic arrangement to produce forest statistics is composed of the autonomous regional corporations, the environmental authorities of the four main cities, the five environmental research institutes (coordinated by IDEAM) and the Ministry of the Environment. All them run the Environment

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[5] Approved in 1996 by the National Environmental Council. See www.humbold.org.co for the full document.

[6] See www.minambiente.gov.co for the full document and www.dnp.gov.co for the 2001–2003 action plan (CONPES document No 3125/June 2001.

Table 1. Summary of main changes on forestry sector during last four decades

Period – Item	Up to mid sixties	Mid sixties-mid eighties	From mid eighties to present
Institutions involved in environmental and natural resources management	Very disperse and based in few local institutions under the head of Ministry of Agriculture. Local people formally absent from decision making within institutions.	Natural resources administration was split again in central and local institutions but under the head of two antagonist bodies, the Ministry of Agriculture (which mostly managed bureaucratic budget) and the National Planning Department (which still manages the whole nation investment budgets). Local people still absent from decision making within institutions.	National Environment System whose main institutions are: Ministry of Environment, 33 autonomous regional corporations five research institutions Communities and private sector also participate. Local people actively involved in decision making processes.
Knowledge about forest status	Not well known. Huge forest reserves were declared	First approaches to estimate forest cover and deforestation annual average. Forest Management Plans, watershed management initiatives and flora and fauna surveys flourished.	Improved but still not satisfactory and timely prepared and released.
Remarks on Forest Policy and regulations	Natural resources uses driven mainly by market forces in a "mining-like" regulatory scheme hard to keep under control and monitoring	National regulations turned too conservationist to counteract the domain of market forces. But, it was very difficult to enforce the Law in spite greater political will as there were very low technical and managerial capacities and both institutions and local people failed to achieve economical alternatives to build a more sound way of life. Most protected areas and indigenous reserves were created but forest reserves were seriously diminished. High public and NGOs antagonism to formal forest concessions and timber harvesting permits pushed timber harvesting to informality.	Very dynamic process of entitling (mostly forested) lands to indigenous reserves, black communities collective lands and campesinos reserves was strengthened or launched. More than 30% of country land have been allocated in this way to communities. No forest concessions were standing and very few harvesting permits to timber companies were allowed legally by institutions. Communities strongly oppose timber permits to companies but usually becoming part of the informal timber supply.
Demand of information	Mostly from public sector	More balanced between public and private sectors. NGOs role relevant. Some demand from FAO/ITTO	Mostly from public opinion and private sector. Greater demand from international bodies and conventions
Management of forest information	Very poor. Ministry of Agriculture	INDERENA for the Ministry of Agriculture and about 70% of the country, National Planning Department for the rest	IDEAM/autonomous regional corporations. Recently, National Department of Statistics, CONIF, Ministry of Agriculture and others joining efforts

Table 2. Main institutions currently dealing with forest information and statistics

Institution	Sector/Level	Mandate	Main partners	Main outputs
National Department of Statistics, DANE[7]	Ministry of the Interior, national	To coordinate the preparation and dissemination of socioeconomic statistics, including census of the population	Ministries (Agriculture in particular), Municipalities, Departments, private sector organizations	Population census, Annual Manufacture Survey, Agrarian Information System
Agustin Codazzi Geographic Institute[8]	Ministry of Development, national	To prepare and disseminate geographical information. Also manages research and issues related to land tenure, use and planning	Municipalities, DANE, INGEOMINAS, IDEAM, INCORA[9]	Legal cartography and maps, Geographic Dictionary, Land tenure, Land use and vocation
IDEAM[10]	Ministry of Environment, national	To prepare and provide scientific information on ecosystems and to lay technical background for the classification and planning of land use	Ministry of Environment, ARCs, all other institutions of the Environment System, DANE, IGAC, CONIF[11], National Parks Unit[12], NGOs and Private reserves	Meteorology and Hydrology statistics Land cover maps, Socioeconomic information on environment issues Environment indicators Environment diagnostics
Von Humboldt Biodiversity Institute	Ministry of Environment, national	Issues related with biodiversity	Ministry of Environment, ARCs, all other institutions of the Environment System, IGAC, CONIF, National Parks Unit NGOs and Private reserves	Inventories of flora fauna and ecosystems, Ecosystem (biomes) maps, Endangered species lists, Ecosystems fractioning analysis

Information System within which there is a subsystem for the management of forest statistics (Colombian Forest Statistical System, SEFC for its Spanish acronym) which is under development and testing. The SEFC serves information purposes to the national and international levels.

[7] See www.dane.gov.co

[8] See www.igac.gov.co

[9] National Institute for Agrarian Reform. See www.incora.gov.co

[10] See www.ideam.gov.co

[11] National Corporation for Forest Research and Promotion. See www.colciencias.gov.co/conif

[12] See www.parquesnacionales.gov.co

Problems, gaps and opportunities for linking national and global forest inventories

In Table 3 main aspects related with the preparation of forest information and statistics are compiled. It should be noted: (a) that there is an ongoing process, pulled by environmental policies but very much affected by the country's current political condition, particularly in relation to fieldwork; (b) there are strengths not commended here due to space limitations.

Conclusions

National forest resource assessment is a very complex exercise and process where not all demands could be fulfilled at the same time and one that needs to involve several key actors which in turn need time to maturate conceptual aspects, methodologies and capacities in a process of "learning by doing". In the Colombian case, the basic questions to be answered may be the ones originated by the National Forest Development Plan. The exercise of forest resources assessment could be carried out on the basis of a bi-directional rewarding scheme, as a key element or strategy to promote local/sub-national participation and contributions. This strategy would also reduce required periods of time for assessments completion.

Table 3. Summary of main problems and situations that need to be solved on forest information and statistics

PROBLEM/GAP/SITUATION	PROPOSED STRATEGIES, METHODOLOGIES OR MECHANISMS TO OVERCOME	STATUS OF ACTION
There are not formally adopted procedures and methodologies for carrying out National Forest Inventories	Design, agree and carry out a joint pilot exercise	Discussions and agreements being held and near to be completed
There is not an agreed information system in place to support NFI and data management	Review existing systems and linkages and make them of friendly use	Attached to above mentioned process
Maps and statistical information on forest cover is not comparable along time	Need of standardized methodologies	Pending various actions mentioned here
Forest statistics are not linked to national socioeconomic statistics processes	Invite responsible institution for joint work and open share of information	Under implementation for commercial plantations as pilot exercise. Planned for NFI
No single institution can deal or cope alone with NFI and related management of forest information	Propose a joint work effort and agree on rules of procedure and responsibilities	Attached to first above mentioned process
Technical capacity is still very low	Estimate and prioritize investment and fund rising	Pending
Most timber use of natural forest is done under local and informal rules and for energy purposes thus making difficult data collection	Revise and agree on regulations with local stakeholders	On course
Field work is not being carried out due mainly to institutional reorganization	Decide on National Forest Service arrangement	Under very slow and erratic discussion
Centralization of activities does not stimulate local partners to contribute due to failures in returning to local actors useful information of their interest	Management of information on a bi-directional and mutually "rewarding" basis	Attached to first above mentioned process
Local partners overloaded with information (not only on forest issues) demands	Rationalization and organization of demands and communication channels	Attached to first above mentioned process
Centralized use of remote sensing dislikes local institutions	Work under joint and agreed efforts, responsibilities and shared costs	Pending
There are (solvable) conflicts between views and products among institutions, particularly on ecosystem and cover and land use maps	Achieve agreements on conceptual guidelines, procedures and quality standards, share of responsibilities and timeframes for products	Under discussion and pending frame agreements
Law and National Forest Development Plan, reflecting society's interests demands for socioeconomic and biodiversity issues to be considered in database management but still weak development and diffuse linkages with field work and stakeholders	Seek the way to incorporate cost-effective indicator in forest and statistics preparation processes, try to get the most from usual activities	Pending
Decision makers need updated information before local, sub-national or national government changes	Define deadlines for products to be obtained	A general proposal have been made within national environmental baseline and monitoring program process

Kotka IV Report

Background

1. FAO has, on request from its member countries, implemented assessments of global forest resources since 1947, in collaboration with countries and other partners. The latest report was the Global Forest Resources Assessment 2000 (FRA 2000), published in 2001.

2. At its fifteenth session in March 2001, the FAO Committee on Forestry (COFO)[1] was informed about the main findings of the FRA 2000. COFO made a number of recommendations in relation to forest resources assessments, reflected also in the subsequent FRA 2000 Main report.

3. In particular, COFO recommended that the Forest Resources Assessment (FRA) programme continue to be a priority for the FAO Forestry Department. FAO was requested to provide continued technical and financial assistance to build national capacities for carrying out forest assessments. Of particular relevance is the following paragraph in the COFO 2001 report:

> "47. The Committee noted the inclusion of a wider range of forest-related variables in FRA 2000 than in past assessments. It *recommended* that FAO continue its efforts to carry out broad assessments that included various aspects of forest resources, such as biological diversity, forest health, and resource use. While acknowledging the importance of the studies on forest cover and cover change, the Committee recognized that the monitoring of indicators of sustainable forest management would require assessment of qualitative forest and ecosystem parameters, as well as variables related to social and economic features of forest use."

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[1] The Committee on Forestry (COFO) is the most important of the FAO Forestry Statutory Bodies. The biennial sessions of COFO (held at FAO headquarters in Rome) bring together heads of forest services and other senior government officials, usually representing more than 100 countries, to identify emerging policy and technical issues, to seek solutions and to advise FAO and others on appropriate action. Other international organizations and, increasingly, non-governmental groups participate in COFO.

4. FAO's role in spearheading global forest resources assessments and country capacity building for forest assessments has also been acknowledged in other intergovernmental fora, for example in the fourth session of the Intergovernmental Panel on Forests in 1997 which also stated that "national inventories are an important basis for effective national forest programmes", that "Forest assessments at the national level should adopt an integrated and holistic multidisciplinary approach, and should be user-oriented and demand-driven.", and that "International and national forest assessments should take account of appropriate international, regional, subregional and national-level criteria and indicators for sustainable forest management."

5. In light of the above, FAO in collaboration with UNEP and UNECE, and with support from the Government of Finland, arranged the "Kotka IV" expert consultation on *"Global Forest Resources Assessments – Linking National and International efforts"* in Kotka, Finland on 1–5 July 2002.

6. The Kotka IV meeting was the fourth expert consultation held in this location on the subject global forest resources assessment. The previous consultations were held in 1987, 1993 and 1996. The latter of these, Kotka III, was held to define the scope and output of FRA 2000, and resulted in detailed specifications of tables and variables. By comparison, Kotka IV addressed more conceptual and strategic aspects of global forest resources assessments, including aspects relevant at regional and national levels, and building on the experiences from FRA 2000 and considering future reporting requirements at the international level.

7. The objective of Kotka IV was formulated as to make recommendations to FAO and its partners regarding:

- The overall scope of global forest assessments;
- The level and mechanisms for participation of countries;
- The relationships between FAO/FRA and other international bodies;
- Organization of secretariats and supporting groups, particularly the establishment of a global advisory group;
- The scope and technical approach of country capacity building related to national forest assessments;
- The role of independent remote sensing surveys in future global assessments.

Terminology used

8. For the purpose of this report, the following terms and concepts are defined. Note also that some of the terms and concepts are further elaborated throughout this report:

Forest resources	Forest resources explicitly include forests, other wooded land and trees outside of the forest, as defined by FAO.
National Forest Assessment	A national process to collect, manage, make available and analyze information on forest resources, their management and use covering the entire country, including also analyses, evaluations and scenario development for use, e.g., in policy processes.
National Forest Inventory (NFI)	The principal activity to collect data within a National Forest Assessment. A NFI is based on systematic field sampling and can be complemented by remote sensing components.
Global Forest Resources Assessment (GFRA)	The global process led by FAO that collects, analyzes, manages and makes available information about forest resources, their management and uses for all countries.
Forest Resources Assessment (FRA) Programme	The FAO Programme tasked to lead the implementation of GFRA, and to support National Forest Assessments

Consultation process

9. The Kotka IV consultation was organized as an FAO Expert Consultation with the title *"Global Forest Resources Assessment – Linkages between National and International Efforts"*. The United Nations Environmental Programme (UNEP) and the United Nations Economic Commission to Europe (UN-ECE) co-sponsored the meeting. The Government of Finland hosted the consultation and provided the necessary financial contributions to make the consultation possible, and in addition, through the Finnish Forest Research Institute (Metla), provided substantial in-kind support to the management of the consultation.

10. Kotka IV was held between 1–5 July 2002 in the College of Forestry and Wood Technology of Kymenlaakso Polytechnic in Kotka, which provided excellent facilities including meeting rooms, computers and networks, lodging and full board.

11. In all, 57 experts participated in Kotka IV, of which 32 were nominated by countries (Regional distribution: Africa: 5, Asia: 6, Near East: 3, Latin America and the Carribbean: 4, North America: 3, Oceania: 3, Europe: 8). 10 experts represented intergovernmental organisations and 15 other organisations. 52 of the experts were male and 5 female. 12 of the experts participated in the Kotka III meeting on 1996. Eighteen technical background papers had been prepared for Kotka IV by the participating experts and were presented in plenary. Background papers are reproduced in the Kotka IV proceedings published by Metla.

12. Mr. Risto Seppälä (Metla and also President of IUFRO) was elected chairperson of the consultation. Mr. Adrian Newton (UNEP), Ms. Susan Braatz (UNFF secretariat), Mr. Christopher Prins (UNECE) and Mr. Kari Korhonen (Metla) were elected as co-chairs and alternated to chair the plenary sessions.

13. The consultation was implemented in three phases, (a) presentation and discussion of background papers in plenary (two days), (b) group work in four groups addressing specific aspects of the agenda (two days), (c) compilation, discussion and agreeing on findings and recommendations (one day).
14. An opening icebreaker on the old icebreaker ship Tarmo was hosted by the City of Kotka represented by the Mayor Mr. Henry Lindelöf and members of the City Council. An excursion to study Finnish small-scale mechanized forest operations and an example of large-scale integrated forest industry establishment was hosted by StoraEnso AB.

Findings and recommendations

Introduction

15. The Forest Resources Assessment (FRA) Programme is a continuing programme within the FAO Forestry Department. It consists of two components, (a) Global Forest Resources As-

sessments (GFRA), and (b) Support to National Forest Assessments.

16. The FRA Programme is implemented together with a wide range of partners, including countries, international bodies and organisations, NGOs, and the scientific community.

17. The following findings and recommendations from the Kotka IV expert consultation are organized by the three major components: (a) National Forest Assessments, (b) Global Forest Resources Assessment (GFRA), and (c) Linkages between National and Global Assessments.

National Forest Assessments

Why have a National Forest Assessment?

18. National Forest Assessments, carried out by countries, are important to:

- contribute to the developments of national policies and laws (including national forest programmes), notably related to sustainable forest management, nature conservation, rural community development, social policies, land tenure, land use change, and forest health, and to guide their implementation;
- fulfil international commitments, for instance with regard to the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity, the International Tropical Timber Agreement, the Convention for Combatting Deforestation, United Nations Forum on Forests; and with respect to indicators of sustainable forest management and sustainable development;
- respond to concern expressed nationally and internationally for improved forest management and protection of forests; provide information to market actors and other stakeholders.

Scope and status of National Forest Assessments

19. National Forest Assessments are generally developing towards comprehensive assessments, including all aspects of forest resources. The assessments may include information on physical quantities, qualitative aspects as well as estimates of

values of forest products and services.

20. National Forest Assessments provide important and relevant information to the forestry sector, and also to other economic sectors and policy processes, including agriculture and energy.

21. National Forest Inventories (NFI) are essential data sources for National Forest Assessments. Significant gaps in information and timeliness of information have been identified by FRA 2000 for many countries. Potential reasons for this include low priorities and awareness at the national level, low national capacities, and lack of financial resources.

22. As a consequence of the information gaps, there is also lack of experience in presenting and using NFI information for overall policy development, which, in turn, probably hampers the awareness of the utility of good forest information. Without such awareness, countries may not prioritize to develop and maintain NFI's.

23. National forest inventories and assessments, and the capacity to implement these over time, will only be maintained if the information demand originates from national forest policy processes.

24. While the responsibility for implementing National Forest Assessments is with respective Governments, FAO has a mandate to offer support to countries in this field, including methodology development as well as support to implementation and capacity building.

Recommendations

25. Countries should assess whether they need external assistance to implement National Forest Assessments and consider to seek such help from FAO, for example through the National Forest Programme Facility, implemented by FAO.

26. FAO should work closer with countries, and other institutions, to build national capacities for implementing national forest assessments, raise awareness for capacity maintenance

and for inclusion of forest resources monitoring in the national policies. This should include development of assessment methods for wood products, non-wood forest products, and forest services including biological diversity. FAO should also support countries in the formulation of projects for consideration by donors in this respect.

27. The proposed FAO approach to develop guidelines for and to support National Forest Assessments based on a low-intensity, and permanent field sampling and collecting data on the biophysical status as well as the management and uses of forest resources is relevant and feasible for countries lacking effective national forest inventory capacities. The approach needs to be further evaluated and developed to more effectively meet the requirements of these countries.

28. The FAO approach to support National Forest Assessments should take into consideration existing information and inventory systems to make efficient use of available inventory resources.

29. The FAO approach to support National Forest Assessments should include activities to strengthen information management and analysis, and reporting on data reliability, including to strengthen the capacity to report to international processes.

30. FAO should work with countries and the donor community to revive and/or maintain the interest in committing resources to National Forest Assessments being an important part of national policy development, including capacity building and capacity maintenance; and to promote co-ordination of efforts in the field of forest resources assessments.

Global Forest Resources Assessment (GFRA)

Rationale

31. The Global Forest Resources Assessment (GFRA) is a process, led by FAO and involving all countries and other partners, that reports on the world-wide status and trends of forest resources, their management and uses. The latest report

was the Global Forest Resources Assessment 2000 (FRA 2000).

32. GFRA has many functions including to:

- Provide as accurate and quality-rated a picture as possible of the status and trends of forest resources world-wide for facilitation of improved policies in relation to forests and forest management;
- Enable countries with the ability to view their forest sector within regional and global environmental and socio-economic contexts;
- Contribute some of the validated and harmonised data required for monitoring and assessment functions of international processes;
- Provide data that can be used in scientific and technical studies;
- Provide data that can contribute to investment decision support and private sector development;
- Present relevant information on forests to wider communities, including other sectors, NGOs and the general public.

33. GFRA has multiple users including:

- National Governments;
- Inter-governmental, international and regional organizations and processes, and inter-sectoral assessments;
- Scientific, research and academic communities, including education;
- NGOs;
- The public;
- Private sector entities.
- Overall scope

34. GFRA can best serve the needs of many users by providing information that is as consistent over time and in space, reliable and accurate as possible, including information about data quality and gaps. It also contributes to improvement of concepts, definitions and methods related to forest resources assessments.

35. Following recommendations of COFO 2001, GFRA should continue to be a broad assessment that includes information on all aspects of forest resources. In particular, it is recommended that the overall conceptual framework of GFRA be guided by criteria used by the various regional processes on criteria and indicators for sustainable forest management, i.e.:

- Extent of forest resources and Global carbon cycle,
- Forest ecosystem heath and vitality,

- Biological diversity,
- Productive functions,
- Protective functions, and
- Socio-economic functions.

36. Within this framework GFRA, in consultation with countries, should identify key parameters related to forest resources. GFRA should maintain and publish validated and harmonised national, regional and global data for these key parameters. Among these parameters, some are collected, harmonized and validated as a core set of global variables by GFRA. Other parameters, produced by regional FRA initiatives or other partners should be made available through linkages.

37. GFRA data essentially consists of data provided by countries. Countries through their national correspondents are responsible for the data provided. In addition some GFRA datasets may originate from other sources, for instance remote sensing surveys. Countries should validate national data before publication.

38. GFRA serves as a source of official, defined and validated information, which may be used by international processes. The availability of officially validated national data in an international dataset can contribute to reduce the reporting burden on countries. In defining the parameters to be collected, GFRA should take account of the reporting requirements of different processes and agreements, for instance any agreement on indicators that may emerge from the International Conference on Criteria and Indicators scheduled for 2002. It is expected that the international processes should support and promote GFRA as an important mechanism to facilitate data supply from countries, and as the major contributor of information on sustainable forest management at the global level.

39. The GFRA is carried out by the FRA team in close collaboration with national correspondents, and advised by the advisory group, which is recommended to be established, as well as periodic expert consultations with the participation of users and national correspondents.

Medium-term (~5 year) objectives and priorities

40.The emphasis of the GFRA should be to consolidate the progress achieved by FRA 2000 towards a broad assessment. This implies, for nationally reported data, in order of priority:

- Increase accuracy, completeness, timeliness, reliability and comparability of data and parameters reported in FRA 2000;
- Refine reporting formats for parameters reported in FRA 2000;
- Include new parameters as feasible in relation to countries' priorities and capacities.

41.National information should be compiled by GFRA on a more frequent basis than previously, based on annual requests for national updates from national correspondents, who would only submit data if and when new national data are available. For countries where new data have become available, the GFRA database should be updated as soon as possible. On reporting of global datasets, taking note of needs of forthcoming international meetings, and in particular UNFF5 scheduled for 2005, an intermediate global report, including the new national submissions, should be issued around 2005. A comprehensive global assessment should be published around 2010.

42. The continued improvement of GFRA data, including comparability over time, implies stability in concepts and definitions relating to core parameters.

43. Regional initiatives related to forest resources assessment should continue to contribute to and, where appropriate, be co-ordinated with the GFRA work, notably in relation to concepts, definitions and core parameters. Regional Forest Commissions have an important role in increasing political support for country involvement in forest resources assessment. The participants recognized the benefits of the regional FRA effort contributing to FRA 2000, co-ordinated by the UNECE/FAO secretariat in Geneva ("TBFRA 2000"), wherein variables and information specific for the regional needs were incorporated in addition to the global information requirements. This regional FRA effort continues. Participation in such regional FRA initiatives should be determined by the countries themselves.
Actions

44. FAO should establish a multi-disciplinary and informal advisory group to GFRA consisting of about 20 persons, with a balanced representation of experts, FRA national correspondents, representatives from relevant international bodies, and other stakeholders. Its tasks should be to advise FAO and its partners on the implementation of GFRA, and in particular its concepts, classifications, definitions, methods, organisation, timing and communication of results. The group should meet about annually.

45. FAO should carry out a wide-ranging user demand survey for the GFRA, trying to reach all potential types of users, and clarify their data requirements. The survey should also investigate the willingness and ability to pay for the information required. The objective of the survey should be to help define priorities for the development of GFRA contents.

46. Following the user survey, an expert consultation with users and data providers should be held in about three years. The consultation should complement the advisory group proposed above. The consultation should aim at refining and further develop the scope and output of GFRA, including specification of parameters and variables. The possibility to repeat such consultations should be considered.

47. FAO should carry out a feasibility study for a remote sensing study of land cover and land use changes to complement national reporting, including options for a global coverage of the study as well as possible partnerships for the implementation, noting also that countries should be consulted when considering options that may result in national level estimates. The study should include aspects on field sampling necessary to validate the remote sensing output. Objectives of a remote sensing study could be:

- improve accuracy and precision in countries with poor data;
- provide regional level estimates of state and change;
- provide global estimates of state and change; or
- provide global forest map for visualization.

Linkages between national and global assessments

Rationale

48. National forest inventory and assessment information is the basis for national reporting on forest resources to international processes, including GFRA.

49. Since GFRA data essentially consists of data provided by countries, the GFRA depends on good linkages and partnerships between FAO, regional partner institutions and countries.

Recommendations

50. FAO should inform Governments in each country about recent developments of the GFRA process, and ask them to nominate or confirm their national correspondent to GFRA, including allocating time and resources for the correspondent to be able to contribute to the GFRA work.

51. The GFRA secretariat should keep national correspondents informed about timing of future work and reporting, and request information from the correspondents about national assessment activities, to enable good work planning.

52. The primary channel of communication for the GFRA secretariat, regarding requests for and validation of national forest resources information, is the officially nominated national correspondent.

53. Countries should take into account international reporting requirements when designing national forest inventories. Countries should, to the extent possible, collect data in national forest inventories in a way that makes national information suitable for reporting against agreed international definitions, procedures and methods for inclusion in the global forest resources assessment. FAO should offer advice to countries in these respects.

54. National correspondents should be prepared to submit updated national data to GFRA as it becomes available.

55. FAO should facilitate the transformation from national to

GFRA data for instance through guidelines, consultations and efficient use of information and communication technology.

56. The incorporation of national information into GFRA data should be undertaken collaboratively between countries and the GFRA, and be transparent and documented to ensure credibility and consistency in the GFRA database. It is expected that this approach will over time reduce the effort required to maintain the GFRA database.

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Kotka IV Study Tour

Wednesday 3rd July, 2002

13.00 Departure from the campus by bus

13.15 Visit to Langinkoski

14.00 Forest tour organised by StoraEnso

- Bus trip to a typical Finnish forest site
- Presentation of the StoraEnso Group
- Demonstration to Finnish harvesting system and family forestry
- Outdoor dinner in forest
- Bus tour to StoraEnso Anjalankoski mill

19.00 Return to the campus


UN-ECE/FAO
EXPERT CONSULTATION
KOTKA IV
Kotka, Finland 1-5 July 2002


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KOTKA IV










Holmgren







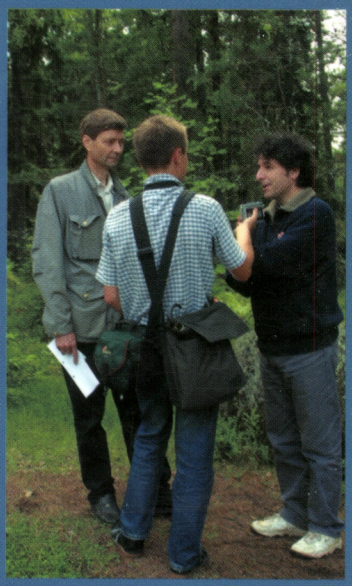


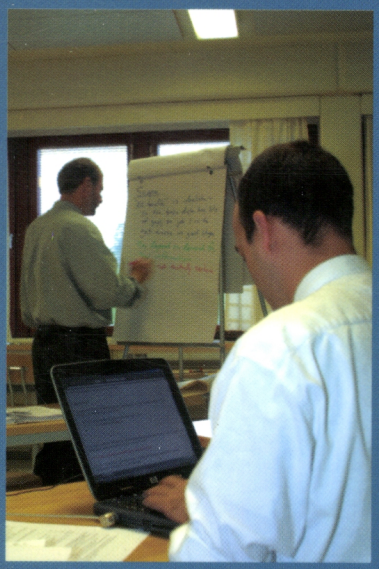














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